5-2011

Disaster Risk Management Disparity in the Caribbean: Evidence from Barbados, Dominican Republic, Jamaica and Trinidad and Tobago

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WESTERN HEMISPHERE
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EXECUTIVE SUMMARY

This study on risk and disaster management capacities of four Caribbean countries: Barbados, the Dominican Republic, Jamaica, and Trinidad and Tobago, examines three main dimensions: 1) the impact of natural disasters from 1900 to 2010 (number of events, number of people killed, total number affected, and damage in US$); 2) institutional assessments of disaster risk management disparity; and 3) the 2010 Inter-American Bank for Development (IADB) Disaster Risk and Risk Management indicators for the countries under study. The results show high consistency among the different sources examined, pointing out the need to extend the IADB measurements to the rest of the Caribbean countries. Indexes and indicators constitute a comparison measure vis-à-vis existing benchmarks in order to anticipate a capacity to deal with adverse events and their consequences; however, the indexes and indicators could only be tested against the occurrence of a real event. Therefore, the need exists to establish a sustainable and comprehensive evaluation system after important disasters to assess a country's performance, verify the indicators, and gain feedback on measurement systems and methodologies.

There is diversity in emergency and preparedness for disasters in the four countries under study. The nature of the event (hurricanes, earthquakes, floods, and seismic activity), especially its frequency and the intensity of the damage experienced, is related to how each has designed its risk and disaster management policies and programs to face natural disasters. Vulnerabilities to disaster risks have been increasing, among other factors, because of uncontrolled urbanization, demographic density and poverty increase, social and economic marginalization, and lack of building code enforcement. The four countries under study have shown improvements in risk management capabilities, yet they are far from being completed prepared. Barbados' risk management performance is superior, in comparison, to the

majority of the countries of the region. However, is still far in achieving high performance levels and sustainability in risk management, primarily when it has the highest gap between potential macroeconomic and financial losses and the ability to face them. The Dominican Republic has shown steady risk performance up to 2008, but two remaining areas for improvement are hazard monitoring and early warning systems. Jamaica has made uneven advances between 1990 and 2008, requiring significant improvements to achieve high performance levels and sustainability in risk management, as well as macroeconomic mitigation infrastructure. Trinidad and Tobago has the lowest risk management score of the 15 countries in the Latin American and Caribbean region as assessed by the IADB study in 2010, yet it has experienced an important vulnerability reduction.

In sum, the results confirmed the high disaster risk management disparity in the Caribbean region.

INTRODUCTION

This paper examines the different levels of disaster risk management capabilities to face natural disasters with a focus on the Caribbean. This region is particularly prone to natural hazards, including earthquakes, volcanic activity, hurricanes, and floods. Uncontrolled demographic growth, poverty and inequality, and high population density have deepened Caribbean countries' vulnerabilities in the last decades.[1]

In order to study the existing disaster risk management capacity in the Caribbean, we have decided to analyze four countries representing existing diversity in the region: Barbados (BB), the Dominican Republic (DR), Jamaica (JM), and Trinidad and Tobago (TT).

OVERVIEW OF COUNTRIES

To illustrate the diversity of the selected countries, Table 1 describes their basic demographics[2] within their geographical location, ascendency and predominant language, human development achieved, and disaster history [profile].

[1] Delegación de la Unión Europea en La República Dominicana y Cuba, "Disaster Preparedness," available at http://www.deldom.ec.europa.eu/echo/dipecho_en.htm, (Accessed on November 1, 2010).
[2] 2010 CIA Fact Book, available at https://www.cia.gov/library/publications/the-world-factbook (Accessed on November 9, 2010).

Table 1 – Countries' Fact Sheet

Country	Area	Population	Density	Urban Population
Barbados	430 sq. Km	285,653	664 p/Km2	40%
Dominican Republic	48,670 sq. Km	9,823,821	202 p/Km2	69%
Jamaica	10,991 sq. Km	2,847,232	259 p/Km2	53%
Trinidad and Tobago	5,128 sq. km	1,228,691	240 p/Km2	13%

These countries are diverse in several aspects. In terms of geographical location, two countries are from the Greater Antilles (DR and JM) and two countries from the Windward Islands (BB and TT). Their ascendency is represented by one country with Spanish legacy (DR), two countries with English heritage (BB and JM), and one country with both Spanish and British traditions (TT). The Dominican Republic is the only Spanish-speaking country of the study; the other three countries are English-speaking countries. Although Trinidad and Tobago was first colonized by the Spanish, the islands came under British control in the early 19th century. In addition, contract laborers from India between 1845 and 1917 shifted the ethnic composition of the island.

In regard to the human development indicator and based on the 2010 Human Development Index (HDI),[3] one country

[3] The 2010 Human Development Index has established four country categories according to HDI ranking: Very High Human Development Ranking (#1-42); High Human Development Ranking (#43-85); Medium

ranks in the Very High HDI Ranking category (i.e., BB #42), while two countries are in the High HDI Ranking (i.e., TT #59, JM #80) and one country is in the Medium HDI Ranking (i.e., DR #88). In terms of disaster history, based on the EM-DATA[4], Table 2 shows the most relevant information of the four countries under study in the last 110 years.

Human Development Ranking (#86-127); and Medium Human Development Ranking (#128-169).

[4] The International Disaster Database (EM-DAT), Centre for Research on the Epidemiology of Disasters (CRED).

Table 2 - Top 10 Natural Disasters in Barbados, the Dominican Republic, Jamaica, and Trinidad and Tobago, 1900 to 2010[5]

Barbados		Dominican Republic		Jamaica		Trinidad and Tobago	
Disaster Type/ Date	**No. of Af-fected**	**Disaster Type/ Date**	**No. of Af-fected**	**Disaster Type/ Date**	**No. of Af-fected**	**Disaster Type/ Date**	**No. of Af-fected**
Flood (10/2/ 1970)	210	**Drought** (8/1968)	240,000	**Earth-quake** (1/14/ 1907)	90,000	**Storm** (8/14/ 1974)	50,000
Storm (7/31/ 1980)	5,007	**Storm** (8/1979)	1,554, 000	**Storm** (11/18/ 1912)	94,820	**Storm** (7/25/ 1990)	1,000
Flood (10/3/ 1984)	100	**Flood** (5/1981)	150,000	**Drought** (1/1968)	100, 000	**Flood** (10/5/ 1993)	10
Storm (1987)	230	**Flood** (8/24/ 1988)	1,191, 150	**Flood** (4/25/ 1979)	40,000	**Flood** (10/17/ 1996)	200
Storm (9/24/ 2002)	2,000	**Storm** (9/3/ 1996)	25,000	**Flood** (6/12/ 1979)	210, 000	**Volcano** (2/22/ 1997)	200
Storm (9/8/ 2004)	880	**Storm** (9/20/ 1998)	975,595	**Flood** (5/15/ 1986)	40,000	**Earth-quake** (4/22/ 1997)	17
Earth-quake 11/29/ 2007	1	**Flood** (11/14/ 2003)	65,003	**Storm** (9/12/ 1988)	810, 000	**Storm** (9/9/ 2004)	560
		Storm (10/28/ 2007)	79,728	**Flood** (5/21/ 1991)	551, 340	**Mass move-ment wet** (11/12/ 2004)	1,200
		Storm (12/11/ 2007)	61,605	**Storm** (9/11/ 2004)	350, 000		
		Flood (2/14/ 2010)	25,700	**Storm** (8/20/ 2007)	31,188		

Except for two cases in Jamaica—the earthquake in 1907 and the floods in 1912—the major disaster events are

[5] Ibid, "Country Profile," available at http://www.emdat.be/country-profile (Accessed on October 28, 2010).

concentrated in the 1968-2010 period. Although Caribbean countries are vulnerable to an ample diversity of natural hazards, the prevailing events include floods, storms, and earthquakes; with only minor registries of volcanic activity, drought, and mass movements.

In addition to the demographics, location, ascendency, predominant language, human development achieved, and disaster profile of the analyzed countries, we should take into consideration the geopolitical point of view when studying the impacts and consequences of disasters. Whereas the Dominican Republic is seen as being closer to the Latin American block, more specifically the Central American group, the remaining three countries (with Guyana) were the first signatories of the Caribbean Community (CARICOM). Even taking into consideration that the Dominican Republic is part of CARICOM, some important differences remain between this country and the other nation islands, beyond predominant languages: The Dominican Republic is a Spanish-speaking country while the remaining three are English-speaking countries. These facts have serious implications in terms of international relations, economic policies, development planning, and interaction and cooperation among countries.

The geographical location of the Dominican Republic is also critical when examining the relationship with Haiti, with whom the former shares the island of Hispaniola. Haiti, an extremely vulnerable country to natural disasters, has been recently affected by a devastating earthquake that left more than 200,000 victims, followed by a cholera epidemic. Considering the leverage of the Dominican Republic in the emergency and recovery process of Haiti, the country should not be overlooked in terms of widespread vulnerabilities, hazards, and risk.

Table 3 - Total Number of Natural Disasters, 1974-2003

AMERICAS	1974-1978	1979-1983	1984-1988	1989-1993	1994-1998	1999-2003	1974-2003
Caribbean	10	39	44	43	44	53	233
Central	20	39	37	50	69	111	326
Northern	26	55	84	143	114	148	570
Southern	43	66	90	83	93	163	538
Total	99	199	255	319	320	475	1,667

Table 3 shows that the Caribbean sub-region in the Americas experienced a steady increase in the number of natural disasters during the last thirty years. This trend, as mentioned elsewhere, has been the result not only of increased and better reporting of natural events, but also of increasing vulnerabilities that exacerbated levels of risk, as reflected primarily in uncontrolled urbanization, demographic density and poverty increase, social and economic marginalization, and lack of building code enforcement.

Table 4 - Total Number of Natural Disaster Victims (people killed and affected), 1974-2003

COUN-TRIES	1974-1978	1979-1983	1984-1988	1989-1993	1994-1998	1999-2003	1974-2003
Barbados	Ndr	5,007	330	Ndr	na	2,000	7,337
Dominican Republic	Ndr	1,706,459	1,194,072	21,540	1,004,809	61,520	3,988,400
Jamaica	Ndr	280,059	876,419	555,721	804	2,710	1,715,713
Trinidad and Tobago	50,002	Ndr	Ndr	1,015	417	Ndr	51,434

When looking at the total number of victims, considering both people killed and affected[6] by the impacts of natural hazards, the Dominican Republic is by far the country that has been most widely affected in the number of victims (killed and affected) of natural disasters from 1974 to 2003[7], followed by Jamaica, Trinidad and Tobago, and Barbados.[8]

BARBADOS

The Organization of American States (OAS) database[9] (1997) covering the period from 1889 to1989 shows that

[6] Although we would prefer to independently analyze killed from affected data, current sources for the period selected are unfortunately very limited.

[7] Guha-Sapir D., Hargitt D., and Hoyois P. 2004. "Thirty Years of Natural Disasters 1974-2003: The Numbers," Center for Research on the Epidemiology of Disasters, Presses Universitaires de Louvain, p. 82

[8] As noted by Tom Crowards (Caribbean Development Bank), the measure of "number of persons affected" may be useful to give "an indication of the extent of disasters and their effect on human activity." (p. 6) Crowards (2000) emphasizes that even in the EM-DAT database the most comprehensive source on worldwide disasters the number of people affected is not always available for all disaster episodes. See Tom Crowards, "Comparative Vulnerability to Natural Disasters in the Caribbean," Caribbean Development Bank, paper presented at the OAS/USDE-NOAA/CSC Workshop on Vulnerability Assessment Techniques, Charleston, South Carolina, March 20-22, 2000

[9] Crowards, 7.

Barbados has had a relatively high number of events (especially hurricanes) compared to other islands of the Lesser Antilles, even when considering the fact that the small islands north of Barbados are more prone to suffer the impacts of hurricanes.[10]

Table 5 shows the natural hazard events in Barbados from 1900 to 2005, according to the EM-DAT (CRED/OFDA database 2006).[11] The data reveal that, in general, storms have been the most typical event on the island, having been responsible for the greatest number of people affected and the most damage in infrastructure.

Table 5 – Natural Disasters in Barbados, 1900 to 2010

Type of Hazard	No. of Events	Killed	Total Affected	Damage (000 US$)
Drought	1			
Earthquake	1		1	
Flood	2	3	310	500
Storm	6	58	8117	106,700

A 2010 report by the International Strategy of Disaster Reduction (ISDR) has revealed that the Disaster Management Programme in Barbados has accomplished successful results in the areas of disaster preparedness and response, but much more needs to be done in the rehabilitation and recovery areas. The report further notes that the focus on prevention and mitigation is of very recent development, and more substantial national strategies on disaster risk reduction need to be integrated across national

[10] Ibid
[11] EM-DAT, Available at http://www.emdat.be/result-country-profile#summtable (Accessed on October 15, 2010)

agencies.[12] The report identifies future challenges for the disaster risk management framework of Barbados, including:

- ✓ The need to raise awareness of actions related to disaster response;
- ✓ The incorporation of partners in key economic sectors to reduce vulnerability (tourism and agriculture);
- ✓ The promotion of community-based organizations for disaster risk reduction purposes;
- ✓ A self-supportive coordination institution (equipped with the necessary technology and resources);
- ✓ Solid monitoring, assessment, and review mechanisms to feed a multi-hazard disaster management system.[13]

DOMINICAN REPUBLIC

The Dominican Republic is a country severely prone to natural disasters, mostly recurrent hurricanes and floods. It should be noted that, with the support of the international community and Inter-American Development Bank, the National System of Prevention, Mitigation and Response in the Dominican Republic was established as a reaction to the

[12] PreventionWeb, Department of Emergency Management (DEM), Barbados, "National Progress Report on the Implementation of the Hyogo Framework for Action, (2009-2011), October 2010, available at http://www.eird.org/wikien/images/15815_NationalHFAprogress-brb(2009-11)_Barbados.pdf (Accessed on November 15, 2010).
[13] PreventionWeb, Department of Emergency Management (DEM), Barbados, op.cit, pp. 34-35.

disaster generated by Hurricane Georges in 1998.[14] The Emergency Operations Centre (EOC), the body responsible for coordinating the preparation and response for disasters in the country,[15] provides national alerts to the affected communities. However, in order to do so, several technical institutions must first provide adequate and timely information to the EOC in order to facilitate the coordination in the preparation, mitigation, and response activities. Table 6 shows natural hazard events in the Dominican Republic from 1900 to 2005, according to the EM-DAT (CRED/OFDA database 2006).[16]

Table 6 – Natural Disasters in the Dominican Republic, 1900 to 2010

Type of Hazard	No. of Events	Killed	Total Affected	Damage (000 US$)
Drought	1		240,000	5,000
Earthquake	2	76	2,015	
Epidemic	5	63	4,522	
Flood	19	837	1,512,305	97,623
Storm	25	4496	2,769,561	2,767,910
Wildfire	3			1,000

[14] Emergency Operations Center (DR) and Disaster Prevention and Preparedness Program (PNUD), "Lessons learned from the 2008 Hurricane Season," January 2009.
[15] Ibid, 5.
[16] EM-DAT, available at http://www.emdat.be/result-country-profile (Accessed on November 3, 2010).

Considering the country's high level of hydro-meteorological vulnerability, two institutions have been assigned responsibility for providing accurate information to the EOC: the National Meteorological Office (ONAMET) and the Dominican Institute of Hydraulic Resources (INDRHI).[17]

For the Dominican Republic, the 2008 hurricane season was the strongest of the last decade, according to the UNDP/EU assessment. The country was directly affected by Tropical Storm Fay and indirectly by three major hurricanes (i.e., Gustav, Hanna, and Ike).[18] The EOC's assessment concluded that the preparation and response management had been effective, specifically due to the proper alerts that contributed to reducing the number of people affected, effective decision-making for evacuation policies, and attitude shifts in the population on the need to evacuate.[19]

The report noted that the information provided by technical and scientific institutions often lacks organization, hurting the effectiveness of the monitoring and alert system.[20] Additional practices that were identified as being in need of improvement included:

- ✓ The monitoring of national hydro-meteorological events (vigilance of telemetric stations);
- ✓ Better technology equipment for the EOC;
- ✓ Improved coordination of partner organizations;

[17] Emergency Operations Center (DR) and Disaster Prevention and Preparedness Program (PNUD), "Lessons learned from the 2008 Hurricane Season," January 2009, op. cit., p. 5.
[18] Ibid, 7.
[19] Ibid
[20] Ibid, 24.

- ✓ Simulation exercises among the most vulnerable populations.[21]

Finally, preparation and emergency management for disasters in the Dominican Republic reaches a complete different level when examining the close relationship with Haiti. Both countries share the island of Hispaniola in the middle of the Caribbean Sea. As such, the implications of the Dominican Republic's policies, in the face of natural disasters, are not only important for the country, but also for its neighbor Haiti. The devastating 2010 earthquake in Haiti exposed the leverage of the Dominican Republic in the logistics, transportation, and emergency response of Haiti, contributing to its disaster management.

JAMAICA

Jamaica, located in the northwestern Caribbean basin, has considerable risk exposure to natural hazards, with hurricanes having been shown to be the most important threat in terms of expected damage, although floods and landslides are the most frequent hazards on the island.[22] However, the literature has not noted the island's severe vulnerability to a potential devastating earthquake,[23] which would seriously affect communities and infrastructure located in the Kingston Metropolitan Area.[24]Table 7 highlights the natural hazard events in Jamaica from 1900 to

[21] Ibid, 14-18.
[22] Inter-American Development Bank and Economic Commission for Latin America and the Caribbean, "Information on Disaster Risk Management, Case Study Jamaica," p.1
[23] It is worth noting that Jamaica suffered a very destructive earthquake in 1692, which devastated Port Royal, the commercial capital of the country at the time.
[24] Ibid

2005, according to the EM-DAT (CRED/OFDA database 2006).[25]

Table 7 – Natural Disasters in Jamaica, 1900 to 2010

Type of Hazard	No. of Events	Killed	Total Affected	Damage (dollars)
Drought	3	0	100,000	6,000
Earthquake	1	1,200	90,000	30,000
Epidemic	4	46	300	0
Flood	13	767	898,712	1,262,740
Slides	1	40	0	0
Windstorm	23	574	1,324,161	1,793,912

Jamaica's risk management structure is led by the National Disaster Plan and coordinated by the Office of Disaster Preparedness and Emergency Management (ODPEM), which aims to provide a comprehensive view for prevention, mitigation, preparedness, and response and recovery procedures for natural hazards. ODPEM also coordinates response activities, operating from the National Emergency Operations Centre (NEOC).[26] Areas of priority in disaster preparedness, as identified by ODPEM, are:

- ✓ Community capacity resilience;
- ✓ Multi-hazard mapping and risk analysis;

[25] Worth noting is that the IADB and CEPAL warn of the lack of inclusion of known events in these data. It should also be mentioned that the categories "windstorm" and "flooding" are expected to include the effects of hurricanes. IADB, CEPAL, op. cit., pp. 38-39, based on EM-DAT Database, 2006.
[26] IADB and CEPAL, 1.

- ✓ Institutional strengthening;

- ✓ Partnership strengthening, working closely with the Meteorological Service and Earthquake Unit to improve early warning systems.[27]

A joint report developed by Inter-American Development Bank (IADB) and Economic Commission for Latin America (*Comisión Económica para America Latina*—CEPAL) notes the smooth exchange of information among technical agencies of the government, primarily coordinated by the Land Information Council of Jamaica and private companies in the country.[28] The report further acknowledges the leading role of Jamaica in having integrated government and private sector stakeholders into the country's disaster management structure, successfully pursuing an integrated approach to disaster risk management.[29] ODPEM has been largely involved in promoting disaster risk mitigation at the community level. However, ODPEM Director Ronald Jackson recently acknowledged the need for developing a macroeconomic mitigation infrastructure, especially in coastal areas.[30] Although much more remains to be done In terms of achieving disaster risk reduction strategies at the policy level, Jamaica has demonstrated relevant efforts to introduce disaster risk reduction into development processes.[31]

[27] Ibid
[28] Ibid
[29] Ibid, 2
[30] Office of Disaster Preparedness and Emergency Management (OPDEM), http://www.odpem.org.jm/ArticleDetails/tabid/226/Default.aspx?article=1146 (Accessed on November 15, 2010)
[31] Ibid

TRINIDAD AND TOBAGO

Trinidad and Tobago is located in the southern Caribbean, northeast of Venezuela.[32] In regard to natural hazards, the location of the islands in the extreme southern Caribbean decreases the risks of hurricanes. However, they experience heavy rainy seasons that result in landslides and flooding.[33] Other risks include moderate earthquakes and periodic droughts. Table 8 shows natural hazard events in Trinidad and Tobago islands from 1900 to 2005, according to the EM-DAT (CRED/OFDA database 2006).[34]

Table 8 – Natural Disasters in Trinidad and Tobago, 1900 to 2010

Type of Hazard	No. of Events	Killed	Total Affected	Damage (000 US$)
Drought	1			
Earthquake	1		17	25,000
Flood	2	5	210	70
Mass movement wet	1	2	1,200	
Storm	7	40	51,560	39,057
Volcano	1		200	

[32] The Caribbean Disaster Emergency Response Agency (CDERA), "Status of Hazards Maps Vulnerability Assessments and Digital Maps: Trinidad and Tobago Country Report, October 2003, http://www.cdera.org/projects/cadm/docs/trinidadtobago_hmvadm.pdf p. 4.

[33] Ibid, 4.

[34] EM-DAT, available at http://www.emdat.be/result-country-profile (Accessed on October 20, 2010)

The Office of Disaster Preparedness and Management (ODPM) is Trinidad and Tobago's responsible agency for "leading the National effort in protecting public health and safety; restoring essential government services, and providing emergency relief to those affected severely by hazards."[35] Among ODPM's many responsibilities, the following stand out: 1) coordinate first responder agencies in national emergencies; 2) provide infrastructure protection; 3) get involved in preparation and mitigation initiatives to reduce risks of disasters; 4) promote community outreach activities. The ODPM's mission has been clearly established, especially when differentiating responsibilities among first responders.

In Trinidad and Tobago, the first responders include: i) municipal and regional corporations; ii) TT fire service; iii) TT police service; iv) special anti-crime unit of TT; v) TT defense force; vi) emergency medical service; and vii) the Ministry of Works and Transport.[36] It is worth noting is that the Disaster Management Units (DMUs) focus on disaster risk reduction initiatives and management in the planning and implementation of disaster plans.[37] Trinidad and Tobago has a special division within ODPM called the Preparedness and Response Unit, which is responsible for coordinating first response agencies during and after an event, promoting training and capacity-building, and providing shelter management. [38]

According to Trinidad and Tobago's government[39], "ODPM has been working assiduously towards the creation and

[35] Government of the Republic of Trinidad and Tobago, available at http://www.nema.gov.tt/about/overview.aspx (accessed on September 27, 2010)
[36] Ibid, 7.
[37] Ibid, 8.
[38] Ibid, 19.
[39] John Sandy, Minister of National Security Trinidad & Tobago- Workshop in Disaster Risk Management for Primary School Teachers,

implementation of plans and policies that outline how disaster management is to be integrated into the wider Government policy. It has identified as some of its critical areas of focus:

- ✓ Working with communities and empowering the citizens to be better able to prepare and respond to emergencies;

- ✓ Integrating disaster management/ disaster risk reduction in development planning;

- ✓ Sensitizing and educating the children on disaster management issues."

MEASURING DISASTER RISK MANAGEMENT AND PREPAREDNESS CAPABILITIES

Several attempts have been made to measure disaster preparedness capabilities in the last decade. One of the problems that indicators present, however, are related to the risk of incurring "subjectivity, bias, weighting, mathematical combinations, and selection of indicators and data sources."[40] In addition, only few of the existing indexes have been fully implemented and maintained during a period of time in which measurements can be properly assessed. We ultimately decided to select the methodology promoted by the IADB—namely, the Indicators for Disaster Risk and Risk Management[41]—as it is the only one that has been

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Oct 12, 2010, available at http://www.news.gov.tt/index.php?news=5633 (Accessed on November 8, 2010).

[40] Simpson, David M., and Matin Katirai. 2006. "Measurement and Indicators for Disasters: Topical Bibliography." Working Paper # 06-01. Louisville, KY: University of Louisville, Center for Hazards Research and Development, p. 2.

[41] Cardona, Omar Dario. 2005. *Sistema de indicadores para la gestión del riesgo de desastre: Programa para América Latina y el Caribe,*

implemented throughout the Latin American and Caribbean region and accepted by key international stakeholders such as de United Nations International Strategy for Disaster Reduction (UN-ISDR), the World Bank (WB), (IADB). After a couple of years of intense work in twelve countries, the first report on disaster risk management indicators was published in 2005. Three Caribbean countries—the Dominican Republic, Jamaica, and Trinidad and Tobago—were included at that time. In 2009, the IADB decided to expand the original list of countries and update the information. A more recent 2010 publication compiled the results of the 2009 individual country evaluation, including Barbados and the three countries studied back in 2005.
The methodology proposed by the IADB comprises four indicators: 1) the Disaster Deficit Index (DDI), 2) the Local Disaster Index (LDI), 3) the Prevalent Vulnerability Index (PVI), and 4) the Risk Management Index (RMI).

- The *Disaster Deficit Index* measures country risk from a macroeconomic and financial perspective according to possible catastrophic events
- The *Local Disaster Index* identifies the social and environmental risks resulting from more recurrent lower level events (which are often chronic at the local and sub-national levels)
- The *Prevalent Vulnerability Index* is made up of a series of indicators that characterize prevalent vulnerability conditions reflected in exposure in prone areas, socioeconomic weaknesses and lack of social resilience in general.
- The *Risk Management Index* brings together a group of indicators that measure a country's risk management performance.[42]

Informe Técnico principal. (Universidad Nacional de Colombia, Instituto de Estudios Ambientales (IDEA), Inter-American Development Bank)

[42] Inter-American Development Bank, *Indicators of Disaster Risk and Risk Management – Program for Latin America and the Caribbean*

This study examines the results of three of the four indicators as developed by the IADB—namely, the DDI, PVI, and RMI. We believe that, currently, the LDI lacks a systematic and consistent data source, which may improve in the future with more reliable and extended data series.

1. Disaster Deficit Index

According to the IADB, the DDI shows "the relationship between the demand for contingent economic resources to cover the economic losses that the public sector must assume, and the nation's economic resilience, that is, its ability to generate internal and external funds to replace the affected infrastructure and goods. A DDI greater than 1.0 reflects the country's inability to cope with extreme disasters even by going into as much debt as possible. The greater the DDI, the greater the gap between losses and the country's ability to face them."[43]

According to the methodology, government responsibility is limited to the losses generated by the collapse of infrastructure (public sector buildings) and dwellings of the lowest income population.

Report. Environment, Rural Development and Disaster Risk Management Division (INE/NRD) Technical Notes No. IADB-TN-169, September, 2010, p. 2.

[43] Ibid, 6.

Table 9 - DDI and Probable Maximum Loss in 500-100-50 Years

Countries	DDI 500y	L 500y*	DDI 100y	L 100y*	DDI 50y	L 50y*
Barbados	5.75	1,420	3.15	259	1.49	95
Dominican Republic	5.41	7,818	2.42	1,779	1.02	652
Jamaica	2.40	1,616	0.73	349	0.28	121
Trinidad & Tobago	0.80	1,197	0.10	143	0.04	54

* Probable Maximum Loss in US$ Millions.

The results indicate certain variances among the countries studied. Even when Barbados has lower probable economic loses than the Dominican Republic or Jamaica, the DDI value is excessively high for the three return periods analyzed. As such, Barbados has an important gap between potential losses and its ability to face them. Trinidad and Tobago is at the other end of the spectrum, meaning that it has the capacity to cover the losses due to a low probability/high consequences extreme event. In this indicator, the Dominican Republic is very close to Barbados and Jamaica is very close to Trinidad.

2. The Prevalent Vulnerability Index (PVI)

This index identifies the primary vulnerability conditions by measuring exposure and susceptibility (ES), socioeconomic fragility (SF), and lack of social resilience (LR) in disaster-prone areas. According to the IADB, PVI varies between 0 and 100; a value of 80 indicates very high vulnerability, 40 to 80 indicates high, 20 to 40 indicates a medium value, and less than 20 indicates a low value. The data highlight trends in the three components analyzed as well the identification of priority areas in which efforts need to be directed to intervene in existing vulnerability and risk of disasters.

Table 10 below shows the evolution of the final index over time in the four countries of the Caribbean region.

Table 10 – Prevalent Vulnerability Index (1995-2007)

Countries	1995	2000	2005	2007
Barbados	43,550	40,426	37,996	39,342
Dominican Republic	46,356	47,619	46,286	45,708
Jamaica	51,666	48,971	49,355	51,374
Trinidad & Tobago	44,971	44,760	44,091	43,504

Table 11 shows the individual contributions of the three components (exposure and susceptibility, socioeconomic fragility, and lack of social resilience) to the PVI.

Table 11 – Prevalent Vulnerability Index (ES, SF, LR)

	1995			2000			2005			2007		
	ES	**SF**	**LR**	**ES**	**SF**	**LR**	**ES**	**SF**	**LR**	**ES**	**SF**	**LR**
BB	53,524	33,751	43,375	51,783	25,223	44,271	54,200	25,550	34,237	54,603	25,036	38,386
DR	38,652	35,903	64,513	45,812	35,444	61,600	40,546	34,223	64,090	37,093	34,100	65,931
JM	49,834	38,237	66,928	45,855	35,326	65,732	51,018	35,571	61,475	53,551	35,129	65,440
T&T	44,856	29,157	60,899	47,647	25,904	60,731	46,211	21,181	64,880	45,140	20,475	64,896

ES - Exposure and susceptibility; SF - Socioeconomic fragility; and LR - Lack of social resilience

The PVI figures illustrate a reduction in the existing vulnerability until 2005, which is more evident in Barbados and much less intense in Trinidad and Tobago, the Dominican Republic, and Jamaica. The data reveal that, in

2007, a slight increase occurred in the indicator of lack of resilience in the four countries. The increase in the indicator means that no risk prevention-mitigation investments occurred during that period. Comparing the three indicators, the lack of resilience makes the greatest contribution to prevalent vulnerability. According to the IADB, this indicator has the main incidence in developing countries.

3. The Risk Management Index (RMI)

For the purpose of this study, RMI is the most important measurement because it directly assesses risk management performance against predefined targets or benchmarks. The index has four components: risk identification (RI), risk reduction (RR), disaster management (DM), and governability and financial protection (FP). Each component (in the IADB report, these are called public policy) has six sub-indicators that characterize management performance in the country.

Evaluating the sub-indicators using a non-linear aggregation model determines the value of each component of RMI.[44] The value of each element is between 0 and 100, where 0 is the minimum performance level and 100 is the maximum level. Total RMI is the average of the four indicators. High values of RMI mean better performance of risk management in the country.

[44] IADB, Inter-American Development Bank 2009, p. 20.

Table 12 – Risk Management Index, Barbados (1995 – 2008)

Barbados				
Index	**1995**	**2000**	**2005**	**2008**
RMI-Risk Identification	11,85	29,79	35,76	37,81
RMI-Risk Reduction	17,21	38,78	38,78	50,61
RMI-Disaster Management	13,61	35,46	55,41	55,41
RMI-Governability & Financial Protection	5,25	11,35	13,65	35,78
Risk Management Index	**11,98**	**28,84**	**35,9**	**44,9**

As Table 12 shows, risk management related to risk identification in Barbados has demonstrated an important and progressive advance from 1995 to 2008. According to the IADB, Barbados' RMI performance is superior, in comparison, to the majority of the countries of the region. However, there is still a long way to go in order to achieve high performance levels and sustainability in risk management.

Table 13 – Risk Management Index, Dominican Republic (1995 – 2008)

Dominican Republic				
Index	**1995**	**2000**	**2005**	**2008**
RMI-Risk Identification	9,43	11,34	30,07	30,49
RMI-Risk Reduction	10,92	28,52	16,17	32,58
RMI-Disaster Management	4,56	13,28	38,15	38,15
RMI-Governability & Financial Protection	4,56	12,17	15,48	15,48
Risk Management Index	**7,37**	**16,33**	**24,97**	**29,18**

The data in Table 13 reveal that, in general, the risk management index in the Dominican Republic has been increasing steadily up to 2008. The indicators of risk identification and risk management are those that present the most significant variance. Regardless of this performance, it

is necessary to continue to work persistently to increase and maintain the four indicators at acceptable levels.

Table 14 – Risk Management Index, Jamaica (1995 – 2008)

Jamaica				
Index	**1990**	**1995**	**2005**	**2008**
RMI-Risk Identification	34,45	40,08	40,20	57,44
RMI-Risk Reduction	30,40	30,46	17,21	33,25
RMI-Disaster Management	51,10	55,64	57,26	57,26
RMI-Governability & Financial Protection	35,55	36,89	13,39	23,67
Risk Management Index	**37,87**	**40,77**	**32,01**	**42,90**

Jamaica's RMI made uneven advances between 1990 and 2008. Indicators that varied more considerably during the first five years were those related to risk identification and disaster management. The decrease in governability and financial protection and risk reduction from 1995 to 2005 is critical. The risk reduction indicator value recovered in 2008, but it has not achieved its 1995 value. Although the RMI indicates a significant level of performance, there is still so much to do in order to achieve high performance levels and sustainability in risk management.

Table 15 – Risk Management Index, Trinidad and Tobago (1995 – 2008)

Trinidad and Tobago				
Index	**1990**	**1995**	**2005**	**2008**
RMI-Risk Identification	29,79	29,79	34,57	34,57
RMI-Risk Reduction	5,247	10,61	10,61	10,61
RMI-Disaster Management	10,71	11,7	13,61	33,15
RMI-Governability & Financial Protection	10,84	11,35	11,35	11,35
Risk Management Index	**14,15**	**15,86**	**17,53**	**22,42**

In Trinidad and Tobago, the progress of the Risk Management Index shows a slight advance from 1995 to 2008 due to the contribution of the disaster management and the risk identification indicators. It is worth noting that Trinidad and Tobago has the lowest risk management score of the 15 countries in the Latin American and Caribbean region as assessed by the IADB study in 2010.

CONCLUSIONS

This paper has identified the diversity in emergency and preparedness for disasters in the Caribbean, with a focus on Barbados, the Dominican Republic, Jamaica, and Trinidad and Tobago. Bearing in mind that most of the countries in the region face diverse natural hazards, including hurricanes, earthquakes, floods, and seismic activity, we have highlighted that the nature of the event (especially its frequency and the intensity of the damage experienced) is clearly related to the way in which countries have designed their risk and disaster management policies and programs to face natural disasters, incorporating preparedness and emergency management as components of this broader approach.

This paper examined three main components: 1) the impact of natural disasters in each of the four countries under study from 1900 to 2010 (number of events, number of people killed, total number affected, and damage in US$); 2) institutional assessments of disaster risk management disparity; and 3) the 2010 IADB Disaster Risk and Risk Management indicators. The study emphasized the analysis of each of the four countries rather than the regional capacities and mechanisms, which would require a different approach and methodology.

The findings from the 2010 IADB report reveal that Barbados has the highest DDI for a 500-, 100- and 50-year return period of the four countries under study, showing an

important gap between potential losses and the ability to face them. The PVI has shown a slight improvement in vulnerability reduction since 1995, with the exception of the 2005-2007 period, during which the lack of resilience (no risk reduction investments) indicator rose. Regarding the RMI, a clear and important increase in the final score (1995-2008) demonstrated a superior performance to the other three countries analyzed. As mentioned elsewhere, natural disasters have a low impact in Barbados in comparison to the other countries, which may affect recognition of the effective disaster management capabilities of the country as well as an inchoate shift to risk reduction and financial strategies to manage and cope with disaster risks.

The Dominican Republic's DDI reflects a low capacity to face probable economic losses in the three return periods considered. The lack of economic resilience calls for special attention to cover economic losses for potential disasters with return periods of 50 years. The PVI shows that a slim improvement has occurred in the index because of the advance in social and economic conditions; however, the lack of necessary risk mitigation investments in the country should be kept in mind. The Dominican Republic has performed really well in improving its TMI from 1995 to 2008. We should take into consideration that the Dominican Republic and Jamaica have been affected by natural disasters more severely than the other two countries under study, which has resulted in better response and preparedness capabilities. Again, the Dominican Republic findings are consistent between the IADB indexes and sources from multilateral organizations that depict advances in disaster management performance with remaining areas of improvement, such as hazard monitoring and early warning systems. However, few references in these sources indicate the current state of disaster risk reduction measures.

Jamaica's DDI reveals that the economic losses expected for a 500-year return period exceeds the economic capacity to

cover them, but this trend is totally reversed for the 100- and 50-year return periods, in which the country shows good potential economic ability to respond. The PVI reveals no changes in the final scores throughout the analyzed period. A slight improvement occurs in some of the sub-indicators, but there is backslash in the susceptibility indicator. Although a slight rate of improvement occurs during the eighteen-year period analyzed, the RMI's final score is high compared to the other countries considered. Special consideration should be given to the decrease in the governability and financial protection sub-indicator. We should note that Jamaica has developed an institutional capacity, endorsed by national authorities and acknowledged by other countries in the region, and an effective management capacity. However, further areas require attention, such as macroeconomic mitigation infrastructure.

Finally, Trinidad and Tobago is the only country of the four cases studied herein that economically performs appropriately for the 500-, 100-, and 50-year return periods in the DDI. With the exception of the high level of the lack of resilience indicator, the PVI index shows that the country has experienced an important vulnerability reduction. However, the RMI in Trinidad and Tobago demonstrated a very slight increase in the final score, ranking the lowest of the four cases.

In sum, the results confirmed the high disaster risk management disparity in the Caribbean region. Indexes, indicators, and sub-indicators showed a high consistency with other sources utilized, surpassing without exception the spectrum and the depth of the available information. Looking beyond the snapshot at a particular time, the indexes offer the possibility to observe a dynamic behavior, capturing the individual contributions of the indicators and sub-indicators.

Even considering that this study did not move forward in analyzing the methodological details of the IADB index, the

experts participating in the data gathering and processing, and the periodicity of updates, the results indicate that this measurement system is a true "report card" when looking at risk management in the four cases under study. The authors strongly encourage and point out the need for extending the IADB indicators to the rest of Caribbean countries.

Finally, the indexes and indicators are attempts to approximate specific realities; in other words, the indicators are aimed at providing a measurement guideline, wherein the topic of risks and disasters constitutes a comparison measure vis-à-vis existing benchmarks to anticipate a capacity to deal with adverse events and their consequences. Indexes and indicators could only be tested against the occurrence of a real event. This analysis would include forecasted capability of potential events, their characterization (magnitude, duration, frequency, recurrence, coverage or area of influence), exposure and susceptibility to identified hazards, and the capacity to absorb the impact and recover from it. Therefore, the need exists to establish a sustainable and comprehensive evaluation system after important disasters to assess a country's performance, verify the indicators, and gain feedback on measurement systems and methodologies.

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