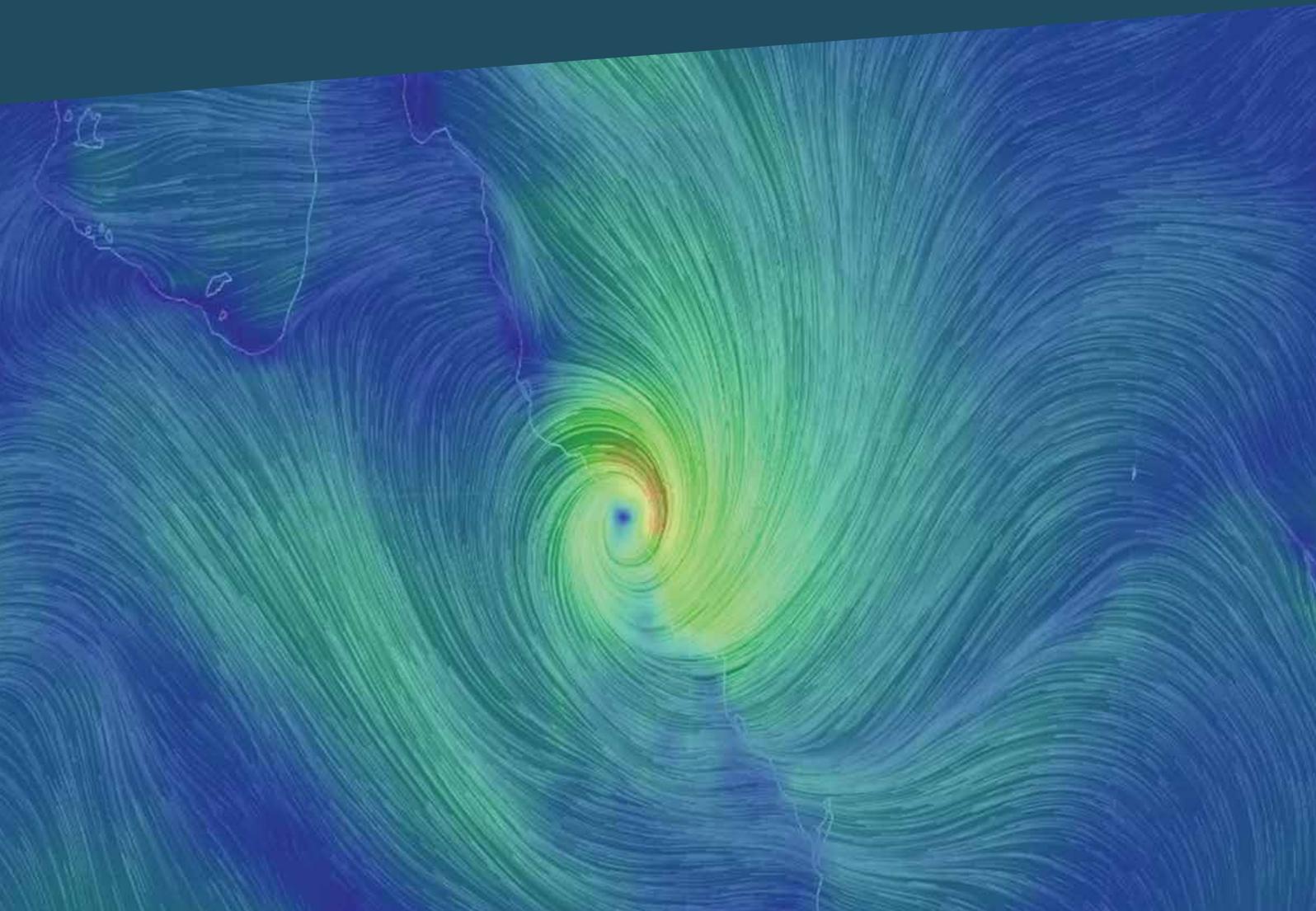




QUEENSLAND  
FARMERS'  
FEDERATION

WillisTowersWatson 

# TROPICAL CYCLONE INSURANCE FOR QUEENSLAND AGRICULTURE



## WHO AND WHAT IS THIS REPORT FOR?

This report is for Queensland agricultural producers and related industries as well as local and state governments interested in insurance options that mitigate the financial risks associated with cyclones. The report outlines the risks and impacts of cyclones on the Queensland agricultural sector and the availability of insurance solutions to mitigate the financial consequences of such events. The cyclone insurance solutions outlined in this report are preliminary and the parameters and pricing will vary according to the location covered and as more data become available.

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## IMPACTS OF TROPICAL CYCLONES ON QUEENSLAND AGRICULTURE

Cyclone events in Queensland are frequent and the impacts can be severe and widespread. It is estimated that Tropical Cyclone Debbie caused ~ AUD 450 million of damage (Nicholas and Miller 2017). Sugarcane and horticulture crops including beans, capsicums, melons, tomatoes and mango orchards were all affected (Nicholas and Miller 2017). Cyclones can also impact bananas and many other types of crop (Leigh et al. 2014; Lindsay 2016) and also fisheries. It is not just the high winds that cause damage to agricultural crops, the associated low pressure systems and heavy rainfall can cause flooding that can also result in substantial agricultural damage.



## WHAT PARTS OF QUEENSLAND ARE MOST OFTEN HIT BY TROPICAL CYCLONES?

The cyclone season officially runs from November to April, and on average 4.7 tropical cyclones affect Queensland per year (BoM 2018). Cyclone risk varies across the state (Figure 1) with the northern coastal areas being most frequently impacted by cyclones. The area with the highest cyclone risk (the red area depicted in Figure 1) is around Ayr and to its south. Most of coastal Queensland is at medium risk of cyclone (Figure 1). The likelihood of cyclones occurring is also influenced by the southern oscillation, with cyclones more likely to occur in La Niña compared to El Niño conditions (Hastings 1990; Figure 2).

Figure 1

Map of estimated cyclone density across Queensland. Data from CSIRO (2015).

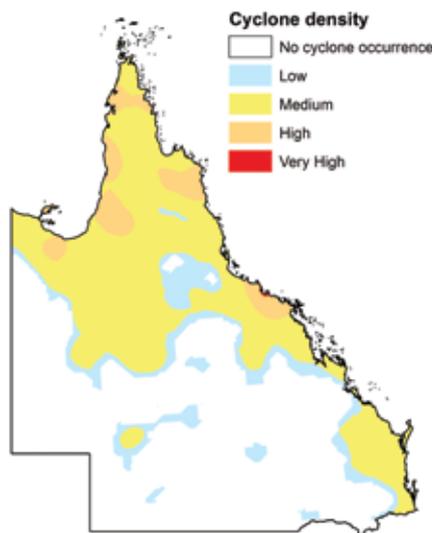
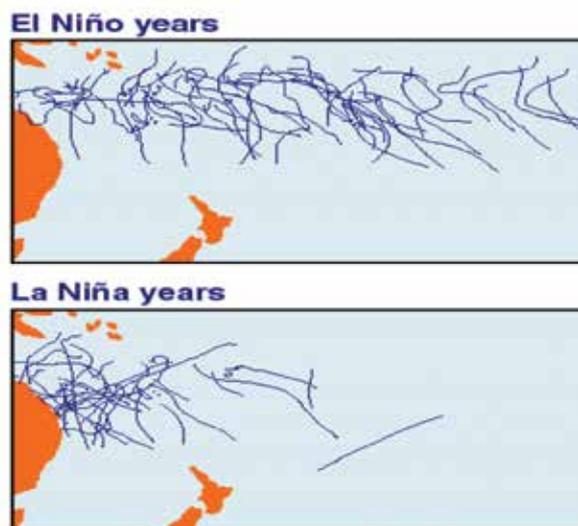


Figure 2

Cyclone tracks in El Niño and La Niña years. Data from Hastings (1990).



## AVAILABLE OPTIONS FOR MITIGATING CYCLONE RISKS FOR THE QUEENSLAND AGRICULTURAL SECTOR

### Insurance

Whilst certain Australian insurers are willing to provide property damage cover (including cyclone damage) for buildings, contents, plant, mobile equipment and the like (albeit at significantly increased premiums for high cyclone risk regions), there are no insurers offering cyclone cover to the agricultural sector in cyclone-exposed areas of Queensland.

Other industries such as mining and energy have been successful in transferring cyclone exposure to the insurance market through the purchase of parametric or index-based insurance products; however until now, these products have not been offered to the agricultural sector.

Parametric or index-based insurance is now accessible for Queensland's agricultural producers, through certain specialist insurance markets. The following pages outline the type of product available and the benefits to Queensland's farmers.

### Government support

#### ***Natural Disaster Relief and Recovery Arrangements (NDRRA)***

The NDRRA is a joint funding initiative of the Commonwealth and State Governments to provide disaster relief and recovery support to help communities recover from the effects of natural disasters.

The level of assistance is dependent on the amount of damage caused, with more severe disaster activating more assistance. Assistance measures are broken down into four categories; Category A, Category B, Category C and Category D, with Category A offering the smallest amount and the remaining categories building off this assistance as the disaster activates the higher levels.

For primary producers, category B offers the first tangible assistance with access to low-interest loans. Category C offers special recovery grants of up to \$25000 for primary producers, while Category D 'exceptional circumstances' offers tailored assistance projects to help community recovery and resilience.

Primary producers are sometimes reluctant to take on further debt so the assistance, although welcome, in many cases doesn't cover the damage caused or the loss in income.

## MANAGING CYCLONE IMPACTS ON AGRICULTURAL IN QUEENSLAND USING INSURANCE

### Parametric solutions

Parametric solutions provide a way of transferring the revenue or cost impact of natural catastrophes. These solutions differ from traditional insurance policies in that loss payments respond to the occurrence of a pre-agreed trigger event (e.g. a cyclone hitting an area), or movement in a reference index rather than the normal principles of indemnity and loss assessment. The policies are extremely flexible and are designed and calibrated to reflect the specific locations, exposures and risk management objectives of the buyer. They can be structured as single season, annual or multi-year arrangements.

The transparent and objective nature of the parametric policies leaves no debate about the operation of the cover or the calculation of a claim. There is no protracted loss settlement process and so claims are settled very quickly after the occurrence of the policy trigger. Limits of up to AUD500m are available from insurance, reinsurance and capital markets. Policies can be executed in insurance or derivative format (where applicable and regulation permits).

### Benefits of parametric solutions

The benefits of parametric solutions are listed below;

#### *Cover*

- Transfer of risks not covered by traditional insurance.
- No physical damage is required to trigger a claim.

#### *Structuring*

- Programmes tailored to reflect specific geography, risk exposure, risk appetite and budget.
- Flexibility in trigger design (e.g. temperature, precipitation, cyclone track and intensity).

#### *Data*

- Policies respond to a trigger event based on external data which is robust, independently recorded and verifiable. Large amounts of data are available for structuring and underwriting.

#### *Capacity*

- Significant capacity is available from insurance and capital market sources.

*Claims settlement*

- Transparency and clarity of coverage means there is no ambiguity in the interpretation of the policy. Very quick settlement and insurance pay-out after the occurrence of an event.

**How would a parametric solution work?**

*Structuring*

The following parameters of the policy are agreed in advance:

- An indemnification zone which reflects the location of concern. Indemnification zones can be of any shape, can be distinct, can intersect or overlap (Figure 3).
- A cyclone intensity threshold(s) which acts as the policy trigger.
- A reporting agency (e.g. BOM).
- A policy term.
- A policy limit and claims calculation formula.

**Figure 3**

**Example map of an indemnification zone.**



### *Claim calculation*

The track and central pressure (category) of a cyclone is reported by the BOM. If the cyclone track enters the indemnification zone and the category exceeds the policy trigger, then a claim is paid. The value of the claim is pre-agreed as (1) Digital: the full policy limit is paid if a triggering cyclone enters the indemnification zone or (2) Linear: scaled payments are made based upon the total time that the triggering cyclone remains within the indemnification zone.

### **Basis risk explained**

Parametric solutions respond to the physical characteristics of the event as opposed to the loss suffered by the insured. Any mismatch between the two is known as basis risk. Basis risk arises due to the policy trigger and payout formula being only an approximation of the financial exposure of the insured. This misalignment can originate from differences in:

- Location e.g. the indemnification zone does not reflect the region of concern
- Time e.g. the policy period does not reflect the relevant timeframe
- Design e.g. the policy trigger is set too high to capture impactful cyclones
- Calibration e.g. the payout is set too high or too low to match the financial impact

Basis risk can lead to a policy either under or over performing. Under performance occurs when the policy does not cover the risk in its entirety or at all. Over performance occurs when a payout occurs that is not matched by actual loss or damage of the same amount.



### Example

For illustrative purposes, the following parametric policies have been structured to provide an outline of the coverage and price ranges available for cyclone risk in Queensland.

#### Indemnification zones

The indemnification zones are defined as circles centered on an agreed centroid. The example centroids (shown below) are based on the latitude and longitude co-ordinates taken from BOM geocodes of the location shown below in Figure 4. Other locations specific to individual growers can be added.

Figure 4

Example centroids.



Two options for an indemnification zone size are considered. Circles with either a 50km or 100km radius.

#### *Policy trigger*

The policy trigger is set at cyclone category 3 and above. Category 3 is defined as a cyclone with Central Pressure  $\leq$  965mb.

#### *Policy Limit*

The policy limit is set at AUD 1m; this can be scaled

#### *Claims calculation formula*

Two payout options are available:

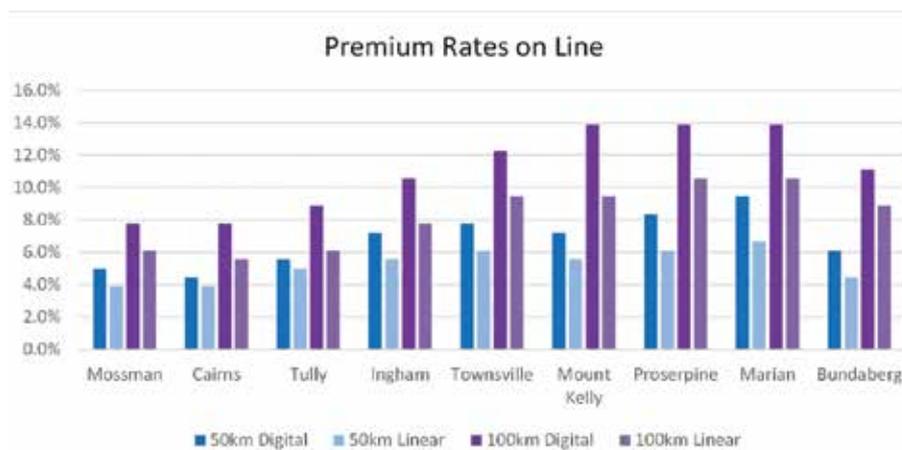
- Digital: full policy payout if a triggering cyclone enters the indemnification zone.
- Linear: scaled payout based on the total time that a triggering cyclone remains in the indemnification zone. Here the payout is set at AUD 100k per hour up to a maximum of AUD 1m.

#### *Rate on line applied to AUD 1m policy limit*

Premiums vary between AUD 39,000 and AUD 139,000 for an AUD 1m policy limit (Figure 5).

**Figure 5**

**Estimated premium rates on line.**



## EXAMPLE: CYCLONE DEBBIE

In March 2017, Cyclone Debbie caused widespread damage to the region’s sugarcane industry resulting in losses of 25% to 30% across the region.

The wind caused extensive lodging and in some cases snapped the sugarcane whilst the associated rainfall also caused widespread damage.

Cyclone Debbie would have triggered payments under a number of the illustrative policies detailed above.

The policies with 100km radius indemnification zones centred on Proserpine and Marian would each have triggered.

### *Marion*

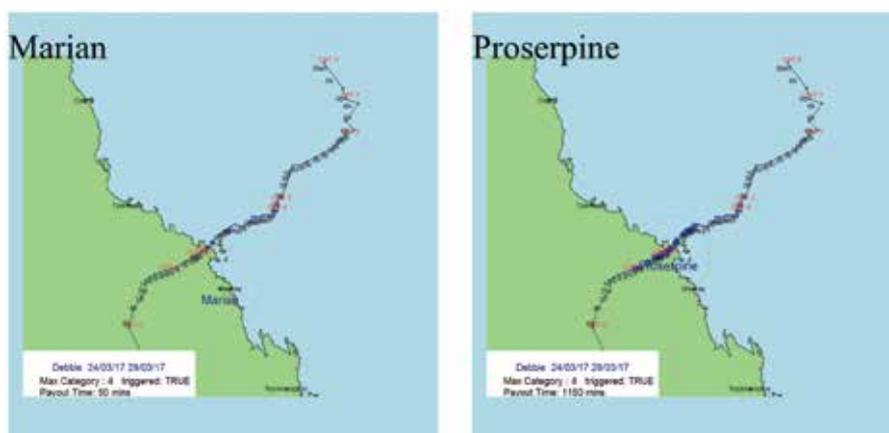
Cyclone Debbie spent 50 mins (~ 1 hour) in the 100km radius circle centred on Marian. The payout would have been AUD 1m for a digital cover AUD 83,000 for a linear cover

### *Proserpine*

Cyclone Debbie spent 1150 mins (~19 hours) in the 100km radius circle centred on Proserpine and the payout would have been: AUD 1m for a digital cover AUD 1m for a linear cover (due to the policy limit). Figure 6 below shows the track of cyclone Debbie.

Figure 6

The track of Cyclone Debbie through Marian and Proserpine.



## KEY FACTS: CYCLONE DEBBIE CASE STUDY

### Farm profile

The farm is located approximately 70km North West of Mackay in Central Queensland. The 140-hectare dry land farm yields around 9,000 tonnes of sugarcane per year. High rainfall and mild temperatures typify central Queensland weather, with the farm identifying cyclones and the associated rainfall as the biggest weather risks.

### Risk

A major risk for farm businesses in this region is the occurrence of cyclones. The cyclone season officially runs from November to April, and on average 4.7 tropical cyclones affect Queensland per year. In March 2017, Cyclone Debbie caused widespread damage to the region's sugarcane industry resulting in losses of 25% to 30% across the region.

The wind caused extensive lodging and in some cases snapped the sugarcane whilst the associated rainfall also caused widespread damage.

Name	Date	Maximum Category
TC Debbie	Mar 2017	4
Ita	Apr 2014	1
Dylan	Jan 2014	2
Ului	Mar 2010	3
Kerry	Feb 1979	2
Otto	Mar 1977	1
Dawn	Mar 1976	1
Ada	Jan 1970	3



### Structuring

After consultation with the farm, a parametric ('cat-in-a-box') solution was structured which responds if a category three or above cyclone enters the agreed indemnification zone. This indemnification zone is circular with a radius of 50km and with the centroid set 25 km north of the location of the farm.

## KEY FACTS: CYCLONE DEBBIE CASE STUDY

### Policy parameters

- Indemnification Zone: Circle with a 50km radius with the centroid located 25km north of the farm location.
- Policy Period: 1 December 2018 to 30 April 2019.
- Policy Trigger Event: Any cyclone which reaches category three or above whilst within the indemnification zone during the policy period.
- Payout: If a policy trigger event occurs, this policy will pay the full policy limit assigned to the indemnification zone in which the trigger event occurred.
- Premium Rate on Line (ROL): 10.6%

The policy developed for the farm is bespoke to its needs but is transferable for other cyclone exposed farms throughout the region. Cyclones throughout this region are frequent which is reflected in the ROL of 10.6%. The premium is calculated by applying the ROL to the policy limit. Hence, if the farm requires AUD 100,000 of cover, the premium for the policy would be 10.6% of AUD100,000, i.e., AUD 10,600. The policy limit is scalable to the amount wanted or needed by the farm to offset the financial impacts of the cyclone, but the ROL is consistent; at 10.6% of the policy limit.

### Demonstrated

Cyclone Debbie resulted in approximately 25% decrease in yield potential due to crop damage and crop loss while earthworks to recover the farm were roughly AUD 200 per hectare for this farm. Using a cane price of AUD 37.45 per tonne, the financial loss for the event equates to AUD130,000. If the farm wanted to offset all of this financial loss with a parametric solution, it could have done so for a premium of AUD13,780. In practice it is likely that the policy limit chosen would be lower than this reflecting the farm's ability to withstand some of the financial impacts of a cyclone. The cost of recovery to restore the farm to its pre-event state (earthworks, irrigation equipment, pump damage etc.) is a more realistic policy limit. For this example, the policy limit might be about AUD 35,000, therefore the premium will be AUD3,710.

## ARE CYCLONE INSURANCE PRODUCTS CURRENTLY AVAILABLE?

Parametric solutions such as the 'cat-in-a-box' example given above are provided by a small number of approved and well rated insurance carriers in Australia, including Lloyd's of London.

We can therefore confirm that when farmers receive quotations and request cover be bound with insurers, we will be in a position to issue compliant legal documentation, including policy wordings and insurance certificates.

### Options

#### *Individual producers*

Parametric solutions can be tailored to meet the requirements of individual farmers. In each case the policy would be structured to reflect the location, exposure and budget of the buyer. Each buyer can specify the indemnification zone, policy trigger, policy limit, policy period and claim payment formula required.

#### *Group Buying*

Where a risk – such as cyclone – is largely systemic throughout a farming community, the concept of mutualisation is likely to make more sense. Parametric solutions that cover an entire industry or region can be constructed using a mutual fund structure. As a separate topic, we would recommend further exploration of the possibility of wide scale mutualisation.

#### *Governments and councils*

Options also exist for local and state governments to take out insurance to cover the widespread impacts of cyclones on communities. Parametric solutions can also be structured for other industries whose revenues or costs are impacted by cyclones.

## GLOSSARY

- **Indemnity:** To be compensated after a loss to such an extent that the policyholder is returned to the same position they were in immediately prior to the loss.
- **Indemnification Zone:** Usually express a specified geographical area, within which losses or specified perils (as defined by the contract) will be considered valid for the onward calculation of claims.
- **Trigger:** The value on an index at which an index-based policy (derivative or insurance) begins to pay.
- **Parametric:** A form of risk transfer where the value of the loss is driven by the triggering of pre-agreed criteria as opposed to post event loss adjustment. The actual value of the loss incurred loss may differ from the calculated loss on the policy.
- **Index-based:** A policy which pays according to the value of an index as opposed to the actual incurred loss, as defined by post event loss adjustment.
- **Digital:** In index-based policies, once the strike has been met, the pay-out is made in its entirety, regardless of the extent to which the value of the index has exceeded the strike.
- **Linear:** A mathematical term which suggests the arrangement or development of data-points along a straight line (“an increase in the x-value causes a proportionate increase or decrease in the y-value”).
- **Basis Risk:** The risk that the quantum of the loss suffered by the (re)insured [according to the policy] differs from the actual loss incurred. This has specific relevance to parametric products.
- **Capacity:** The monetary amount of coverage available from the (re)insurance market or on a specific policy (“ABC Insurance Ltd., have offered \$10 million of capacity on the policy. We need an additional \$10 million capacity to meet the \$20 million policy limit”).
- **Mutual:** Usually refers to a mutual insurance company, where the company is owned by its policyholders. Any profits are usually retained within the company or returned to policyholders. Policyholders typically have a unifying characteristic: their profession, for example.
- **Rate on Line:** A percentage rate calculated by dividing the premium by the policy limit, as opposed to the total sum (re)insured.

## REFERENCES

- BoM (2018) Tropical Cyclones in Queensland  
<http://www.bom.gov.au/cyclone/about/eastern.shtml>
- CSIRO (2015) Australian Region Cyclone Intensity and Frequency Index – CAMRIS. Available from <https://researchdata.andc.org.au/australian-region-cyclone-index-camris/549556>
- Hastings, P.A., 1990. Southern Oscillation influences on tropical cyclone activity in the Australian/south-west Pacific region. *International Journal of Climatology*, 10(3), pp.291-298.
- Leigh, G.M. and Campbell, A.B. and Lunow, Chad P. and O'Neill, M.F. (2014) Stock assessment of the Queensland east coast common coral trout (*Plectropomus leopardus*) fishery. Technical Report. Queensland Department of Agriculture, Fisheries and Forestry.
- Lindsay, S. (2016) Farm practices to manage the impact of severe tropical cyclone damage on banana production – a case study from tropical Australia. *Acta Horticulturae* (1114). pp. 275-284.  
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