Approaches and Results on the Development of Agriculture Insurance in LAC

Agriculture Probable Maximum Loss Estimation System for the Climate Risks in the Insurance Sector

Luis Alvarez M.
Washington, D.C. , February 14, 2013

LATIN AMERICA AND THE CARIBBEAN REGION

AGRICULTURE AND RURAL DEVELOPMENT TEAM

THE WORLD BANK

AMIS
ASOCIACIÓN MEXICANA DE INSTITUCIONES DE SEGUROS

A g e n d a

1. Project objectives
2. Capital requirement regulation
3. The model in the regulation
4. Model description
5. Time horizon, costs and participants
6. Project status and next steps

Project Objectives

The project comprises the development of:

- A methodological study on the probable maximum loss (PML) and mean annual loss or pure premium (PP) estimations for the agriculture insurance in Mexico, based on climate characteristics for different crops and irrigation types.
- A simplified model to estimate PML and PP for livestock insurance.
- A computer system that can be used by the Mexican insurance companies to estimate these parameters for their portfolios.
- A proposal of the regulatory framework for the agriculture and livestock insurance, similar to what we have for Earthquake or Hydrometeorological perils.

Capital Requirement, Insurance Regulation

Current:

- *Max (R5(a) , R5(b)) * Registered reinsurers index*
  *+ 50.23% * (Reinsurance premiums)* (1-quality of reinsurers)*Concentration index*

  where:

  R5(a) = 50.23% of last 12 months Retained Premiums issued.

  R5(b) = 72.86% of last 36 months Net Claims.

Proposed:

a) Solvency Requirement (R12)

b) Eligible Assets (EA)

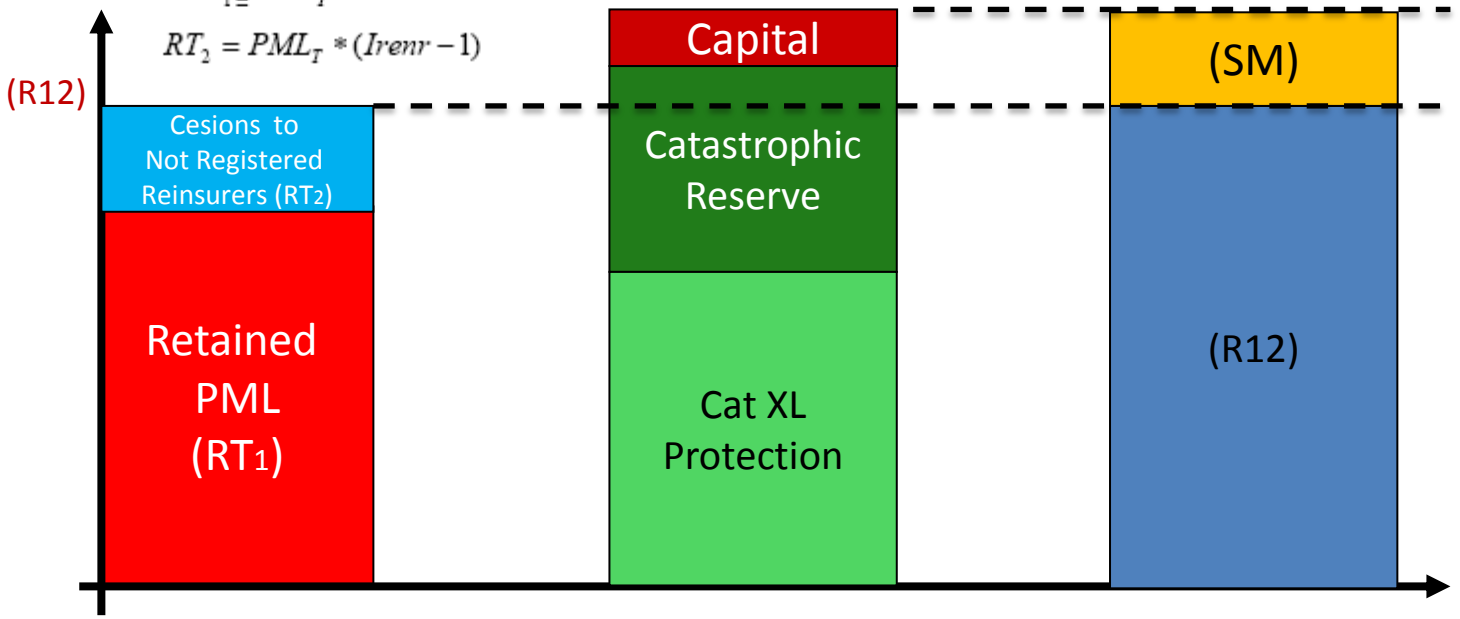
c) Solvency Margin (SM)

$$R12 = RT_1 + RT_2$$

$$RT_1 = PML_T$$

$$RT_2 = PML_T * (Irenr - 1)$$

$$RRCAT + CXLA_T \leq RT_1$$



The Model in the Regulation

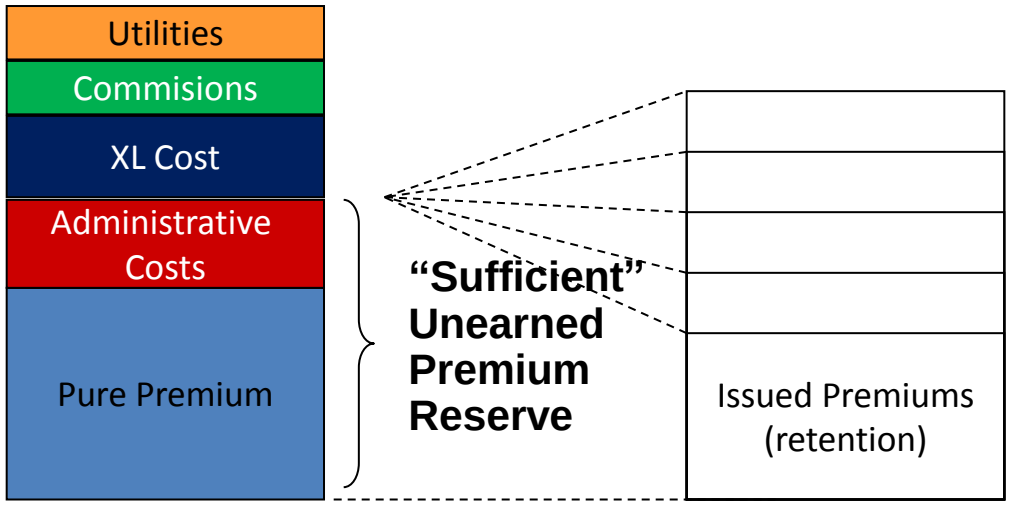
PML and Pure Premium Model

Portfolio of Insurance Company (input):

Generates:

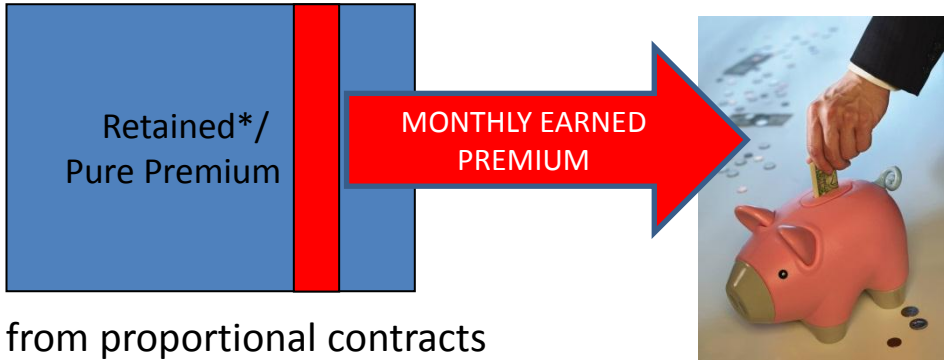
a) **retained pure premium per policy**

b) **Aggregated portfolio PML**



$$INC_{RCAT} = PR * FD_m$$

$$FD_m = \frac{D_m}{D_v}$$



Catastrophic Reserve

*/ Just from proportional contracts

The Model

The model -in general terms- consists of:

- Crops classification and regionalization using:
  - Quality of soil and climate
  - The geographical areas where it is grown
  - Irrigation type (seasonal or with formal irrigation systems)
  - Plant and harvest cycle (spring-summer, autumn-winter, annual, biannual or perennial).
- Stochastic climate simulation.
- Crop performance estimation using EPIC (Erosion Productivity Impact Calculator)*/.
- Calibration of the main crops growth performance with observed information from SAGARPA (Mexican agricultural ministry).

*/ Developed by Dr. Williams from Texas University A&M (TAMU) in collaboration with researchers from the Agricultural Research Service (ARS) from the Unite States Department of Agriculture (USDA). This model was developed to simulate edaphic processes (erosion and water runoff to understand their effects on agricultural productivity and performance on homogenous climatic , soil and irrigation techniques.

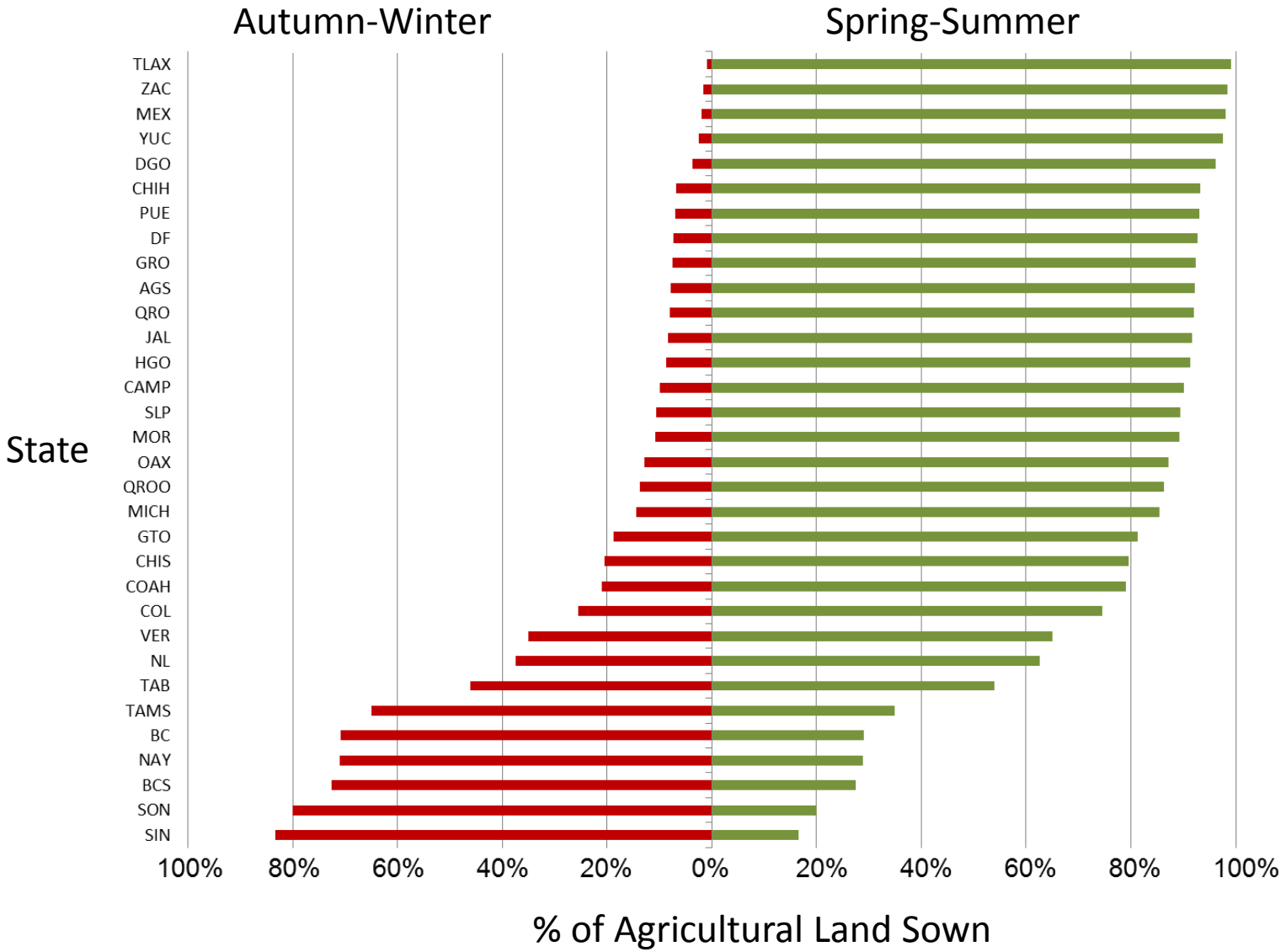
The Model

The methodology is based on:

- Obtaining a crop performance probability distribution for each zone-crop-irrigation type-cycle, for crops representing 95% or the insurers portfolios.
- Estimating distribution functions parameters for the rest 5% crops of the portfolio (there is not sufficient statistical information to calibrate each of these crops).
- Obtaining a joint performance distribution for all the variables on each zone-crop-irrigation type-cycle.
- Assigning for each policy on the portfolio an output/performance distribution and using the output insured, sum insured and area insured produce a multivariate claims distribution for the set of zones insured.
- Producing a claims distribution function for the whole portfolio taking each policy distributions in order to estimate the PML.

The Model

- Production outputs for Mexico were simulated using EPIC.



The Model

- The climate was correlated in accordance to homogeneous agro-climatic regions

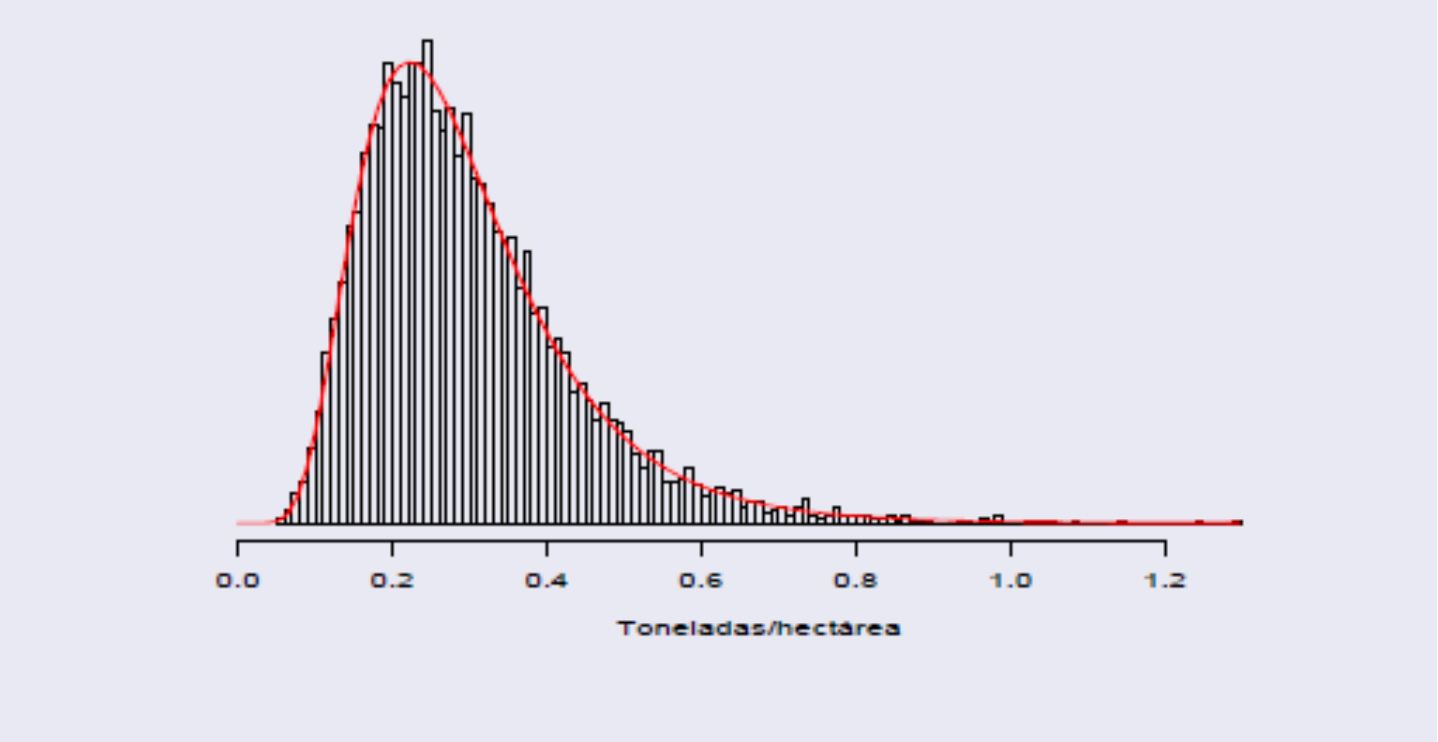
Agro-climatic Regions

- Northwest: Baja California, Baja California Sur, Sonora y Sinaloa
- Central-North-Centro: Chihuahua, Nuevo León, Durango, Zacatecas, Aguascalientes y San Luis Potosí
- Northeast: Coahuila y Tamaulipas
- Golfo-Centro: Veracruz
- Center: Distrito Federal, Morelos, Estado de México, Puebla, Tlaxcala, Hidalgo, Queretaro y Guanajuato
- West: Jalisco, Nayarit, Colima y Michoacán
- South Pacífic Oaxaca y Guerrero
- Southeast: Tabasco y Chiapas
- Yucatán Peninsula : Campeche, Qunintana Roo y Yucatán

The Model

- Production outputs are estimated for each zone-crop-irrigation type-cycle:

Corn in Zacatecas



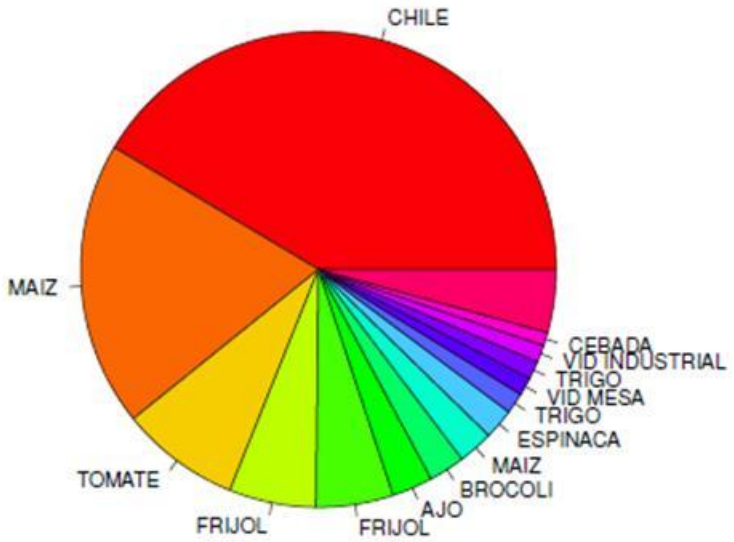
The Model

- Crops representing 95% of the portfolio are simulated for each zone:

Zacatecas Crop Distribution for an Insurance Company

Ejemplo: Zacatecas

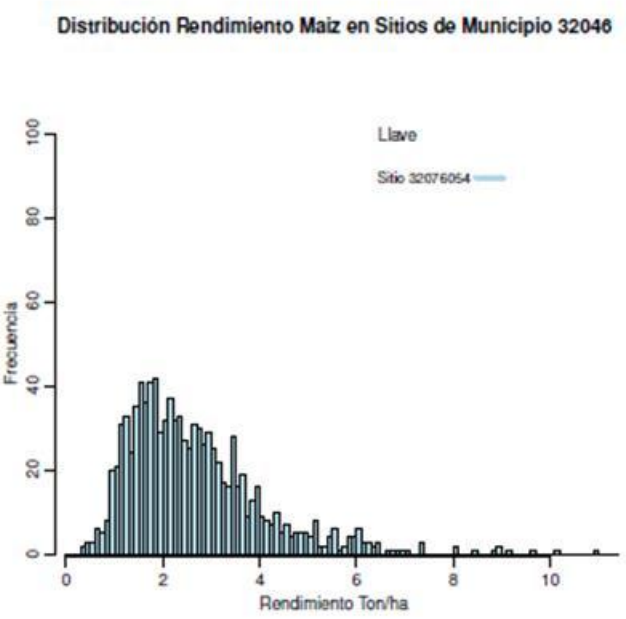
Cultivo	Modalidad	Participación
chile	riego	41.43 %
maíz	riego	19.37 %
tomate	riego	8.12 %
frijol	temporal	5.91 %
frijol	riego	5.26 %
ajo	riego	2.77 %
brocoli	riego	2.46 %
maíz	temporal	2.39 %
espinaca	riego	2.07 %
trigo	riego	1.41 %
vid mesa	riego	1.24 %
trigo	temporal	1.22 %
vid industrial	riego	1.16 %
cebada	temporal	0.92 %

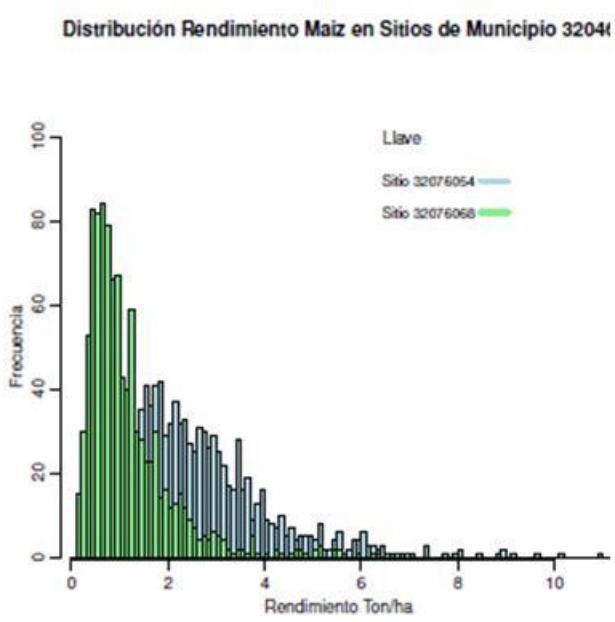


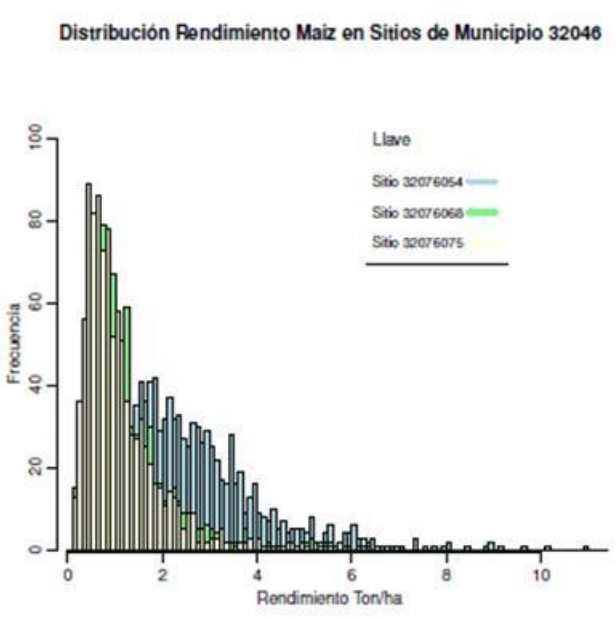
The Model

- Production outputs vary from zone to zone

Corn Production Output in Three Municipalities



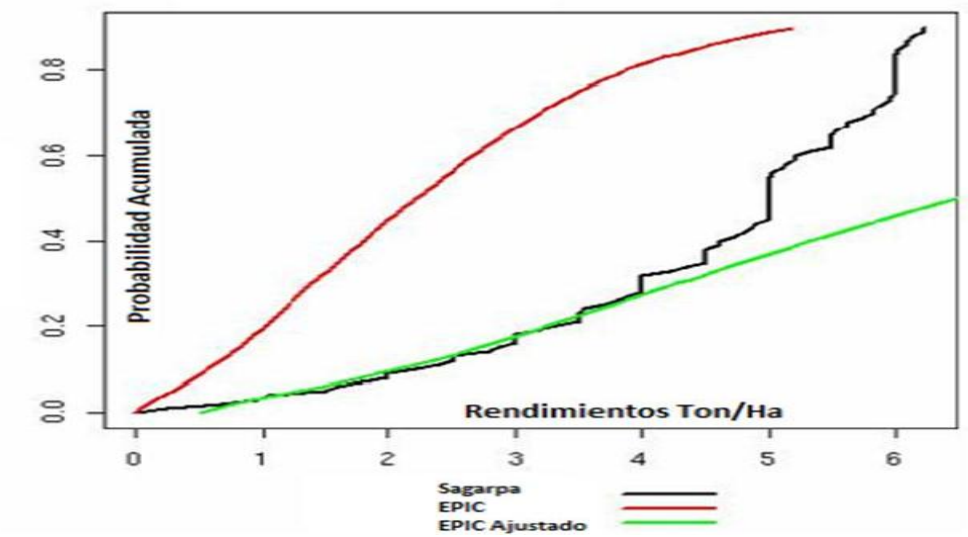


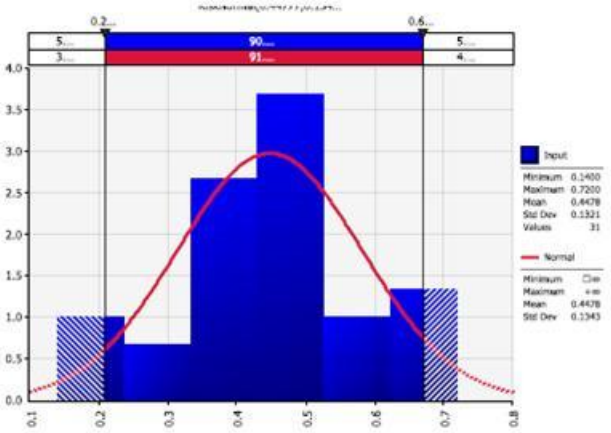


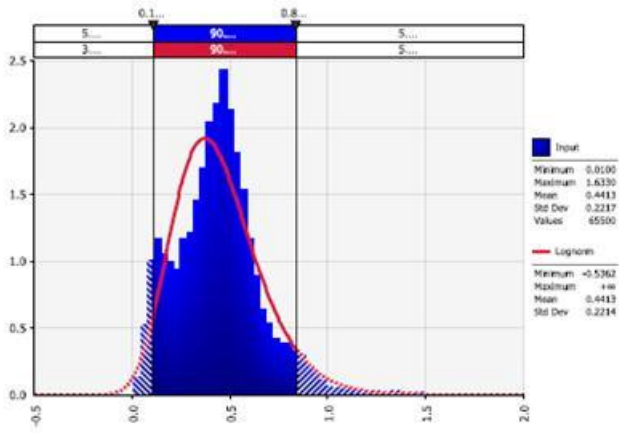
The Model

- Adjustments in Production outputs had to be implemented for some crops due to different behaviors between soils and climate in United States and Mexico.

Wheat Quartile Production Output Comparison



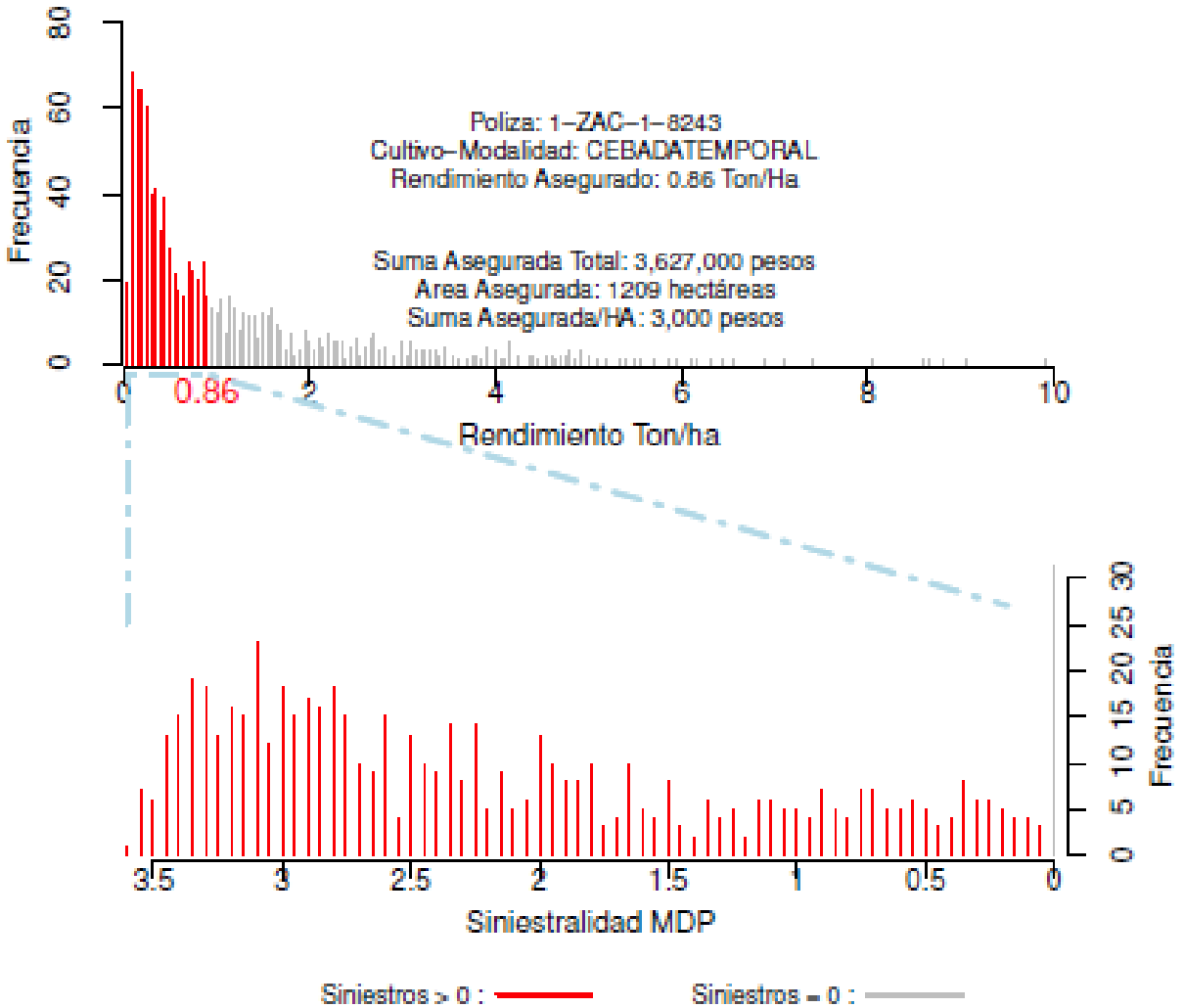




The Model

- All outcomes lower than the *insured output* are considered claims (red bars).

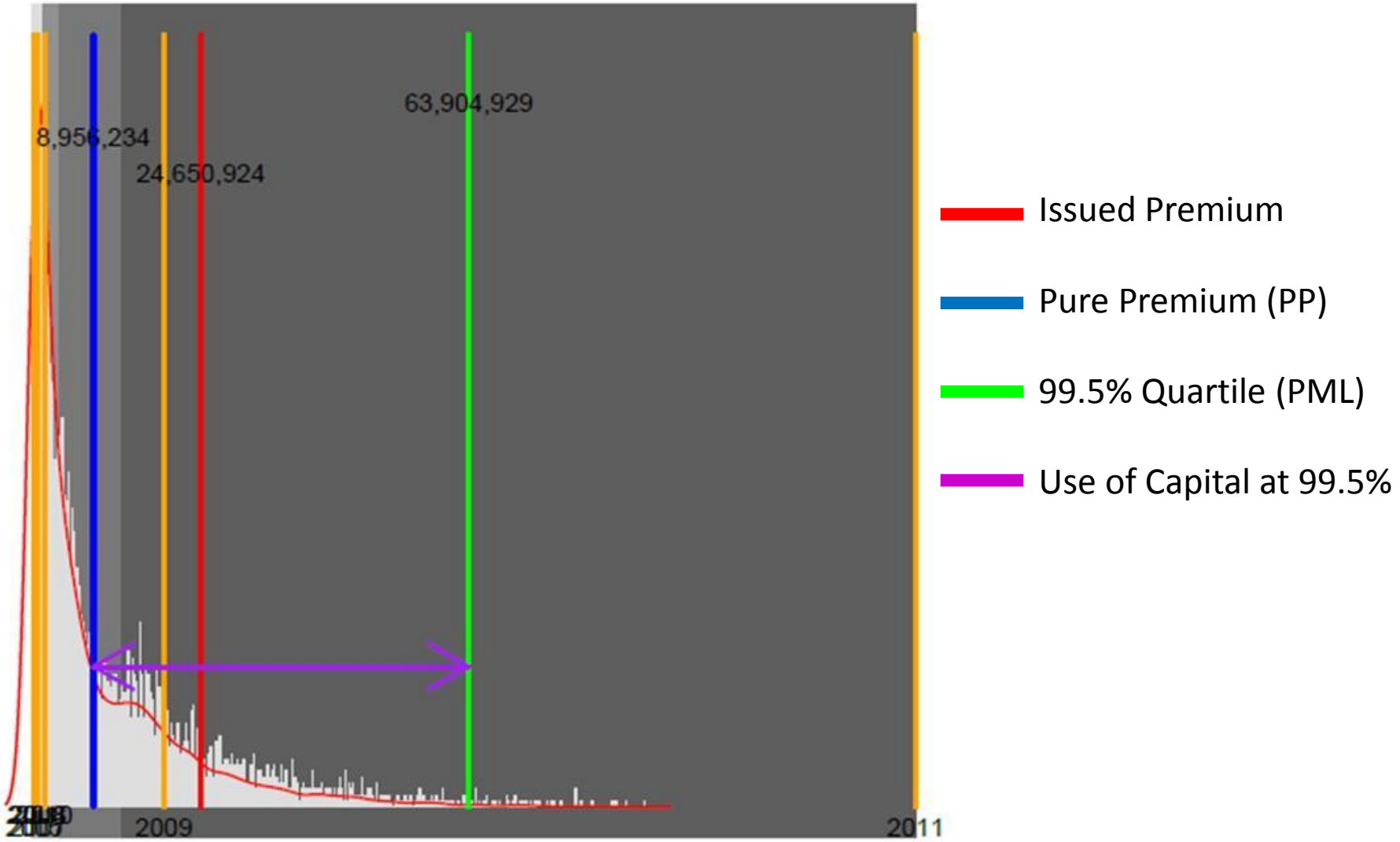
Barley Production Output in a Certain Municipality



The Model

- Probable Maximum Loss (PML) and Pure Premium (PP) estimation.

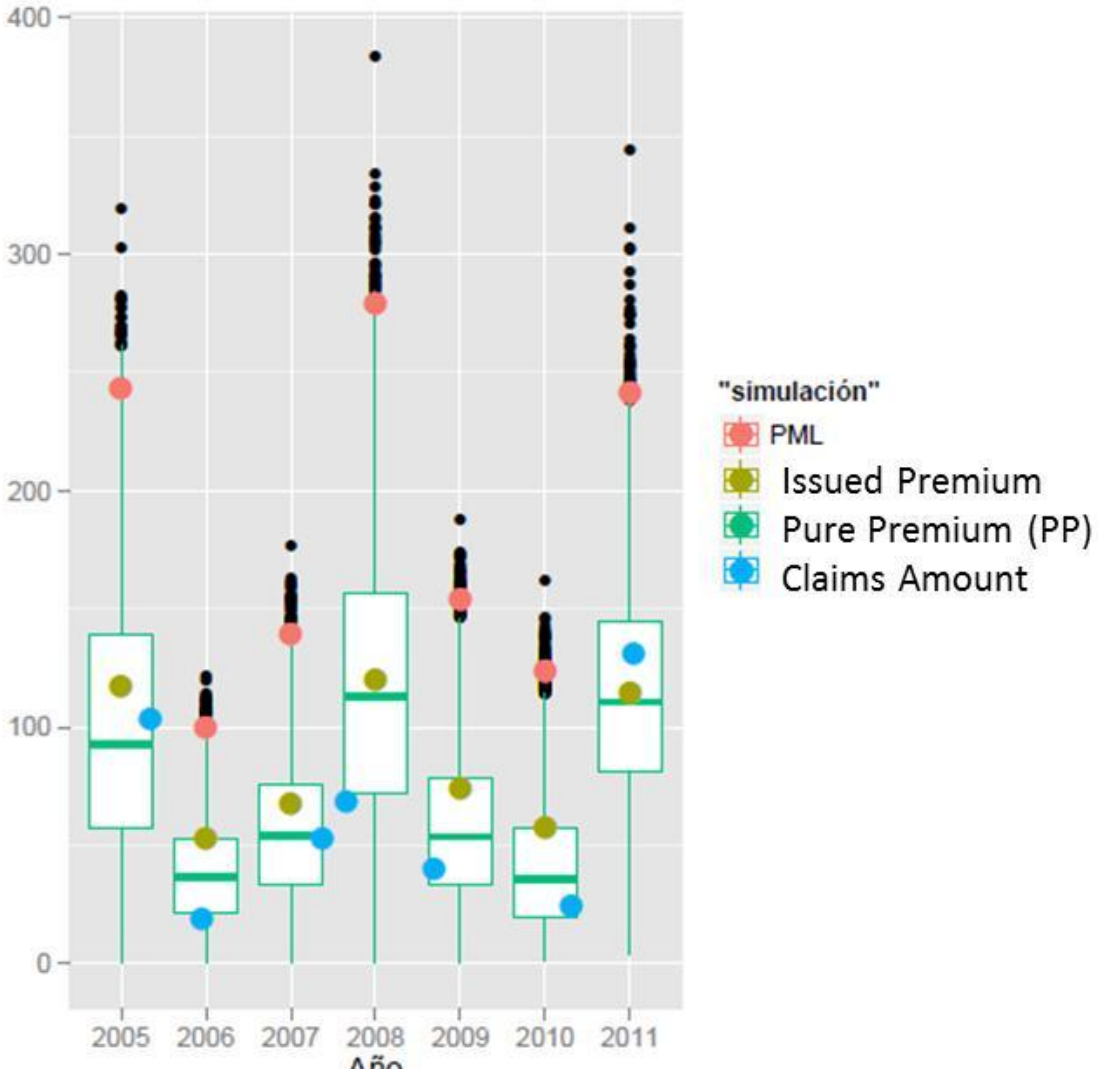
Bean Production Output for Zacatecas Spring Summer (No Irrigation System)



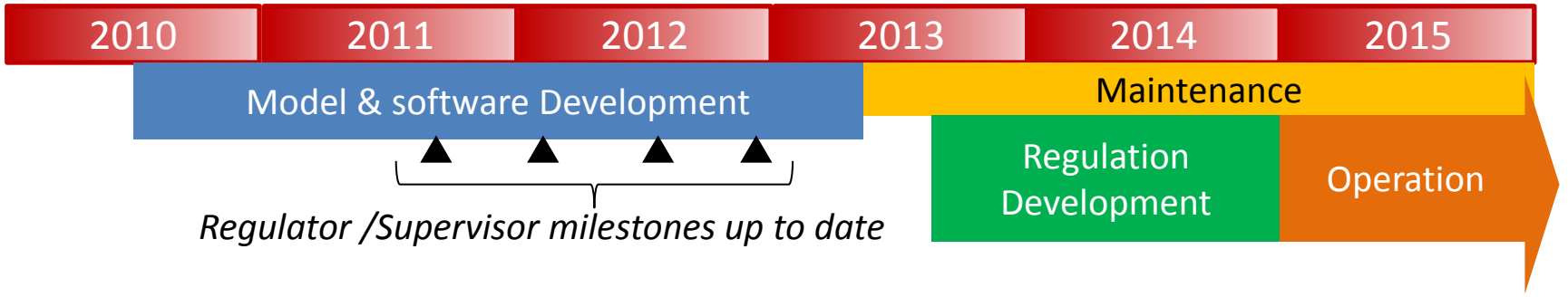
The Model

- Backtesting.

Claims Amount (in millions of pesos per annum)



Time Horizon, Costs and Participants



- Total cost of the project in round figures is $420,000 dollars. World Bank financed $105,000 dollars (25%) in three years */. The rest is been paid by the three local private companies (Proagro, General de Seguros and Mapfre).

  */ World Bank participation: $31,000 in 2010, $34,000 in 2011, and $40,000 in 2012.

PROJECT CONTRIBUTORS:

Insurance Sector	AMIS Asociación Mexicana de Instituciones de Seguros; Pro Agro; Mapfre; General de Seguros, S.A. Una Compañía Diferente
Financing/ Mgmt	FIDES Federación Interamericana de Empresas de Seguros; The World Bank Working for a World Free of Poverty; APESEG Asociación Peruana de Empresas de Seguros
Consultants	Técnica Actuarial Consultores y Actuarios; financialscience; AgroClima® Informática Avanzada S.A. de C.V.

Project Status and Next Steps

The project has been presented to the Supervisor in four different moments and suggestions from them have been considered.

Next Steps:

- To Incorporate deterministic possible scenarios given by the Supervisor (that have never happened). Stress the model beyond historic climate known scenarios.
- To make simulations and adjustments for the non privately own insurance company (Agroasemex).
- To review the livestock information to define a model for this type of insurance.
- To complete the user friendly computer system.


Muchas Gracias