Caribbean Studies
ISSN: 0008-6533
iec.ics@upr.edu
Instituto de Estudios del Caribe
Puerto Rico

López-Marrero, Tania; Wisner, Ben
Not in the Same Boat: Disasters and Differential Vulnerability in the Insular Caribbean
Caribbean Studies, vol. 40, núm. 2, julio-diciembre, 2012, pp. 129-168
Instituto de Estudios del Caribe
San Juan, Puerto Rico

NOT IN THE SAME BOAT: DISASTERS AND DIFFERENTIAL VULNERABILITY IN THE INSULAR CARIBBEAN

Tania López-Marrero
Ben Wisner

Abstract

The Caribbean region is exposed to various natural hazards due to its geographic position and geological situation. Hurricanes, floods, landslides, earthquakes, and volcanoes cause loss of lives and property, disrupt livelihoods, and in some cases erase years of development. But not everyone suffers equally; the frequency and impacts of disasters triggered by natural hazards differ within the region. These differences reflect determinants of vulnerability and capacities, which include access to various natural, physical, economic, human, social, and political resources. Differential access to such resources determines how effectively people deal with hazards and manage disasters. This article summarizes trends in the occurrence of disaster within the Caribbean islands and discusses these trends in terms of the determinants of vulnerability and capacities. The paper calls attention to lessons learned in reducing vulnerability, and enhancing capacities and risk management. In some instances, this requires rethinking current strategies and management practices.

Keywords: natural hazards, vulnerability, capacity, climate, risk, Caribbean

Resumen

La región del Caribe está expuesta a varios peligros naturales debido a su posición geográfica y situación geológica. Huracanes, inundaciones, deslizamientos de terrenos, terremotos y erupciones volcánicas ocasionan pérdidas de vida y propiedad, interrumpen los medios de subsistencia, y en algunas instancias retroceden años de desarrollo. No todas las personas, sin embargo, sufren de manera igual; la frecuencia y los impactos de desastres provocados por peligros naturales varían en la región. Estas variaciones reflejan los diferentes elementos asociados a la vulnerabilidad y las capacidades de las personas, que incluyen acceso a recursos naturales, materiales, económicos, humanos, sociales y políticos. Las variaciones al acceso a estos recursos influencian cuán efectivamente las personas pueden lidiar con peligros y manejar desastres. Este artículo resume las tendencias en la ocurrencia de

desastres en las islas del Caribe, y discute estas tendencias a la luz de los elementos que determinan vulnerabilidad y capacidad para lidiar con peligros naturales. El artículo hace un llamado a prestar atención a las lecciones aprendidas para reducir la vulnerabilidad y mejorar las estrategias de manejo de riesgos. En algunas instancias esto requiere repensar estrategias y prácticas de manejo actuales.

Palabras claves: peligros naturales, vulnerabilidad, capacidad, clima, riesgo, Caribe

RÉSUMÉ

La région caribéenne est exposée à diverses catastrophes naturelles en raison de sa position géographique et sa situation géologique. Ouragans, inondations, glissements de terrains, tremblements de terre et éruptions volcaniques causent des pertes en vies humaines et de biens matériels, perturbent la vie quotidienne et dans certains cas provoquent des années de retards de développement. Cependant, tout comme les risques naturels varient dans la région, les personnes affectées connaissent des peines distinctes. Ces différences reflètent différents facteurs associés a à la vulnérabilité et de la capacité des gens, y compris l'accès aux ressources naturelles, matérielles, économiques, humaines, sociales et politiques. Les différences a l'accès à de telles ressources déterminent comment la population fait face aux risques naturels et gère de façon plus efficace les catastrophes naturelles. Cet article résume les tendances en cas de catastrophes naturelles dans les îles caribéennes et examine ces tendances en tant que facteurs de vulnérabilité et capacité. Il attire aussi l'attention sur les techniques apprises pour réduire la vulnérabilité, et pour améliorer la capacité à gérer les risques. Dans certains cas, il a paru important de repenser les stratégies et les pratiques actuelles de gestions des risques.

Mots-clés : danger naturels, vulnérabilité, capacité, climat, risque, Caraïbe

Received: 28 August 2012 Revision received: 26 November 2012 Accepted: 30 November 2012

Introduction

On January 12, 2010 a magnitude 7.0 earthquake struck the Caribbean country of Haiti. The earthquake's epicenter was about 25 kilometers southwest from Haiti's capital, Port-au-Prince, with a population of nearly two million. Conservative estimates cite at least 217,300 people killed, 300,600 injured, and 2.1 million displaced, with 175,000 homes damaged or destroyed (OCHA 2012).

Other estimates report more than 300,000 people killed. The true death toll will never be known. Even with the lowest estimate, the number of people killed in that single event is twenty-five times greater than all deaths caused by all other hazard types (hurricanes, floods, mass movements, volcanic eruptions, and droughts) in all countries of the insular Caribbean in a 30-year period, from 1980 through 2009. Ten months after the catastrophic earthquake, in October 2010, a case of cholera was reported in the country. An outbreak rapidly spread and affected several departments, including the capital, which was previously affected by the earthquake. The limited access by the population to safe water, basic sanitation, and health care has been cited among the proximate causes of the rapid spread of the disease (WHO 2011). At the beginning of November of that same year, Hurricane Tomas passed near the western part of the country, killing 20 people (EM-DAT 2010) and causing floods that intensified the cholera outbreak. As of March 2012, the cholera epidemic had claimed the lives of at least 7,000 people (OCHA 2012).

Although these series of events in Haiti, beginning with the earthquake, are extreme, many people throughout the insular Caribbean are vulnerable to similar circumstances. A common denominator, we will argue, is suffering triggered by natural hazards and exacerbated by political instability, government corruption, and poverty. Some countries have made considerably more progress in overcoming some of these systemic causes of vulnerability to hazards than Haiti; nevertheless, the challenge of social transformation persists alongside the region's formidable array of natural hazards.

The Caribbean is prone to hazards due to its geographic position and geological situation. The geographic position of the region within the Atlantic Basin exposes it to hurricanes from June through November, with most storms occurring in August, September, and October. All Caribbean islands are exposed to hurricanes, but Trinidad and Tobago, Aruba, Bonaire, and Curaçao are less likely to be hit by these systems because of their southern position closer to the equator (Pielke *et al*. 2003). Hazards that accompany hurricanes, such as rainfall, winds, and storm surges, are common elements in the Caribbean. Historically significant hurricanes like San Calixto (1780, the Lesser Antilles), San Ciriaco (1899, Puerto Rico), and San Zenón (1930, the Dominican Republic) are among the deadliest hurricanes to have passed through the region (Rappaport and Fernández-Partagas 1995). These three events are believed to have caused around 20,000, 3,500, and 8,000 deaths, respectively.

Floods are the most common type of hazard in the region and cause great economic damage and loss of lives and property. Floods are triggered by rainfall events during the hurricane season and at other times as well. Mass movements (including land- and mudslides) which are

also frequent in the insular Caribbean, are likewise usually triggered by intense rainfall, although earthquakes may also cause slopes to fail. For example, the flood on the Haitian-Dominican border in 2004 resulted from a low-pressure system during May that brought more than 500 millimeters of rainfall over the Haitian mountains, causing sudden floods downstream in Haiti and the Dominican Republic (Brothers, Wilson and Dwyer 2006). In this instance, floodwaters and landslides caused at least 1,500 deaths and about 2,000 missing people, mostly in Haiti (Gubbels and Brakenridge 2004). Intense rainfall, mountainous and steep topography, unstable slopes, and deforestation are among the physical-environmental factors associated with floods and mass movement events in the insular Caribbean.

The tectonic setting of the region results in exposure to earthquakes, tsunamis, and volcanoes. Past earthquakes manifest the tectonic activity in the region (Potter *et al*. 2004: chapter 4; Tomblin 1981): Port Royal, Jamaica in 1692 (4,000 fatalities) and Point-à-Pitre, Guadeloupe in 1843 (5,000 fatalities), along with the earthquake-triggered tsunami in Puerto Rico in 1918 (40 fatalities, of the approximately 120 caused by the earthquake), and the eruption of the Mt. Pelée volcano in Martinique in 1902 (30,000 fatalities).

Why hazards become disasters, however, is not solely explained by exposure to hazards and the physical-environmental aspects associated with such events; the social and human conditions of the exposed populations also put people at risk and determine outcomes. Regarding studies of natural hazards and disasters, an increasing amount of literature from the field of political ecology[1] emphasizes the roles of various historical, social, cultural, economic, institutional, and political structures and factors in influencing differential impacts and losses (see, for example, Wisner *et al*. 2012; Gaillard *et al*. 2010; Kelman 2008; Wisner *et al*. 2004; Turner *et al*. 2003; O'Brien and Leichenko 2000; Comfort *et al*. 1999). These and other studies contest the "naturalness" of "natural" disasters. The only "natural" part is the triggering event, so one might think of such events as disasters with a natural trigger. A chorus of such contrarian views has grown since the 1970s (Meillasoux 1973; O'Keefe *et al*. 1976; Hewitt 1983). The relationships among hazards, vulnerability, and risk are captured in terminology that has developed over these decades. We define these terms in Box 1 and use them throughout the paper.

In this article we first provide an overview of disaster occurrence in the insular Caribbean[2] during the past three decades. Based on these trends we discuss some factors that have influenced vulnerability to natural hazards in the region.We then provide examples of the capacities and resources people have drawn from to deal with such exposures, particularly at the local level. Finally, we provide some recommendations

Box 1. Key terms and definitions

Hazard: The potential interaction between a physical event (such as a hurricane or an earthquake) and a human system; an event that is potentially harmful to people and their assets, and can cause disruption of their daily activities. Hazard includes elements such as potential occurrence, magnitude, frequency, and speed of onset (Wisner, Gaillard and Kelman 2012).

Disaster: A situation in which a hazard actually influences a vulnerable human system and has consequences in terms of damage, loss, disruption of activities, or casualties that are of such a magnitude that the affected people do not have the mechanisms to deal effectively with them (Wisner, Gaillard and Kelman 2012). Note that the definition of hazard emphasizes the potential for damage, loss, and so forth, while the definition of disaster emphasizes their actuality.

Vulnerability: Being susceptible to loss, damage, and injury. The characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist, and recover from the impact of a disaster (Wisner *et al*. 2004).

Risk: The coincidence of hazard and vulnerability, with the potential for harm depending on the degree of vulnerability, including personal and social protection, and on the resources the system can draw from to cope and adapt. As a function of combined elements of hazard and vulnerability, disaster risk combines a hazard's potential occurrence, magnitude, and frequency with people's susceptibility to loss, injury, and death (Wisner *et al*. 2004).

Capacities: The abilities of a person or group to take actions in order to resist, cope with, and recover from disasters (Wisner, Gaillard and Kelman 2012; Wisner *et al*. 2004). These capacities are based on the availability of and access to various resources and assets people can draw from to face hazards and manage disasters (Brooks and Adger 2005; Eakin and Lemos 2006; Smit and Wandel 2006; Yohe and Tol 2002; Wisner, Gaillard and Kelman 2012; Wisner *et al*. 2004).[10]

- **Natural resources:** Resources present in the physical environment, such as land, water, mangroves, forests, raw materials, crops, and seeds, and the benefits they provide.
- **Physical resources and technology:** Infrastructure (for example, transport, drainage systems, housing) and production equipment and materials. Technological systems such as communications systems, warning systems, protective structures.
- **Economic resources:** Economic and financial resources people have or can count on, including income, savings, credit, loans, pensions, remittances, and transfers from the state.
- **Human resources:** Skills, knowledge, awareness, experience, views of nature, culture and belief systems, ability to work, and good health.
- **Social resources:** Informal social networks, social mobilization, collective actions, kinship ties, and relations of trust, reciprocity, and exchange; and formal institutions, including, for example, education and health care systems.
- **Political resources and institutions:** Political representation and political voice, leadership, development of political capabilities or claims people can make to the state. Critical institutions that promote and support risk and disaster management, along with the way they operate and are structured (for example, transparent decision making, institutional requirements).

that we believe can increase personal and social protection in the face of current and future hazardous impacts in the region.

Disasters in the Insular Caribbean: A Review of the Past Three Decades

Data compilation

The collection of data on disasters triggered by natural hazards is a difficult task because it depends on information provided by local governments, relief agencies, nongovernmental organizations (NGOs), press releases, and global databases, among others (Serje 2012). In many cases, each of these sources has its own definitions and criteria as to what it reports as a disaster, which can make comparisons difficult. Disaster reports and impacts can also be subject to under- or overestimations. Also, data is generally presented in an aggregated form, usually at the national level, which limits analysis at lower scales. We need to be aware and cautious of such factors when analyzing and making statements using these data. Nevertheless, available data provided by publications and data sets are useful at least as a starting point to identify general trends and make some comparisons.

In our case, most importantly, general trends and comparisons allow us to reflect on and discuss differential vulnerabilities and capacities among countries within the region. For this, we present data for each Caribbean country[3] on the number of disasters reported and use the number of people killed as a proxy of the impact of disasters. The number of people killed is a variable that is commonly available within a dataset and other sources of references. It is also usually more consistent and comparable compared to other variables such as economic damages and the impacts on countries' GDPs. Other analyses, however, can be done using different variables (for instance, economic losses, losses as a percentage of GDP, and infrastructure damage); these analyses can have different implications and produce different discussions and conclusions.

To generate the data presented in this article (Tables 1 through 3), we reviewed, compiled, and summarized information from different datasets, publications, and thematic and regional sources: the Emergency Events Dataset (EM-DAT) operated by the Centre for Research on the Epidemiology of Disaster at the University of Louvain, Belgium, the National Oceanic and Atmospheric Administration (NOAA), the Office for the Coordination of Humanitarian Affairs (OCHA), the United States Geological Survey (USGS), Lindsay *et al*. (2007), Longshore (2008), and the University of the West Indies Disaster Studies Unit. We determined that a disaster event had occurred if at least one of the

following was documented in the material we reviewed: people were killed or otherwise affected (for example, they were injured or made homeless), houses and buildings were damaged or destroyed, the country's infrastructure was damaged or destroyed, services (for example, the provision of water, electricity) were affected, agricultural damages were reported, or a disaster was reported on global databases such as EM-DAT, a commonly used source of data.[4] In the case of hurricanes, a hurricane did not have to make landfall in order to be considered a disaster. When comparing data sources, care was taken not to count an event more than once.[5] When the number of people killed differed among sources, a range was provided based on the lowest and highest available estimates. The data cover a 30-year period, from 1980 through 2009.[6] A summary for the years 2010 through 2012 is also provided.[7]

An important consideration was to pick up events that were "small" by international standards but nevertheless had significant impacts locally. Small local events may add up to quite surprising total losses (Petley 2012) and, in particular, they may have an erosive effect on the livelihoods of the poor, something the United Nations Office for Disaster Risk Reduction (UNISDR) has termed "extensive risk" (UNISDR 2009a; 2011). These small- and moderate-scale events tend to be missed by EM-DAT and other major monitoring systems (Wisner and Gaillard 2010). The UNISDR (2009b:15-16) defines extensive risk as "the widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts."

Trends on disaster events and people killed

The Greater Antilles are the most hazard-prone islands, where Haiti and Cuba reported the most events from 1980 through 2009 (67 and 57, respectively). They were followed by the Dominican Republic, Jamaica, and Puerto Rico (Table 1). Storms (including tropical storms and hurricanes) and floods were the types of disasters that most affected these countries, a pattern similar to that found on the islands of the Lesser Antilles.

We have to keep in mind that many deaths and much damage have resulted from rainfall triggered by hurricanes or other meteorological systems that cause both floods and mass movements. Mass movements such as land- and mudslides are underrepresented in Tables 1 through 3, but that does not mean that they are of low occurrence and impact. Landslides and other mass movements may occur along with hurricanes or floods and end up grouped within either of those two categories.

Table 1. Number of reported disaster events by type, 1980 through 2009[a]

Country	Hurricane[b]	Flood[c]	Mass movement[d]	Earthquake[e]	Volcanic eruption[f]	Drought[g]	TOTAL
Anguilla	2	1	0	0	0	0	3
Antigua & Barbuda	8	0	0	0	0	1	9
Bahamas	17	1	0	0	0	0	18
Barbados	6	1	0	1	0	0	8
Cayman Islands	8	0	0	0	0	0	8
Cuba	27	20	0	1	0	9	57
Dominica	8	0	0	1	0	0	9
Dominican Republic	25	16	0	1	0	0	42
Grenada	5	0	0	0	0	0	5
Guadeloupe	8	2	0	1	0	0	11
Haiti	23	35	1	0	0	8	67
Jamaica	19	7	0	0	0	4	30
Martinique	10	0	0	1	0	0	11
Montserrat	13	0	0	0	9	0	22
Netherlands Antilles	4	0	0	0	0	0	4
Puerto Rico	21	5	2	0	0	1	29
St. Kitts & Nevis	6	1	0	0	0	0	7
St. Lucia	11	0	1	1	0	0	13
St. Vincent & Grenadines	8	3	0	0	0	0	11
Trinidad & Tobago	10	2	2	2	0	0	16
Turks & Caicos	4	0	0	0	0	0	4
Virgin Islands (U.K.)	3	0	0	0	0	0	3
Virgin Islands (U.S.)	9	0	0	0	0	0	9

[a] See the subsection "Data Compilation" in this article for the definition of what constitutes a disaster in this study.

[b] The number of hurricanes and storms: our compilation is based on EM-DAT, NOAA

Table 1 continued.

Monthly Review, and Longshore (2008). Tropical cyclones include named tropical storms and hurricanes.

[c] The number of floods: our compilation is based on EM-DAT. Floods are associated with rainfall from systems occurring inside and outside the hurricane season. Data of floods that occurred as results of heavy rainfall caused by named tropical storms or hurricanes are usually not differentiated from hurricanes; instead, they are grouped with hurricanes or tropical storms and are difficult to distinguish from the latter category.

[d] The number of mass movements (including land- and mudslides): our compilation is based on EM-DAT. Mass movements include landslides and mudslides. As with floods, mass movements are associated with rainfall from systems occurring inside and outside the hurricane season. Mass movements also occur with floods and tropical storms, but the data sources usually do not provide for distinguishing them from the two general categories.

[e] The number of earthquakes: our compilation is based on EM-DAT and USGS.

[f] The number of volcanic eruptions: our compilation is based on EM-DAT and Lindsay *et al*. (2007).

[g] The number of droughts: our compilation is based on EM-DAT.

Another reason for low records of mass movements is that they are more difficult to record (or may not be recorded at all), particularly medium- to smaller-scale events. One notable slope failure occurred in southern Puerto Rico in 1985 on the periphery of the city of Ponce, where intense rainfall triggered a landslide where saturated soils, leaky water connections, and sanitary tanks had already caused water logging. Survivors reported that evacuation warnings were not heeded because people were afraid of theft. A whole community was affected when 260 homes were destroyed and 180 people were killed (Wisner 1985).

Regarding the Lesser Antilles, the islands of Montserrat, Trinidad and Tobago, and Saint Lucia are among the ones that reported more disaster events; a similar pattern is true for the northern islands of The Bahamas. In these cases, hurricanes were the most recurrent event, and in the case of Montserrat, also volcanic eruptions. Earthquakes, volcanic eruptions, and drought were the least reported events in the region; this is not to say, however, that they do not have impacts on the region's countries, as was evident in the Haitian earthquake of 2010.

Haiti is the country that, without doubt, has had the largest number of deaths caused by disasters, with estimates as high as 8,608 over the period 1980 through 2009 (Table 2). The majority of these deaths resulted from rains caused by hurricanes and other meteorological systems outside of the hurricane season that triggered floods and mudslides (Figure 1). For instance, in 2004 Tropical Storm Jeanne caused at least 2,700 deaths, the majority of them resulting from mudslides (NOAA Monthly Review 2006). Similarly, most of the deaths caused by a rainfall event in May 2004 and Tropical Storm Gordon in 1994 were

Table 2. Number of reported disaster-related deaths by type, 1980 through 2009[a]

Country	2009 population[b]	Number of people killed					
		Hurricane[c]	Flood[d]	Mass movement[e]	Earthquake[f]	Volcanic eruption[g]	TOTAL
Anguilla	14,438	0	0	0	0	0	0
Antigua & Barbuda	85,632	7-9	0	0	0	0	7-9
Bahamas	307,552	19	0	0	0	0	19
Barbados	284,589	1	0	0	0	0	1
Cayman Islands	49,035	2	0	0	0	0	2
Cuba	11,109,721	86-96	107	0	0	0	193-203
Dominica	72,660	5	0	0	0	0	5
Dominican Republic	9,690,787	529-655	524-798	0	3	0	1,056-1,456
Grenada	107,199	40	0	0	0	0	40
Guadeloupe	458,000	11-17	0	0	0	0	11-17
Haiti	9,777,973	5,104-5,446	1,562-3,162	0	0	0	6,666-8,608
Jamaica	2,825,928	105-116	97	0	0	0	202-213
Martinique	404,000	37	0	0	0	0	37
Montserrat	5,098	10	0	0	0	19-32	29-42
Netherlands Antilles	198,000	19	0	0	0	0	19
Puerto Rico	3,967,233	47-59	22	177-206	0	0	246-287
St. Kitts & Nevis	49,480	4-6	0	0	0	0	4-6
St. Lucia	160,267	56-84	0	0	0	0	56-84
St. Vincent & Grenadines	104,574	4	3	0	0	0	7
Trinidad & Tobago	1,229,953	2	5	2	0	0	9
Turks & Caicos	40,983	4	0	0	0	0	4
Virgin Islands (U.K.)	28,895	0	0	0	0	0	0

Table 2 continued.

Country	2009 population[b]	Number of people killed					
		Hurricane[c]	Flood[d]	Mass movement[e]	Earthquake[f]	Volcanic eruption[g]	TOTAL
Virgin Islands (U.S.)	109,809	18-23	0	0	0	0	18-23
TOTAL	41,081,806	6,110-6,654	2,320-4,194	179-208	3	19-32	8,631-11,091

[a] A range is provided when there were differences in the number of people killed among data sources. No deaths were reported for droughts.

[b] Population data for 2009 is provided for comparison purposes. Population from Guadeloupe, Martinique, and the Netherlands Antilles is from the Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT); all other population data is from the U.S. Census International Database.

[c] The number of reported deaths by hurricanes and storms: our compilation is based on EM-DAT, NOAA Monthly Review, and Longshore (2008). The majority of deaths associated with hurricanes and storms are due to floods and mudslides.

[d] The number of reported deaths by floods: our compilation is based on EM-DAT (all events). For the rainfall event of May 18-24, 2004 in Haiti and the Dominican Republic, data also came from Gubbels and Brakenridge (2004). See note c in Table 1 regarding the categorization of floods and hurricanes.

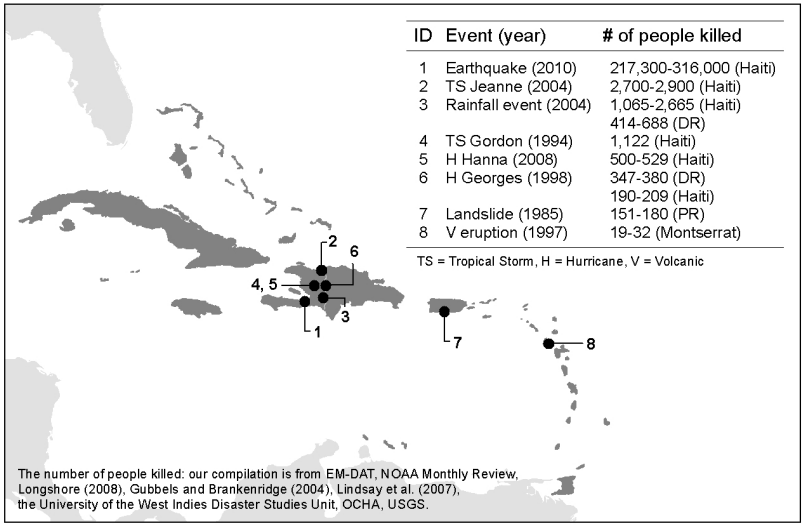
[e] The number of reported deaths by mass movement (including land- and mudslides): our compilation is based on EM-DAT and the University of the West Indies Disaster Studies Unit. See note d in Table 1 regarding the categorization of mass movements, floods, and hurricanes.

[f] The number of reported deaths by earthquakes: our compilation is based on EM-DAT and USGS.

[g] The number of reported deaths by volcanic eruption: our compilation is based on EM-DAT and Lindsay *et al*. (2007).

due to floods and mudslides. The Dominican Republic follows Haiti in terms of the number of people killed, with estimates ranging from 1,056 to 1,456 during the 30-year period. The rainfall of May 2004 and Hurricane Georges in 1998 were the main events associated with those deaths. Other hurricanes that have caused great losses of life in Haiti, the Dominican Republic, and elsewhere in the region were Allen in 1980, Noel in 2007, and Hanna in 2008 (Figure 2). Cuba, despite being the country with the second greatest amount of reported disaster events, and the one with the largest population within the region, reported a relatively low number of deaths (193-203). As we will discuss later in the article, this reflects Cuba's successful risk and disaster management.

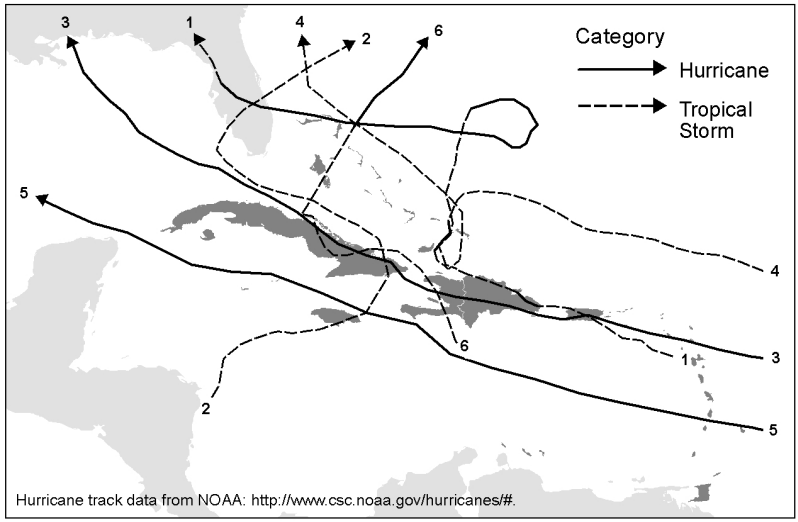
Figure 1. Examples of major disasters based on the number of people killed and the type of disaster.



The location of earthquakes in the insular Caribbean reflects the regional pattern of plate tectonic boundaries and activity.[8] While some countries in the region experience ground shaking every day, most of these movements are minor or light, with insignificant damage, and most go unnoticed by the population (Figure 3). During the 30-year period, one to two earthquakes causing some impacts were reported for some countries (Table 1), and three people were reported to have been killed in the Dominican Republic (Table 2).Volcanic activity in the region is restricted to the Lesser Antilles (Figure 4) and is associated with subduction plate boundaries. The Soufrière Hills volcano in Montserrat was the only volcano with documented eruptions; it erupted in 1995 and has been active since. The most intense period of volcanic activity occurred, however, in 1997, when at least 19 people were reported dead (Lindsay *et al*. 2007).

The years 2010 through 2012 showed a pattern of disaster occurrence and associated deaths that was similar to the pattern of the preceding 30 years. Hurricanes and floods were the events that occurred most often in the region, affecting about half of the countries (Table 3). Haiti was, again, the country reporting the most events as well as the largest number of people killed by those events. One evident difference from the pattern observed in the previous years was, unquestionably, the earthquake that hit Haiti on January 12, 2010, causing at least 217,000 deaths and massive destruction in the impoverished country.

Figure 2. The six deadliest storms in the Caribbean region, 1980 through 2009.



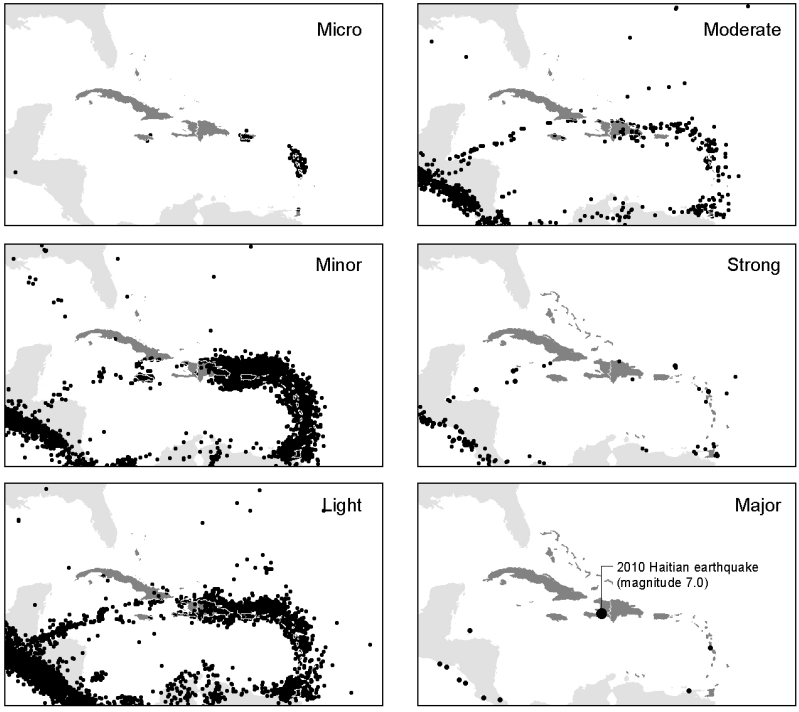
Storm	Year	Strongest category*	Number of deaths**	Countries reporting deaths (number of deaths in each country)**
1. Jeanne	2004	H3	2,721-2,934	Haiti (2,700-2,900), Dominican Republic (11-24), Bahamas (9), Puerto Rico (1)
2. Gordon	1994	TS	1,132	Haiti (1,122), Dominican Republic (5), Jamaica (3), Cuba (2)
3. Georges	1998	H4	560-614	Dominican Republic (347-380), Haiti (190-209), Puerto Rico (12), Cuba (6), St. Kitts and Nevis (3-5), Antigua and Barbuda (2)
4. Hanna	2008	H1	501-530	Haiti (500-529), Dominican Republic (1)
5. Allen	1980	H5	244-265	Haiti (220), Dominican Republic (7), Jamaica (7), St. Lucia (6-27), Cuba (3), Martinique (1)
6. Noel	2007	H1	146-234	Dominican Republic (87-129), Haiti (57-103), Cuba (1), Jamaica (1), Bahamas (1)

* Strongest category within the region (latitude 10° to 30°N and longitude 55° to 90°W). TS = Tropical storm, H1, H3, H4, H5 = hurricane category 1, 3, 4, 5, respectively.
** Data sources: EM-DAT, NOAA Monthly Review, Longshore (2008). A range is provided when there were differences in the number of reported deaths among sources.

The Progression of Vulnerability

Wisner and colleagues propose a framework that helps us understand risks and explain why disasters occur when natural hazards affect vulnerable people (Wisner *et al*. 2004; Wisner, Gaillard and Kelman

Figure 3. Earthquake occurrence in the Caribbean region, 1980 through 2009. The Haitian earthquake of 2010 is also shown.



Category	Magnitude (Richter scale)	Number of events	Earthquake effect
Micro	< 2.0	295	Micro earthquake, not felt, might be recorded
Minor	2.0-3.9	16,876	Could be felt but rarely causes damage
Light	4.0-4.9	6,400	Noticeable shaking of indoor items, rattling noises, significant damage unlikely
Moderate	5.0-5.9	855	Can cause major damage to poorly constructed buildings over small regions, at the most slight damage to well-constructed buildings
Strong	6.0-6.9	104	Can be destructive in areas up to 160 kms across populated areas
Major	7.0-7.9	10	Can cause serious and devastating damage over larger areas

Location data within the Caribbean region (latitude 10° to 30°N and longitude 55° to 90°W) from USGS - Earthquakes Hazards Program website: http://earthquake.usgs.gov/earthquakes/eqarchives/epic/epic_rect.php. Earthquake categories, magnitude, and earthquake effects: USGS.

Figure 4. The distribution of volcanoes in the Lesser Antilles, including the submarine volcano Kick 'Em Jenny (volcanoes' locations are from Lindsay *et al*. 2007).

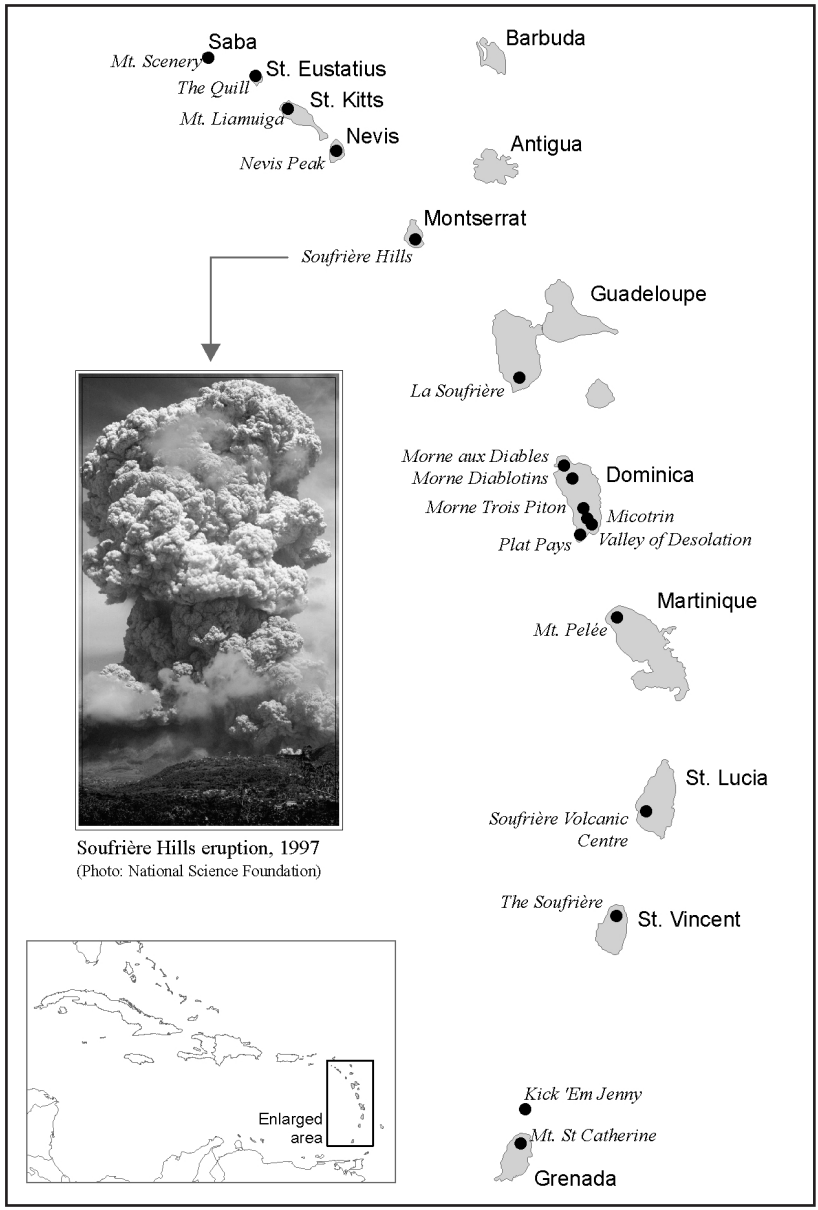


Table 3. The number of reported disaster events (left-side number) and deaths (right-side number) by type, 2010 through 2012[a]

Country	Hurricane	Flood	Earthquake	TOTAL
Antigua & Barbuda	1 / 0	0 / 0	0 / 0	1 / 0
Bahamas	2 / 0	0 / 0	0 / 0	2 / 0
Cuba	1 / 0	1 / 2	0 / 0	2 / 2
Dominica	1 / 0	0 / 0	0 / 0	1 / 0
Dominican Republic	3 / 7	4 / 11	0 / 0	7 / 18
Haiti	3 / 23	7 / 104	1 / 217,300-316,000	11 / 217,427-316,127
Jamaica	1 / 14	0 / 0	0 / 0	1 / 14
Martinique	2 / 1	0 / 0	0 / 0	2 / 1
Puerto Rico	3 / 2	0 / 0	0 / 0	3 / 2
St. Lucia	1 / 12	1 / 0	0 / 0	2 / 12
St. Vincent & Grenadines	1 / 0	0 / 0	0 / 0	1 / 0
Turks & Caicos	1 / 0	0 / 0	0 / 0	1 / 0
Virgin Islands (U.K.)	1 / 0	0 / 0	0 / 0	1 / 0
Virgin Islands (U.S.)	1 / 1	0 / 0	0 / 0	1 / 1
TOTAL REPORTED DEATHS	60	117	217,300-316,000	217,477-316,177

[a] Only countries with reported events and deaths are shown. There were no reported mass movements and droughts. There were no reported major volcanic events from 2010 through 2012, but there was continuous activity of the Montserrat volcano. Data source: EM-DAT. Data for 2012 is for January through April. Data source for the number of people killed by the 2010 Haitian earthquake: OCHA and USGS; a range is provided due to differences in estimations from both sources.

2012). In that framework, known as "Pressure and Release" or PAR, disaster risk represents the intersection of hazard (with its associated probabilities of occurrence, magnitude, and frequency) and vulnerability as well as the capacity of people to cope and to recover. Wisner and colleagues conceptualize vulnerability and capacity to be the result of processes working at different scales, what they refer to as "the progression of vulnerability" and which include root causes, dynamic pressures, and unsafe conditions (Figure 5). Root causes refer to processes that

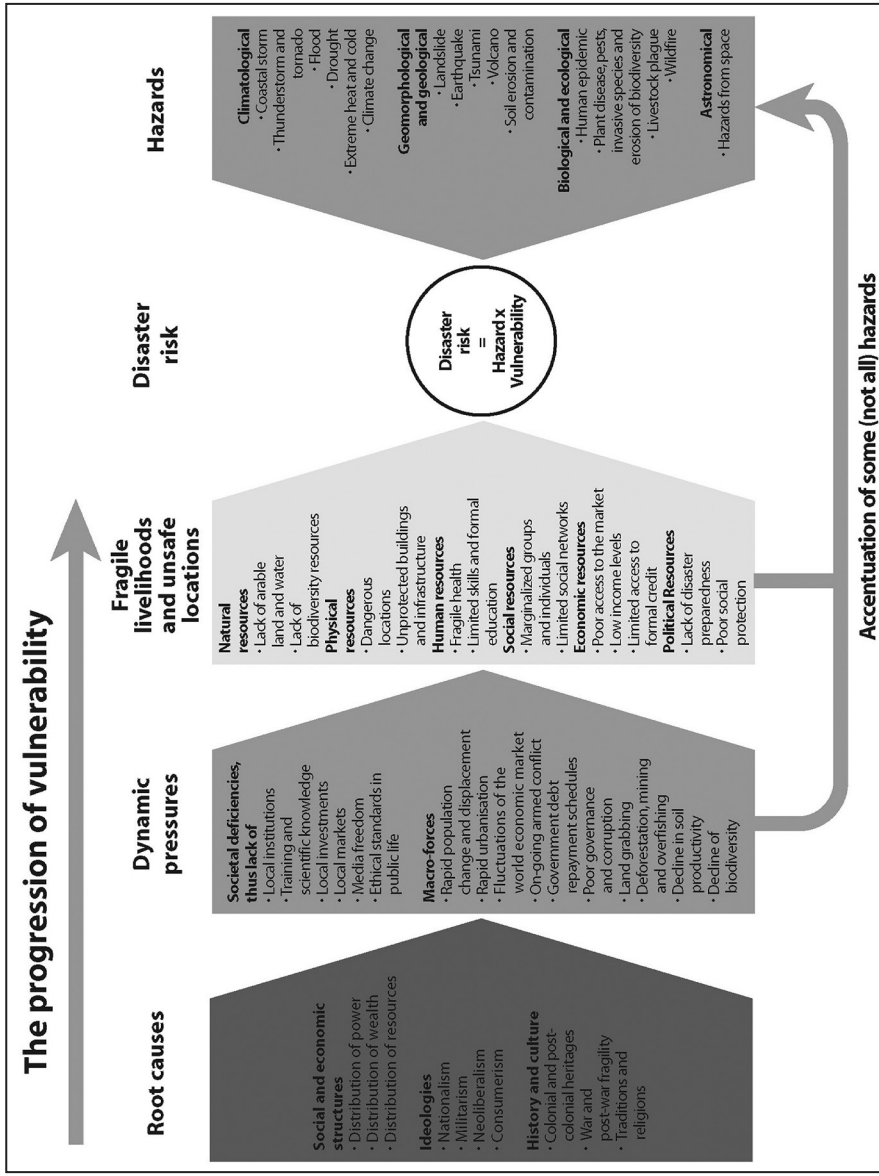


Figure 5. The progression of vulnerability (from Wisner, Gaillard and Kelman 2012).

are most often spatially and temporally distant: historically derived patterns of social inclusion and exclusion, governance, and socioeconomic structure. These historical, political, social, and economic structures in turn interact with the other two components—dynamic pressures and unsafe conditions—which are more immediate or recent and localized in nature. Dynamic pressures are processes that focus and channel root causes into situations that become unsafe. Dynamic pressures are processes that work on the time frame of decades (as opposed to centuries) and may be regional or global in scale. Examples of dynamic pressures include population growth, government indebtedness, price fluctuations (such as the current rising price of grain and fluctuations in the price of petroleum, as well as producer prices for such exports as coffee and minerals), and environmental degradation. Unsafe conditions (also referred to as unsafe locations), in turn, are the specific forms and situations in which the vulnerability of people is expressed in a specific place and time. They reflect the lack of, or limited access to, different resources (natural, material, technological, economic, social, institutional, and political) that permit the reduction of risk and allow for the coping with and recovering from hazards. An example would be the collapsed houses on the waterlogged slope outside Ponce, Puerto Rico referred to earlier.

The PAR framework helps explain disasters in the insular Caribbean. In the next subsections we discuss some examples of how different processes influence disaster risk and vulnerability in the region. We also provide some specific examples by country.

Geographic, historical, and socioeconomic commonalities

The Caribbean islands share many characteristics that put their populations at risk and increase their people's vulnerability to natural hazards. We have already touched on factors that are intrinsic to the islands' geographies and locations: the islands, for example, are located in an area that is prone to different natural hazards. In addition, other scholars have emphasized geographic isolation, small size, limited natural resources, large exposed coastal zones, and high susceptibility to the potential effects of climate change and its associated rise in sea levels (Méheux, Dominey-Howes and Lloyd 2007; Mimura *et al*. 2007; Pelling and Uitto 2001). Other factors are related to social, economic, and political processes at various scales, including a common history of colonialism and slavery (Beckford 1999), economic changes that have affected the hemisphere as a result of globalization processes (Girvan 2006; ECLAC 2009), different political ideologies, high levels of urbanization and population densities, and small economies with little diversification (ECLAC 2009), among others.

External economic processes such as economic liberalization and globalization are major stressors for small islands and influence their vulnerability to natural hazards; this is particularly true of small islands developing states (SIDS) (Méheux, Dominey-Howes and Lloyd 2007; Pelling and Uitto 2001). In the Caribbean, money loaned for "development" by the World Bank and the International Monetary Fund (IMF), for example, has become "very expensive money" (Skelton 2004:44). These loans and their associated interest rates, along with the imposition of structural adjustment programs that mandate the reduction of government budgets (required by the World Bank for its loans), have resulted in high debt levels, debts repayments that take much of governmental budgets, currency devaluations, cuts to social services like education and health programs, and little budget left for public investment in countries' physical infrastructures (Skelton 2004). This is an excellent example of what we mean by "dynamic pressures" that cascade through society and the economy, resulting in "unsafe conditions."

Social costs are also a manifestation of socioeconomic situations, including stagnation of wages, increasing unemployment and poverty, increasing informal and insecure jobs, and a decline in living standards and well-being (Clarke and Howard 2006; Handa and King 2003; Pomeroy and Jacob 2004). All these factors exacerbate a whole range of local economic and social problems that ultimately also exacerbate vulnerability to natural hazards by limiting the availability or access to resources needed for personal protection (for example, flood proofing one's house or buying flood insurance) and social protection (for example, government investment in sea walls and other protective infrastructure, maintenance of early warning systems). While there are examples of some positive effects of external socioeconomic factors and globalization on natural disaster vulnerability and adaptation (see, for example, Pelling and Uitto 2001 for the case of Barbados), we believe that these are exceptions, or at least that those processes do not benefit all countries and persons equally.

Country examples

In Jamaica, for instance, loans by the World Bank, the IMF, and the Inter-American Development Bank (IDB) to develop agriculture and manufacture imposed tremendous restrictions on how the money could be spent (Black 2001). Little money (if any at all) from those loans could be spent on health, education, and local infrastructure; governmental cuts to these services resulted in limits to the construction of or even upgrades to hospitals and schools. This is ironic since one of the principle campaigns mounted by the United Nations' Disaster Reduction

Secretariat has focused on retrofitting and relocating schools and health facilities so that they are safe from natural hazards (UNISDR 2012). When cuts are made in health, education, and infrastructure, then it is difficult to develop the human and material/physical resources needed for coping with and adapting to natural hazards.

In the agricultural sector, for example, trade liberalization and loans and policies like those of the IDB and the World Trade Organization (WTO) have resulted in the loss of preferential trading agreements that Caribbean countries such as Jamaica, Grenada, Dominica, Saint Lucia, and Saint Vincent had with the European Community, particularly England, regarding agricultural products such as bananas (Black 2001; Potter *et al*. 2004:chapter 3). Small-scale farmers in the Caribbean have lost access to guaranteed markets and now have to compete in an open market that favors low-cost products like the bananas produced in Central American countries by large U.S. multinationals. Small farmers have also lost access to previously accessible local subsidies and have to purchase imported materials like seeds and fertilizers; all these factors make production costs higher and subsequently result in higher product prices that cannot compete with cheaper agricultural products used for domestic consumption and for export.

In the manufacturing sector, foreign corporations take advantage of free trade, tax exemptions, and cheap labor. The result is often dangerous working conditions and not enough income to allow home improvements and other personal investments in disaster risk reduction. These overseas companies usually make no investment in the long term, closing factories when lower-cost options present themselves, leading to the loss of jobs and subsequent increases in unemployment in the areas where factories have been shuttered (Black 2001).

In Haiti, trade liberalization and policies imposed by the IMF and the World Bank have affected local manufacturers and farmers as well, destroying local industries such as rice and poultry production (Gros 2011). Tax revenues collected by the Haitian government from agricultural products have also decreased because of external policies. Revenues from agricultural products allowed the state to undertake at least some development initiatives that could, perhaps, have resulted in a state that was a little better prepared to deal with disasters like the earthquake of 2010 (Gros 2011; Wisner *et al*. 2005).

The cases above have implications for the economic situations and well-being of people throughout the insular Caribbean, as for example in the case of small-scale farmers and manufacturing workers and their families. In terms of people's everyday lives, these situations translate into low wages, insecure jobs, and income that is just enough for day-to-day survival but not enough to allow for any savings or investments to

improve their situations. In terms of hazard and risk management, these situations mean limits to income and savings that people can draw from to prepare for and recover from disasters. These situations also imply limits to the improvements that people can make to local infrastructure and housing conditions in order to better withstand the impacts of hazards. Such unstable economic situations can, moreover, trigger wider societal problems, like increasing conflict and crime rates, which in turn can limit the development of social capital and the relationships of trust and reciprocity needed for disaster management at the local level.

In the case of low-income communities in Puerto Rico, for example, residents described how mutual help and solidarity among community members in times of crises like floods are sources of support shortly before, during, and after such events (López-Marrero 2010). Assistance includes but is not limited to help in securing belongings, cleaning up, and the provisioning of food and household equipment. Although social resources are still present in times of crises, residents described how mutual help and collective actions have declined compared to the past, when social networks were stronger and more people shared more and relied on each other. While community members asserted that technological strategies and external aid have contributed to these declining patterns of social resources, they also attributed these declines to changing social conditions at the community level. They mentioned, for example, how increases in the crime rate in the community and nearby areas, along with problems related to drug traffic and use, make people frightened and act in more individualistic ways. They even mentioned how the composition of the community is also affecting these relationships of trust and reciprocity. For instance, they indicated that as the old people in the community die and new people move in, the newcomers do not relate to and share much with the already existing residents.

Urbanization

Rapid urbanization is an example of a dynamic pressure that has increased the development of vulnerability to natural hazards and disaster outcomes in the region. The insular Caribbean is one of the most urbanized regions in the world, where rapid urbanization has occurred primarily since the mid-1940s, mostly in response to economic opportunities and other services offered by urban areas (Potter *et al*. 2004:chapter 7). By 2010, about 67% of the region's population was classified as urban, with some countries (like Anguilla and the Cayman Islands) having 100% urban populations (FAOSTATS 2012). Furthermore, ten out of twenty-three countries have more that 75% urban populations.

Countries such as Antigua and Barbuda, the Dominican Republic,

Haiti, Saint Lucia, and Saint Vincent are showing high rates of urban population growth (Potter *et al*. 2004:chapter 7). This combines with the fact that in many Caribbean countries, 30 to 50% of the total population lives in the capital city and its metropolitan areas. In Puerto Rico, the Dominican Republic, and Haiti, for example, at least 7 million people are settled in urban areas, equaling 30% of the population for the three countries, with Puerto Rico having the highest percentage, 73%, and the Dominican Republic and Haiti about 22%. In most instances, urban population growth has occurred while the infrastructure and services have remained fairly unchanged. Moreover, most of the main cities are situated in coastal areas, which increase the exposure of people and infrastructure to the effects of natural hazards such as floods, coastal storm surges, and tsunamis, and, subsequently, the potential effects of climate change and associated rises in sea levels (Mimura *et al*. 2007). Additionally, some portions of cities, like San Juan (Puerto Rico), Kingston (Jamaica), and Port-au-Prince (Haiti), are also located in low-lying, geologically unstable soils that in some areas have also been artificially filled with sediments to allow urban expansion. This increases exposure to liquefaction effects that can result from earthquakes and land shaking. In fact, liquefaction effects triggered by the Haitian earthquake along the coastline were responsible, in combination with other factors, for severe damages in coastal areas in 2010 (Olson *et al*. 2011). Low-lying areas filled with sediments are also exposed to flood hazards.

High levels of urbanization in the Caribbean have been accompanied in some instances by unplanned and spontaneous settlements (usually lacking construction codes and building standards), poor-quality housing, lack of urban services such as potable water and wastewater treatment, social discrimination and inequalities, and high rates of unemployment, violence, and crime (see, for example, Clarke 2009; Howard 2009), all of which can generate urban vulnerability to natural hazards (Pelling 2012). Urban, low-income, coastal communities of Puerto Rico, for example, developed spontaneously in response to employment opportunities in the sugar industry during the first decades of the 1900s. Today, many of their residents live in insecure houses that cannot withstand the effects of floods and hurricanes; they do not have the resources (for example, economic and political) to improve their housing conditions (López-Marrero 2010). Others do not have secure land tenure and thus cannot purchase insurance or they choose not to make improvements to their houses because they are uncertain they will be able to stay in them. Additionally, and as mentioned before, changing social conditions related to crime, drugs, and migration in those communities are eroding the ties and solidarity among community members that are needed for hazard preparedness and disaster recovery.

If one combines the above-mentioned conditions in urban areas with other factors such as political instability, violence, weak government and institutions, and high levels of corruption and poverty, then understanding Caribbean disasters becomes easier. The Haitian earthquake of 2010 makes clear how these connections influence disaster outcomes. The event was triggered by the country's geographic and geological situation; yet, the extent of destruction was due to years of interacting social, political, institutional, and economic conditions. Gros (2011) describes how the failure of the state and Haitian institutions, along with international policies has not necessarily promoted development and capacity building in the long term. Instead, wide-spread poverty, inadequate delivery of basic services, increasing urban populations living in congested spaces with old and insufficient infrastructure, and poor enforcement building codes all came together and were the underlying causes of the devastation wreaked by the catastrophic event. Overcoming these urban vulnerabilities under such circumstances is especially challenging (Lomnitz and Wisner 2012:319-321).

Characteristics of national economies

Having a small and undiversified economy is another element that characterizes Caribbean countries, particularly the smaller island states. Tourism is a major economic sector in the region. The "sun, sand, and sea" image brings millions of visitors to the region yearly, and for some countries like Saint Lucia, Antigua and Barbuda, Anguilla, and the U.S. Virgin Islands, visitors' expenditures constitute more than 50% of each island's gross domestic product(GDP) (Potter *et al*. 2004:chapter 11). While the benefits of tourism for Caribbean countries are evident, it is also true that tourism has many social, cultural, and environmental implications (Mullings 2004). Dependency on tourism makes fragile the economies of Caribbean countries because tourism is subject to different external factors, such as global economic changes that influence airfares, and changes in tourists' tastes and preferences. Earnings from tourism are also subject to the occurrence of natural hazards as well, as illustrated by the hurricane season of 2004. The passage of Hurricane Ivan over Grenada, for example, destroyed a large part of the country's agriculture and infrastructure, including tourism-related facilities. In just a few hours, more that 90% of hotel guest rooms were either damaged or completely destroyed (Nurse and Moore 2005; OECS 2004). Decreases in tourist arrivals and the contribution of tourism to the GDPs of countries like The Bahamas, Jamaica, the Dominican Republic, the Cayman Islands, and Grenada were evident after hurricane occurrences (ECLAC 2005). Climate change and associated increases in coastal ero-

sion, changes in sea level, and changes in the frequency and magnitude of storm events and associated storm surges are expected to have a negative impact on coastal infrastructure and economic activities like tourism (Mimura *et al*. 2007).

In the preceding subsections we presented and discussed some examples of root causes, dynamic pressures, and unsafe conditions that combine to produce disaster impacts in the insular Caribbean. There is a need for studies that explore these causal cascades in such complex systems at different scales in order to inform practical risk reduction strategies. Much of the work in this area has been done in relationship to agricultural vulnerability in the context of global changes (see, for example, Barker, this issue), but studies regarding the impacts of these processes and their implications in other sectors and at various scales deserve further attention and are much needed.

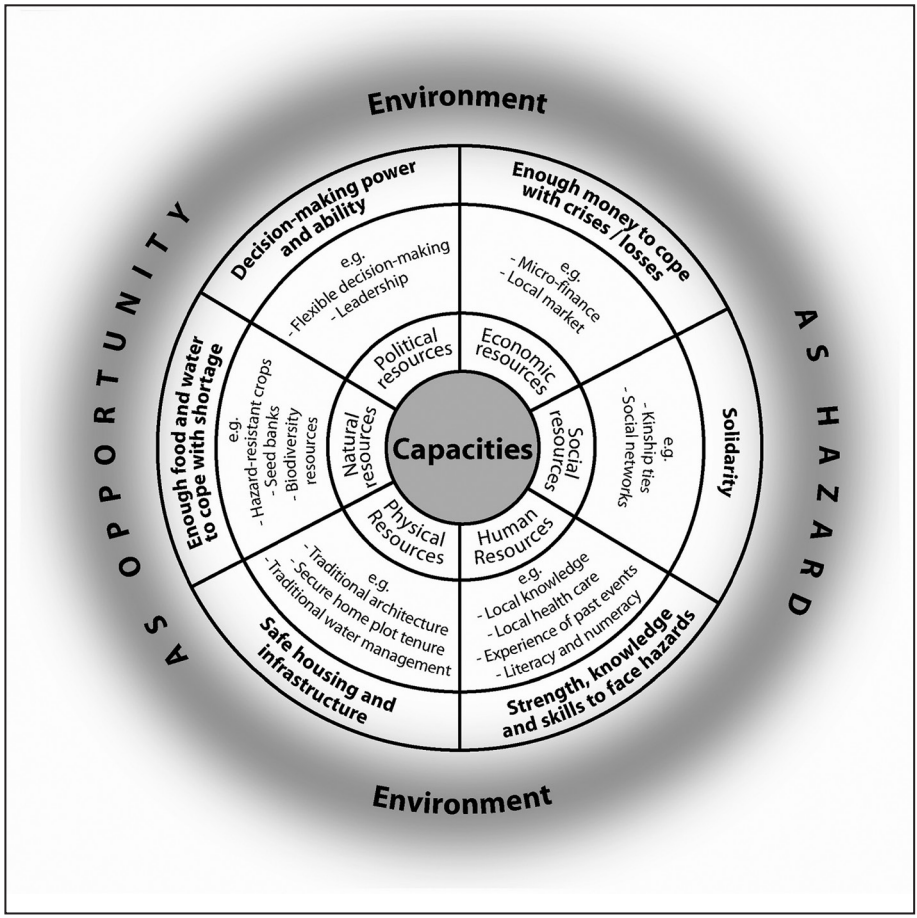
Reducing Vulnerabilities and Building Capacities at the Local Level

The previous sections showed some of the elements that influence the vulnerability to natural hazards of the region's inhabitants. People in the Caribbean have, however, repeatedly demonstrated the ability to protect themselves and to recover from these events. Far from being passive "victims" waiting for a disaster to occur, inhabitants have managed in different ways to prepare for and recover from disasters, even in cases of limited financial resources. Moreover, some past disasters have created opportunities for governments and NGOs to advance social protection and risk reduction.

Risk management and vulnerability reduction occur at different scales, from the local level (such as the individual, the household, and the community) to the national level (for example, governments) to the regional level (as in the case of hurricane warnings, for example). In this section we provide some examples that show how people in the region have made use of different capacities and resources to cope with natural hazards and manage risk and disasters, particularly at the local level.

Capacities refer to the ability of a person or group to take actions in order to resist, cope with, and recover from disasters (Wisner, Gaillard and Kelman 2012; Wisner *et al*. 2004). These capacities are based on the availability of and access to various resources and assets: natural, physical, economic, human, social, and political. Wisner, Gaillard and Kelman (2012) summarize and provide examples of these capacities and resources in what they refer to as a "Circle of capacities" (Figure 6). Actions people undertake making use of these resources can take different forms; they can be anticipatory or responsive, long term or short term.

Figure 6. The circle of capacities (from Wisner, Gaillard and Kelman 2012).



In the case of hurricanes and floods, residents have drawn from various physical, technological, institutional, economic, and human resources to protect themselves and their properties from disaster events (see, for example, Hobson 2003 on the case of Nevis and López-Marrero 2010 on the case of Puerto Rico). Long-term strategies such as physical and technological changes in the style and materials of construction are among the strategies most employed. Moreover, short-term social resources are often employed shortly before and after the occurrence of an event, when people elevate their belongings or move them to safer places outside their homes, clean up their surroundings, and use water and wind barriers to protect their belongings. Evacuation to shelters or family houses is another strategy to withstand hurricanes and floods; yet some people do not evacuate for fear of losing their belongings during

the event or because of potential theft after. The deteriorating social conditions of some communities aggravate this situation. Warning systems have also allowed for better preparation in the case of floods and hurricanes (Wisner *et al*. 2005). However, some residents do not believe the warnings and do not take the necessary precautionary measures or evacuate their communities. Actions like the ones just mentioned, along with social protection in the form of public works such as dyke construction, may in some cases create a false sense of security. This was evident in the case of low-income coastal communities in Puerto Rico, where some residents were not willing to undertake additional measures to deal with floods (López-Marrero 2010).

Disaster events have served in different cases as catalysts for new approaches and management practices. In the case of the British Virgin Islands, the great damage caused by Hurricane Hugo in 1989 prompted new policies and regulations to reduce the impacts of future hurricanes (CGCED 2002). Rather than continuing to focus on responses and recovery, the new approaches emphasized mitigation and preparedness, including public awareness and education. Emphasis was also put on construction techniques, and people received tax exemptions when constructing in accordance with hurricane-resistant standards. In the Dominican Republic, the passage of Hurricane Georges in 1998 led to the creation of a new emergency law and a nationwide civil defense system that cooperated with churches, NGOs, youth groups, and neighborhood associations to issue warnings at the local level in the face of storms' occurrences (Wisner *et al*. 2005). These networks were put into place and warnings were rapidly spread before Tropical Storm Jeanne in 2004; unfortunately not everyone got the warning promptly or trusted it. In the case of volcanoes, Potter *et al*. (2004:chapter 4) describe how the eruption of Mt. Pelée in Martinique in 1902 prompted the scientific study of volcanoes in the region. Since then, both the ability to predict events and the availability of early warning systems have improved considerably and have helped in the preparation to cope with such hazards. Hence, when more recent eruptions have occurred, like the one in Montserrat in 1995, early warning systems and monitoring along with evacuation plans resulted in little loss of lives, in spite of great infrastructure losses (Wisner *et al*. 2004). Today, the eastern Caribbean can rely on the Seismic Research Centre at the University of the West Indies in Trinidad, which monitors and provides information regarding volcano and earthquake hazards <http://www.uwiseismic.com/>. The University of Puerto Rico Seismic Network also conducts research and provides information about earthquakes and tsunamis <http://redsismica.uprm.edu/english/>. The United States Geological Survey is another source of regional information about earthquakes <http://earthquake.usgs.gov/earthquakes/

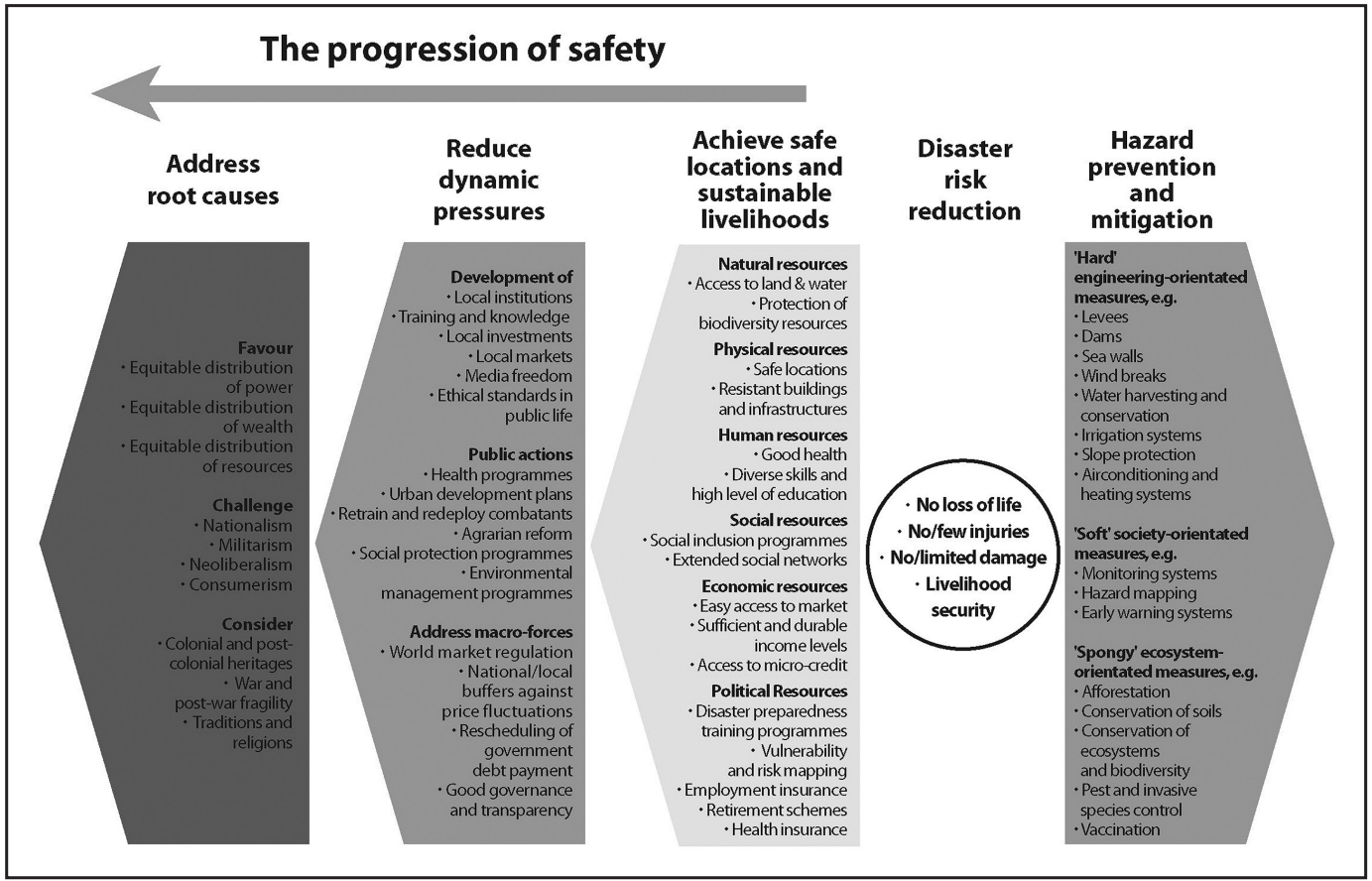
world/?regionID=27>.

Cuba provides an instructive case of disaster risk and reduction through the combination of personal and social protection. A review of Tables 1 through 3 reveals that in Cuba few people have been killed by disasters, in spite of the fact that Cuba has reported the second highest number of disaster events in the insular Caribbean (after Haiti). For example, in 1998 Hurricane Georges hit Cuba and only six people were killed, while there were at least 500 deaths in neighboring Hispaniola and 12 in Puerto Rico. This achievement of protecting lives has occurred in a country with the insular Caribbean's largest population and with one of its lowest GDPs per capita. Cuba has also had to cope with an economic blockade imposed by the United States for over 50 years and the disappearance of subsidies and assistance from the former Soviet Union and its satellites. While hurricanes in Cuba do, of course, cause great economic and infrastructural damage, Cuba has had clear success in saving lives during these events.

Cuba's success in risk reduction and disaster management has been achieved through a variety of factors, including, among others, a well-organized and trained civil defense system, an early warning system (with the whole population having access to the information), a high level of educational attainment and literacy among its population (which permits a better understanding of warning systems), timely evacuations, community-based training programs (including training and simulation exercises in schools), and community mobilization during the different phases of disaster (Llanes-Guerra and Montes de Oca Días 2002; Sims and Volgemann 2002; Thompson and Gaviria 2004; Wisner *et al*. 2005). Cuba's achievements have been attained because disaster and risk management are not seen as different entities; rather, they are viewed as an integral part of the development of the country and its people. Universal access to services such as health and education (both in urban and rural areas), policies to reduce social and economic disparities, investment in the country's infrastructure (including rural areas), and social organization have been among the priorities in Cuba's overall development over the years (Skelton 2004; Thompson and Gaviria 2004). The case of Cuba provides an excellent example of what Wisner *et al*. (2012) refer to as the "Progression of safety" (Figure 7), in which the effects of policy and practice at various scales and sectors prove to be effective at tackling unsafe conditions, dynamic pressures, and root causes, ultimately reducing disaster impacts.

Community-based disaster risk reduction (CBDRR) initiatives provide a complementary approach to broader disaster risk management and vulnerability reduction, emphasizing community and local action while at the same time promoting partnerships with governmental,

Figure 7. The progression of safety (from Wisner, Gaillard and Kelman 2012).



nongovernmental, and other sectors of the society (Maskrey 2011). As illustrated above, Cuba provides an example of CBDRR in the region; CBDRR is increasing in other Caribbean countries, albeit slowly. In the Dominican Republic, for instance, the *Asociación Dominicana de Mitigación de Desastres* (Dominican Disaster Mitigation Association) has been collaborating with NGOs to conduct workshops with vulnerable communities (CGCED 2002). Participating communities have developed plans and actions to address their vulnerability to natural hazards. They have constructed small-scale projects (for example, drainage ditch embankments and containment walls), established emergency committees, made evacuation plans, and organized clean-up brigades to put into place when a disaster is imminent. These communities had reduced impacts during the passage of Hurricane Georges in 1998. Disaster preparedness projects have also been undertaken elsewhere in the Dominican Republic—in urban neighborhoods, rural communities, and *bateyes*[9] (Bastidas, Santamaría and Urbano 2009). These projects were undertaken in collaboration with the Dominican government and various NGOs, and emphasize early warning systems, community vulnerability mapping, local capacity building and training, public awareness and education, and small infrastructure projects. The projects emphasize community organization and leadership, particularly among participating women and the youth. This emphasis has the dual functionality of preparing for disaster management while increasing the well-being of participants.

In Jamaica, community disaster response teams (CDRTs) have focused on early warning systems as a way to save lives during hurricanes (Wisner *et al*. 2005). In Cedar Valley, part of the local municipality (parish) of Saint Thomas, for example, the CDRT went street by street to warn local residents about the imminent strike of Hurricane Ivan in 2004. As part of the response plan, CDRTs encourage those most vulnerable, like the elderly and the mentally impaired, to hang a white flag or other type of identification outside their homes as a way to let people know that they will need help when it is time to evacuate. The teams also prepare local maps with information about potential risks and resources, and know where the most vulnerable live. In collaboration with the local Red Cross, the team members were trained to carry out rescue, emergency first aid, and rapid assessment. During Ivan's passage, despite great damage to property, no one died in Cedar Valley.

Supporting CBDRR projects requires identifying elements that are important to community members in their everyday lives and identifying ways to mainstream those elements into risk and disaster management (Delica-Willison and Gaillard 2012). Interventions that suit multiple purposes have greater chances of acceptance by stakeholders. In Santo

Domingo, in the Dominican Republic, for example, residents of low-income areas valued and supported the construction of stairways and bridges because they enabled social interaction between neighborhoods and provided market access that stimulated local businesses. In addition, these stairs and bridges provide emergency access in case of disaster (Pelling 2011). López-Marrero and Yarnal (2010) also advocate for identification of everyday concerns among residents of hazard-exposed communities as a starting point for CBDRR. In low-income communities in Puerto Rico, López-Marrero and Yarnal found that health conditions, family well-being, economic factors, and land tenure were more immediate and worrying problems than floods. Recalling the PAR framework, one understands that all these problems are related to vulnerability and unsafe conditions; hence tackling these problems will both treat pressing concerns and strengthen the capacity to cope with natural hazards.

Enhancing community capacity also calls for integrating diverse knowledge (including local knowledge and experiences), integrating stakeholders across scales, promoting effective linkages and collaborations between community members and other groups such as governmental emergency managers and NGOs, and cultivating new partners. Unfortunately, highly politicized environments and social interactions can slowdown or limit progress as López and Tschakert (2011) and Pelling (2011) found in Puerto Rico, the Dominican Republic, and Haiti. In those cases, mutual distrust and lack of confidence between stakeholders and governance systems that do not promote inclusiveness represent barriers that undermine the effective building of partnerships and collaborations. Overcoming such obstacles might not be easy or immediate, but if the goal is to promote sustainable community development, including the long-term reduction of vulnerability and disaster impacts, then we believe that working to overcome these and other obstacles is crucial. Also vital is engaging stakeholders in a social learning process, which consists of learning to enhance common knowledge, awareness, and skills by engaging multiple participants, sharing diverse perspectives and thinking, and acting together (Schusler *et al*. 2003).

Concluding Remarks and Recommendations

Exposure to hazards varies among countries, and their inhabitants are not uniformly vulnerable to loss, dislocation, injury, and death. How effectively people deal with natural hazards and disasters will depend on the availability and access to various natural, physical, economic, human, social, and political resources. In this article we have provided an overview of disasters with a natural trigger that have occurred in the insular Caribbean during the past three decades, along with elements

that create vulnerability to natural hazards in the region. We have also provided examples showing how people have resisted, coped, and recovered from disaster events. Learning about these successful stories provides lessons that could be applied in different Caribbean communities, countries, and beyond.

Reducing disaster impacts and saving lives require tackling the different root causes, dynamic pressures, and unsafe conditions that cause such disasters, as explained by the "Pressure and Release" framework used in this article. Doing so also requires promoting, strengthening, and supporting the capacities at various levels (local, national, regional) to face hazards. Attending the wider root causes will certainly decrease the pressures associated with disasters at lower levels; unfortunately, these root causes usually occur at scales beyond where the disasters take place and thus are more difficult to tackle. Consequently, their resolution is often very slow, except in rare instances such as the rapid, deep social changes in Cuba after 1959. This is not to say we should ignore root causes; we all should be aware of them and work toward improving the conditions associated with them. However, we should also think of actions and strategies that are more immediately applicable and practical at the local level, and perhaps more achievable in the short to medium term. Many actions have proven to be effective to reduce disaster impacts in the Caribbean and elsewhere, and we provide recommendations based in part on lessons learned and in part on ideas that we believe can also increase capacities.

Focusing on the local scale, we recommend that local officials, national and international NGOs, and civil society, together with nearby educational and research institutions (secondary school faculty, university staff, government and private sector research personnel) consider doing the following:

- Develop trust relations with local communities and seek to understand what they know about locally significant hazards, how they try to anticipate these events and cope with them; discuss with local people additional sources of knowledge of hazards from outside the community in a spirit of mutual respect.
- Develop and promote outreach and public awareness campaigns, including hazard knowledge and disaster and risk management strategies at various levels and settings (for example, in households and communities, with risk communicators, in the school curricula). These campaigns should involve local and youth media workers and be based on the respectful dialogue and co-production of knowledge mentioned just above.
- Develop different ways to disseminate warning systems in different situations and base them on the available technology

and capacities. Keep in mind, however, that sophisticated and expensive technologies are not always necessary for the creation of effective warning systems; local practices, knowledge, and experiences people can draw from should be showcased in many ways as they can be very effective. Popular and folk music, street theater, locally produced video, and many existing cultural vehicles have been used successfully in the past.

- Identify ways to increase social memory of past disaster events and how communities have dealt with them. This is particularly important for the younger generations and migrants, which in some cases have not even experienced a disaster in their lifetimes. Developing projects where children interview the elderly and producing short video documentaries that include elements that are attractive to different audiences and that involve residents in their development are examples of some outreach efforts that can be used to increase knowledge and awareness among residents of exposed communities. These types of materials can be used to promote discussions in communities and schools, among others.

At the national and regional scales in the insular Caribbean, we recommend the following:

- Develop systems that are well coordinated at all scales and that combine different resources and knowledge—scientific, technical, and local. Bring together these different knowledge bearers and stakeholders when identifying and implementing risk reduction strategies. It is important here that the system and the government structures are trusted by the population. As Tropical Storm Isaac passed over Haiti on August 26-27, 2012, some of the 400,000 people who were still living in tents as a result of the earthquake said they did not trust government warnings and invitations to move to safe shelters.
- Stress the importance of developing and implementing a diverse and complementary set of actions, strategies, and management options, beyond just technical and engineering ones. Here options that clearly acknowledge the value of developing and supporting human and social resources are key.
- Provide different groups—including, for example, community members, policy makers, government employees, decision makers, donors, and researchers—with information that is appropriate, accessible, and useful at different levels and for different audiences and that advances the development of practical adaptations. This calls for more creativity when disseminating

research and project results, going beyond just peer reviewed articles that, albeit important and necessary, oftentimes do not reach the necessary audiences. Outputs like factsheets, videos, and games are just a few tools that could attract attention at different levels and provide different media through which to disseminate information, promote discussion, and increase awareness.

- Promote research, from a social perspective, about those "less known" and "less experienced" hazards such as earthquakes, tsunamis, and droughts. Earthquakes and tsunamis, for instance, have been studied from technical and scientific points of view, and there are also studies that describe precipitation patterns and potential drought, particularly as related to climate change. Yet, from a social perspective, studies of hazard management, preparedness, and response, among others, are still very limited.
- Create and make available a regional database of disaster occurrence and impacts that includes information at more local scales and not just aggregated numbers at the country level, which would obscure impacts at local levels where perhaps more assistance and intervention are needed.
- Compile various materials such as the materials mentioned above (data, articles and reports, and video documentaries, among others) in a regional database (depository) that is accessible and can be used by different people in different countries in the Caribbean: government agents, donors, schools, and communities, among others. Such an initiative could be coordinated among different countries for wider dissemination and use.

Finally, we would like to see the development of pilot projects that bring together different stakeholders such as community members, risk managers, NGOs, and others as a way to initiate partnerships and promote social learning. Evaluation of such projects would determine which elements were successful and what limitations need to be overcome for further large-scale attempts to build partnerships and reduce the risks of disaster.

Acknowledgments

We thank the review and constructive suggestions of Antonio González Toro (Bloustein School of Planning and Public Policy, Rutgers University), Félix Aponte Ortiz (Graduate School of Planning, University of Puerto Rico), Frederick N. Scatena (Department of Earth and Environmental Science, University of Pennsylvania), and two anonymous reviewers.

Notes

1. According to Walker (1995),"Political ecology, which grew primarily out of the traditions of cultural ecology and political economy, attempts to examine how human practices of resource use are shaped by social relations at multiple levels over time, and the ways that these relations shape and are shaped by the physical environment. Numerous authors have observed that political ecology constitutes less of a theoretically coherent field of study than a loosely knit body of research with broadly similar approaches and concerns. Among these are: (1) the role of the local resource user and the capabilities and 'decision-making environment' that affect the ways that resources are used; (2) the ways that local resource use is shaped by social and economic relations at multiple scales (the household, the community, the market, the state, transnational capital); (3) the ways that historical processes have shaped and continue to shape these relations; (4) the ways that society and the 'natural' or human-modified physical environment mutually shape each other over time."
2. Refer to Figure 1 in the introduction to the special issue for a location map of the insular Caribbean.
3. The data contained in Tables 1 through 3 usually appear in aggregated forms (at the country level) in the sources we reviewed. Consequently, it was not possible to provide disaggregated data for different islands that are grouped, such as Antigua and Barbuda, the Cayman Islands, The Bahamas, the former Netherlands Antilles (including Aruba, which is not actually considered part of the Netherlands Antilles, but is still included in some global databases as such), Saint Kitts and Nevis, Trinidad and Tobago, the British Virgin Islands, and the U.S. Virgin Islands.
4. The EM-DAT International Disaster Database, for example, enters a disaster into its database if at least one of the following criteria is fulfilled: ten or more people reported killed, one hundred or more people reported affected, declaration of a state of emergency, or a call for international assistance <http://www.emdat.be/criteria-and-definition>.
5. When comparing disaster events among sources we used certain indicators— name, date of occurrence, or disaster type—to avoid the replication of a disaster event in our summary.
6. For a summary of historical disasters and impacts in the region, see, for example, Tomblin (1981).

7. The data for 2012 covers January through April.
8. Not all the insular Caribbean is influenced by plate tectonic boundaries; northern Cuba, for instance, is not.
9. *Bateyes* are communities (mostly rural) that developed around the sugarcane industry. In the Dominican Republic they were originally composed of Haitian migrant workers in sugar cane plantations. Today, the population of *bateyes* is composed of Dominicans, Dominican-Haitians, and Haitians. They are spaces of marginalization and social exclusion.
10. Brooks and Adger (2005), Eakin and Lemos (2006), and Yohe and Tol (2002) refer to these resources within the specific context of climate change adaptation.

References

Barker, David. 2012. "Caribbean Agriculture in a Period of Global Change: Vulnerabilities and Opportunities." *Caribbean Studies* (this issue).

Bastidas, Pedro, María M. Santamaría, and Sussana Urbano. 2009. *Community Disaster Preparedness in Dominican Republic: Projects History by Component*. Santo Domingo, Dominican Republic: European Commission – Humanitarian Aid Office for the Caribbean.

Beckford, George L. 1999. *Persistent Poverty: Underdevelopment in Plantation Economies in the Third World* (2nded). Kingston, Jamaica: University of the West Indies Press.

Black, Stephanie. 2001. *Life and Debt*. Documentary film. New York: New Yorker Films.

Brothers, Timothy S., Jeffrey S. Wilson, and Owen J. Dwyer. 2006. *Caribbean Landscapes: An Interpretative Atlas*. Coconut Creek, FL: Caribbean Studies Press.

Brooks, Nick and W. Neil Adger. 2005. "Assessing and Enhancing Adaptive Capacity." Pp. 165-181 in *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*, edited by Ian Burton, Elizabeth Malone, Saleemul Huq, Bo Lim, and Erika Spanger-Siegfried. Cambridge: Cambridge University Press.

Caribbean Group for Cooperation in Economic Development (CGECD). 2002. "Natural Hazard Risk Management in the Caribbean: Revisiting the Challenge." Last visited July 14, 2012. <http://siteresources.worldbank.org/INTDISMGMT/Resources/cgced_final.pdf >.

Clarke, Colin. 2009. "From Slum to Ghetto: Multiple Deprivation in Kingston, Jamaica." Pp. 261-278 in *Global Change and Caribbean Vulnerability: Environment, Economy and Society at Risk*, edited by Duncan McGregor, David Dodman, and David Barker. Kingston, Jamaica: The University of the West Indies Press.

——— and David Howard. 2006. "Contradictory Socio-Economic Consequences of Structural Adjustment in Kingston, Jamaica." *The Geographical Journal* 172(2):106-129.

Comfort, L., B. Wisner, S. Cutter *et al*. 1999. "Reframing Disaster Policy: The Global Evolution of Vulnerable Communities." *Environmental Hazards* 1:39-44.

Delica-Willison, Zenaida and J.C. Gaillard. 2012. "Community Action and Disaster." Pp. 711-722 in *The Routledge Handbook of Hazards and Disaster Risk Reduction*, edited by Ben Wisner, J.C. Gaillard, and Ilan Kelman. London: Routledge.

Eakin, Hallie and Maria Carmen Lemos. 2006. "Adaptation and the State: Latin America and the Challenge of Capacity-Building under Globalization." *Global Environmental Change* 16:7-18.

Economic Commission for Latin America and the Caribbean (ECLAC). 2009. "Caribbean Development Report." Volume 2. Last visited July 14, 2012. <http://www.eclac.cl/publicaciones/xml/3/38253/LCARL.245part1.pdf >.

———. 2005. "Comparison of the Socio-economic Impacts of Natural Disasters on Caribbean Societies in 2004". Last visited July 14, 2012. <http://www.eclac.cl/publicaciones/xml/0/23560/L.039.pdf>.

Gaillard, J.C., Ben Wisner, Djillali Benouar *et al*. 2010. "Alternatives pour une réduction durable des risques de catastrophe." *Human Geography* 3:66-88.

Girvan, Norman. 2006. "Caribbean Dependency Thought Revisited." *Caribbean Journal of Development Studies* 27(3):329-352.

Gros, Jean-Germain. 2011. "Anatomy of a Haitian Tragedy: When the Fury of Nature Meets the Debility of the State." *Journal of Black Studies* 42(2):131-157.

Gubbels, Timothy and Robert Brakenridge. 2004. "Flood Disaster Hits Hispaniola." NASA-Earth Observatory Feature Article. Last visited July 14, 2012. <http://earthobservatory.nasa.gov/Features/Haiti2004/>.

Handa, Sadhanshu and Damien King. 2003. "Adjustment with a Human Face? Evidence from Jamaica." *World Development* 31(7):1125-1145.

Hewitt, Kenneth, ed. 1983. *Interpretations of Calamity*. Boston: Allan & Unwin.

Hobson, Alexis. 2003. "The Responses of Residents of Nevis to Hurricane Threat: The Case of Hurricane Hugo." Pp. 153-172 in *Resources, Planning, and Environmental Management in a Changing Caribbean*, edited by David Barker and Duncan McGregor. Kingston, Jamaica: The University of the West Indies Press.

Howard, David. 2009. "Urban Violence, Crime and Threat to 'Democratic Security' in the Dominican Republic." Pp. 298-316 in *Global Change and Caribbean Vulnerability: Environment, Economy and Society at Risk*, edited by Duncan McGregor, David Dodman, and David Barker. Kingston, Jamaica: The University of the West Indies Press.

Kelman, Ilan. 2008. "Addressing the Root Causes of Large-Scale Disasters" Pp.

94-119 in *Large-Scale Disasters: Prediction, Control, and Mitigation*, edited by Mohamed Gad-el-Hak. Cambridge, UK: Cambridge University Press.

Lindsay, Jan M. *et al*. 2007. *Volcanic Hazard Atlas of the Lesser Antilles*. Kingston, Jamaica: The University of the West Indies.

Llanes-Guerra, José and Madelyn Montes de Oca Días. 2002. "Cuba: Beyond a Simple Response to Hurricanes." *Latin America and the Caribbean* 6:8-11.

Longshore, David. 2008. *Encyclopedia of Hurricanes, Typhoons, and Cyclones*. New York: Checkmark Books.

Lomnitz, Cinna and Ben Wisner. 2012. "Earthquake". Pp. 310-321 in *The Routledge Handbook of Hazards and Disaster Risk Reduction*, edited by Ben Wisner, J.C. Gaillard, and Ilan Kelman. London: Routledge.

López-Marrero, Tania. 2010. "An Integrative Approach to Study and Promote Natural Hazards Adaptive Capacity." *The Geographical Journal* 176(2):150-163.

——— and Petra Tschakert. 2011. "From Theory to Practice: Enhancing Resilience to Floods in Exposed Communities." *Environment and Urbanization* 23:229-249.

——— and Brent Yarnal. 2010. "Putting Adaptive Capacity into the Context of People's Lives: A Case Study of Two Flood-Prone Communities in Puerto Rico." *Natural Hazards* 52:277-297.

Maskrey, Andrew. 2011. "Revisiting Community-Based Disaster Risk Management." *Environmental Hazards* 10(1):42-52.

Méheux, Kristie, Date Dominey-Howes, and Kate Lloyd. 2007. "Natural Hazard Impacts in Small Islands Developing States: A Review of Current Knowledge and Future Research Needs." *Natural Hazards* 40:429-446.

Meillasoux, Claude. 1973. *Qui se nourrit de la famine en Afrique?* Paris: Gallimard.

Mimura, N., L. Nurse, R.F. McLean *et al*. 2007. "Small Islands. Climate Change 2007: Impacts, Adaptation and Vulnerability." Pp. 687-716 in *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson. Cambridge, UK: Cambridge University Press.

Mullings, Beverley. 2004. "Caribbean Tourism: Trouble in Paradise?" Pp. 97-117 in *Introduction to the Pan-Caribbean*, edited by Tracey Skelton. London: Arnold Publishers.

Nurse, Leonard and Rawleston Moore. 2005. "Adaptation to Global Climate Change: An Urgent Requirement for Small Island Developing States." *Review of European Community and International Environmental Law* 14(2):100-107.

O'Brien, Karen and Robin Leichenko. 2000. "Double Exposure: Assessing the Impacts of Climate Change within the Context of Economic Globalization." *Global Environmental Change* 10(3):221-232.

Office for the Coordination of Humanitarian Affairs (OCHA). 2012. "Haiti:

Humanitarian Snapshot". Last visited July 14, 2012. <http://reliefweb.int/sites/reliefweb.int/files/resources/map_1852.pdf>.

O'Keefe, Phil, Ken Westgate, and Ben Wisner. 1976. "Taking the 'Naturalness' Out of 'Natural' Disasters." *Nature* 260(5552):566-567.

Olson, Scott M., Russell A. Green, Samuel Lasley *et al*. 2011. "Documenting Liquefaction and Lateral Spreading Triggered by the 12 January 2010 Haiti Earthquake." *Earthquake Spectra* 27:93-116.

Organization of Eastern Caribbean States (OECS). 2004. "Grenada: Macro Socio-Economic Assessment of the Damages Caused by Hurricane Ivan". Last visited July 14, 2012. <http://www.gov.gd/egov/docs/reports/Ivan-Report-07-09-04.pdf>.

Pelling, Mark. 2012. "Hazards, Risk and Urbanization." Pp. 145-155 in *The Routledge Handbook of Hazards and Disaster Risk Reduction*, edited by Ben Wisner, J.C. Gaillard, and Ilan Kelman. London: Routledge.

———. 2011. "Urban Governance and Disaster Risk Reduction in the Caribbean: The Experiences of Oxfam GB." *Environment and Urbanization* 23:383-400.

——— and Juha I. Uitto. 2001. "Small Island Developing States: Natural Disaster Vulnerability and Global Change." *Environmental Hazards* 3:49-62.

Petley, David. 2012. "Global Patterns of Loss of Life from Landslides – My New Paper in the Journal Geology." Last visited July 14, 2012. *The Landslide Blog/ American Geophysical Union Blogosphere*, 16 August. <http://blogs.agu.org/landslideblog/>.

Pielke, Roger A., José Rubiera, Christopher Landsea *et al*. 2003. "Hurricane Vulnerability in Latin America and the Caribbean: Normalized Damage and Loss Potentials." *Natural Hazards Review* 4:101-114.

Pomeroy, Carlton and Steve Jacob. 2004. "From Mangos to Manufacturing: Uneven Development and its Implications on Social Well-Being in the Dominican Republic." *Social Indicators Research* 65:73-107.

Potter, Robert B. *et al*. 2004. *The Contemporary Caribbean*. England: Pearson/Prentice Hall.

Rappaport, Edward N. and José Fernández-Partagas. 1995. "The Deadliest Atlantic Tropical Cyclones, 1492-1996." NOAA Technical Memorandum NWS NHC 47. Last visited July 14, 2012. <http://www.nhc.noaa.gov/pastdeadly.shtml?>.

Schusler, Tania M., Daniel J. Decker, and Max J. Pfeffer. 2003. "Social Learning for Collaborative Natural Resource Management." *Society and Natural Resources* 15:309-236.

Serje, Julio. 2012. "Data Sources on Hazards." Pp. 179-190 in *The Routledge Handbook of Hazards and Disaster Risk Reduction,* edited by Ben Wisner, J.C. Gaillard, and Ilan Kelman. London: Routledge.

Sims, Holly and Kevin Volgelmann. 2002. "Popular Mobilization and Disaster Management in Cuba." *Public Administration Development* 22:389-400.

Skelton, Tracey. 2004. "Issues of Development on the Pan-Caribbean: Overcoming Crises and Rising Challenges?" Pp. 42-71 in *Introduction to the Pan-Caribbean*, edited by Tracey Skelton. London: Arnold Publishers.

Smit, Barry and Johanna Wandel. 2006. "Adaptation, Adaptive Capacity and Vulnerability." *Global Environmental Change* 16:282-292.

Thompson, Martha and Izaskun Gaviria. 2004. "Weathering the Storm: Lessons in Risk Reduction from Cuba." Oxfam American Report. Last visited July 14, 2012. (http://www.walterlippmann.com/oxfam-america-cuba-weathering-the-storm.pdf).

Tomblin, John. 1981. "Earthquakes, Volcanoes and Hurricanes: A Review of Natural Hazards and Vulnerability in the West Indies." *Ambio* 10(6):340-345.

Turner, B.L., Roger Kasperson, Pamela A. Matson *et al*. 2003. "A Famework for Assessing Vulnerability in Sustainability Science." *Proceedings of the National Academy of Sciences* 100(14):8074-79.

United Nations Strategy for Disaster Reduction Secretariat (UNISDR). 2012. "Safe Schools and Hospitals." Last visited July 14, 2012. <http://www.unisdr.org/we/campaign/schools-hospitals>.

———. 2011. *Global Assessment of Disaster Risk Reduction 2011.* Geneva: UNISDR.

———.2009a. *Global Assessment of Disaster Risk Reduction*. Geneva: UNISDR.

———.2009b. "Terminology". Last visited July 14, 2012. <http://www.unisdr.org/we/inform/terminology>.

Walker, Peter. 1995. "The Politics of Nature: An Overview of Political Ecology". Berkeley, CA: University of California, Berkeley, Center for Political Ecology. (http://www.centerforpoliticalecology.org/resources/walker_pol_nat.html).

Wisner, Ben. 1985. "Mudslide in Mameyes, Puerto Rico: A "Natural" Disaster?" *Puerto Rico Libre* 16-17.

——— and J.C. Gaillard. 2010."Introduction to Neglected Disasters." *Jamba: Journal of Disaster Risk Studies* 2(3):151-8.

———, J.C. Gaillard, and Ilan Kelman. 2012. "Framing Disasters: Theories and Stories Seeking to Understand Hazards, Vulnerability and Risk." Pp. 18-33 in *The Routledge Handbook of Hazards and Disaster Risk Reduction*, edited by Ben Wisner, J.C. Gaillard, and Ilan Kelman. London: Routledge.

———, Piers Blaikie, Terry Cannon, and Ian Davis. 2004. *At Risk: Natural Hazards, People's Vulnerability and Disasters* (2nd ed). London: Routledge.

———, Víctor Ruiz, Allan Lavell, and Lourdes Meyerles. 2005. "Run Tell Your Neighbor! Early Warning During the 2004 Hurricane Season in the Caribbean". Pp. 38-59 in *World Disaster Report 2005*. Geneva: International Federation of Red Cross and Red Crescent Societies.

World Health Organization (WHO), Global Task Force on Cholera Control. 2011. "Cholera Country Profile: Haiti." *L*ast visited July 14, 2012. <www.who.int/cholera/countries/HaitiCountryProfileMay2011.pdf>.

Yohe, Gary and Richard S.J. Tol. 2002. "Indicators for Social and Coping Capacity – Moving toward a Working Definition of Adaptive Capacity." *Global Environmental Change* 12:25-40.

Data sources

EM-DAT (Emergency Events International Disaster Database): <http://www.emdat.be/>.

FAOSTATS (Food and Agriculture Organization of the United Nations Statistics Division): <http://faostat.fao.org/site/550/default.aspx#ancor>.

NOAA (National Oceanic and Atmospheric Administration) Monthly Review: <http://docs.lib.noaa.gov/rescue/mwr/data_rescue_monthly_weather_review.html>.

NOAA (National Oceanic and Atmospheric Administration) Historical Hurricane Tracks: <http://www.csc.noaa.gov/hurricanes/#>.

USGS (United States Geological Survey) Caribbean Earthquake Information: <http://earthquake.usgs.gov/earthquakes/world/?regionID=27>.

USGS (United States Geological Survey) Earthquake Hazard Program: <http://earthquake.usgs.gov/earthquakes/eqarchives/epic/epic_rect.php>.

United States Census Bureau International Programs: <http://www.census.gov/population/international/data/idb/informationGateway.php>.

University of the West Indies Disaster Studies Unit: <http://www.mona.uwi.edu/uds/>.