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Agricultural Insurance in Asia: A growing market

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12 May 2017

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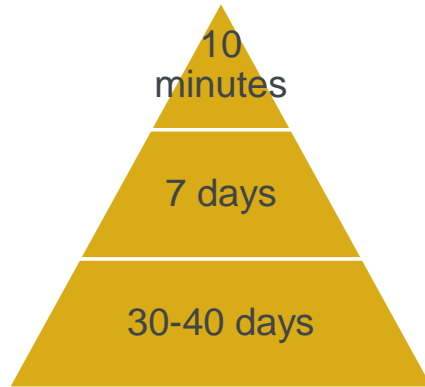and Faculty
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Overview of Presentation

- Food Security
- World Agricultural Insurance Market
- Comparison between countries
- USA rate-making methodologies
- China Agricultural Insurance
- India Agricultural Insurance
- Korea Agricultural Insurance
- Thai Agricultural Insurance
- Challenges in Agricultural Insurance
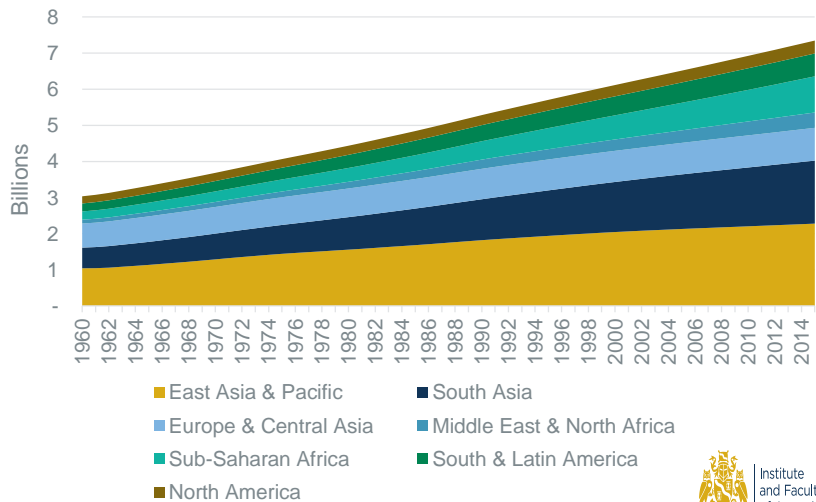- Q&A

12 May 2017

Food Security – Why important?
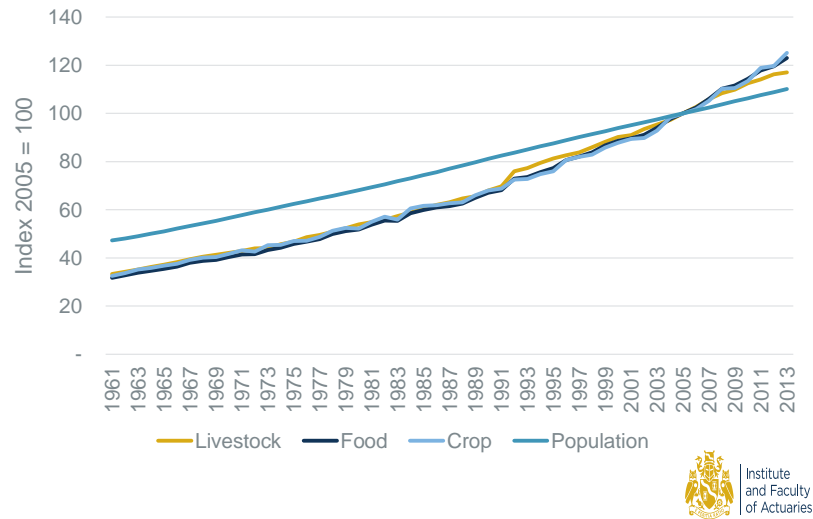
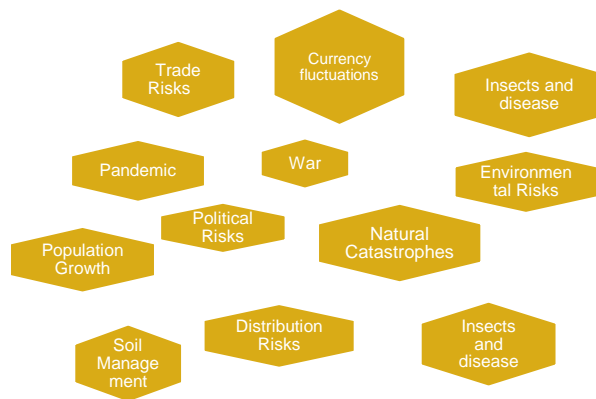Humans approximate time to death without:

- Oxygen

- Water

- Food

10 minutes

7 days

30-40 days

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Food Security – Population Growth

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Food Security – Food Production vs Population Trends

Index 2005 = 100

Legend: Livestock — Food — Crop — Population

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Food Security – Why important to individual country

- Trade Risks
- Currency fluctuations
- Insects and disease
- Pandemic
- War
- Environmental Risks
- Political Risks
- Natural Catastrophes
- Population Growth
- Soil Management
- Distribution Risks
- Insects and disease

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Food Security – Why insurance is important to farmer
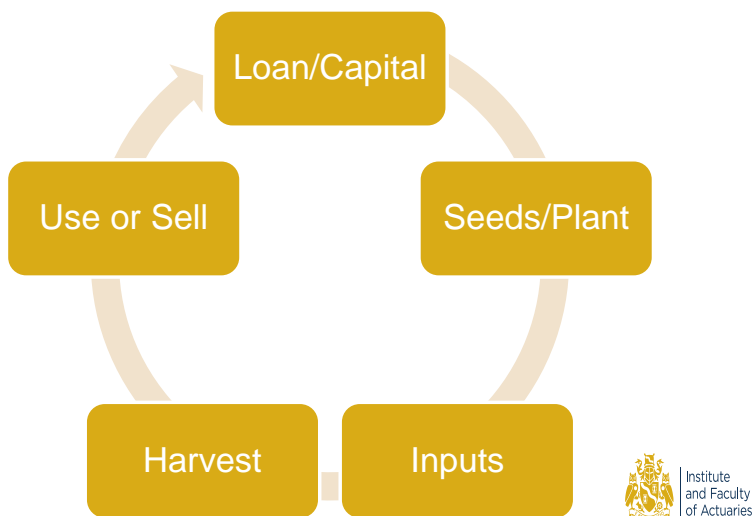
World Agricultural Insurance Market

Country	2016 (or most recently available) Gross Premium in $B	Approximate Subsidy Percentage	Approximate Participation Rates
USA	$10.0	65%	High
China	$6.0	35%	Increasing
India	$2.5	80%	Low but Increasing
Canada	$1.1	60%	65%
Spain	$0.8	72%	35%
Japan	$0.5	50%	55%
South Korea	$0.3	75%	20%
Japan	$0.5	50%	50%
Thailand	$0.0	65%	3%
Australia	$0.2	0%	50% (Mainly named peril)
Worldwide (Estimated)	$20 to $25	50%	40% - 60%

Source: World Bank, USDA-RMA, Internet

Comparison of Select Countries Agricultural Insurance

Country	Delivery	Notes
USA	Private/Public Partnership	Some private products
Canada	Public (Provincial)	Federal government reinsurers Provinces
China	Private/Public	Government administers program – private insurers
India	Private/Public	Recently increased subsidies
Japan	Co-operatives	Major crops compulsory
Australia	Private	Named events – 50% participation; low for MPCI

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10 May 2017   Source: World Bank   9

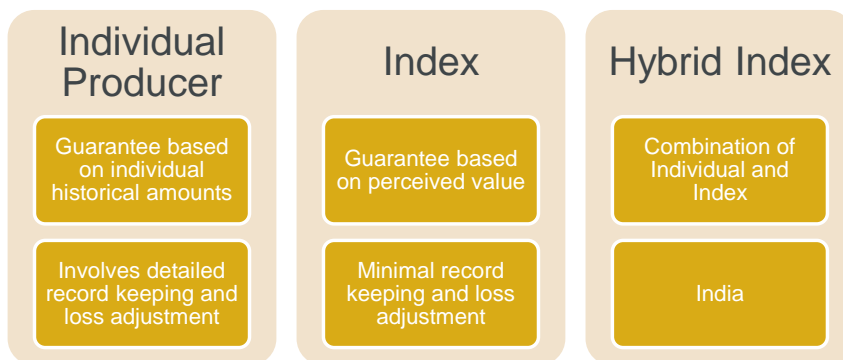## Types of Policies

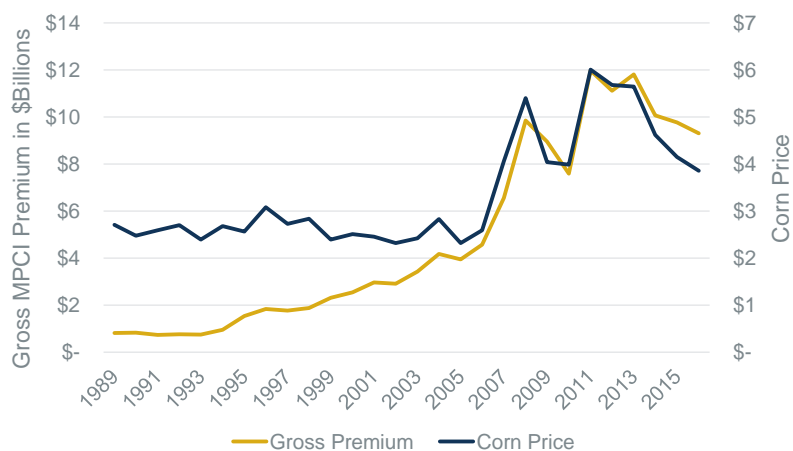| Yield	Revenue	Index
Guarantee based on expected yield (x price)	Guarantee based on expected revenue (yield x price)	Guarantee based on an index (measurement of something)
Indemnity paid if actual yield less than expected (less deductible)	Indemnity paid if actual revenue less than expected (less deductible)	Index can be yield, revenue, rainfall, weather, etc.

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Types of Policies

Individual Producer	Index	Hybrid Index
Guarantee based on individual historical amounts	Guarantee based on perceived value	Combination of Individual and Index
Involves detailed record keeping and loss adjustment	Minimal record keeping and loss adjustment	India

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US Agricultural Insurance Market

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US Agricultural Insurance Market – Premium by Crop

Whole Farm, 86 , 1%
All Other, 1,377 , 15%
RICE, 87 , 1%
APPLES, 100 , 1%
ALMONDS, 135 , 1%
GRAIN SORGHUM, 189 , 2%
PRF, 238 , 2%
COTTON, 646 , 7%
WHEAT, 1,104 , 12%
SOYBEANS, 1,837 , 20%
CORN, 3,515 , 38%

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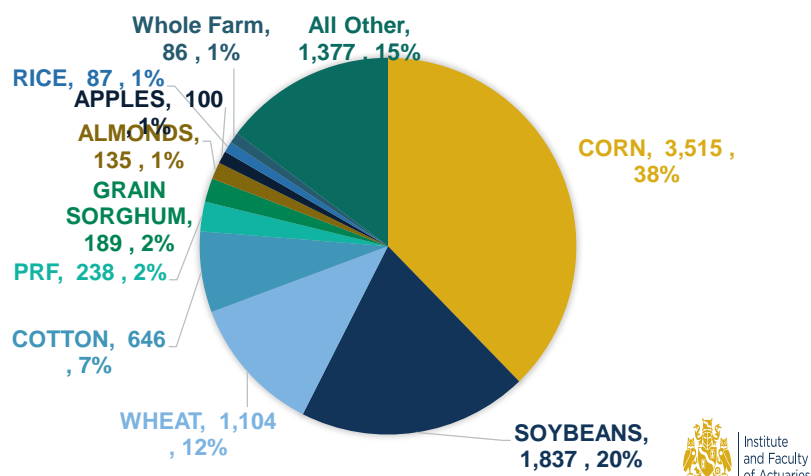
US Agricultural Insurance Rating Methodology

Public program (MPCI) rates set by government (RMA). All private insurers charge the same rates.

Private products fall under each state insurance department – can vary by insurer.

RMA publishes detailed studies on rating methodology – publically available.

Significant amount of MPCI data publically available, as are the rating factors.

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US Agricultural Insurance Rating Considerations

Pure premium data (StatPlan) since 1975.

Changes in participation, technology, commodities, catastrophes.

StatPlan – base rate @ 65% coverage level. Mismatch between base rate and selected coverage level recently.

Multitude of other policies which are rated differently (smaller percentage of overall policies)

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US Agricultural Insurance Individual Rating

- $Premium\ Charged\ to\ Farmer = Liability\ \times \{(1 - Subsidy\ Factor) \times (Base\ Premium\ Rate\ \times Unit\ Structure\ Discount\ Factor\ \times Multiplicative\ Optional$

- *Where (for yield risk):*

- $Base\ Premium\ Rate = Minimum\ \{\,[Current\ Year\ Base\ Rate\ \times Rate\ Differential\ Factor\ \times Unit\ Residual\ Factor\,]\,, [Prior\ Yea$
  $1.2\ \}$

- *Where*:

- $Current\ Year\ Base\ Rate = \{\,(Current\ Year\ Rate\ Multiplier\ \times Reference\ Rate\,) + Fixed\ Rate\,\}$

- $Current\ Year\ Rate\ Multiplier = (\frac{Rate\ Yield}{Reference\ Amount})^{Exponent\ Value}$

- $Reference\ Rate = \left(\frac{\frac{County\ Unloaded\ Rate + County\ Catastrophic\ RL}{Disaster\ Reserve\ Factor}}{Unit\ Division\ Factor}\right) \times Type\ \frac{and}{or}\ Practice\ Factor$

- $Fixed\ Rate = \frac{Prevented\ Planting\ RL\ \times RePlant\ RL\ \times Quality\ Adjustment\ RL\ \times StateCatastrophe\ RL}{Unit\ Division\ Factor}$

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US Agricultural Insurance Individual Rating

- Revenue Risk

- $Capped\ Revenue\ Add\ On\ Factor = Revenue\ Rate - Yield\ Rate$

- Where:

- $Yield\ Rate = \sum_{i=1}^{500} \frac{Max\{0, C \times Y - Max(0, y_i \times \sigma_i + \mu_i)\}}{500 \times Y \times C}$

- $Revenue\ Rate = \sum_{i=1}^{500} \frac{Max\{0, C \times Y \times Max(P, \rho) - Max(0, (y_i \times \sigma_i + \mu_i) \times P)\}}{500 \times Y \times C \times P}$

- Where:

  - $C = Coverage\ Level$
  - $Y = Approved\ Yield$
  - $P = Spring\ (Projected) Price$
  - $Harvest\ Price = \rho = e^{\sigma_p \times p_i + \mu_p}$

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Agriculture Insurance in China

- PICC first commenced agriculture insurance offering since 1950

- 1982 – 2004 PICC and China United

- 2004 – 2008 four new Specialised Agriculture Insurers

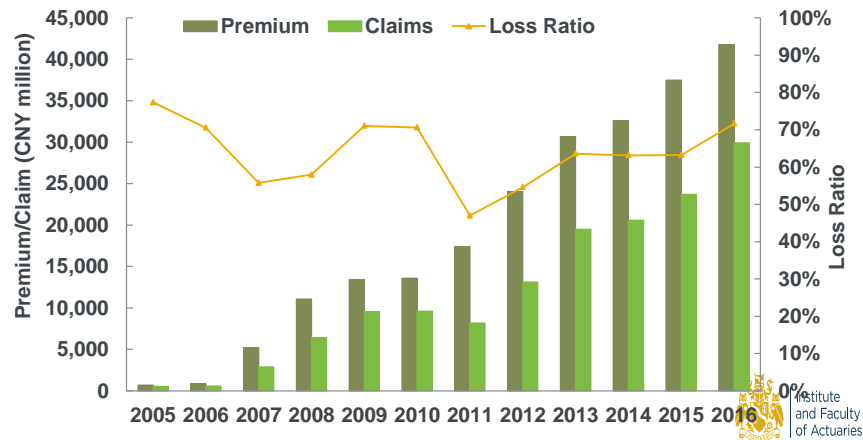- China Agriculture Reinsurance Pool (Nov 2014)

Company	2014 Premium (RMB millions)	Share
PICC	17,142.57	52.46%
China United	5,706.90	17.47%
Sunlight	2,303.78	7.05%
Guoyuan	1,796.00	5.50%
Anhua	1,620.12	4.96%
Groupama	1,036.32	3.17%
CPIC	896.64	2.74%
Anxin	480.27	1.47%
Others	1,691.82	5.18%
Total	32,674.42	
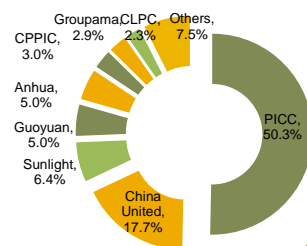
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Agriculture Insurance in China

Agriculture Insurance in China

• Premium by Class

LOB	2015		
	Premium	Claim	LR
Crop	21,898,604,322	15,876,075,631	72%
Forestry	3,049,630,145	1,093,164,370	36%
Livestock	7,612,069,350	5,669,305,202	74%

7,612.07

3,049.63

21,898.60

■Crop
■Forestry
■Livestock
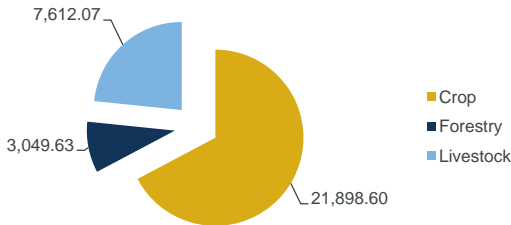
Agriculture Insurance in China

- Role of Government
  - Premium Subsidy
  - Approval of Original Premium Rates
  - Product Design
  - Underwriting Control and Administration
  - Animal Epidemic Law and Response
  - Agriculture Policy

Outbreak	Compensation	Average Insured Value (RMB)
Avian Influenza Shandong Province 2008	RMB 10 per bird destroyed	11
Blue Ear Disease of Pigs Shandong Province 2008	RMB 180 per pig destroyed	805
Blue Ear Disease of Pigs Hunan Province 2007	RMB 600 per pig destroyed	805
	RMB 100 per pig dying	
Pig epidemic diseases Shanxi Province 2009	RMB 1500 per breeding sow destroyed	965
	RMB 800 for pig over 50 kg destroyed	
	RMB 400 for pig under 50 kg destroyed	
	RMB 150 for weaner pig destroyed	
Blue Ear Pig Disease Hubei Province 2011	RMB 600 per pig destroyed	805

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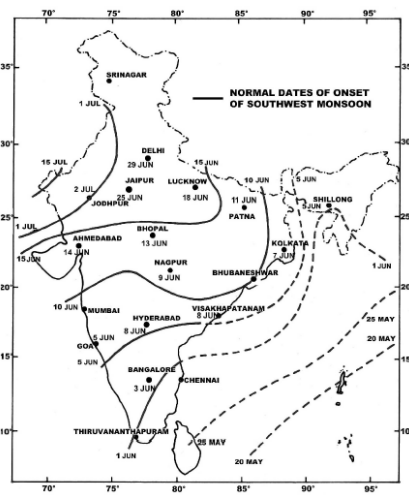10 May 2017   21

Agriculture Insurance in India

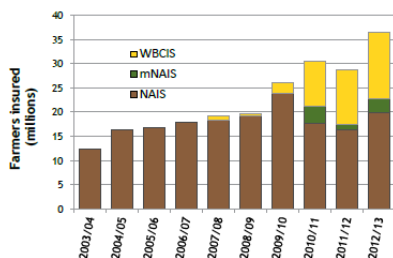Exhibit 13: Area Planted per Crop type in 2010-11. Major crops only. Source: Department of Agriculture & Cooperation.

Crop	Area (Million Hectares)	Share (%)
Rice	42.9	22.30%
Wheat	29.1	15.12%
Other pulses (peas)	12.9	6.69%
Cotton	11.2	5.85%
Soyabean	10.7	5.56%
Pearl Millet	9.6	5.00%
Chick pea	9.2	4.78%
Vegetables	9.0	4.68%
Corn	8.6	4.45%
Other crops	8.1	4.20%
Sorghum	7.4	3.84%
Rape & Mustard	6.9	3.59%
Fruits	6.7	3.49%
Peanut	5.9	3.05%
Sugarcane	4.9	2.54%
Pigeon pea	4.4	2.27%
Other Millets	2.9	1.50%
Sesame	2.1	1.08%
Total	192.2	100.00%

NORMAL DATES OF ONSET OF SOUTHWEST MONSOON

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Agriculture Insurance in India (2016)

Ministry of Finance 2014: Objectives of India index insurance

- *Provide a measure of financial support to farmers in the event of crop failure from drought, cyclone and incidence of pest & disease;*
- *Restore the credit eligibility of a farmer for the next season after crop failure;*
- *Encourage the farmers t adopt progressive farming practices, high value inputs and higher technology in agriculture;*
- *Help stabilize farm incomes, particularly in disaster years*

- Small farm holding size (average of 1.4 ha), 80% are small/marginal farmers

- Predominantly rain-fed agriculture, 90% of crop shortfall is due to rainfall variance

- PMFBY: Area-yield index

- WBCIS: Weather based Index
- Rainfall Index
- Drying Days Index
- Temperature Index

- Compulsory for farmers who takes production loan and volunteer, which guarantees a good spread of business

- 2016 premium: 2.5 billion USD
- 2017 premium: 4.25 billion USD

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Agriculture Insurance in India - Area Yield Index

Crop: Corn		Sum Insured (INR):	10000			
Year	Yield					
2005	550	calamity year1				
2006	1950					
2007	2200					
2008	1875					
2009	750	calamity year2				
2010	1950					
2011	2200					

Current Yield - 2012 (Kg/Ha.):	1500
Average Yield of latest 7 years: (Kg/Ha.):	1639.29
Average Yield of latest 7 years less 2 calamity years (Kg/Ha.):	2035

$$\text{Indemnity} = \text{Max}\left(0, \frac{\text{Threshold Yield} - \text{Actual Yield}}{\text{Threshold Yield}}\right) \times \text{Sum Insured}$$

Risk category	Indemnity level	TY (Kg/Ha.)	Shortfall (Kg/Ha.)	shortfall %	claim (INR)
high risk	70%	1424.5	0	0.00%	0.00
medium risk	80%	1628	128	8.53%	853.33
low risk	90%	1831.5	331.5	22.10%	2210.00

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Agriculture Insurance in India-Weather Index

WEATHER BASED CROP INSURANCE SCHEME (KHARIF 2009)
TERM SHEET

State: **MAHARASHTRA**   Distrcit: **Akola**   Tehsil: **Akola**

Crop: **COTTON**   Reference Weather Station: **Backup Weather Station:**

DEFICIT RAINFALL

1 A.	RAINFALL VOLUME		PHASE - I			PHASE - II			PHASE - III			PHASE - IV	
		PERIOD	16-Jun	to	15-Jul	16-Jul	to	15-Aug	16-Aug	to	15-Sep	16-Sep to	31-Oct
		TRIGGER I (<)	100	mm		200	mm		130	mm		70	mm
		TRIGGER II (<)	40	mm		70	mm		40	mm		20	mm
		EXIT	0			0			0			0	
		RATE I (Rs./ mm)	10			8			8			12	
		RATE II (Rs./ mm)	47.5			28			44.5			70	
		Max. Payout (Rs.)	2500			3000			2500			2000	

MAXIMUM PAYOUT (Rs.)   10000

Note: Rainfall of more than 2 times the trigger during a particular phase is considered for 'Carry Forward' to the next Phase. In case of Phase-I, rainfall in excess of the trigger (provided rainfall is more than twice the trigger value) would be carried forward to Phase-II. In case of Phase - II, rainfall in excess of the trigger (provided rainfall is twice the trigger value) would be carried forward to Phase III. In case of Phase - III, rainfall in excess of the trigger (provided the rainfall is twice the trigger value) would be carried forward to Phase IV.   **25%** of the   **30%** of the   **30%** of the

1 B.	RAINFALL DISTRIBUTION (Consecutive Dry Days)	PERIOD	1-Jul	to	15-Sep				
		TRIGGER DAYS (>=)	15	22	30				
		PAYOUT (Rs.)	500	1250	3000				

TOTAL PAYOUT (Rs.)   3000

Note: Total rainfall of less than **5 mm over 2 consecutive days** shall not be considered as rainy days. **Multiple events** shall be considered for the final payout.

EXCESS RAINFALL (Multiple events)		PHASE - I			PHASE - II			PHASE - III		
	PERIOD	16-Jun	to	15-Jul	16-Jul	to	31-Aug	1-Sep	to	31-Oct
	DAILY RAINFALL TRIGGER (>)	65	mm		125	mm		65	mm	
	EXIT (mm)	200	mm		250	mm		175	mm	
	Payout (Rs. / mm)	4			6			6.81818		
	Max. Payout	500			750			750		

TOTAL PAYOUT (Rs.)   2000

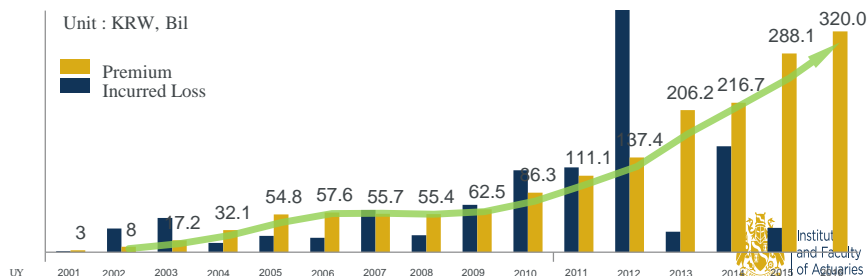| TOTAL SUM INSURED (Rs.)	15000
PREMIUM (Rs.)	1800
PREMIUM %	12.00%

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Agriculture Insurance in Korea

- Crop insurance program was introduced in 2001 with the enactment of the Crop Disaster Insurance Act
  - In order to compensate farmers affected by natural disasters

- The volume has grown about 97 times bigger than its inception (during 15 years)
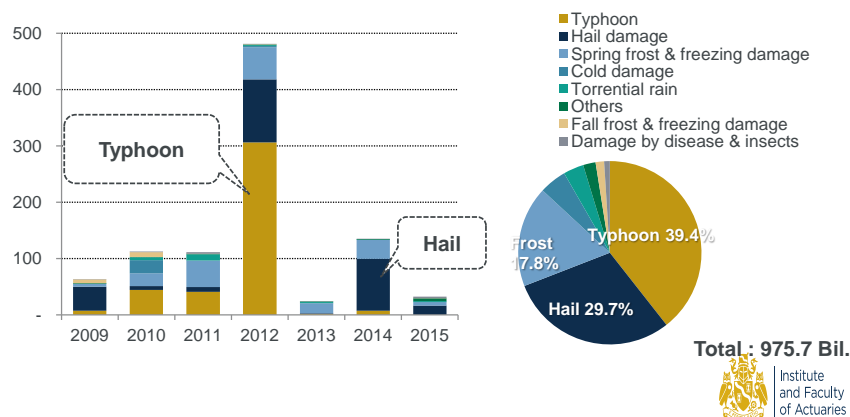 - In 2015, total 45 items were insured at the risk premium of KRW 288.1 Bil.

Unit : KRW, Bil

- Premium
- Incurred Loss

320.0
288.1
206.2 216.7
137.4
111.1
86.3
62.5
54.8 57.6 55.7 55.4
32.1
17.2
3 8

UY 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

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Agriculture Insurance in Korea

• Main Perils: Frost, Typhoon and Hail

Total : 975.7 Bil.

Agriculture Insurance in Korea

• As of 2016, 46 types of crops(including greenhouse) are covered

• Crops are divided into 3 risk categories:

 – High: historical loss ratio > 170%

 – Medium: historical loss ratio > 65% <170%

 – Low: historical loss ratio <65%

< Main-High >
Astringent Persimmon, Sweet Potato, Soybean (3)
< Main-Medium >
Apple, Pear, Autumn Potato, Autumn Onion, Sweet Persimmon,
Jujube, Corn, Kiwi, Prune, Japanese Apricot, Greenhouse Tomato,
Pepper, Grape (13)
< Main-Low>
Tangerine, Chestnut, Spring Potato, Garlic, Greenhouse
Crops(watermelon, Strawberry, Cucumber, Oriental melon,
Green-chilli pepper, Pumpkin, Chrysanthemum, Paprica, Melon,
Rose, Garlic Chive, Spinach, Lettuce), Greenhouse(18)

< Pilot >
Rice, Peach, Apple(MPCI), Pear(MPCI),
Sweet Persimmon(MPCI), Astringent
Persimmon(MPCI), Ginseng, Green Tea,
Mulberry, Oyster Mushroom, Shiitake
Mushroom, Raspberry (12)

Thai Rice Top-Up Scheme

An efficient distribution system to attain critical mass and ensure spread of risk ;

Thailand Rice 2011

National scheme with a single rate, 40% penetration expected

- Only 2% penetration and only worst farmers bought insurance

National average loss cost   - 15.6%

Insurance Scheme loss cost   - 48.6%

- No cut -off date

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Anti-Selection – Risk-Based Rating

- Only way to combat anti-selection was price :
- Risk rating was introduced

Rating

Zone		Premium	Government Subsidy
Light Green		**THB 115**	THB 55
Med Green		**THB 220**	THB 150
Dark Green		**THB 330**	THB 250
Yellow		**THB 420**	THB 330
Red		**THB 450**	THB 350

- Sales cut off date
- Strengthened loss assessment procedure

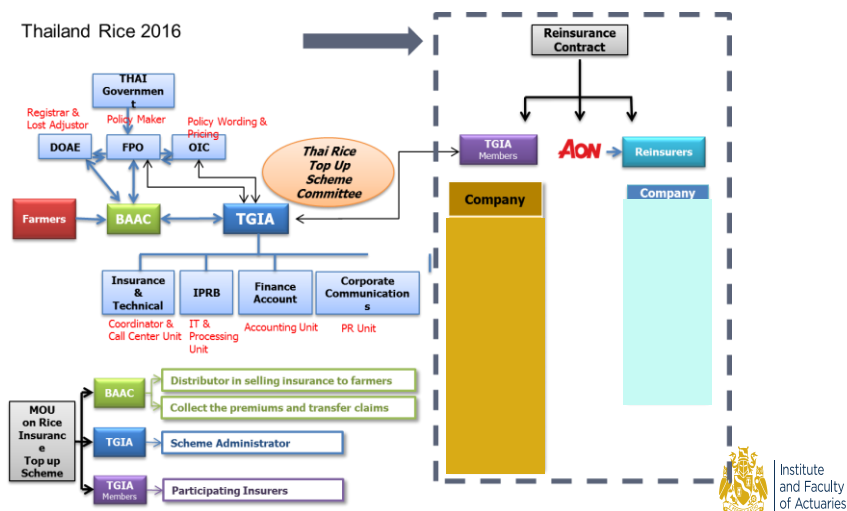Scheme was restored to profit despite
a 3% penetration rate and loss ratio
4 times greater than national average

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Thai Rice Top-Up Scheme

Thailand Rice 2016
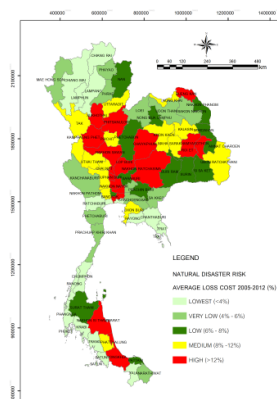
Anti-Selection/ Cheap Distribution

- India have made it compulsory for all farmers with a bank loan to take insurance.

- This ensures 40% penetration and cheap distribution as banks do all the administration and only pass a bordereau over to insurance companies.

- Thailand has implemented "Compulsory" Crop Insurance Scheme which bring the average loss cost down by 70% and reduces the rate charged to farmers

Premium Subsidy

- All countries with a national crop insurance scheme have the government subsidise the premium, except Australia, Argentina and South Africa

- Levels of subsidy differ but in general :

US	70%	85% penetration
Japan	50% subsidy	90% penetration on rice
South Korea	75% subsidy	80% penetration on apples and pears

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Premium Subsidy

- Heavily subsidised premiums do not guarantee good penetration

Thailand	65% subsidy	3% penetration (2011)
Korea	75% subsidy	20% penetration
India	80% subsidy	1% penetration on voluntary basis*

* Before 2015 (Target 40-50% in 2019 with compulsory covers)

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Weather Based Insurance : Challenges

- When trying to develop new products, there can be insufficient data. This is normally because the government are looking for a product at a smaller resolution than provided by the data.

- This problem has been addressed in three ways :

  – Using the historical data of a higher resolution to apply uniformly across the smaller unit areas

  – There are programmes that can be used to simulate very incomplete data sets to develop a series of complete historical data sets

  – For incomplete data sets, averages can be used to fill in the missing series
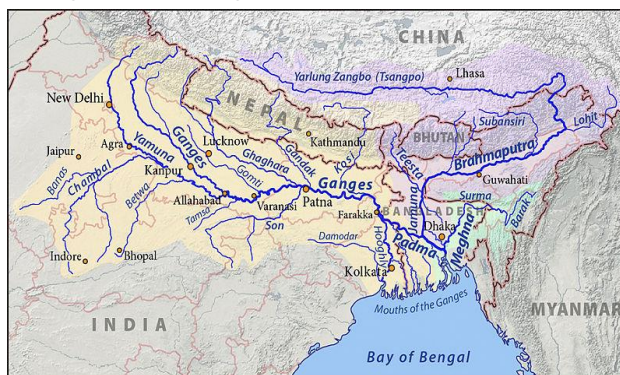
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Weather Based Insurance: Challenges

- Severe Flooding in Bihar in August 2008. Farms were underwater.
- However minimal payouts from Weather Insurance as rainfall In the area was normal and flooding came via the Ganges river from excess rainfall further west.

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Weather Based Insurance : Challenges

- In India, the Weather Based products operate off a daily rainfall reading. However, there are times when the data is not delivered. This can be due to ……..

- This problem is addressed in the policy wording. A clause like the below can be used :

Appendix No - 1 MISSING DATA DAY

"Missing data day" means any day during the policy period of an original policy for which the applicable data Provider is unable to measure and/or report weather data in its final and edited form.

Missing Data Day Adjustment to be done in any one of the following methods, whichever is applicable

1. Weather data for any missing data day is replaced by weather data of the nearest backup station as reported in the risk report.
2. Weather data for any missing data day is replaced by the average during the corresponding missing data day of the immediately preceding years where weather data is available at the missing data day as follows: Temperature and humidity: 10 years; Rainfall: 5 years.
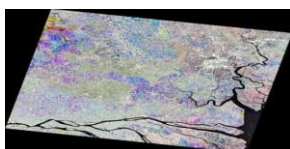
If weather data of the backup station is found missing, then method 2, as outlined above will be applied to calculate missing data. However, if a state government notifies its methodology for filling missing day data the same would be binding for that particular state.

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Innovations in Agriculture Insurance

- Remote Sensing

▶

- Drones

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Loss Assessment

Position	Data	Platform
GPS：定位	**RS：数据**	**GIS：平台**

GPS is a technology for geographical location calculating, navigation and communication by receiving information from GPS satellites

Remote Sensing is a comprehensive detection technology that records the electromagnetic wave of long-range objects by detection device and indicates the traits and changes

Geography Information System is a computer system to collect, store, manage, handle, search, analyze the geography space data, and also a general technology to analyze mass geography data.

Source: PICC

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Questions   Comments

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