RMS® India Agricultural Model

Advanced Agricultural Modeling for India
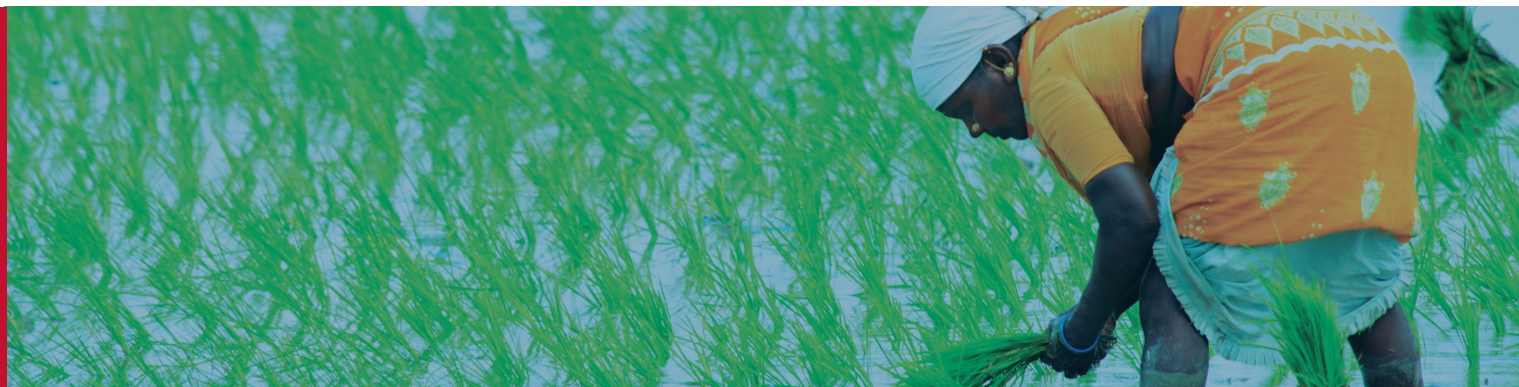
Overview

India is the largest market for both weather and yield index-based agriculture insurance schemes. Different forms of experiments on agriculture insurance in India started in 1972-73 when the General Insurance Corporation (GIC) of India introduced a crop insurance scheme on cotton, and the general insurance business was nationalized.

The market developed further when index insurance was introduced in the 2000's and the private sector became involved. With the launch in 2016 of the new Pradhan Mantri Fasal Bima Yojana (PMFBY) scheme, the premium volume exceeded USD 1.0 bn in 2016, of which the majority was from yield index insurance contracts.

Being mainly non-irrigated (rain-fed), India's agriculture is highly exposed to natural disasters – with dramatic consequences possible if delays of monsoon rainfalls occur. Since 2007, the industry has not seen disasters of national scale like the severe 1987 and 2002 droughts.

Addressing Challenges for Insurers and Reinsurers

Weather based crop Insurance schemes (WBCIS) are derived from indices reported from weather station data. Since 2016, yield based crop insurance schemes – previously referred as the Modified National Agricultural Insurance Scheme (mNAIS), and operated within the guidelines of the PMFBY scheme – are based on annual crop yield data provided by government agencies.

Rapid growth, newly insured risks, frequent changes in financial terms and conditions, and short loss histories make actuarial risk pricing a challenge for insurers and reinsurers. Observed yields, which form the basis for price yield indices, are typically only available for 15 years, and can show significant trends and gaps. This can lead to over-or under-estimation of risk.

The RMS India Agricultural Model (IAM) is the first model that covers both weather (WBCIS) and yield (mNAIS, currently operated within PMFBY scheme) index-based insurance contracts at the district level. IAM extends the view of risk beyond the historical data usually used by the market. It includes a database of current market term sheets, stochastic loss distributions, and historical scenarios (including El Nino and La Nina years).

The first version of the model has been released in 2015 and revised in 2017, updating all databases up to 2016, adding crops being modelled, improving some components of the crop model (cyclone modeling and irrigation modifiers), simulating losses up to 10,000 years, aggregating weather based and yield based index losses, as well as new user interfaces, and improved performance.
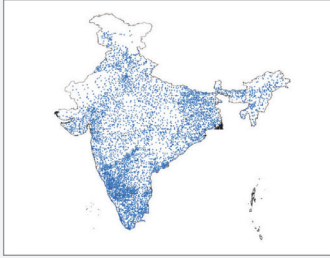
Weather Station Network (Rainfall)
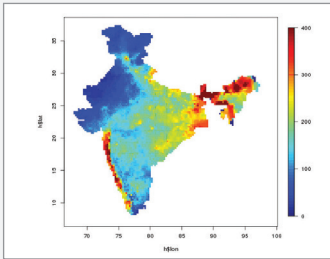
Seasonal Simulated Rainfall

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RMS is the world's leading catastrophe risk modeling company. From earthquakes, hurricanes, and flood, to terrorism, agriculture, and infectious diseases, RMS helps financial institutions and public agencies understand, quantify, and manage risk.

Modeling Approach

IAM contains a large database of term-sheets for WBCIS and mNAIS, and includes most insured crop types and districts. Term sheets are processed in the same way that insurers price risk for agriculture in India.

India crop seasons are generally classified into two main seasons: Kharif, during the July to October monsoon, and Rabi from October to March. The model allows disaggregation of exposure per crop season (Kharif and Rabi) and crop type from state to district and/or direct import of district exposure. Daily weather and "synthetic" yields are simulated (over 10,000 years) to calculate stochastic losses. IAM provides modeled losses for a total of 85,000 combinations of crop types and term sheets covering most of India's districts. Historical weather and yield data are used to calculate historical losses. Modifiers have been created, should the user know if a crop is rain fed or irrigated.

Weather Index Model

Daily gridded weather data are used to generate 48 years (1969-2016) of historical losses with the WBCIS scheme under many weather-based indices used by the Indian insurers, including "Deficit and excess rainfall" and "Number of dry/heat/cold days". Different financial options in use by the market with the term sheets are included, such as "Rolling Limits" and "Super Covers".

Yield Index Model

"Synthetic" yields are generated using a proprietary Crop Yield Model, which simulates the effect of weather variations on different crop yields. These yields are used in calculated losses with the mNAIS scheme, both using historical yield reconstruction and simulated yields using simulated climate conditions. Daily rainfall and temperature data (1969-2016) on a 25-km grid, form the basis of the hazard models – both for historical scenarios and stochastic events of simulated yields. A climate simulation was developed to simulate spatial and temporal patterns for 10,000 years of weather, to provide a probabilistic view of the tail risk. Reported tropical cyclone track information was used to create a hazard model for historical years, and to create a stochastic simulation for use with the 10,000s years of climate simulation. Impacts of tropical cyclones on crop yields were modeled based on location, timing and intensity of historical and simulated landfalls of cyclones.

The Crop Yield Model is driven with climate variables on 25km grid and includes the effect of slope, irrigation, and total available soil water capacity (TAWC). Major crops insured under mNAIS include: rice, wheat, maize (corn), potato, cotton, soybean, and sugarcane. Over 70 crop types are modeled.

Financial Model

Contract exposure can be entered at state or district level, by crop and by season. Using the yield index model, users can select the levels of indemnity, or use built-in default values to view results for rain fed or irrigated crops. Contract level Exceedance Probability curves, provided in the user interface and full Event Loss Table, are available for export and can be combined with other lines of business. The user can select 5,000 or 10,000 simulated years for the analysis.

Software Technology

IAM is delivered through a laptop/desktop application supporting standalone or client/server configuration. User interface is based on the .Net framework 4.0, and Windows Presentation Foundation (WPF) SQL Server database, capable of supporting access for multiple users.

Find out more

Ask your RMS sales or customer services representative for more information, or email **sales@rms.com**.