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# OPERATIONAL INNOVATIONS IN LATIN AMERICA AND THE CARIBBEAN

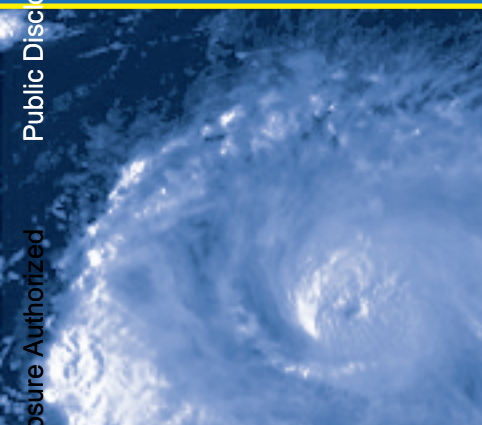


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## THE CARIBBEAN CATASTROPHE RISK INSURANCE FACILITY

Providing Immediate Funding After  
Natural Disasters

VOLUME 2 NUMBER 1

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THE WORLD BANK  
LATIN AMERICA AND CARIBBEAN REGION

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**Operational Innovations  
in Latin America and The Caribbean**

**Volume 2 Number 1**

**The Caribbean Catastrophe  
Risk Insurance Facility:  
Providing Immediate Funding After  
Natural Disasters**

**Sustainable Development Department**

**Caribbean Department**

**Operations Services Department**

**Latin America and the Caribbean Region  
The World Bank**

March 2008





# Table of Contents

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Foreword	iv	
Acknowledgements	iv	
Abstract		1
I. Introduction		2
II. The Need for Liquidity in the Aftermath of Natural Disasters		4
III. The Caribbean Catastrophe Risk Insurance Facility as a Liquidity Insurance Vehicle		6
IV. The 2007-08 CCRIF Portfolio		10
V. Going Forward		12
Glossary		14

## Figures

1. Liquidity Gap	4
2. Availability of Resources After Disasters	5
3. Probable Maximum Losses (PML), 1-in-200 Year Event	8
4. 1-in-200 Year PML as a Percentage of Aggregate Country PMLs	8
5. U.S. Catastrophe Reinsurance Price Indexes	9
6. Operating Structure of the Facility	9
7. CCRIF Multi-Donor Trust Fund: Flow of Funds Contributed by Partners	9
8. 2007-2008 CCRIF Portfolio—Loss Exceedance Curve	10
9. CCRIF Risk Financing Strategy	11

## Boxes

1. Financial Vulnerability to a Hurricane: The Case of Grenada and Hurricane Ivan	3
2. Catastrophic Risk Models	7
3. The Benefits of Risk Pooling	7

## Acronyms

ART	Alternative Risk Transfer
CARICOM	Caribbean Community
CCRIF	Caribbean Catastrophe Risk Insurance Facility
ECLAC	United Nations Economic Commission of Latin America and the Caribbean
GDP	Gross Domestic Product
IBRD	International Bank for Reconstruction and Development
LEC	Loss Exceedance Curve
OECS	Organization of Eastern Caribbean States
PML	Probable Maximum Loss

# Foreword

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Operational innovations are critical to meet and anticipate the rapidly evolving needs and development challenges of emerging economies in Latin America and the Caribbean. Working with a broad range of member countries, the World Bank helps achieve development results by delivering flexible, timely, and tailored financial services, knowledge services, and strategic advice, while using its convening capacity to further members' specific objectives.

We are pleased to continue our Operational Innovations Series with a fourth paper on "The Caribbean Catastrophe Risk Insurance Facility: Providing Immediate Funding After Natural Disasters". Among the challenges facing governments in the aftermath of natural disasters is the need for immediate access to cash to implement urgent recovery efforts and maintain essential government services. This challenge is particularly acute for small island states in the Caribbean whose economic resilience is limited by the combination of mounting vulnerability and high levels of indebtedness. The Caribbean Catastrophe Risk Insurance Facility was recently established to provide CARICOM (Caribbean Community) Governments with an insurance instrument to address this need.

The Operational Innovations Series is designed to disseminate, in a concise and lucid form, the latest practices and thinking on cutting-edge operational approaches of special relevance to our clients in Latin America and the Caribbean, for readers inside and outside the Bank. Previous papers in the series are "Control and Accountability Mechanisms Conditional Cash Transfer Programs", "IBRD Banking Products: Achieving Results Latin America and the Caribbean Region", and "Improving Transparency and Accountability World Bank Supported Projects: The Argentina Fiduciary Action Plan". Topics of upcoming papers include Innovative Non-Lending Assistance and Performance-Based Lending. We welcome and encourage suggestions for further Operational Innovations Papers.

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# The Caribbean Catastrophe Risk Insurance Facility: Providing Immediate Funding After Natural Disasters

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## Abstract

*Among the challenges facing the governments of small island states in the aftermath of natural disasters is obtaining immediate access to cash to implement urgent recovery efforts and maintain essential government services. This challenge is particularly acute for Caribbean countries whose economic resilience is limited by mounting vulnerability and high levels of indebtedness and which face high transaction costs relative to the small amount of business brought to the reinsurance market. The Caribbean Catastrophe Risk Insurance Facility (CCRIF) was recently established to provide Caribbean Community (CARICOM) Governments with an insurance instrument, akin to business interruption insurance, which furnishes short-term liquidity if they suffer catastrophic losses from a hurricane or earthquake. A wide range of instruments exists to finance long term expenditures, but the CCRIF fills a gap in the financing of short term needs. It does so through parametric insurance, which disburses funds based on the occurrence of a pre-defined event, without having to wait for an on-site loss assessment and formal confirmation. Parametric insurance is generally less expensive and provides for claims payments to be settled quickly, as the measurement of the parametric index is almost instantaneous. It is also less exposed to moral hazard and adverse selection problems. The CCRIF allows participating countries to pool their individual risks into one, better-diversified portfolio. The CCRIF Company is backed by donor funds held by the World Bank as a Multi-Donor Trust Fund. An important lesson of the experience with Hurricane Dean in mid-2007 is that facilities like the CCRIF need a robust communications strategy. Another lesson is the importance of situating this kind of parametric insurance within a comprehensive financial strategy for using an array of instruments to cover different event probabilities and types. New technology shows promise to improve the accuracy and sensitivity of parametric insurance for both clients and providers and to extend coverage beyond wind-related events. The CCRIF is reviewing the possibility of insuring more frequent events and widen its coverage. The World Bank is considering further work on a possible expansion of the CCRIF model to small island states in other regions.*

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# I. Introduction

Among the challenges facing the governments of small island states in the aftermath of natural disasters is the need for immediate access to cash to implement urgent recovery efforts and maintain essential government services. This challenge is particularly acute for Caribbean countries whose economic resilience is limited by the combination of mounting vulnerability and high levels of indebtedness. The **Caribbean Catastrophe Risk Insurance Facility (CCRIF)** was recently established to provide Caribbean Community (CARICOM) Governments<sup>1</sup> with an insurance instrument, akin to business interruption insurance, which will provide them with short-term liquidity if they suffer losses from a hurricane or earthquake.

**Caribbean countries are exposed to a variety of adverse natural events (such as hurricanes, tidal waves, earthquakes, volcanic eruptions), which can result in disasters affecting their entire economic, human and physical environment.** Experience since 1970 shows that natural disasters can inflict damage equivalent to more than two percent of an affected country's GDP. Individual events can result in major losses overnight. Major hurricanes can be expected to hit the Caribbean basin once every two and a half years. Other types of catastrophic events are less frequent but can be devastating, as demonstrated by the near total destruction of the island of Montserrat in 1995 by a volcanic eruption. The growing concentration of assets and inadequate



environmental management contribute to increasing the loss burden from natural disasters.

**Of particular concern to the small island states of the Caribbean Basin are the recurrent losses due to hurricanes.** The Caribbean Basin lies directly in the track of storms originating in the Atlantic Ocean, many of which ultimately make landfall in North America. The economic impact of hurricanes is highly variable. During the 27 year period from 1979 to 2005, 13 years are classified as "loss free," meaning no significant economic damage was incurred by any Caribbean country; eight years saw a single storm causing losses to one small island state in the region; and there were six years in which significant damage was caused by multiple storms. In rare instances, storms can also cause damage to multiple countries. Hurricane Ivan, a category 3 hurricane in 2004, had a measurable impact in eight different countries<sup>2</sup>.

**The aggregate economic losses incurred by the small island states of the Caribbean Basin as a result of storms during 1979–2005 are estimated at US\$613 million annually.** Both the frequency and the intensity of storms are determining factors influencing economic losses. The record shows that storm losses to private property, public infrastructure, and other state assets can be considerable. When Hurricane Ivan struck Grenada in 2004, the

1. CARICOM members: Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago. Associate members: Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Turks and Caicos Islands.

2. Netherlands Antilles, Cuba, Aruba, Jamaica, Grand Cayman, Grenada, Mexico, and USA.





**Because of their small size and limited borrowing capacity, Caribbean countries have limited economic resilience to disasters.** Larger countries can generally absorb the impact of adverse natural events, and an affected area can be subsidized by revenues from unaffected regions. This type of geographic distribution of risk is not possible in the small island states of the Caribbean. Their limited borrowing capacity also hinders them from accessing loans, preventing them from spreading their risk over time. See Box 1 for an example of such vulnerability in Grenada.

**Caribbean Governments' access to insurance is limited because of high transaction costs** resulting from elevated investment costs (e.g., developing country-specific catastrophic risk models) and the relatively small amount of business brought to the reinsurance market, making these investments costs non-viable in the conventional insurance market. As a result, most of the economic loss is borne by governments and households.

loss was calculated at US\$800 million, about two times the country's GDP, of which government losses accounted for about 30 percent.

### Box 1. Financial Vulnerability to a Hurricane: The Case of Grenada and Hurricane Ivan

Hurricane Ivan struck Grenada on September 7, 2004. Classified as a Category 3 hurricane, with sustained winds of 120 mph and gusts of up to 135 mph, Ivan left tremendous devastation in its wake. A damage assessment jointly conducted by the Organization of Eastern Caribbean States (OECS) and the United Nations Economic Commission of Latin America and the Caribbean (ECLAC) estimated damage over US\$800 million - or twice Grenada's Gross Domestic Product (GDP).



Just as it required additional resources to finance relief, cleanup and emergency rehabilitations, Grenada experienced a dramatic decline in revenues. The revenue shortfall was an estimated 5 percent of GDP between September and December 2004. The Government, which had only limited reserves, faced serious problem financing the public service bill, including salaries and the continuation of key services. It also became evident that the country would not be able to meet its debt obligations as they fell due.

In an effort to secure the necessary resources to continuing functioning, the Government sought donor assistance in the reconstruction of the island and in helping it meet its expense liabilities (imports and civil servant salaries). Despite over US\$150 million in pledges, only US\$12 million was available to address immediate liquidity needs. The remainder of the funds pledged was earmarked for reconstruction projects that were implemented over the following two years. In addition to the requested donor assistance, the Government also sought the cooperation of its creditors by developing a proposal to restructure over 85 percent of its commercial debt. The final effort of the Government to address its revenue short-fall was to pass revenue-enhancing measures yielding over 2 percent of GDP. These included: (i) an increase of about 45 percent in the retail price of fuel; (ii) an increase in excise taxes on alcohol and tobacco; (iii) a special levy on incomes over US\$375 per month for a five year period; and (iv) improved tax administration.

Despite all these efforts, Grenada's fiscal situation remained challenging and the country still faced a financing gap of 4.5 percent of GDP for 2005 with total debt projected to increase to 150 percent of GDP. Furthermore, instead of focusing on recovery and reconstruction, the Government was distracted by the need to finance the emerging resource gap. This led to delays in the recovery and reconstruction periods.

## II. The Need for Liquidity in the Aftermath of Disasters

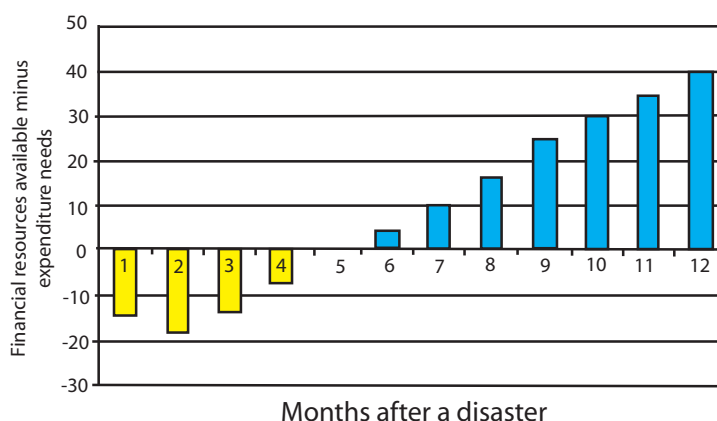
*In addition to the high human toll, natural disasters generally create enormous strain on the budget of an affected country.* The budgetary implications can be derived from the financing needs faced by governments during the three main phases of recovery after disasters.

- **Relief operations** include emergency assistance provided to the affected population to meet basic needs, such as shelter, food and medical attention. Such costs can be difficult to estimate *ex-ante*, as they depend on the specific characteristics of the catastrophic event (location, intensity, period of the year, period of the day, etc.), but are relatively small compared to the subsequent recovery and reconstruction operations. The capacity of governments to mobilize resources for relief operations at short notice should be a key component of its risk financing strategy.
- **Early recovery operations** following the initial relief efforts are crucial to limit secondary losses and ensure that reconstruction can start promptly. They include the emergency restoration of lifeline infrastructure (e.g., water, electricity and transportation lines), the removal of debris, and the like. It is during this phase that engineering firms can be mobilized to start the design of infrastructure works that will be undertaken during the reconstruction phase.
- **Reconstruction operations** generally center on the rehabilitation or replacement of assets damaged by a disaster. These include public facilities and infrastructure which are the direct responsibility of the state, but national or municipal authorities usually face obligations that go beyond their own assets. Governments often are called on to subsidize the reconstruction of private assets, in particular housing for low-income families who could not otherwise afford to rebuild their homes.

*The governments of small island states often face serious liquidity constraints after a disaster,* as result of the aforementioned factors, greatly reducing their capacity to effectively respond to and recover from disasters. Poor post-disaster response leads to secondary socioeconomic consequences that often have a disproportional impact on the poor.

*The potential liquidity gap is a key factor in the design of a strategy* aimed at reducing the financial risks at given stages of post-disaster operations. In the immediate aftermath of a disaster, expenditure needs are high while available financial resources are usually limited, creating a liquidity gap. Over time, more post-disaster resources become available, allowing the government to better meet its financial needs. In the example depicted in Figure 1, the government faces a short-term liquidity gap but not a long-term resource gap.

Figure 1 - Liquidity Gap



*Caribbean Governments often depend extensively on financing from international donors to finance post-disaster needs.* While ex-post disaster funding from bilateral and multilateral agencies can be an important part of a government's catastrophe risk management strategy, over-reliance on this approach has major limitations. Donor assistance can take a long time to materialize and usually supports investment projects, with limited possibilities of financing budget outlays such as civil servants' salaries, other recurrent costs, and the immediate costs of reconstructing lifeline infrastructure. See Box 1 for an example of this in Grenada.

*A variety of instruments can be considered in the establishment of a risk financing strategy.* These can be classified as ex-ante risk financing instruments such as the building of financial reserves, contingent debt agreements, insurance (and alternative risk transfer solutions), and post-disaster risk financing instruments including tax increases, reallocating funds from other budget items, access to domestic and international credit, and borrowing from multilateral finance institutions. While international donors have been generous in a number of cases,

such assistance has been highly dependent on the visibility of a given event in the international press, making it a somewhat unreliable instrument for risk management.

**While a wide range of instruments exist to finance long term expenditures, the financing of short term needs is more challenging.** Figure 2 depicts potential financial gaps between the available budget and various needs after a disaster and how ex ante financing instruments can fill these gaps.

Figure 2 - Availability of Resources After Disasters

	Immediate hours / days	Short term 1-3 months	Medium term 3-9 months	Long term over 9 months
Financial needs for post-disaster operations				
Relief	←→			
Recovery	←		→	
Reconstruction			←→	
Financing tools				
Ex post financing	Budget contingencies	Donor assist. (relief) Budget reallocation	Domestic / external credit	Donor assist. (reconst) Tax Increase
Ex ante financing	Reserve fund	Parametric insurance Cont. debt	Traditional insurance	

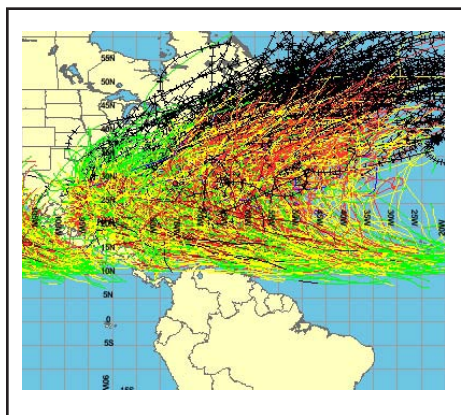
**Parametric insurance is a cost-effective way to finance any liquidity gap arising in the immediate aftermath of a disaster.** Parametric insurance disburses funds based on the occurrence of a pre-defined event, without having to wait for an on-site loss assessment, in contrast to traditional indemnity insurance that makes claims payments based on formal confirmation of a loss. In the case of the CCRIF, disbursement of an insurance payout is contingent on pre-established trigger events measured in terms of wind speed or ground shaking thresholds.

**The use of parametric insurance brings important advantages.** Parametric insurance is generally less expensive than the traditional insurance indemnity product, as it does not require a loss assessment procedure in case of a disaster. Parametric insurance also provides for claims payments to be settled quickly, as the measurement of the parametric index is almost instantaneous. It is also less exposed to moral hazard and adverse selection problems (which are costly to monitor) because the cost of insurance can be immediately related to the probability of an event, and the payout is independent of any mitigation put in place after the policy is issued. However, parametric products are exposed to basis risk, i.e., the possibility that claims payments may not perfectly match individual losses. Careful design of index insurance parameters is important to help reduce basis risk



### III. The Caribbean Catastrophe Risk Insurance Facility as a Liquidity Insurance Vehicle

*The Caribbean Catastrophe Risk Insurance Facility (CCRIF) was established in 2007 to provide a solution to the short-term liquidity needs of Caribbean governments in the aftermath of a disaster.* As a result of their experiences during the 2004 hurricane season, the CARICOM Heads of Government requested World Bank assistance in improving access to catastrophe insurance. The CCRIF is the result of two years of collaborative work



between the region's governments, key donor partners, and a team of experts from the World Bank. Preparatory studies for the establishment of the CCRIF were funded through a grant from the Government of Japan and with support from

the World Bank's own resources. These included the development of hurricane and earthquake risk models to assess potential monetary impacts, the structuring of a risk financing strategy, and the legal and organizational design of an insurance vehicle to structure and pass excess risk to the international reinsurance and capital markets. The CCRIF itself benefits from the backing of various donors, including Canada, the United Kingdom, France, Bermuda, the Caribbean Development Bank, and the IBRD.

*The CCRIF provides participating governments<sup>3</sup> with coverage akin to a business interruption insurance.* The CCRIF works as a mutual insurance company controlled by the participating governments. Each of them pays a premium related to its own risk exposure and can buy coverage up to an aggregate limit of US\$50 million (for each insured hazard). The speed of payout and low cost of coverage are made possible by combining modern insurance instruments that do not require assessment of losses on the ground and sophisticated financial engineering that significantly lowers the cost of coverage to the participating governments.

*An important feature of the CCRIF policy is the speed of claims settlement to a government affected by an earthquake or hurricane, made possible by the use of parametric insurance instruments.* Payouts from

the CCRIF are derived from advanced hazard impact models designed during the development phase. Using current computer technology and the latest earth and meteorological science information, specialized firms have developed catastrophic risk models of earthquakes, hurricanes and other perils. Insurers, reinsurers and government agencies now consider these models as essential tools to assess the risk of loss from such catastrophes. A typical catastrophic risk model is based on five modules (see Box 2) that are constantly updated based on emerging information. Monetary coverage under the CCRIF typically is capped at 20 percent of total estimated losses, a proportion which is believed to be sufficient enough to cover participants' immediate liquidity needs until other sources of funds can be mobilized.

*The CCRIF aims to provide participating governments with access to catastrophe insurance at the lowest possible cost.* The CCRIF works as a mutual insurance company, charging premiums to its members at a level that covers expected losses, operating costs and reserve growth (net of inflation). To lower the cost of insurance for its members, the Facility benefits from two main assets. First, it has available sufficient reserves to retain some of the risks transferred by participating governments. Second, the Facility functions as a risk aggregator enabling individual governments to transfer their risks into one, better diversified, portfolio.



These two features allow for the CCRIF to access the reinsurance market where it is most efficient. See Box 3 on the benefits of risk pooling.

*The Facility benefits from a strong reserve base which allows it to retain some of the risk transferred by participating governments; the risk that cannot be retained is transferred to the financial market.* Reinsurance is essential to the success and continued existence of the CCRIF, allowing it to secure enough financial capacity to ensure the full payment of claims in the event of a major disaster. However, chronic

3. As of the publication of this document, the only CARICOM members that had not joined the CCRIF were Guyana, Montserrat, Suriname, and the British Virgin Islands

## Box 2. Catastrophic Risk Models

**Hazard module:** The hazard module defines the frequency and severity of a peril, at a specific location. This is done by analyzing the historical event frequencies and reviewing scientific studies performed on the severity and frequencies in the region of interest. Once the hazard parameters for each peril are established, simulated stochastic event sets are generated which define the frequency and severity of thousands of simulated cyclone or flooding events. This module can analyze the intensity at a location once an event in the simulated set has occurred. This module models the attenuation/degradation of the event from its location to the site under consideration and evaluates the propensity of local site conditions to either amplify or reduce the impact.

**Exposure module:** The exposure values of “assets at risk” are estimated either from available secondary data sources or are derived from the distribution of population. This “proxy” approach is used when the preferred specific site by site data are not available. Based on these data, the module then computes the value for all types of exposures as a product of multiplication of the area of total building inventory and the average replacement cost per unit of inventory.

**Vulnerability module:** The module quantifies the damage caused to each asset class by the intensity of a given event at a site. The development of asset classification is based on a combination of construction material, construction type (say, wall & roof combination), building usage, number of stories and age. Estimation of damage is measured in terms of a mean damage ratio (MDR). The MDR is defined as the ratio of the repair cost divided by replacement cost of the structure. The curve that relates the MDR to the disaster (earthquake or hurricane) intensity is called a vulnerability function. Each asset class and building type will have different vulnerability curves for each peril.

**Damage module:** To calculate losses, the damage ratio derived in the Vulnerability module is translated into dollar loss by multiplying the damage ratio by the value at risk. This is done for each asset class at each location. Losses are then aggregated as required. Government assets or assets that are likely to be financed with government resources can be easily isolated and an assessment of financial needs for reconstruction calculated. Based on the likely timing for reconstruction, these costs can be ventilated between short, medium and long term financial needs.

**Loss module:** The module estimates the losses from the damage distribution. When dealing with government losses, this module estimates relief and recovery costs, as well as tax revenue losses.

## Box 3. The benefits of Risk Pooling

To understand the CCRIF one could consider a system through which several countries would agree to combine their emergency reserve funds into a common pool. If each individual country were to build up its own reserves to sustain a catastrophic event, the sum of these country-specific reserves would be much larger than the actual needs of the pooled countries in a given year. Considering that on average only one to three Caribbean countries are affected by a hurricane or an earthquake in any given year, a pool holding only the reserves for three potential payouts should be sufficient for the entire group of countries participating in the pool. Each year as the pool is depleted; participating countries would replenish it in proportion to their probable use of the funds in the pool.

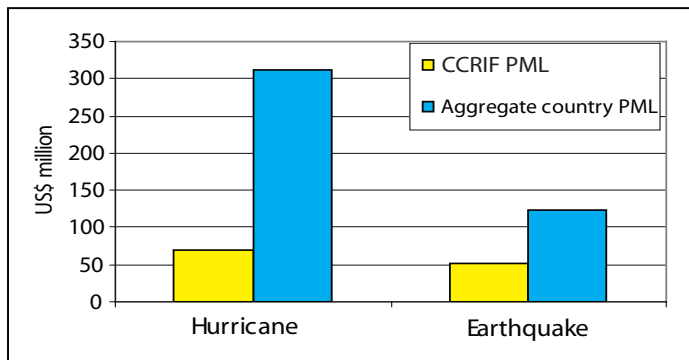
The CCRIF works in a similar manner by combining the benefits of pooled reserves from participating countries with the financial capacity of the international financial markets. It retains some of the risks transferred by the participating countries though its own reserves and transfers some of the risks to reinsurance markets where this is cost-effective. This structure results in a particularly efficient risk financing instrument that provides participating countries with insurance policies at approximately half the price they would obtain if they approached the reinsurance industry on their own.

overdependence on reinsurance is neither desirable nor sustainable over time. It is common practice in the reinsurance market that the insured party retains one third of its risk and transfers the rest to the reinsurance market. Given the pricing structure, it is usually cost-effective for the insured party to retain small but frequent losses and to transfer large but infrequent losses to the reinsurers.

***The CCRIF allows participating countries to pool their country-specific risks into one, better-diversified portfolio.*** The cost of catastrophe insurance in the financial market is immediately dependent on the variability of the risk that is being insured. Since natural disaster risks in any given year among the Caribbean islands are randomly distributed, the cost of coverage for a pooled portfolio is less than the sum of individual coverages. In the case of the CCRIF, the pooling of country-specific risks allows for a reduction of individual insurance premiums by almost half, compared with the cost of coverage a participating government would pay if it had to approach the reinsurance market independently.

Figure 3 illustrates the benefits of risk pooling by comparing the probable maximum loss (PML) for a 1-in-200 year event of the Facility's insurance portfolio including all CARICOM countries with that for the sum of the country-specific PMLs. The PML can be interpreted as the risk capital requirements (including reserves and reinsurance) the Facility should hold to sustain a 1-in-200 year event. The analysis shows that the risk capital requirements for the actual 2007-08 CCRIF portfolio are reduced by 78% for hurricanes and by 59% for earthquakes.

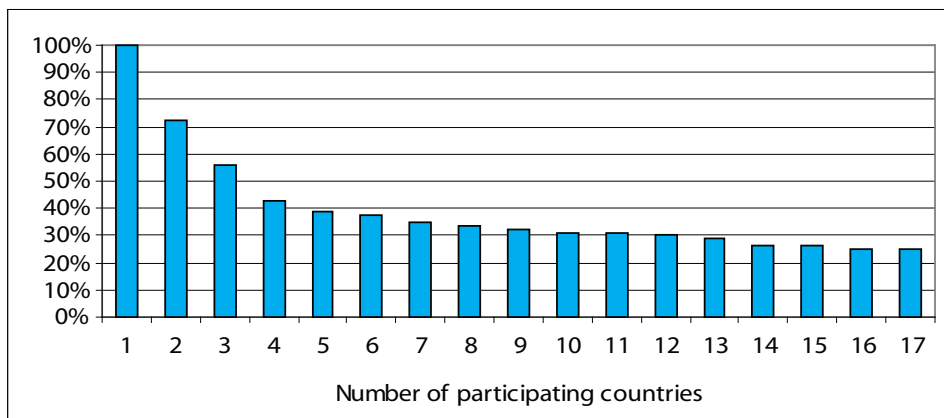
Figure 3 - Probable Maximum Losses (PML), 1-in-200 Year Event



Source: CCRIF Background Document, World Bank, 2007

Refining this analysis, Figure 4 shows how the participation of each additional Caribbean country affects the level of risk capital needed by the Facility<sup>4</sup>. For example, the relative risk capital requirement of the CCRIF is reduced by 65% when seven countries participate. It is further reduced by 75% if the CCRIF portfolio insurance includes 17 countries.

Figure 4. 1-in-200 year PML as a Percentage of the Aggregate Individual Country PMLs



Source: CCRIF Background Document, World Bank, 2007

**The CCRIF aims to achieve a high level of financial security while maximizing long-term sustainability.** A key tradeoff faced by the Facility's risk manager is the need for survivability – minimizing the probability of bankruptcy – against the need for reserve accumulation. A strategy in which the Facility would transfer most of its risk portfolio to the reinsurance market would ensure a very high survivability but compromise its chance to accumulate reserves over time, since the larger share of the premiums collected would be used to pay a high reinsurance premium. On the other hand, a strategy under which the Facility would retain a larger part of the risk may jeopardize its survivability in any given year.

**The CCRIF's operating structure is designed to provide stable insurance costs over time.** Catastrophe insurance prices are known to be highly volatile, creating particular difficulties in the planning and execution of insurance programs. Figure 5 illustrates this point by providing an analysis of catastrophe insurance pricing in the U.S. financial markets over the last 20 years. The problem became particularly acute after the 2004/2005 hurricanes season, which led to a 100% increase in the cost of some reinsurance layers for catastrophe risk in the Caribbean.

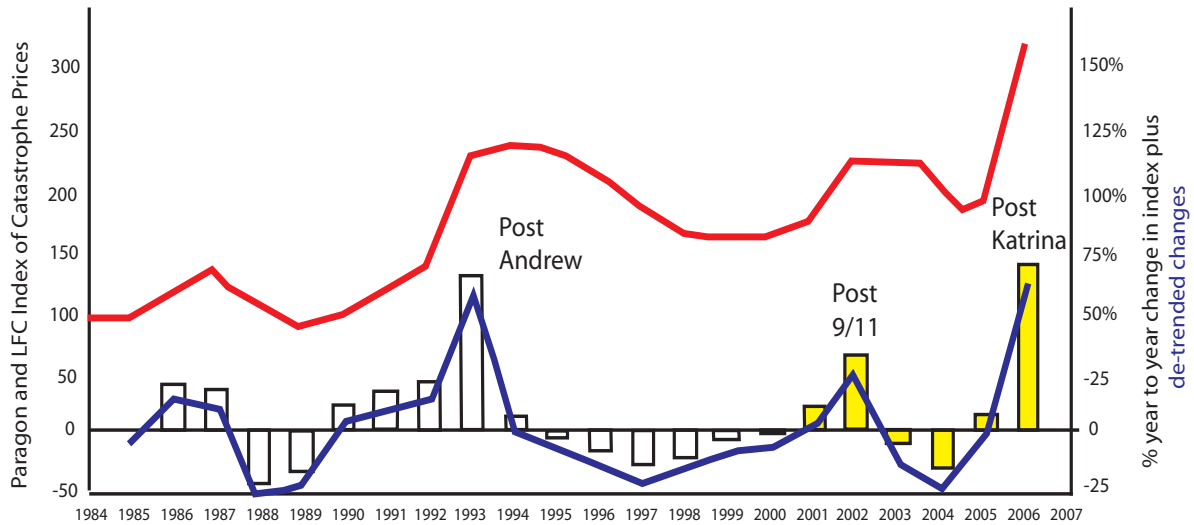
As its reserve base grows, the CCRIF will be able to retain more of the risk and thus smooth the cost of risk transfer and provide greater stability to insurance premiums than in the commercial market.

**The CCRIF is an independent legal entity, registered as a fully capitalized Limited Liability Company in the Cayman Islands.** It is owned by a trust (the CCRIF Trust) whose beneficiaries are the participating countries that buy insurance policies from the CCRIF Company. This allows for a system in which the participating countries are not liable for a possible default of CCRIF but can still benefit from residual assets in case it is dissolved. In case of dissolution of the CCRIF Company, its assets will revert to the CCRIF Trust (as 100 percent owner of the CCRIF Company).

**The CCRIF is managed by an Insurance Manager under the supervision of a Board of Directors composed of representatives from the participating donors and client countries. This Board is supported with**

4. The order of inclusion of the Caribbean countries in the CCRIF portfolio affects the PML and thus the risk pooling benefit. A robust approach would have been to compute all possible combinations and then average them. However, given the very large number of possible combinations, only a random set of combinations was computed and averaged.

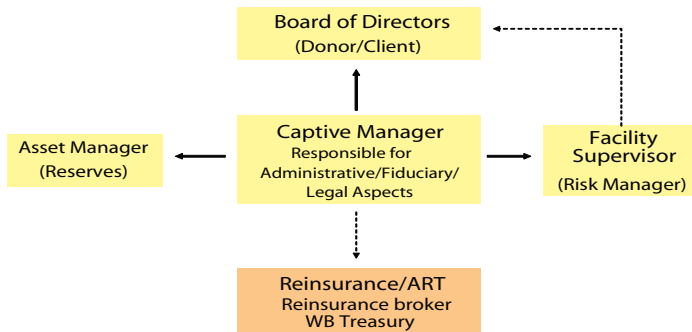
Figure 5. U.S. Catastrophe Reinsurance Price Indexes



Source: Lane Financial L.L.C.

**the technical advice of a specialized Facility Supervisor.** Figure 6 presents the principal elements in the CCRIF's organizational structure. The CCRIF is currently operated by Sagicor Insurance Managers Ltd.

Figure 6. Operating Structure of the Facility



(Insurance Manager) with support from Caribbean Risk Managers Ltd. (as Facility Supervisor) and Benfield Group Ltd. (as Reinsurance Broker). Each of these firms was selected on a competitive basis and will

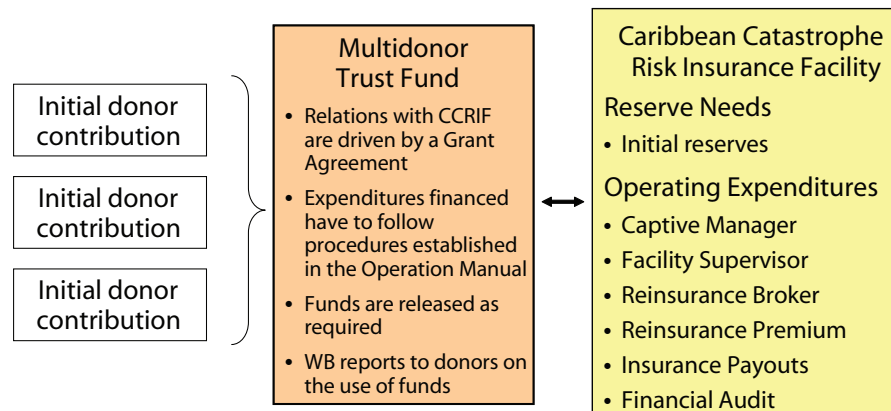
have to compete for its position every two to three years.

**The CCRIF Company is backed by donor funds held by the World Bank as a Multi-Donor Trust Fund.**

These funds complement the Facility's own reserves to cover some of its operating expenses. These additional resources help reduce the CCRIF's dependence on the reinsurance market, allowing for a larger share of the premium collected to help further build its reserves, as depicted in Figure 7.

The financial capacity of the Facility to pay all valid claims in full is secured through its own reserves (building up from the insurance premiums paid by the participating countries) to cover small and recurrent losses and through access to external risk capital to cover major losses. External capital has been secured on the reinsurance market with the help of a reinsurance broker, and on the capital markets through alternative risk transfer (ART) instruments such as a catastrophe swap (see text below) with the help of the World Bank Treasury.

Figure 7. CCRIF Multi-Donor Trust Fund: Flow of Funds Contributed by Partners





## IV. The 2007-08 CCRIF Portfolio

**Sixteen countries purchased catastrophe insurance from the CCRIF for the 2007-08 season starting on June 1, 2007:** Anguilla, Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St Kitts & Nevis, St Lucia, St Vincent & the Grenadines, Trinidad & Tobago, Turks and Caicos Islands.

**The country insurance coverage is designed to protect against infrequent catastrophic losses.** Country insurance coverage typically attaches at a 1-in-20 year event and exhausts at a 1-in-100-year event. The insured country can cede up to 20% of the potential loss (“ceding percentage”), such that the insurance contract may pay indemnities only for losses within a specified range of magnitude. The total CCRIF risk exposure is about US\$365 million for hurricane risks and US\$160 million for earthquake risks. Each country selects the attachment point (deductible), the exhaustion point (maximum payout), and a ceding percentage (the portion of the risk not covered). If the estimated loss is less than the attachment point, no payout is made. When the attachment point is triggered (i.e., the estimated loss exceeds the attachment point), the policyholder receives an indemnity payout equal to a fraction (ceding percentage) of the estimated loss in excess of the attachment point. The maximum payout is capped by the exhaustion point.

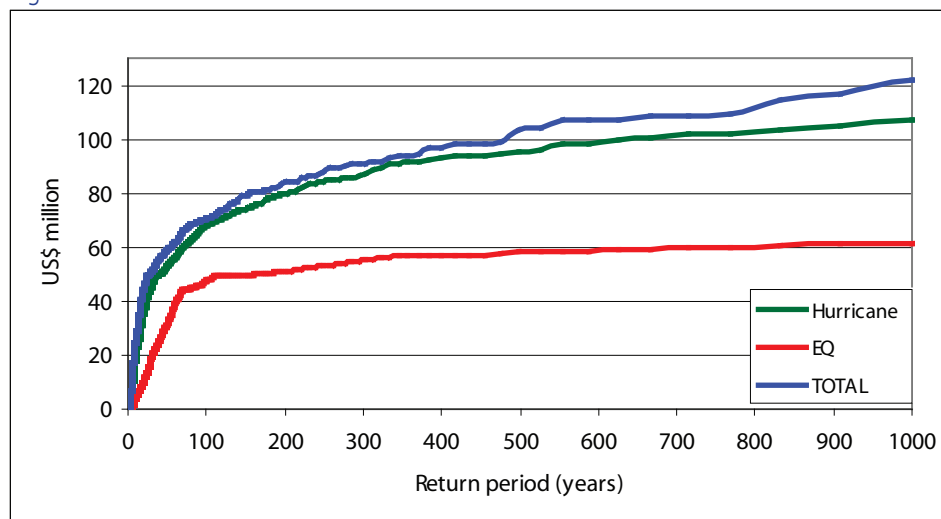
**CCRIF portfolio risk profile.** The average annual loss faced by the CCRIF is estimated at US\$7.8 million. However, this risk metric is only a partial indicator of the CCRIF risk exposure because it does not capture the variability around this average value. Figure 8 depicts the Loss Exceedance Curve (LEC) of the CCRIF portfolio. The LEC is the set of probable maximum losses (PMLs) at different event frequencies (known as return periods). It shows that CCRIF losses will exceed US\$71 million once every 100 years (on

average) and will exceed US\$120 million once every 1,000 years.

**For its first year of operation, the CCRIF has developed a financial strategy with a claims-paying capacity for surviving at least a 1-in-1,000-year event.** CCRIF was able to secure US\$120 million of capacity on the international reinsurance and capital markets. The claims-paying capacity consists of four layers (as shown in Figure 9): CCRIF retains the first layer of US\$10 million; reinsurers underwrite the second (US\$15 million) and third (US\$25 million) layers; and the top layer (US\$70 million) is financed with reinsurance (US\$50 million) plus US\$20 million coverage through a catastrophe swap (see below) organized by IBRD’s Treasury. Reinsurance capacity was secured from Munich Re (as the lead reinsurer), Paris Re, and Hiscox (Lloyds Syndicate 33). This allows the CCRIF to sustain events occurring once every 1,000 years or more, achieving a level of resiliency above international standards. The CCRIF, assisted by its reinsurance broker Benfield, was able to secure the US\$120 million capacity at a very competitive price; the overall reinsurance premium is less than twice the estimated average annual reinsurance payout.

**The World Bank Treasury assisted the CCRIF in the first-ever multi-country risk swap with the capital market.** As part of the risk placement, the World Bank Treasury arranged for CCRIF to transfer a portion of the catastrophe risk to the

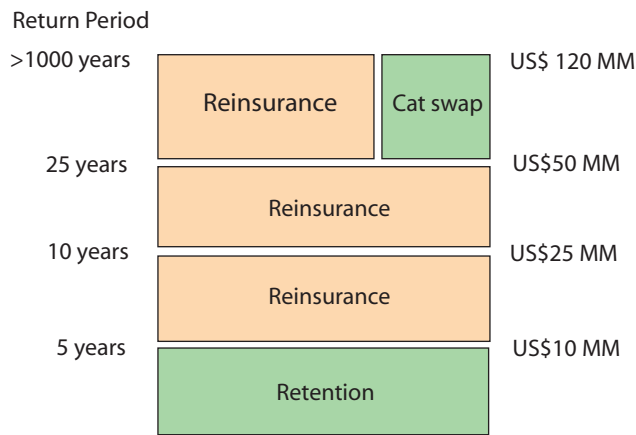
Figure 8. 2007-08 CCRIF Portfolio - Loss Exceedance Curve



Source: CCRIF.



Figure 9. CCRIF Risk Financing Strategy



capital markets through a US\$20 million swap transaction<sup>5</sup>. This is the first transaction to enable developing countries to use a derivative instrument to access the capital market to insure against natural disasters. It is also the first time a diversified pool of emerging market countries' catastrophe risk is placed in the capital markets. This risk placement allows the Facility to diversify its sources of external risk capital, thus making it less exposed to potential reinsurance price cycles.

**From June 1 to December 31, 2007, five earthquakes and two hurricanes were reported to CCRIF Participants.** Hurricane Dean, which passed through the Caribbean Basin on August 18-20, 2007, generated losses on several islands. However, the estimated losses remained below the attachment point of the policies purchased by the affected countries and thus no payments were triggered<sup>6</sup>. On November 29, 2007 a 7.4 magnitude earthquake occurred close to Martinique in the Eastern Caribbean. This event, which was reported to be a 1-in-50 year earthquake, triggered the first indemnity payments under CCRIF policies for Saint Lucia and Dominica, for a total of approximately US\$1 million. These events were a good test of the CCRIF operational mechanisms. The Facility functioned as planned, with all affected countries informed within 24 hours after the occurrence and indemnity payouts made within four weeks.

5. There are two catastrophe swaps offsetting each other. Each of these swaps has a US\$20 million notional and a one-year maturity. In the swap with the CCRIF, the Bank receives an insurance premium up front and would pay according to a parametric formula upon the occurrence of a disaster. The Bank eliminates its exposure by entering into the same swap with Munich Re.

6. CCRIF report dated 27 August 2007.

## V. Going Forward

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***An important lesson of the experience with Hurricane Dean in mid-2007 is that facilities like the CCRIF need a robust communications strategy.*** The CCRIF received unfavorable publicity when the magnitude of damage caused by Hurricane Dean was insufficient to trigger any payments. As a result, substantial outreach efforts were undertaken, starting with meetings between top officials of the CCRIF and the Government of Jamaica, a presentation to the Board of the Caribbean Development Bank (which includes many Finance Ministers of CARICOM as well as representatives of key donors), and the contracting of a consultancy firm to prepare and help implement a communications strategy. Significant external relations efforts were made surrounding the presentation of payments to the governments of St. Lucia and Dominica in response to the earthquake in November 2007. The CCRIF Facility Supervisor has made further presentations in Haiti (at a workshop of the Association of Caribbean States), Jamaica, Grand Cayman, and Barbados (at the annual conference of the Caribbean Disaster Emergency Response Agency of CARICOM). The new communications strategy emphasizes, among other things, the nature of CCRIF as a regional joint reserve fund rather than a for-profit insurance company.

***New technology shows promise to improve the accuracy and sensitivity of parametric insurance for both clients and providers and to extend coverage beyond wind-related events.*** Current wind speed measurement instruments, for example, have limited capacity and resistance (for wind speeds of up to around 95 miles per hour). New instruments are being developed that can withstand forces of up to 140 miles per hour. In addition, greater numbers of more closely-spaced measurement stations can greatly enhance the validity of the data on which parametric insurance modeling and payouts are based. In addition, the CCRIF is currently working on a flood model for the Caribbean islands. Flood risks are more difficult to model than risks from wind speed, so it will take some time to finalize and validate the flood model.

***In light of the experience with Hurricane Dean and based on suggestions from various stakeholders, the CCRIF is reviewing the possibility of insuring more frequent events and widen its coverage.*** The CCRIF team is studying the

possibility of lowering the minimum allowable attachment point of the insurance policy. Following Hurricane Dean, several participating countries expressed interest in insuring more frequent events even if this would entail higher premiums or lower coverage. The team is studying the possibility of reducing the minimum available attachment point on CCRIF policies from a 20 year return period to a 15 year return period for its 2008 renewals. To allow for a further lowering of the attachment point on its policies, the CCRIF is currently updating its catastrophe risk model. A new version of the model should be available for testing and calibration in early 2008. The CCRIF also is consulting with stakeholders on other possible risk pooling mechanisms which may benefit from the regional approach.

***The World Bank is considering further work on a possible expansion of the CCRIF model to small island states in other regions.*** While financial instruments can be useful to limit the impact of adverse natural events, they should be considered as part of broader risk management strategies including risk identification, preparedness, and mitigation. Much work is needed to prevent damage and losses in the first place, including strengthening emergency response capacity, enforcement of appropriate building codes, and improving infrastructure to better withstand the effects of adverse natural events. A clear benefit of the parametric instrument provided by the CCRIF is that it avoids the usual moral hazard problem associated with insurance. Investments in risk mitigation do not affect the level of a payout but will eventually reduce the cost of the annual insurance premiums paid by a participating government. This keeps the incentives aligned to limiting the impact of adverse natural events and reducing the number and amplitude of disasters.

Other Caribbean countries, such as the Dominican Republic, have expressed interest in participating in the CCRIF. Others, like Guyana, are ready to join the Facility if flood coverage is made available. Pacific island countries and Central American countries have also requested the World Bank's assistance for the establishment of a similar facility in their respective regions. Feasibility studies have just started to investigate whether a catastrophe insurance pool is an appropriate financial vehicle for the financing of natural disasters in these regions.

*In summary, key lessons from the Bank's early experience with the CCRIF include:*

- Policy-makers need to be informed up front that facilities like CCRIF are for catastrophe insurance, not disaster insurance.
- In the collaboration with governments to establish such facilities, it is important to situate this kind of parametric insurance within a comprehensive financial strategy for covering a variety of event probabilities and types with an array of instruments.
- Going forward, achieving greater financial sustainability and less donor dependence for such facilities should be a key topic of policy dialogue. For example, donors that finance the payment of premiums should examine options for gradually phasing down such support and placing more emphasis on helping countries to devise and implement comprehensive risk financing strategies.
- The World Bank should continue to clearly separate itself from the direct management of the CCRIF and similar facilities in order to avoid any perceived conflict of interest. The principal roles of the Bank are (i) to facilitate, through its global knowledge and convening power, the establishment of such mechanisms, (ii) to mobilize technical skills and provide quality enhancement, (iii) to help finance related public goods such as data bases, models, and legal instruments, and (iv) to provide financing for establishment of these mechanisms and, on a selective basis, the premiums.
- Catastrophe risk insurance is a new business line for the World Bank, and to scale up its work in this area it will need to harmonize the efforts of various units. At least 20 World Bank initiatives<sup>7</sup> related to catastrophe risk were recently identified, and a new internal working group is being established. Among the issues that need to be addressed is how to adequately resource this type of work within the Bank. The CCRIF was established using a \$1.2 million Trust Fund plus a very substantial (not yet quantified) amount of Bank staff time. In addition, the Bank is now examining how to add more technical expertise in the risk insurance field.

For additional information on the CCRIF, please visit the Caribbean Catastrophe Risk Insurance Facility page on the World Bank's External web site (<http://www.worldbank.org/lac>).

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7. Examples include a Turkish Catastrophe Insurance Pool for homeowners in the aftermath of the 1999 Marmara earthquake, for which the Bank contributed capitalization through a loan facility; a Livestock Insurance Indemnity Pool for Mongolia to protect herders against excessive losses due to harsh winters and summer droughts, financed partly by a Bank loan facility; technical assistance to the Government of India to improve its weather-based index insurance system for farmers; technical assistance to the Government of Mexico for issuance of a catastrophe bond to help cover the risk of damage from earthquakes; and provision of a \$150 m. contingent credit line to the Government of Colombia to offer immediate liquidity in the event of a major disaster.

# Glossary

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<b>Adverse Selection</b>	Adverse selection occurs when potential insurance purchasers know more about their risks than the insurer does, leading to participation by high-risk individuals and nonparticipation by low-risk individuals. Insurers react by either charging higher premiums or not insuring at all, as in the case of floods.
<b>Average Annual Loss</b>	Expected loss per year when averaged over a very long period (e.g., 1,000 years). Computationally, AAL is the summation of products of event losses and event occurrence probabilities for all stochastic events in a loss model.
<b>Basis Risk</b>	The risk with index insurance, that the index measurements will not match individual losses. Some households that experience loss will not be covered, for example, and some households that experience no loss will receive indemnity payments. As the geographical area covered by the index increases, basis risk will increase as well.
<b>Capacity</b>	The maximum amount of insurance or reinsurance that the insurer, reinsurer, or insurance market will accept.
<b>Catastrophe</b>	A severe, usually sudden, disaster that results in heavy losses.
<b>Claim</b>	An insurer's application for indemnity payment after a covered loss has occurred.
<b>Ex ante Risk Mechanism</b>	Action taken prior to a potential risk event. Making preparations before a disaster helps avoid inefficient, quick-response coping decisions. If ex ante strategies are not in place, resort will be to short-term coping strategies that have no significant benefit in the long run.
<b>Ex post Risk Mechanism</b>	Risk-management strategies that are developed in reaction to an event, without prior planning. Although ex post strategies have a role to play in a risk-management program, risk-management mechanisms can be more effective when introduced ex ante.
<b>Exposure</b>	The amount (sum insured), exposed to the insured peril(s) at any one time. In crop insurance, exposure may increase, and then decrease, during the coverage period, following the growth stages of the crop from planting to completion of harvest.
<b>Hazard</b>	A physical or moral feature that increases the potential for a loss arising from an insured peril or that may influence the degree of damage.
<b>Indemnity</b>	The amount payable by the insurer to the insured, in the form of cash, repair, replacement, or reinstatement in the event of an insured loss. This amount is measured by the extent of the insured's pecuniary loss. It is set at a figure equal to but not more than the actual value of the subject matter insured just before the loss, subject to the adequacy of the sum insured. For many crops, this means that an escalating indemnity level is established as the growing season progresses.
<b>Insurance</b>	A financial mechanism that aims to reduce the uncertainty of loss by pooling a large number of uncertainties so that the burden of loss is distributed. Generally, each policyholder pays a contribution to a fund in the form of a premium, commensurate with the risk he introduces. The insurer uses these funds to pay the losses (indemnities) suffered by any of the insured.
<b>Insurance Captive</b>	An insurance company that is owned and controlled by its insureds.
<b>Insurance Policy</b>	A formal document (including all clauses, riders, and endorsements) that expresses the terms, exceptions, and conditions of the contract of insurance between the insurer and the insured. It is not the contract itself but evidence of the contract.
<b>Layer</b>	The term used to define a range of potential loss that is covered by insurance. For example, an insurance contract may pay indemnities only for losses within a specified range of magnitude.
<b>Moral Hazard</b>	In insurance, moral hazard refers to the problems generated when the insured's behavior can influence the extent of damage that qualifies for insurance payouts. Examples of moral hazard

are carelessness, fraudulent claims, and irresponsibility.

<b>Parametric Insurance</b>	Parametric insurance makes indemnity payments based not on an assessment of the policyholder's individual loss, but rather on measures of a parametric index that is assumed to proxy actual losses.
<b>Premium</b>	The monetary sum payable by the insured to the insurers for the period (or term) of insurance granted by the policy. $\text{Premium} = \text{premium rate} \times \text{amount of insurance}$ Also, the cost of an option contract—paid by the buyer to the seller.
<b>Premium Rate</b>	The price per unit of insurance. Normally expressed as a percentage of the sum insured.
<b>Probable Maximum Loss (PML)</b>	The largest loss believed to be possible for a certain type of business in a defined return period, such as 1 in 100 years, or 1 in 250 years.
<b>Reinsurance</b>	When the total exposure of a risk or group of risks presents the potential for losses beyond the limit that is prudent for an insurance company to carry, the insurance company may purchase reinsurance (that is, insurance of the insurance). Reinsurance has many advantages, including (1) leveling the results of the insurance company over a period of time; (2) limiting the exposure of individual risks and restricting losses paid out by the insurance company; (3) possibly increasing an insurance company's solvency margin (percent of capital and reserves to net premium income), hence the company's financial strength; and (iv) enabling the reinsurer to participate in the profits of the insurance company, but also to contribute to the losses, the net result being a more stable loss ratio over the period of insurance.
<b>Risk Retention</b>	Risk retention is the process whereby a party retains the financial responsibility for loss in the event of a shock.
<b>Risk Transfer</b>	Risk transfer is the process of shifting the burden of financial loss or responsibility for risk financing to another party, through insurance, reinsurance, legislation, or other means.
<b>Risk Financing</b>	The process of managing risk and the consequences of residual risk through products such as insurance contracts, CAT bonds, reinsurance, or options.
<b>Risk Pooling</b>	The aggregation of individual risks for the purpose of managing the consequences of independent risks. Risk pooling is based on the law of large numbers. In insurance terms, the law of large numbers demonstrates that pooling large numbers of roughly homogenous, independent exposure units can yield a mean average consistent with actual outcomes. Thus, pooling risks allow an accurate prediction of future losses and helps determine premium rates.



