JBA risk management

THE FLOOD PEOPLE.®

INDIA CROP MODEL EXECUTIVE BRIEFING.

The JBA India Crop Model is a 10,000-year probabilistic insurance loss model developed to facilitate risk management and (re)insurance pricing within the guidelines of the Pradhan Mantri Fasal Bima Yojana scheme (Indian Prime Minister's Crop Insurance Scheme or PMFBY).

With approximately 40 million farmers covered under the PMFBY scheme, the model helps to capture the multitude of extreme weather perils that contribute to seasonal crop failure in India.

Developed with industry partners and covering both growing seasons in India (Kharif and Rabi), the JBA model uses unique physical crop modelling techniques to simulate historic crop yields using current farming practice.

HIGHLIGHTS.

Facilitates risk management and (re)insurance pricing within PMFBY guidelines

Captures multiple extreme weather perils contributing to seasonal crop failure and losses

Integrated probabilistic Tropical Cyclone Wind Model

Captures the daily growth cycle of major insured crops

Background

The PMFBY scheme in India is dedicated to providing insurance coverage and financial support to local farmers in the event of failure of crops as a result of natural calamities, pests and diseases.

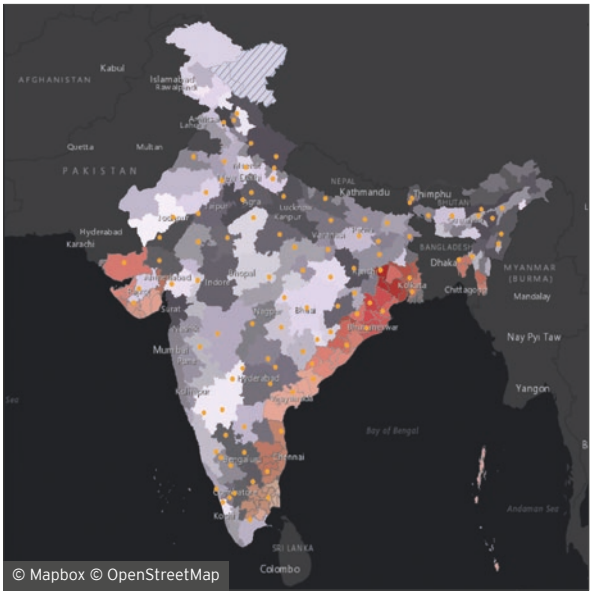

Figure 1
District locations of physical crop modelling (orange); thematic shading of districts by agroclimatic zones (grey) with those districts affected by tropical cyclone wind (in red).

With the backing of the Indian Government, insurance premiums in PMFBY grew 30% in 2017 and, therefore, it has become a major industry for international (re)insurers.

The scheme is based on a single insurer typically being granted a cluster of districts. Risk insurance is then provided to cover yield losses from natural catastrophe perils such as drought, flood and wind damage.

JBA India Crop Model

JBA utilises the Decision Support System for Agrotechnology Transfer (DSSAT) in creating the India Crop Model. DSSAT is a set of computer programs for simulating agricultural crop growth. The benefit of the DSSAT programs is their ability to simulate crop growth in numerous and diverse agroclimatic regions around the world to which it has successfully been applied.

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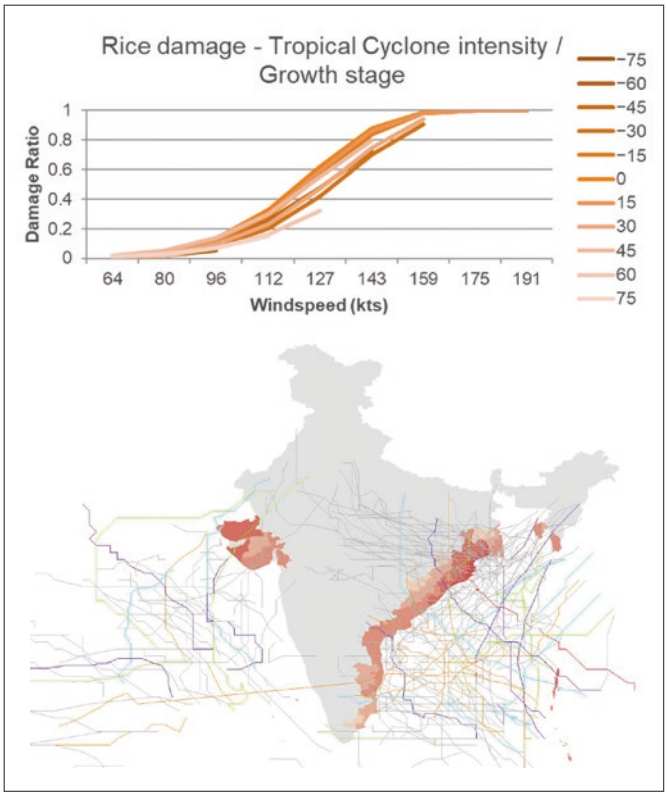

Figure 2
Districts with a higher risk of tropical cyclone crop damage (red); historic severe tropical cyclones from the Bay of Bengal and Arabian Sea highlighted (based on 162 years of IBTrACS cyclone track records). Top chart shows the fragility curves of rice crops to extreme wind based on their growth stage in the year.

The modular approach allows DSSAT to take data on soil conditions, daily weather conditions (rainfall, wind, temperature), management practice, fertiliser use, irrigation and crop variety and accurately represent processes within the atmospheric, plant and soil systems and the physical interactions between these systems on a daily time step.

The model simulates multi-year outcomes regarding the yield of the crop. These simulations are conducted at a daily time step and, in some cases, at an hourly time step depending on the process and the crop model. At the end of each day, the plant and soil water, nitrogen and carbon balances are updated, as well as the crop's vegetative and reproductive development stage.

Key advantages of this approach compared to statistical methods include avoiding the necessity of de-trending uncertain historic yield data, while capturing the complex daily growth cycle of major insured crops. Physical models focus on simulating the realistic growth of crops by capturing the daily water and nutrient transfer, local geology, soil profile, and irrigation practice.

Results

The JBA model allows (re)insurance data (Estimated Sum Insured, Indemnity level, Quota Shares) per crop to be entered at the district, insurance cluster, state, or national level per season.

MODEL FEATURES.

Covers both Kharif and Rabi growing seasons

Models 11 major crops (which represent approx 97-98% of all insured crops)

10,000 years of losses

Results reported per district, crop, insurance cluster, state or portfolio

Methodology is based on a Physical Crop Model (instead of de-trending historic yields)

Probabilistic results are then reported at various levels of geographical and portfolio-level aggregation. The output of the 10,000 years of modelled yields for each insured production crop represents the hazards of drought, flooding, heat stress, cyclonic wind and post-harvest failure due to extreme weather.

Exceedance probability is calculated per crop, per district, per season and then aggregated to the required level of reporting.

Integrated Tropical Cyclone Wind Model

The India Crop Model includes an integrated probabilistic Tropical Cyclone Wind Model to factor in the catastrophic losses from severe cyclones originating from the Bay of Bengal and Arabian Sea.

Import options include:

- 615 districts
- 96 insurance clusters
- 97% of all insured crops within the PMFBY scheme
- Kharif and Rabi seasons.

Benefits to the (re)insurance industry

The India Crop Model helps (re)insurance companies both price and manage their exposure to insured crop losses under the PMFBY

Pictured right
An impending monsoon ready to hit an Indian tea plantation.

scheme. Results from the catastrophe model can be used for:

- (Re)insurance Pricing/Rate Analysis – based on annual expected loss costs for India States and Districts
- (Re)insurance Exposure to the Probable Maximum Loss (PML) – assessing the potential loss cost from low frequency, high severity catastrophic seasons
- Planning and portfolio management – understanding the impacts of diversification / concentration of risk and changes to reinsurance structures.

Accessing and using the model

The India Crop Model is available in JCalf (JBA's Probabilistic Loss Software Platform) and can be accessed or licensed in different ways:

- Portfolio analysis services by JBA – either on a one-off basis, or under an annual retainer arrangement
- Model licensing – installation and training for staff to run the model at the client's premises.

About JBA Risk Management Limited

Established in 2011, we are a global leader in flood risk management. Affectionately known as The Flood People, our flood maps, catastrophe models and analytics are used by some of the world's largest insurers, reinsurers, financial institutions, property companies and governments. We're experts in translating complex, scientific data into useful information, using sophisticated hydraulic approaches and models to provide cutting-edge flood risk intelligence.

As part of the JBA group, established over 20 years ago, we work closely with leading academic institutions in the field of flood risk. We also support our independent charity, JBA Trust, which enables research, education and training in the water environment sector.

Our commitment to continuous improvement and detailed research and development is what makes us the number one choice for many insurers, reinsurers, financial institutions and governments.

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