New Dawn Risk

Parametric insurance

The scope of solutions for agriculture and natural catastrophe risks

NEW DAWN RISK GROUP

newdawnrisk.com

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1. INTRODUCTION

Agriculture is still the most important sector in many developing economies and remains directly affected by climatic shocks, which have the potential to threaten global food security and stability, cripple livelihoods, disrupt value chains, and even undermine macroeconomic stability.

Climate change and the increased frequency and severity of extreme weather events are causing immense damage to crop and agricultural land. A study by researchers at Stanford University found that higher temperatures attributable to climate change caused payouts from the nation's biggest farm support programme to increase by a staggering $27 billion between 1991 and 2017.

Costs are likely to rise even further with the growing intensity and frequency of heatwaves and other natural catastrophes.

In 2021, analysts at KBW warned that crop losses would likely weigh on insurers' overall underwriting profits, despite being overshadowed by more high-profile catastrophe losses such as Hurricane Ida and European flooding.

While this picture looks daunting, there is a way forward that can benefit both farmers and insurers.

Aditya Singh
Head of Treaty

Max Carter
CEO, New Dawn Risk

2. THE RISE OF PARAMETRICS

The use of parametric structures will be familiar to participants in the insurance-linked securities market. Parametric triggers are the mechanisms that trigger catastrophe bonds to make reinsurance payouts to carriers when losses from a natural catastrophe event exceed insured limits.

The use of parametric triggers is also finding favour in the primary insurance market, with a growing number of applications for parametric insurance promising to fill the gaps that traditional indemnity products have failed to address.

Origins of parametrics

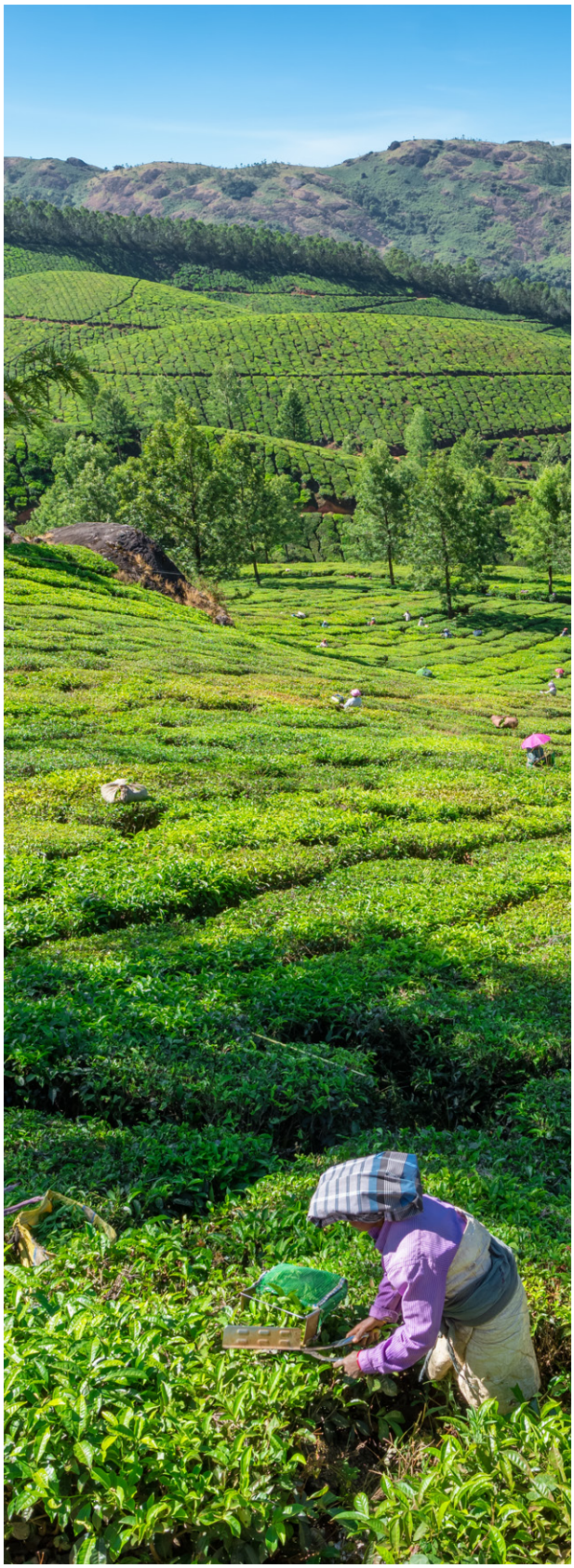
The need for risk financing solutions in countries with low insurance penetration has long been recognised as a critical area of focus for the industry, particularly for funding recovery efforts following a catastrophe.

To date, efforts have focused on government-backed risk pooling schemes, such as the Caribbean Catastrophe Risk Insurance Facility, which pays out to selected governments in the region following major natural catastrophe loss events such as hurricanes and earthquakes.

There is also a growing case for the deployment of parametric insurance coverage in underdeveloped countries to facilitate payments to individual policyholders following loss events. With climate change driving incidents across a range of perils – flood, drought, wildfires, etc. – farmers, small business owners, and householders around the world increasingly need workable insurance solutions that pay out quickly following a claim.

The technology now exists to enable real-time reporting of a number of perils, using accurate, reliable and often freely available data. This means it has been possible to place parametric insurance coverage across a wide spectrum of risk types, including earthquake, hurricane, drought, and flooding.

The parametric triggers for this coverage can be structured using a variety of measurable factors, such as shake density for quake, wind speed for hurricane, water depth for flood, and factors such as rainfall - or the lack thereof - and crop health for certain agricultural risks.



The case for parametrics

While regulations vary between countries on how quickly insurers should respond to insurance claims, anecdotal evidence suggests many claims take more than 30 days to be settled. This naturally leads to policyholders becoming frustrated with the process, and speed of claims acknowledgement and settlement is therefore a key factor for insureds when looking to buy any type of insurance.

In the case of traditional indemnity insurance, claims are handled by assessing damages after the fact, which means disputes can arise between the policyholder and carrier over the scope of coverage. In addition, in many cases the carrier may end up paying out less than the policyholder was expecting, leading to further disputes, or more than they had reserved for, pushing up the carrier's loss ratio.

> By using predetermined metrics that have been mutually agreed by insurer and insureds, carriers can leverage loss data to immediately verify claims against parametric coverage, quickly adjust them and then pay out a pre-agreed amount without the need for any disputes or further processing.

Speedier capital deployment following a loss event helps both individuals and communities recover from natural disasters more quickly. And the predetermined triggers also give a specific payout guarantee, ensuring carriers don't pay out more than necessary, while giving policyholders a settlement that is in line with their expectations.

THE SCOPE OF SOLUTIONS

Parametric solutions also allow for the coverage of risks that have traditionally been excluded from insurance claims processes, but which have a measurable objective parameter - such as demand surge during reconstruction, food spoilage and crop yields.

With weather-related catastrophes continuing to exert a heavy toll on communities across the globe, the use of clearly defined triggers for insurance coverage can help to deliver more precise, streamlined insurance pay-outs, enabling communities to start rebuilding sooner, and empowering carriers to offer more comprehensive coverage.

This is changing the game for insurance carriers around the world and is transforming the way they interact with previously under-served markets.

EXAMPLE

Crop insurance

NEW TECHNOLOGIES, GREATER EFFICIENCIES

One real-world example of where parametric insurance could introduce greater efficiency into the claims process, and ultimately deliver solutions in previously under-served markets, is in the Indian agricultural sector, specifically, by insuring against fluctuations in crop yields.

India has had a government-sponsored agricultural insurance programme for more than 35 years, that provides payouts to small farmers whose crops have failed. The programme has been criticised in the past for both the timeliness of payments and the inefficiency of its administration.

A range of new technologies, including a mobile portal for reporting loss data, the use of satellite and drone imaging technologies for remote sensing of crop damage, and analytics based on data from a variety of weather indices, are now being used to drive claims automation and ultimately make the scheme more profitable and therefore attractive to re/insurers.

3. GROWTH TRENDS

The catastrophe insurance marketplace is subject to two sets of macro trends. Climate change, population growth and urbanisation are all contributing to increases in annual catastrophe damages. However, developing computer power and the Internet of Things means that mass-market parametric insurance is now possible.

2023 Parametrics trends to watch

BUSINESSES NEED QUICK RESOLUTION OF CLAIMS TO SURVIVE NATURAL CATASTROPHES

The COVID-19 pandemic underlined the threat and risks a business may face when an event that is out of their control forces operations to shut down. IN these types of events, claimants might be waiting for many months to receive an insurance payout, during which time they are accruing debt in other areas. The need to recoup financial losses swiftly is a key factor in a company's survival.

INVESTOR INTEREST

There is a now a real interest in parametric insurance solutions from the investor community, with several high profile venture capitalists setting up parametric trading platforms or investing in them in recent months.
This investor appetite is helping to position parametric solutions as a feasible and available solutions for buyers of catastrophe coverage to purchase and for insurers to develop and provide.

HARD MARKETS DRIVE INSURANCE INNOVATION

A combination of factors, notably the impact of the COVID-19 pandemic, have served to fuel increases in insurance rates for many lines of cover in recent months.

Rates for catastrophe cover have hardened severely and terms and conditions have tightened. This has been driven in no small part by an increased frequency and severity of nat cat losses compounding the residual impact of the pandemic; it has often been the case that hard markets drive innovation in insurance.

Rate hikes for catastrophe insurance are fuelling greater interest in innovative parametric covers which can provide insurers and buyers with greater certainty; there are fewer variables than with traditional indemnity-based policies. This can translate into reduced premium rates in many cases.

4. CASE STUDY: SRI LANKA

A large client in Sri Lanka expressed interest in a parametric deal to cover a range of natural catastrophe risks.

The insured perils are Earthquake (EQ), Earthquake-induced Tsunami (TS), Tropical Cyclone (TC) and Excess Precipitation / Rainfall (XP). Various indices - or parameters - were used to design appropriate payout structures.

Earthquake (EQ)

In order to understand and accurately assess the earthquake risk to which Sri Lanka is exposed, extensive catastrophe (CAT) modelling was carried out based on historical and stochastically simulated data. The reinsurers used historical and probabilistic analyses using various data sources and reports to identify the appropriate price for the client.

The area considered for the pricing of the earthquake exposures if it falls within pre-defined buffer polygon encapsulating the borders of Sri Lanka, as illustrated in Figure 1 (below).

THE METHODOLOGY

Reinsurers engaged with a well known catastrophe modeler that has developed an almost global view of earthquake risk by combining data and science from academic, public and private sources. Multiple models were used to simulate synthetic earthquake events, set up in a 10,000-year stochastic catalogue; 10,000 simulations of the EQ events that could possibly happen in a hypothetical "next year". The catalogue was calibrated and validated against regional historical data.

In addition, the reinsurers took account of the historical data available in the archives of the United States Geological Survey. As well as calibration of the stochastic models, historical data is also used to cross-validate pricing.

USGS reporting of real-time events contains, among other seismic fault parameters, the location of the relevant epicentre and the moment magnitude of the relevant event. This data will be used to determine whether or not a payment is triggered in respect of any underwritten earthquake risks.

THE COVER(S)

Based on the location of the epicentre and the magnitude of the relevant earthquake, a payout will be provided on the following basis:

- Index: Earthquake's epicentre of sufficient moment magnitude must be located within the pre-defined buffer polygon
- Data Source/Provider: U.S.G.S. (United States Geological Survey)
- Insured Period: 1 year from the date of contract inception
- Summary of Methodology: If an earthquake of moment magnitude equal to or greater than a certain threshold is triggered in the buffer polygon, a payout will be triggered instantly and the client benefits from immediate cash flow
- Maximum Limit – $30,000,000 (subject to overall aggregate limits)

Figure 1

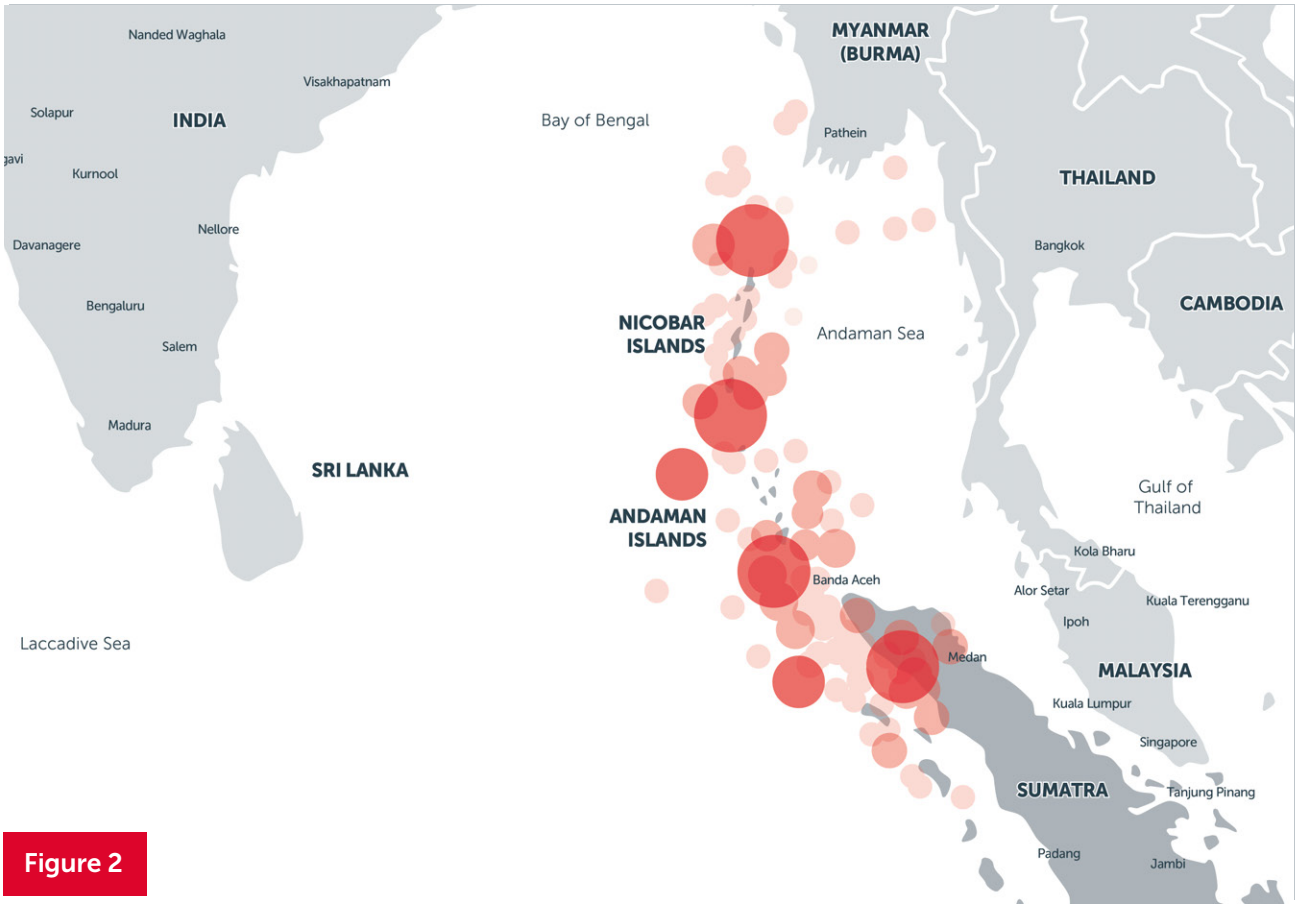


Figure 2

Tsunami (TS)

The methodology used to assess the exposures for an earthquake-induced tsunami is the same as that for a pure earthquake, given that tsunamis are essentially sub-aquatic earthquakes. The data sources used for pricing also remain relatively the same.

Figure 2 (above) defines the stochastic tsunamigenic earthquake zone. The circular data points at the right of Sri Lanka's buffer zone (defined by the polygon outlined in Figure 1) constitute the tsunami trigger area. Any earthquake that originates within these areas (whether or not it results in a tsunami) can trigger a payout as per the pre-agreed payout structure.

THE COVER(S)

Based on the location of the relevant earthquake's epicentre and its moment magnitude:

- Index: Earthquake's epicentre and its moment-magnitude in the polygon which constitutes the tsunami trigger area
- Data provider: U.S.G.S. (United States Geological Survey)
- Insured Period: 1 year from date of contract inception
- Summary of Methodology: If an earthquake of moment magnitude equal to or greater than 8.5 is triggered in the polygon which constitutes the tsunami trigger area, then a payout is triggered.
- Maximum Limit – $5,000,000 (subject to overall aggregate limits)

Tropical Cyclone (TC)

In order to understand and accurately assess the tropical cyclone risk to which our client was exposed, extensive catastrophe (CAT) modelling was carried out by the reinsurers based on historical and stochastically simulated data. The reinsurers used historical and probabilistic analyses using various data sources and reports to identify the appropriate price for the client. As per previous insured perils, the tropical cyclone cover (Figure 3) applies to the polygon buffer zone as defined in Figure 1.

The reinsurers engaged with an experienced catastrophe modeller, climate analytics and data company that uses machine learning techniques and artificial intelligence to model catastrophe scenarios and also supplies real-time services that can support parametric risk transfer.

In addition, the reinsurers consulted historical data contained in the archives of the US National Oceanic and Atmospheric Administration's National Hurricane Centre (NHC), available through the Automated Tropical Cyclone Forecast (ATCF) System. In addition to calibrating the stochastic data, this historical data is used by the reinsurers to cross-validate their pricing.

THE COVER(S)

Based on windspeed and the location of the track of the tropical cyclone:

- Index: the centre of the tropical cyclone of sufficient tropical cyclone category must be located within the polygon which constitutes the coverage area
- Data Provider: Data source is NOAA/NHC track data
- Insured Period: 1 year from date of contract inception
- Summary of Methodology: A payout is established based on the location and maximum windspeed classified as Saffir-Simpson tropical cyclone categories. If the centre of the tropical cyclone crosses the polygon which constitutes the "coverage area" with a maximum windspeed of at least 60 m.p.h, then a payout will be triggered.
- Maximum Limit – $30,000,000 (subject to overall aggregate limits)

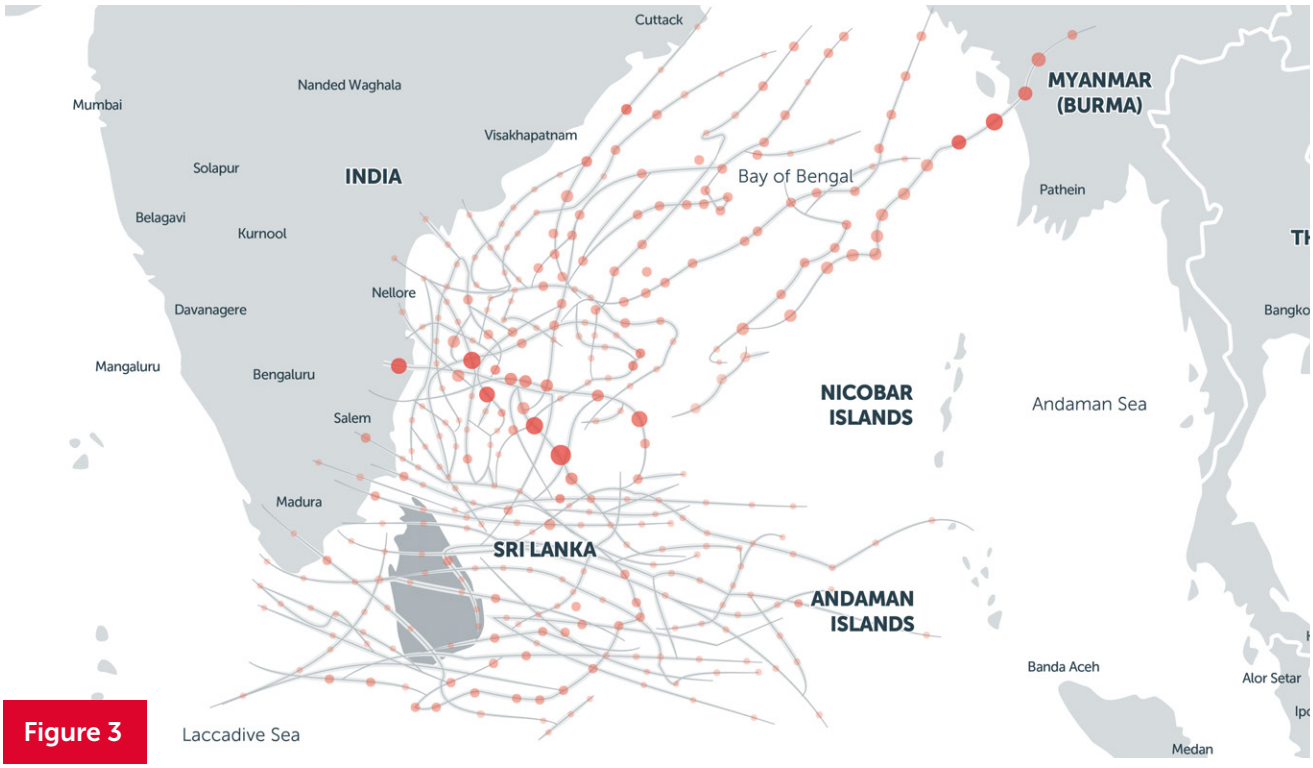


Figure 3

Excess Precipitation as a proxy for flood risk (XP)

As rainfall was one of the more concerning risks for our client, the reinsurers undertook a detailed analysis of historical events, and the appropriate indices were selected in order to seek mitigation for potential effects to the greatest extent possible.

In terms of pricing and data sources used, the reinsurers have used the ERA5 data set , which is publicly available via the ECMWF (European Centre for Medium-Range Weather Forecasts). ERA5 provides hourly estimates of a large number of atmospheric, land and oceanic climate variables. The data covers the Earth on a 30km grid and resolves the atmosphere using 137 levels from the surface up to a height of 80km. ERA5 includes information about uncertainties for all variables at reduced spatial and temporal resolutions. ERA5 combines vast amounts of historical observations into global estimates using advanced modelling and data assimilation systems.

Quality-controlled updates of ERA5 (from 1979 to the present) are published within three months of real time. Preliminary daily updates of the dataset are available to users within five days of real time. The ECWMF also publish a detailed report on the performance of our forecasts every year as an ECMWF Technical Memorandum. This document presents recent verification statistics and evaluations of ECMWF forecasts (including weather, waves and severe weather events) along with information about changes to the data assimilation and forecasting system. The performance of the extended-range and seasonal forecasts is also included.

In order to calculate accurate exposures, the precipitation index is weighted by population (as shown in Figure 4) – the Excess Rainfall structure uses daily ECMWF total precipitation data for building the excess precipitation index for structuring or determining whether or not a payment is triggered in respect of any underwritten excess precipitation risk.

The excess rainfall index is the precipitation that accumulates over a 3-day period and that falls over the whole of the country of Sri Lanka. This is weighted by reference to the population density of each grid cell into which the country is divided (as noted in Figure 4 below with red indicating population centres). This ensures that events that affect the key population centres are captured effectively.

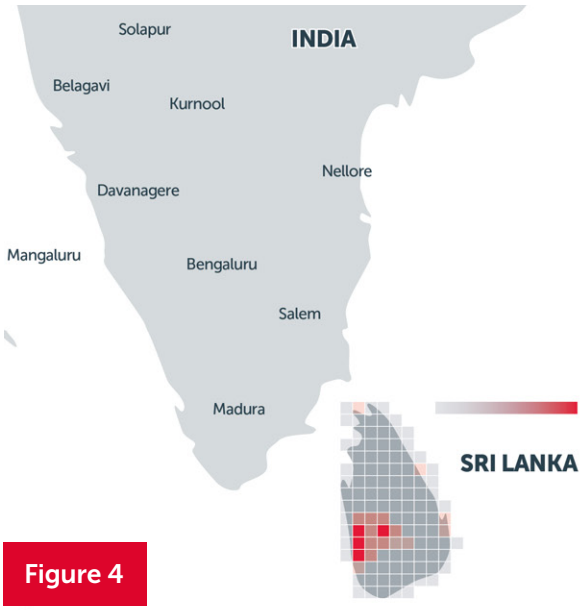


Figure 4

The 3-day accumulated precipitation index for a given day is calculated as the sum of the that day's and the two prior days' precipitation. For example, the value for March 22 is equal to the sum of the precipitation on March 20, 21 & 22. In this context, a day's precipitation is the ERA5 total precipitation value between UTC 00:00 and 23:00 on that day. This seeks to ensure that only significant precipitation events are picked up.

A precipitation event is initiated when the index attachment point (the triggering amount of precipitation) is met. A precipitation event can only have one payout. A payout is initiated only if the relevant daily index value is the highest of the index values applicable in respect of each of the 3 preceding and the 3 following days. This seeks to ensure that the largest payout possible is received for each event.

In the context of the circumstances described in Figure 5 (to the right), there would be a payout for the index values indicated with the red dots that are above the index attachment point. While the orange dot is above the index attachment point, it does not itself trigger a payout as it is not the highest index value within the relevant seven-day window (i.e. the date of the orange dot and the three days preceding such date and the three days following such date).

Furthermore, the index value at the red dot which is located at time = 280 does not itself trigger a payout because it falls below the index attachment point. Therefore, the example set out in Figure 5 would have two payouts only (the first two red data points).

This approach of seeking to detect precipitation "peaks" seeks to ensure that:

1. An "excess precipitation" event should pay out if the index value exceeds the index attachment point at any time during such event;

2. The payout is only triggered by reference to the highest index value in respect of any "excess precipitation" which exceeds the index attachment point during the event;

3. The structure provides the maximum protection against Sri Lankan precipitation extremes regardless of whether the index rises rapidly or more gradually.

THE COVER(S)

The cover is based on modelled precipitation

- Index: Precipitation that accumulates over a 3-day period and that falls over the whole of the country of Sri Lanka and is weighted by reference to the population density of each grid cell into which the country is divided
- Data provider: ECMWF ERA 5, variable "total precipitation", aggregated to daily data from 0 UTC to 23 UTC.
- Period of Insurance: 1 year from date of contract inception
- Summary of Methodology: Calculation of the maximum rainfall events during the period insured geographically weighted by population. Coverage area Is the entire territory of Sri Lanka.
- Maximum Limit – $30,000,000 (subject always to the overall aggregate limits detailed below)

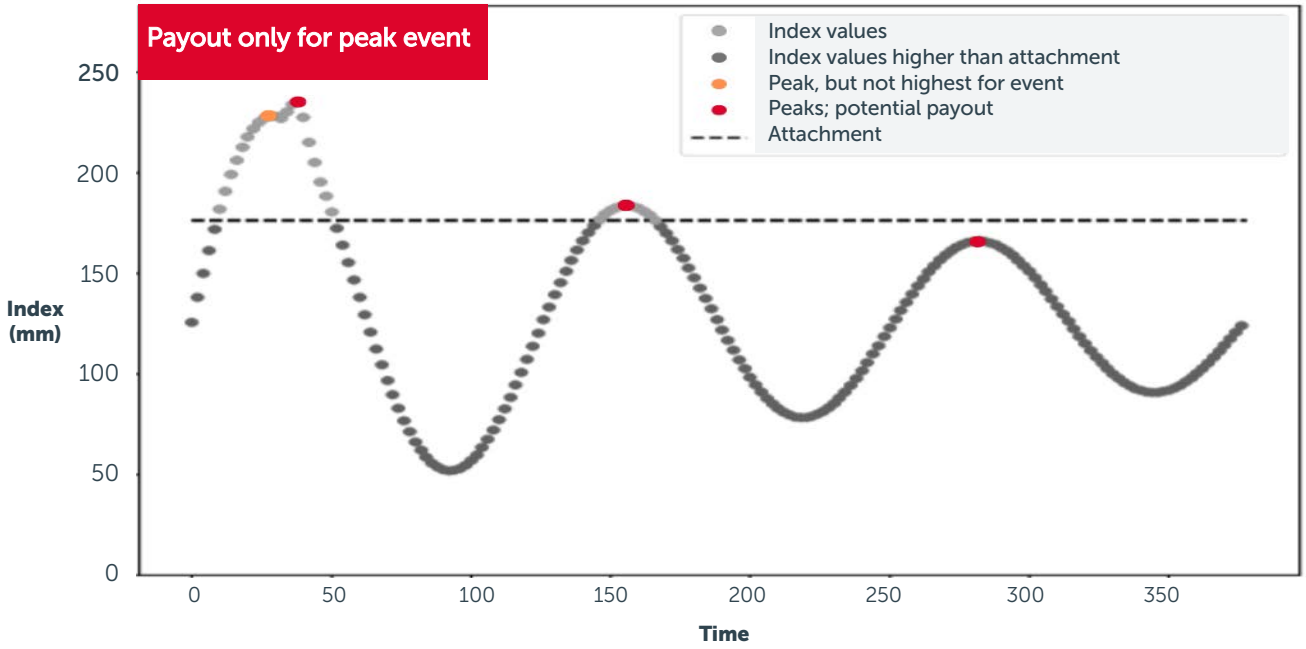


Figure 5

Hypothetical index values with three precipitation events. During the first event, there would have been one payout, despite there being two peaks above the index attachment point. During the second event, there would have been one payout. During the third event, there would not have been a payout, because the highest index value during the event is below the attachment.

5. THE FUTURE OF PARAMETRICS

Claims settlement

Given the pre-agreed payout structure and that the indices can be monitored on an almost real-time basis, a parametric reinsurance structure seeks to provide effective and swift capital relief to the cedant in the event of a natural catastrophe.

The precise timing of any payout will vary from peril to peril given the nature of the corresponding indices and the point in time at which a calculation of the severity of an event may be made (e.g. (a) tropical cyclone severity may only be calculated following the date which is 10 days after the date upon which the relevant named cyclone leaves the polygon that represents the covered area for the last time, and (b) excess precipitation severity is to be calculated quarterly and, in each case, in respect of the events (if any) that have occurred during the immediately preceding period of three months).

In respect of all perils, payouts are to be made within a period of 10 business days from the date upon which a final calculation is made demonstrating that the index has been triggered and that a payout is due in accordance with the provisions of the reinsurance agreement.

THE INSURANCE GAP

Parametric insurance should not be viewed as a competitor to traditional, indemnity-based insurance, but rather as a complementary form of coverage. In areas where traditional insurance is hard to come by, particularly when market conditions are hard, parametric coverage offers a simple, cost-effective way for communities to build resilience to various natural hazards.

Parametric coverages can be bespoke and do not rely entirely on historical data. Statistical models and the use of machine learning and other techniques can help providers to design parametric coverages that are bespoke to the buyer's immediate need.

Another huge benefit of parametric coverages for buyers is the speed of payout. Traditional insurance policies can sometimes take about 18 months to provide a payout because of the need to appoint loss adjusters, prepare documentary evidence, and so on. Once a parametric coverage is triggered, however, claim payment is virtually instant. This is of huge benefit to small companies, or communities, for whom delays in payment can be catastrophic.

The insurance gap for natural catastrophe losses is particularly pronounced in developing and emerging economies, many of which have exposure to extreme weather events and other natural catastrophes. The escalating climate crisis means that this gap shows little sign of closing, especially in times of hard insurance and reinsurance market conditions.

LOOKING AHEAD

Parametric coverages can also be tailored for other hard to insure losses, such as non-damage business interruption. Many traditional insurance policies only pay out for business interruption if it arises directly from material property damage. As recent events like the COVID-19 pandemic have illustrated, however, many business interruption and supply-chain disruption events are not the direct result of a physical property loss.

The way in which parametric solutions are structured, however, means that payouts are automatic when the policy is triggered; there is no need for the buyer to demonstrate a physical loss. This makes them ideally suited to covering non-damage business interruption losses and other intangible assets.

Ultimately, parametric insurance can provide an affordable solution for large-scale insurance of catastrophic risks in exposed areas, and we expect this to become more widely adopted over the next several years.

New
Dawn
Risk

New Dawn Risk Group Limited
106 Leadenhall Street London,
EC3A 4AA
United Kingdom

Tel: +44 20 3668 2800

info@newdawnrisk.com

newdawnrisk.com

Broker at LLOYD'S