



## Understanding CCRIF's Hurricane and Earthquake Policies

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### Background and Introduction

Governments are often challenged with the significant task of financing recovery efforts after a disaster. Whilst dealing with the fiscal demands to undertake relief operations such as ensuring the availability of emergency assistance and sourcing funding for shelter, food and medical attention for displaced persons, governments also have to contend with the simultaneous challenge of mobilising enough resources to undertake the medium- to long-term recovery and reconstruction process. This recovery process can include tasks that range from the clearance of debris to the restoration of critical services such as access to water and electricity for surviving populations through to the reconstruction and rehabilitation of key public infrastructure.

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) was created out of this recognition that natural catastrophes impose a significant burden on the financial ability of states to function after a disaster due to an unavailability of liquidity. The Facility was launched in 2007 and structured as an insurance instrument to provide coverage similar to business interruption insurance in the event of losses from tropical cyclones or earthquakes. Similar to a mutual insurance company, CCRIF is operated on behalf of sixteen participating states in the Caribbean, each of which pays a premium directly

related to the amount of risk each transfers to CCRIF and purchases coverage up to a limit of US\$100 million for each insured hazard (tropical cyclones or earthquakes) within a given year. By pooling their risks into a single diversified portfolio, reinsurance needs are significantly lowered (see Figure 1). This in turn leads to a pricing reduction of more than half of what it would cost if countries were to purchase identical coverage individually compared with buying the coverage from CCRIF.

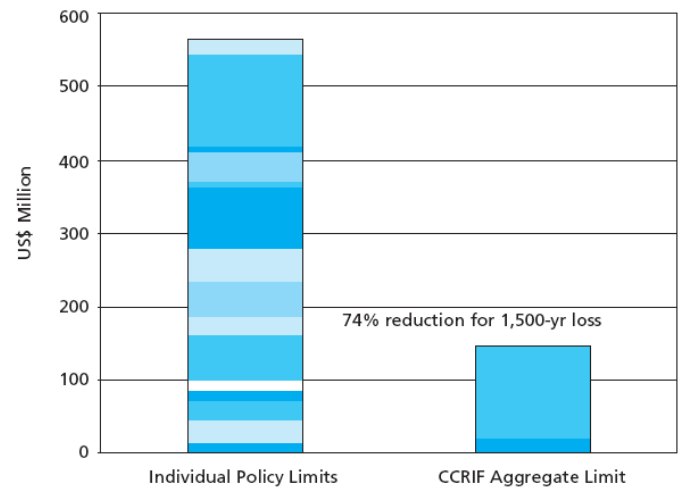


Figure 1: Insurance Costs

## What is CCRIF's Parametric Insurance – How does it Work?

CCRIF offers parametric insurance which disburses funds based on the occurrence of a pre-defined level of hazard and impact without having to wait for an on-site loss assessment. This feature is quite different from traditional indemnity-based insurance products in which claims are paid based on formal confirmation of the amount of a loss through on-site verification.

For the CCRIF instrument, payouts are made on the basis of exceeding a pre-established trigger event loss which is estimated in a model in which hazard inputs are generated (e.g. wind speed and storm surge in the case of tropical cyclones or ground shaking for earthquakes) from independently-provided input data (such as a tropical cyclone track or earthquake location/magnitude). These hazard levels are then applied to the pre-defined government exposure to produce a loss estimate. Payouts above the trigger level increase with the level of modelled loss, up to a pre-defined coverage limit.

Therefore payouts can be calculated and made very quickly because there is no need to estimate damage after an event.

## Why Parametric Insurance?

The selection of a parametric instrument as a basis for the CCRIF policies was largely driven by the fact that parametric insurance is generally less expensive than an equivalent traditional indemnity insurance

product as it does not require a loss assessment procedure in case of a disaster. Parametric insurance also allows for claims to be settled quickly. This is an important feature considering the urgent need for liquidity after a catastrophe. In addition, the instrument is also less exposed to moral hazard and

*CCRIF is a regional catastrophe fund for Caribbean governments designed to limit the financial impact of devastating hurricanes and earthquakes by quickly providing financial liquidity when a policy is triggered.*

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.

Despite these benefits, parametric products are exposed to basis risk, *i.e.*, the possibility that a payout may be higher or lower than actual losses. Although this is a significant challenge in terms of the development of the instrument, careful design of input parameters and the loss model as undertaken by CCRIF helps reduce the basis risk. Furthermore, as large institutions, governments are better able to accommodate basis risk than, say, individuals.

It should be noted that CCRIF's risk-based pricing of parametric policies means that premium costs cover just the parametric losses, and would be substantially higher if they had to cover actual losses, despite there being an equal possibility of 'winning' or 'losing' on the basis risk issue.

## A Closer Look at the CCRIF Catastrophe Model

In undertaking the development of the CCRIF parametric insurance coverage, significant investment went into developing the underlying catastrophe model. Catastrophe models are essential tools in assessing the risk associated with catastrophe events. For the most part they are based on robust datasets containing:

- **A hazard module**
- **An exposure module**
- **A vulnerability module**
- **A damage module**
- **A loss module**

The CCRIF model is no different, with the modules all developed within the context of the particular hazards of relevance to the client countries, these being tropical cyclones and earthquakes.

The hazard module defines the frequency and severity of a hurricane or earthquake, at a specific location. This is done by analysing the historical frequencies of the peril and reviewing scientific studies on the severities and frequencies in the region of interest. Using these historic data,

*The development of the CCRIF catastrophe model is an important contribution to national and regional risk management institutions through its collection of a significant set of detailed databases on national catastrophe risk exposures in its member states. This is important specifically because prior to this initiative most member countries had for the most part never undertaken any major effort to collate this information which would be critical in understanding the catastrophe risks faced at a national and regional level.*

simulated event sets are generated which define the frequency and severity of thousands of simulated cyclone or earthquake events in terms of their tracks/locations/intensities.

This hazard module then calculates the hazard intensity at each location for each event in the simulated set. This is done by modelling 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.

In developing the exposure module, the exposure values of “assets at risk” are estimated from available secondary data sources (including economic and satellite data) and from the population distribution. This “proxy” approach is used due to limitations in availability of site-specific asset data. Based on tested algorithms, the module computes the value of different asset types for each 1-km grid square across the entire country in question.

In terms of the vulnerability module, the starting point is to quantify the damage caused to each asset class by the intensity of a given event at a site.

Estimation of damage is measured in terms of a mean damage ratio (MDR). The MDR is defined as the repair cost divided by replacement cost of the structure. The curve that relates the MDR to the hazard (earthquake shaking, wind or storm surge inundation) intensity is called a vulnerability function. Each asset class has a different vulnerability function for each hazard.

To calculate the 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 in each grid cell. Losses are then aggregated as required (e.g. at the administrative or national level). Government assets or assets that are likely to be financed with government resources can be isolated and an assessment of financial needs for reconstruction calculated.

### How is a CCRIF Policy Triggered?

The trigger level is dependent on the coverage purchased by individual countries. Member governments may purchase coverage which triggers for a '1-in-15-year' hurricane or a '1-in-20-year' earthquake, for example, with maximum coverage of US\$100M available for each peril. The cost of coverage is a direct function of the amount of risk being transferred, ensuring no cross-subsidisation of premiums and a level playing field for all participants.

A CCRIF policy is triggered based on the government loss estimated in the loss model, which in turn is based on the characteristics of the hazard and the distribution and exposure of government assets at

risk of being affected by the hazard (as described above). The trigger level (attachment point or deductible) specified in the policy/contract is then applied to the modelled government loss. The policy is triggered when the modelled loss for a hurricane or earthquake in a member country equals or exceeds the attachment point (deductible) specified in the policy contract.

### How are Payouts Calculated?

In the case of hurricanes, a payout to a country would depend on the storm's intensity and track relative to the distribution and exposure of government assets and on the attachment and exhaustion points and coverage limit that the country has selected. Once the trigger level has been reached, the payout increases as the modelled loss increases, due to higher hazard intensity or a closer track (or both) for the storm (relative to the distribution and exposure of assets).

Payouts for hurricanes are determined based on government losses calculated using storm data from the National Hurricane Center and parameters fixed within the loss estimation model used to underpin CCRIF's policies. The model calculates the level of wind and ocean hazards, such as storm surge, encountered across the affected area and uses the pre-fixed value and distribution of government exposures to those hazards to calculate a government loss.

In the case of earthquake policies, a payout would depend on the source magnitude and hypocentre (location and depth) of the earthquake using data



obtained from the United States Geological Survey. This is translated into a ground shaking intensity across each affected country which in turn drives generation of a modelled loss. The payout increases as the level of losses increases, and losses are directly calculated from the amount of ground shaking in the affected country and what assets are exposed to what level of shaking.

The specific payout totals are based on the level of coverage a country has. Each individual country chooses its own coverage options in terms of the attachment point (deductible), exhaustion point (which determines the coverage limit) and premium. The amount of the premium dictates how much of the risk between the attachment and exhaustion points a country is actually covered for. Since its inception in 2007, CCRIF has made eight payouts totalling US\$32,179,470 to seven member governments. All payouts were transferred to the respective governments less than a month after each event. These payouts are shown in the table to the right.

Event	Country Affected	Payouts (US\$)
Earthquake, 29 November, 2007	Dominica	528,021
Earthquake, 29 November, 2007	Saint Lucia	418,976
Tropical Cyclone Ike, 2008	Turks and Caicos Islands	6,303,913
Earthquake, 12 January, 2010	Haiti	7,753,579
Tropical Cyclone Earl, August 2010	Anguilla	4,282,733
Tropical Cyclone Tomas, October 2010	Barbados	8,560,247
Tropical Cyclone Tomas, October 2010	Saint Lucia	3,241,613
Tropical Cyclone Tomas, October 2010	St. Vincent & the Grenadines	1,090,388
<b>Total for the Period 2007 - 2011</b>		<b>US\$32,179,470</b>

### What Hazards are Included in the Hurricane Payout Calculation?

Hazards that are included in computing the loss are wind in all areas and storm surge in coastal areas where assets can be at risk from storm surge inundation. The CCRIF payout is based on the modelled loss estimate from the storm as it happens. CCRIF runs the storm track and characteristics in the loss model after the storm has impacted the country and computes all losses. That loss estimate then is used in the policy framework to determine if a policy has been triggered or not.



## CCRIF Policies and Coverage Selection

Regarding CCRIF policies and coverage selection, all countries are required to make three key decisions regarding their coverage selection. These are:

- **The selection of an attachment point**
- **The selection of an exhaustion point**
- **The selection of the coverage limit**

## Key Elements of CCRIF Policies and their Definitions

### Attachment Point

The attachment point can be described as the minimum severity of the event loss which gives rise to a payment and therefore is the loss value at which the policy contract is triggered. The attachment point therefore functions like a deductible in a standard insurance policy.

Payouts are made on the policy when the modelled loss for an event in a member country equals or exceeds the attachment point specified in the contract. The policy holder, in CCRIF's case the specific country, covers all losses below the attachment point for any event.

The attachment point applies equally to each individual storm or earthquake. There is no accumulation of attachments (deductibles) from loss events for which the modelled loss was less than the

attachment point. As the modelled loss increases above the attachment point, the corresponding payout increases up to the exhaustion point (see below for exhaustion point).

For example, an attachment point selected at the 1-in-15-year loss level represents the loss amount (in dollars) which is likely to be exceeded once in fifteen years. While countries generally select the attachment point as a return period, the policy includes the equivalent dollar value of loss which that return period represents in the country's risk profile.

### Exhaustion Point

The exhaustion point refers to the severity of the event loss at or above which the maximum payment is triggered. For the 2009-2010 policy year, for example, CCRIF member countries selected exhaustion points equivalent to between 1-in-75 and 1-in-200 year events.

### Ceding Percentage

The ceding percentage is the fraction of the risk between the attachment and exhaustion points that the country is transferring to CCRIF.

Once the attachment point and exhaustion point are chosen, there is a one-to-one relationship between the amount of premium paid and the ceding percentage – more premium means a higher ceding percentage.

## Coverage or Policy Limit

The policy/coverage limit is the difference between the attachment and exhaustion points (exhaustion - attachment) multiplied by the ceding percentage (the amount of risk between the attachment and exhaustion points that the country is transferring to CCRIF).

The coverage limit is the maximum amount that can be paid out under the contract in any one year for any one peril (hurricane or earthquake). Payouts for events that have a modelled loss that exceeds the exhaustion point are paid out at the coverage limit. The policy limit applies to the full term (one year) of the contract; the total amount paid out under the contract during the one-year period will not exceed the policy limit, whether that policy limit is due to payout from one large event or multiple smaller events that each trigger payments under the contract.

The coverage limit that is selected will depend on the capacity of the country to absorb losses and also on what premium the country wishes to pay.

## How is the Premium Cost Determined?

The premium is determined by the amount of coverage a country decides to take, the attachment and exhaustion points of that coverage, and the risk profile of the country. More specifically, a member country's premium cost is based on the frequency with which the hazard (hurricane or earthquake) exceeds the attachment point (as identified by the country-specific hazard profile) as well as the range

between the attachment and exhaustion points and amount of risk being transferred (as encapsulated in the coverage limit).

## Is there a Limit on the Number of Events Covered per Year?

Countries can purchase coverage up to US\$100 million per peril. There is no limit in terms of how many events per year that a policy can cover. The real issue is the specific amount of coverage purchased relative to the impact of an event on a given country in a given year.

## Assessing a Scenario:

**What factors led to a payout of ~US\$8.5M to Barbados as compared to ~US\$3.2M for Saint Lucia after Hurricane Tomas in 2010?**



Although there was some concern expressed about the significantly lower payout received by the Government of Saint Lucia relative to their losses and in comparison to the payout received by the Government of Barbados, it is important to indicate



that in the case of Saint Lucia, most of the damage which occurred was a result of the heavy rainfall and secondary induced hazards such as landslides.

Neither rainfall nor landslides are included in the current CCRIF Tropical Cyclone policies and are not therefore included in the pricing provided to countries for coverage. In the CCRIF policies, hurricane coverage is priced based on damage from wind and storm surge. Also of importance is that payouts countries receive are influenced not only by the hazard levels experienced but also the level of government exposure and the specific policy arrangements.

The coverage selections made by the various countries in terms of their attachment and exhaustion points and coverage limits would have played a significant part in determining the payouts which were received. These parameters are selected by countries and define the policies purchased by the respective governments and essentially are key determinants of when a policy is triggered or not and the level of payouts. Determination of payouts also depend on the value of assets insured which will have a major impact on the dollar value of damage experienced and level of modelled losses.

## Conclusion

It is important to note that current CCRIF policies are not meant to provide full insurance of government assets but rather catastrophe insurance against loss of revenue and additional costs associated with disaster response and early recovery. Hence it is most efficient when used to cover those events which overwhelm the capacity of the state to respond effectively, primarily high intensity, low frequency events. Similarly the insurance instrument is not meant to cover the entire risk profile of countries as a result of a catastrophe but instead is meant to ensure that there is some measure of liquidity available to governments as resources are mobilised to assist with the longer term recovery and redevelopment processes.

## About CCRIF

CCRIF is a risk pooling facility, owned, operated and registered in the Caribbean for Caribbean governments. It is designed to limit the financial impact of catastrophic hurricanes and earthquakes to Caribbean governments by quickly providing short-term liquidity when a policy is triggered. It is the world's first and, to date, only regional fund utilising parametric insurance, giving Caribbean governments the unique opportunity to purchase earthquake and hurricane catastrophe coverage with lowest-possible pricing. CCRIF represents a paradigm shift in the way governments treat risk, with Caribbean governments leading the way in pre-disaster planning. CCRIF was developed through funding from the Japanese Government, and was capitalised through contributions to a multi-donor Trust Fund by the Government of Canada, the European Union, the World Bank, the governments of the UK and France, the Caribbean Development Bank and the governments of Ireland and Bermuda, as well as through membership fees paid by participating governments.

### Sixteen governments are currently members of CCRIF, these are:

Anguilla, Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St. Kitts & Nevis, St. Lucia, St. Vincent & the Grenadines, Trinidad & Tobago and Turks & Caicos Islands

Published by: Caribbean Catastrophe Risk Insurance Facility (CCRIF)

Contact: Caribbean Risk Managers Ltd, Facility Supervisor

Barbados: +1 246 426-1525; Jamaica: +1 876 922-9604

Email: [ccrif@ccrif.org](mailto:ccrif@ccrif.org); Website: [www.ccrif.org](http://www.ccrif.org)