



SUSTAINABLE DEVELOPMENT UNIT ■ LATIN AMERICA AND THE CARIBBEAN

# Disaster Risk Management in Latin America and the Caribbean Region: GFDRR Country Notes

## Grenada



THE WORLD BANK



# GFDRR

Global Facility for Disaster Reduction and Recovery



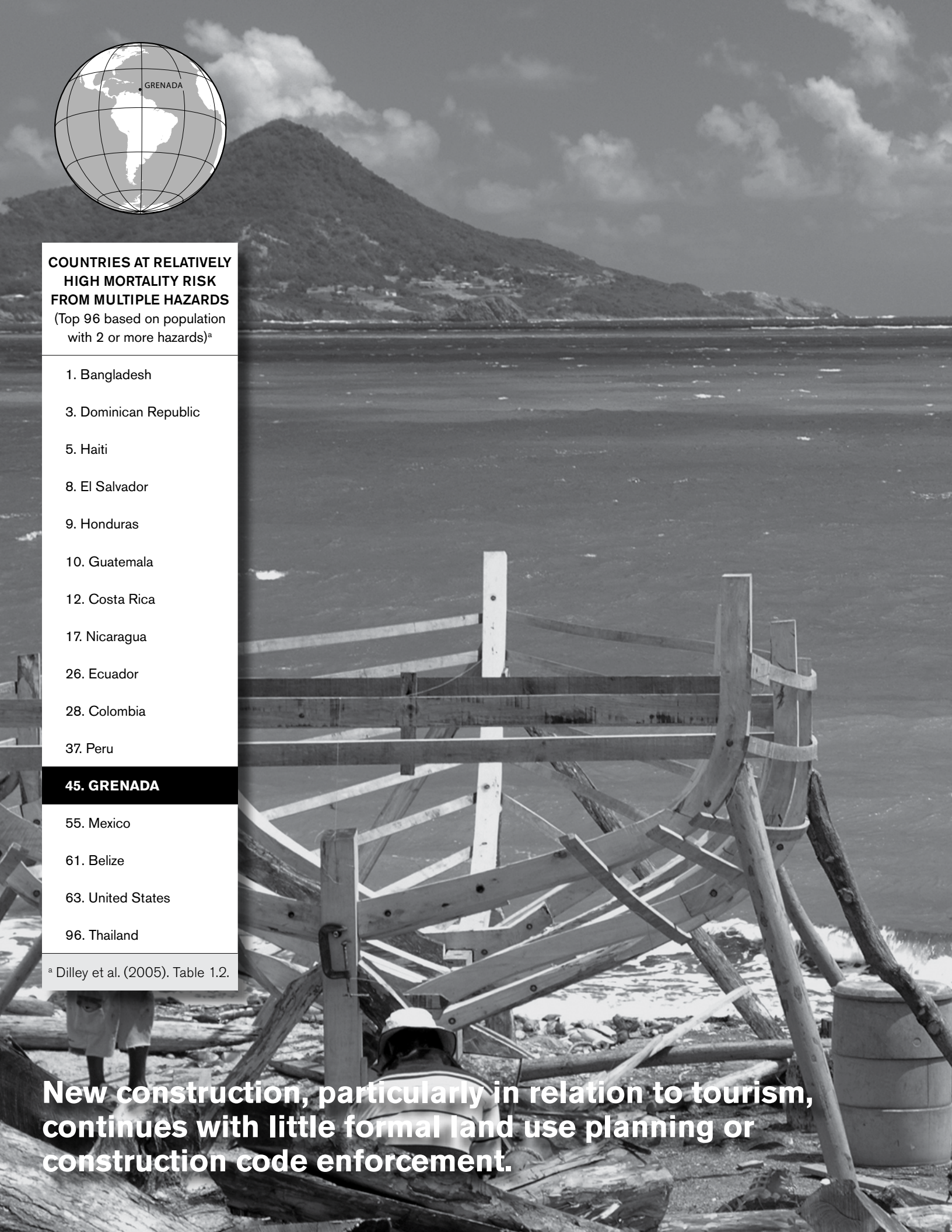


**COUNTRIES AT RELATIVELY  
HIGH MORTALITY RISK  
FROM MULTIPLE HAZARDS**  
(Top 96 based on population  
with 2 or more hazards)<sup>a</sup>

1. Bangladesh
3. Dominican Republic
5. Haiti
8. El Salvador
9. Honduras
10. Guatemala
12. Costa Rica
17. Nicaragua
26. Ecuador
28. Colombia
37. Peru
- 45. GRENADA**
55. Mexico
61. Belize
63. United States
96. Thailand

<sup>a</sup> Dille et al. (2005). Table 1.2.

**New construction, particularly in relation to tourism,  
continues with little formal land use planning or  
construction code enforcement.**



## Natural Disasters from 1980 - 2005<sup>b</sup>

### Affected People

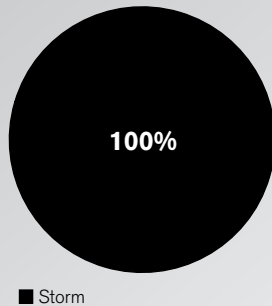
| Disaster | Date | Affected (Number of People) |
|----------|------|-----------------------------|
| Storm    | 2004 | 60,000                      |
| Storm    | 2005 | 1,650                       |
| Storm    | 1990 | 1,000                       |
| Storm    | 1999 | 210                         |
| Storm    | 1980 | 0                           |

### Economic Damages

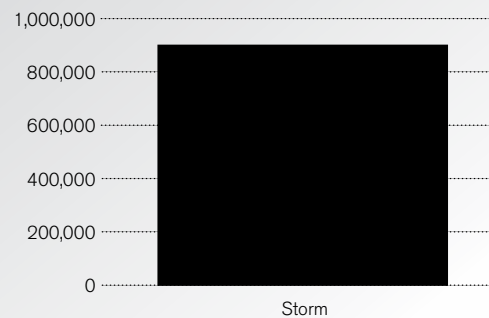
| Disaster | Date | Cost (US\$ x 1,000) |
|----------|------|---------------------|
| Storm    | 1980 | 889,000             |
| Storm    | 1999 | 5,500               |
| Storm    | 1980 | 5,300               |
| Storm    | 1990 | 0                   |
| Storm    | 2005 | 0                   |

## Statistics by Disaster Type<sup>b</sup>

Population Affected by Disaster Type



Economic Damages / Disaster Type (1000s US\$)



<sup>b</sup> UN (2009). <http://www.preventionweb.net/english/countries/statistics/?cid=69>. Source data from EM-DAT. Data displayed does not imply national endorsement.

## DISASTER RISK PROFILE

**Grenada is the southernmost country in the Windward Island chain of the Caribbean and is located at 12° north latitude by 64.47° west longitude.** The country comprises three islands, the largest of which is Grenada followed by Carriacou and Petite Martinique. Grenada is approximately 33 km long north to south and approximately 14 km wide, along the east west axis, and occupies approximately 344 km<sup>2</sup> of land area. By contrast, Carriacou and Petit Martinique cover approximately 34 and 2.36 km<sup>2</sup> respectively.

**Historically, Grenada was considered relatively safe from hurricanes owing to its location in the southernmost region of the hurricane belt.** Prior to 2004, Grenada had seen a total of 3 hurricanes since the beginning of the 20th century.<sup>1</sup> These included one unnamed storm in 1921, Hurricane Janet in 1955 and Hurricane Flora in 1963. While damages associated with Flora and the 1921 storm were relatively minor, Janet passed Grenada as a Category 3 storm<sup>2</sup>, causing severe damage to the island and resulting in 110 storm-related deaths.

**In September 2004, nearly 50 years after the passage of Janet, Grenada was hit by Hurricane Ivan, a Category 3 storm.** The impacts were devastating resulting in an estimated US\$800 million (2004) in losses.<sup>3</sup> While deaths attributed to the storm were relatively few (39), damages to infrastructure and agricultural losses were estimated at twice Grenada's GDP, estimated at US\$450,000 for 2004. Adding to the economic impacts of the storm, the Government was severely crippled as the capital, St. Georges, sustained major damages and many government employees and officials suffered personal losses. Almost 1 year later, in July 2005, Grenada was hit yet

again, by Hurricane Emily. Emily passed the island as a Category 2 storm, further impacting infrastructure already damaged by Hurricane Ivan.

**Approximately 52.1% of the population of Grenada is exposed to risk of mortality from 2 or more hazards.**<sup>4</sup> Given the islands' size, 100% of the estimated population of 110,000 can be exposed during a single storm event. While infrequent, Hurricanes Ivan and Janet demonstrate Grenada's vulnerability to storm-related risks. Apart from storms, Grenada is regularly exposed to risk of landslides which occur with frequency during the annual rainy season from June to December, caused by tropical waves and upper-level troughs. Storm surge is problematic in exposed coastal areas either through localized flooding in low-lying reaches or through cliff side erosion which has its greatest impact on the island's principal road, linking coastal and interior communities. Additionally, Grenada is exposed to the potential effects of volcanic eruption from Kick-'em-Jenny, an active 1300-meter undersea volcano located 8 km north of Grenada.

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### Geological Hazards

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**Grenada is a volcanic island located on the eastern margin of the Caribbean plate.** There are two active volcanoes in Grenada, Mount St. Catherine in the center of the island and the submarine volcano Kick-'em-Jenny located 8 km north of the island. Mount St. Catherine rises above the landscape some 846 meters and while the area supports active fumaroles and hot springs there has been no eruption in historical times. Geologic evidence suggests the last eruption could have produced a scoria (cinder) cone that is less than 1000 years old.

<sup>1</sup> NOAA Historical Hurricane Database.

<sup>2</sup> Saffir-Simpson Scale.

<sup>3</sup> World Bank (2005).

<sup>4</sup> Dilley et al. (2005). Table 7.2b and Table 1.2.



**Kick-'em-Jenny has erupted 12 times since 1939, with the 1939 eruption recorded as the strongest, producing a tsunami estimated at 2 meters.**<sup>5</sup> Kick-'em-Jenny is an under-sea volcano that rises some 1300 meters from the seafloor, reaching a depth below sea surface of approximately 180 meters. Over 2009, the alert level, as defined by the University of the West Indies Seismic Research Center continued as yellow indicating the "volcano is restless: seismicity and/or fumarolic activity are above the historical level or other unusual activity has been observed or can be expected without warning."<sup>6</sup> Given the proximity of the volcano to Grenada's shores, should a tsunami be generated, travel times will be less than 5 minutes, eliminating the possibility of any advance warning.

**While earthquake risk is moderate to low, seismic events associated with Kick-'em-Jenny's activity pose a risk of significant earthquake impact.** Earthquake risk is relatively low, with Grenada classified in seismic zone 2 under a 4-zone system. Grenada regularly experiences low intensity earthquakes of magnitude 3 or less. These are generally related to shallow earthquakes associated with magmatic displacement. An eruption of Kick-'em-Jenny has the potential for producing a significant earthquake.

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## Floods and Landslides

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**Flood risk in Grenada is largely associated with storm surge in low lying coastal areas.** Flash flooding from mountain streams coupled with storm surge events are the primary causes of flood events and effects are generally limited to communities located in the coastal margins along stream passages. As much of the island's coast is formed by steep cliff formations, fishing villages are located where access

to the sea is open along stream mouths. Among the areas of particular risk to storm surge (or tsunami) is the country capital, St. Georges. This is a harbor town and supports the island's principal port. Impacts to this area are particularly important as the port is the island's principal supply link.

**Landslides are a common event in Grenada, with much of the impact experienced along the roadway network.** Grenada's mountainous terrain, coupled with its volcanic geomorphology, promotes an increased risk of landslides, particularly where slopes are cut to accommodate construction. With little flat land available for construction, much of Grenada's housing stock is found on steeply sloping hillsides. Structures built without adequate design or quality controls are at greatest risk. Landslides are usually associated with periods of prolonged rainfall which occurs during the rainy season from June to December.

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## Determinants of Vulnerability to Adverse Natural Events in Grenada

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**Much of the island's construction occurs on steep slopes often exceeding 45 degrees.** There is little protection from the direct impacts of wind forces and prolonged rainfall promotes slope destabilization. Informal constructions are at greatest risk as they do not benefit from adequate engineering.

**New construction, particularly in relation to tourism, continues with little formal land use planning or construction code enforcement.** Construction codes exist but are not evenly applied. Informal settlement continues to occur and vulnerabilities associated with these activities are greatest as settlements tend to be located in areas of increased risk without benefit of engineering support.

<sup>5</sup> [http://www.cdera.org/doccentre/fs\\_tsunami.php](http://www.cdera.org/doccentre/fs_tsunami.php).

<sup>6</sup> <http://www.uwiseismic.com>.

**The health infrastructure is comprised of 6 health centers, 30 medical stations and 4 hospitals.**<sup>7</sup> The St. George General Hospital is the main healthcare facility on the main island of the country.

## CLIMATE CHANGE AND GLOBAL WARMING

**Grenada was cited in the Germanwatch 2010 Global Climate Change Risk Index.** The 2010 Climate Risk Index is based on figures from 2008 and is also an analysis of the worldwide data collection on losses caused by weather-related events during 1998–2008. Grenada was ranked 32nd for the decade with GDP losses of 12.17%.<sup>8</sup> Two factors were cited: the impact of global warming on rising sea levels which increase the risk of storm surges, and secondly the increase in the strength of hurricanes.<sup>9</sup>

**Climate Change models<sup>10</sup> have predicted that Grenada will undergo a warming and drying trend and is expected to endure more frequent heat waves and droughts, rainfalls with increased intensity, and rising sea levels as predicted for the rest of the Caribbean consistent with the projected global median.**<sup>11</sup> It is known that inter-annual climate variability of either the Pacific or Atlantic explains a significant amount of the total variance in rainfall in the Caribbean and Central America.<sup>12</sup> Probable climate change impacts in Grenada include higher temperatures, higher storm intensities and, possibly, more frequent El Niño-Southern Oscillation (ENSO)<sup>13</sup> events, exacerbating

existing health, social and economic challenges affecting Grenada.

**Changes in sea surface temperature as a result of climate variability could increase the intensity of cyclones and heighten storm surges, which in turn will cause more damaging flood conditions in coastal zones and low-lying areas.** According to the World Bank's study, "Sea Level Rise and Storm Surges",<sup>14</sup> the impact of sea level rise and intensified storm surges in Latin America and the Caribbean will be high. While data is not available for Grenada, data for Puerto Rico is showing an increase of 51.84% - with 53.81% of the coastal population exposed and potential losses of coastal GDP projected to exceed 52.71%.

**Grenada's first National Communication on Climate Change (NCCC)<sup>15</sup> was released in 2000.**

The National Vulnerability Statement assesses what is currently known about Grenada's vulnerability to the effects of climate change (rising temperatures, sea level rise and increase in extreme events), identifies existing gaps in the available information and makes recommendations on how such information gaps can be addressed. There are no specific climate change scenarios available for Grenada. The scenarios adopted for temperature changes and sea level rise are based on the IPCC (1995) accepted and recommended scenarios, i.e. temperature rise of 1.0°C to 3.5°C and sea level rise of 15cm to 95cm by 2100. In the case of Grenada, a positive or negative variation of 5% to 20% in total precipitation by the year 2100 may be considered. An increase in the frequency of extreme events may also be experienced. It is

<sup>7</sup> PAHO (2007).

<sup>8</sup> Harmeling (2009). Table 5.

<sup>9</sup> McLymont-Lafayette (2009).

<sup>10</sup> Hadley Centre Coupled Model, Version 2 (HADCM2), as reported in Mulligan (2003). Same modeling data as used by the Intergovernmental Panel on Climate Change (IPCC).

<sup>11</sup> Chen et al. (2008).

<sup>12</sup> Giannini et al. (2002).

<sup>13</sup> El Niño-Southern Oscillation; commonly referred to as simply El Niño, a global coupled ocean-atmosphere phenomenon.

<sup>14</sup> Dasgupta et al. (2009).

<sup>15</sup> Ministry of Health and Environment (2000).

predicted that by the year 2100, there will be a 5 to 10 percent increase in the wind speeds of tropical storms worldwide for a sea surface temperature increase of 2.2 °C (Knutson et al. 1998).

## DISASTER RISK MANAGEMENT FRAMEWORK

**Disaster management in Grenada was formalized in 1985 with the establishment of National Emergency Relief Organization (NERO) and an office for a volunteer disaster coordinator under the office of the Prime Minister.** Through a largely volunteer effort, the first National Disaster Plan was developed. In 2004, the name of the organization was changed to NaDMA, the National Disaster Management Agency. In 2005, the National Disaster Plan was revised.

**NaDMA operates under the authority of the Office of the Prime Minister.** Disaster management in Grenada is a committee-driven program with no specific enabling legislation. Emergency operations are conducted through the authorities established under the Emergency Powers Act of 1987.<sup>16</sup> The Governor-General may, by Proclamation which is then published in the Official Gazette, declare that a state of public emergency exists.<sup>17</sup>

**In 2005 the National Disaster Plan was revised in a workshop conducted with the various national agencies and key private sector groups.** The plan identifies and assigns responsibilities to various committees and their members for the implementation of a range of activities relating to disaster prevention, public awareness, disaster management, and disaster recovery. Roles for all ministries of Government are included in the plan and their operational authorities

are derived from existing legislation relating to their various responsibilities under law. Driving the process is the National Emergency Advisory Council (NEAC), responsible for advising the Prime Minister (and NaDMA) on policy issues relating to disaster management and preparedness. All government ministries are represented along with key private sector businesses, civil and trade groups.

**Operations during a disaster occur under the authorities of the Emergency Powers Act with NaDMA serving the office of the Prime Minister as the national coordinating body.** Line agencies, such as the national police, government ministries, corporations such as the airport authority and port authority, conduct their activities in accordance with the responsibilities assigned under the plan and under the authorities of their respective enabling legislation. NaDMA coordinates and oversees the operations of 17 District Disaster Management Committees.

## ACTIVITIES UNDER THE HYOGO FRAMEWORK FOR ACTION

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**Hyogo Framework for Action (HFA)  
Priority #1: Policy, institutional capacity and consensus building for disaster risk management**

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**Under the National Disaster Management Plan<sup>18</sup>, Grenada has established NaDMA as the national coordinating body to organize and manage a committee-driven disaster management program.** Organizational authorities are established through the Office of the Prime Minister and the

<sup>16</sup> OAS-DSD (1987b).

<sup>17</sup> OAS-DSD (1973).

<sup>18</sup> The National Disaster Management Plan was revised in 2005 after Hurricane Ivan. The plan is currently undergoing revision (2010).



St. George's, Grenada

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Emergency Powers Act of 1987. NaDMA currently consists of a staff of 11 persons with offices in the disaster operations center, constructed in 2004.

**Disaster management in Grenada is organized through a series of national and local committee structures that are designed to foster consensus building and awareness at all levels of government.** The National Disaster Committee is composed of representatives from each of the line ministries as well as the private sector.

**Line ministries are responsible for their respective functional areas prior to and during a disaster.**

Ministries have achieved varying readiness capabilities and work is proceeding in this area. Additionally, disaster response and planning in Grenada is based on the implementation of local activities through the 17 established District Disaster Committees decentralizing various disaster management responsibilities.

**Grenada does not currently have specific Disaster Risk Management (DRM) legislation.**

Much of Grenada's disaster activity is still managed in the preparedness/response context. In 2003, the Caribbean Development Bank (CDB) and the Caribbean Disaster Emergency Management Agency (CDEMA), formerly CDERA, produced the National Hazard Mitigation Policy. National policy currently does not yet mandate DRM as a development objective. Disaster risk reduction through development policy and planning is still in its early development.

**After the experience with Hurricane Ivan, efforts in improving public awareness and preparedness were given renewed emphasis.** NaDMA maintains

a web presence both in its organizational website (<http://mypages.spiceisle.com/nadma>) and through the national Government of Grenada website (<http://www.gov.gd/departments/nadma.html>).



**Since 2005, NaDMA has sought to improve disaster awareness at the community level.** This has been accomplished through a series of initiatives including television presentations, the coordination of disaster awareness in schools with the Ministry of Education, distribution of brochures and various public events including Disaster Awareness Week, to heighten public preparedness and awareness.

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## **HFA Priority #2: Disaster risk assessment and monitoring**

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**Mapping and GIS capability is managed largely through the Ministry of Agriculture with some use in other ministries but progress in this area is limited.** Various risk mapping exercises have been completed, including a school construction risk assessment, school landslide vulnerability assessment, shelter vulnerability and a coastal multi-hazard analysis prepared for selected communities. No comprehensive multi-hazard map compilation has been prepared.

**Supporting the development of hazard maps, GIS resources in Grenada include national topographic maps, soils, infrastructure, rainfall and other base map elements required to support hazard mapping.**<sup>19</sup>

**NaDMA lacks basic GIS capacity.** NaDMA is in possession of 4 junos but requires licenced GIS programs. All the hurricane shelters in the south of the island are mapped. The Agency needs more training in GIS-based mapping resources as they currently lack equipment and a staff GIS professional.

**The ministry of Agriculture maintains a system of stream gauges and meteorological stations on the island.** These are not automated systems. Seismic monitoring is managed through a series of

17 networked seismographs located throughout the country and Kick-'em-Jenny is instrumented through UWI with an independent monitoring system.

**In accordance with the national disaster plan, the Grenada National Meteorology Office monitors and forecasts weather, providing general forecasting services and disaster alert warnings.** The office coordinates with the U.S. National Oceanic and Atmospheric Administration for forecasting support and weather satellite imagery access. NaDMA assists in coordinating the distribution of these warnings and provides public preparedness advice.

**Six networked seismic stations are located in Grenada and Carriou.** A special monitoring system has been installed to observe Kick-'em-Jenny operated by the University of the West Indies Seismic Research Center. Maintained by the Center, the system is used to measure real-time activity and as a basis for informing the public through a 4-level early warning system.

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## **HFA Priority #3: Use of knowledge, innovation, and education to build a culture of safety and resilience at all levels**

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**With Hurricane Ivan in recent memory, Grenada's population is acutely aware of disaster-related risks and potential impacts.** Efforts on the part of NaDMA have continued to provide information and promote risk awareness through meetings, public campaigns and the introduction of disaster preparedness in the educational curriculum.

**As current disaster management efforts are focused on preparedness and response, risk reduction through planning and risk avoidance strategies remains the next advancement to be achieved.** While the post-Ivan reconstruction

<sup>19</sup> CDERA (2003c).

theme was “Building Back Better”, risk avoidance and resilience are not commonly integrated in development practices. Vulnerability assessments are not commonly completed for individual works projects and local contractors still require training and education in resistant-construction practices.

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#### **HFA Priority #4: Reduction of the underlying risk factors (reduction of exposure and vulnerability and increase of resilience)**

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**Reconstruction from Hurricane Ivan included a priority focus on improving disaster resistance in virtually all reconstruction activities.** Additional efforts were realized with the government in the evaluation of existing structural vulnerabilities in strategic facilities such as schools and medical facilities. Disaster risk is currently included in the requirement for environmental assessment as it applies in Grenada.

**A building code for Grenada based on CUBiC<sup>20</sup> was most recently revised in the mid 1990’s.** While new construction for public buildings is monitored for code compliance, private constructions are variously monitored for compliance as the national building code does not have the force of law. Eligibility requirements for mortgages and private insurance are likely factors for building design and construction in the private sector.

**Land use planning is currently a factor for disaster risk reduction in Grenada in areas where local area plans have been developed.** While some land use planning occurs, its translation into actual land use constraints is limited.

**No national system for the reduction of vulnerability is currently in place for the planning or the construction of new facilities.** After the passage of Hurricane Ivan, many businesses took stock of their losses and increased structural resilience during the reconstruction process. Development limitation maps were prepared for a part of the parish of St. Andrew through local area planning, however there is need for policy development by the government.

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#### **HFA Priority #5: Disaster preparedness, recovery and reconstruction at national, regional, and local level**

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**Since Hurricane Ivan, disaster preparedness and awareness have greatly improved at all levels.** Citizens react when informed of impending storm events and are more aware of the seriousness of preparing for possible events. The revision of the National Plan has imparted a greater level of organization to the preparedness and response process, and disaster management is a priority at all levels of government.

**Grenada is a member of the regional Caribbean Disaster Emergency Management Agency (CDEMA).**

**With a total population of around 110,000 persons, Grenada’s capacity to respond to a major disaster without major outside support will remain limited for the foreseeable future.** Risk reduction and improved insurance coverage will be key factors supporting reconstruction capacity. As it relates to public sector risks, Grenada is a subscriber to the Caribbean Catastrophic Risk Insurance Facility.<sup>21</sup> This offers short-term liquidity in the event that the policy is triggered.

<sup>20</sup> Caribbean Uniform Building Code.

<sup>21</sup> The CCRIF is the first multi-country risk pool in the world, and is also the first insurance instrument to successfully develop a parametric policy backed by both traditional and capital markets. It is a regional insurance fund for Caribbean governments designed to limit the financial impact of catastrophic hurricanes and earthquakes to Caribbean governments by quickly providing financial liquidity when a policy is triggered.

**Certain critical facilities are protected to a greater degree.** The St. Georges port facility, for example, is managed as a government-owned corporation and maintains its own commercial insurance. This was responsible for the rapid repair of facilities damaged during Hurricane Ivan.

**The tourism sector, a major contributor to the Grenada economy, is largely insured by commercial underwriters.** Other sectors, such as agriculture, transport, and/or housing remain relatively vulnerable.

**Vulnerability assessments of the health sector infrastructure have been carried out recently.** The St. George General Hospital, main healthcare

facility in the country, was assessed in 1996. Some mitigation works were implemented in Duncan ward in 2000. More recently, in 2008, the hospital was assessed using the PAHO/WHO hospital safety index. The assessment provided an estimate of the hospital's capacity to continue providing services during and after a large-scale disaster or emergency and guided necessary interventions actions to increase the hospital's safety in case of disasters. The recommendations addressed structural, non-structural and functional aspects of the facility. Some of these recommendations have already been implemented. The same methodology was used to assess the rest of the health infrastructure which comprises 2 other hospitals on the main island and one in Carriacou, 6 health centers and 30 medical stations (as of late 2009).

## KEY DONOR ENGAGEMENTS

| Existing Projects with Donors and International Financial Institutions               | Funding Agency / International Partners | Allocated Budget and Period (US\$) | HFA Activity Area(s) |
|--|---|------------------------------------|----------------------|
| Hurricane Ivan Emergency Recovery Project  | World Bank                              | 10 million<br>2004-2009            | 1, 2, 3, 4, 5        |
| Post-Hurricane Ivan School Reconstruction Project                                    | European Union, through<br>World Bank   | 13.4 million<br>2005-2009          | 2, 4                 |
| Caribbean Risk Management Initiative   | UNDP                                    | 2.1 million<br>2004-2010           | 1, 2, 3              |
| Enhancing Resilience to Reduce Vulnerability in the Caribbean                        | Government of Italy                     | 4.5 million<br>2009-2011           | 1, 2, 3, 4, 5        |
| Grenada Reconstruction, Recovery and Development Program                             | IADB                                    | 10 million<br>2005-2010            |                      |
| Regional DRM Strategy for the Caribbean Tourism Sector                               | IADB                                    | 800,000<br>2007-2009               |                      |
| Regional Monitoring and Evaluation Framework for DRM in the Caribbean Tourism Sector | IADB                                    | 750,000<br>2009-2012               |                      |
| Mainstreaming DRM in the OECS Countries  | IADB                                    | 400,000<br>2008-2011               |                      |
| Disaster Mitigation and Restoration – Rockfall and Landslip Project                  | CDB                                     | 5.2 million<br>2006                | 4                    |
| Disaster Mitigation and Restoration – Rockfall and Landslip (Add Loan)               | CDB                                     | 3.7 million<br>2008                | 4                    |



## Global Facility for Disaster Reduction and Recovery

1818 H Street, NW  
Washington, DC 20433, USA

Telephone: 202-458-0268  
E-mail: [drm@worldbank.org](mailto:drm@worldbank.org)  
Facsimile: 202-522-3227



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