Reinsurance approaches to pricing in Indian crop insurance

Institute of Actuaries of India

Capacity Building Seminar in Crop Insurance
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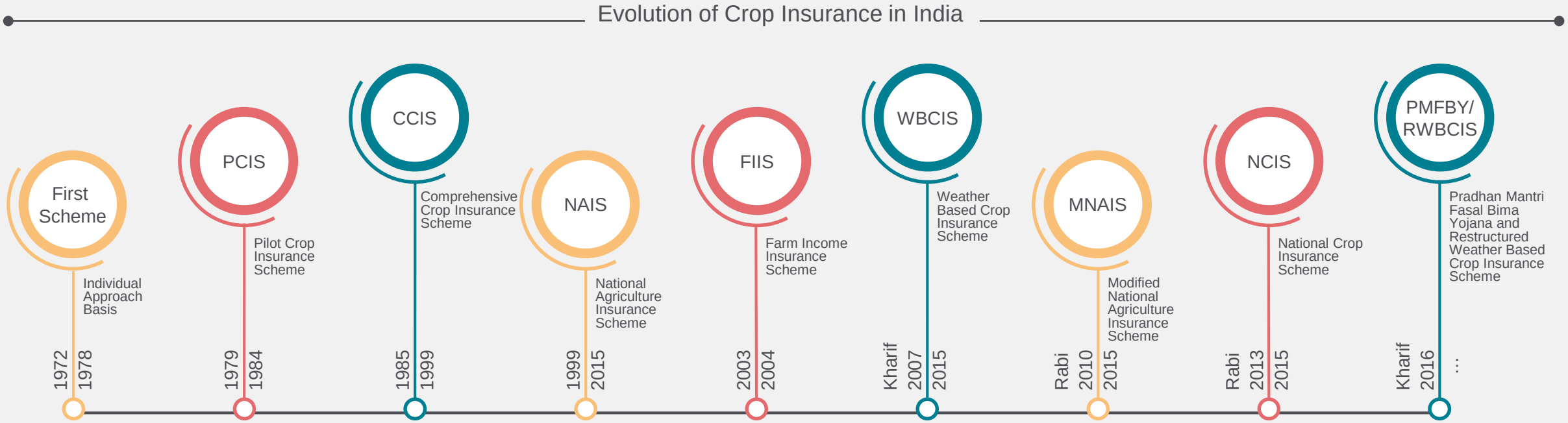
Evolution of Crop Insurance in India

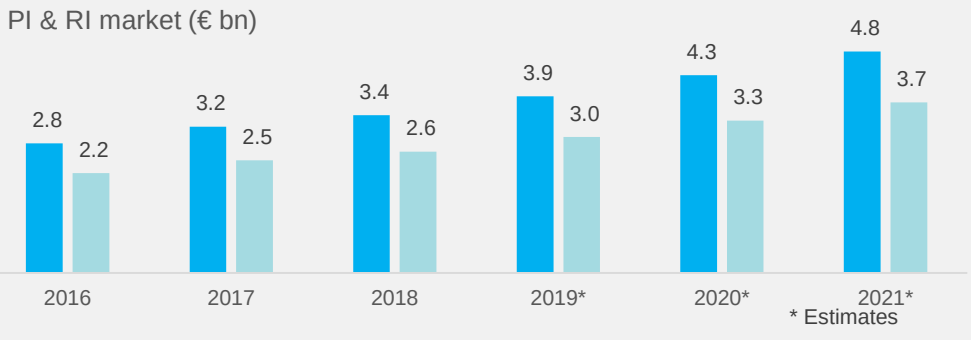
Agriculture in India is highly susceptible to risks like droughts and floods. It is necessary to protect the farmers from natural calamities and ensure their subsistence for the next season. For this purpose, the Government of India introduced many agricultural schemes throughout the country at various stages as outlined below.

The existing scheme was introduced in Jan-2016 on a nation-wide scale and underwent some significant changes in Sept-2018.



India Crop Insurance Scheme

- Indemnity and parametric coverages: area-yield based (PMFBY - 92% of premium) / weather-based (RWBCIS - 8% of premium)
- Re-launched in 2016 with the objective to provide an improved risk management tool compared to predecessor schemes
- Ambitious growth target to reach 50% farmer penetration by 2020 (at 30% for 2018-19)
- Premium still strongly based on mandatory coverage of loanee farmers
- Indemnity levels: 70-90% (high risk – low risk areas)
- Actuarially determined but tendered pricing regime (per regional cluster / “winner takes it all”)
  - Capped premium rate for farmers (Farmer’s share: 2% (Kharif/Summer); 1.5% (Rabi/Winter). Difference of actuarial premium (ca. 10.6%): 100% subsidy beyond rate cap
- Multi-fold jump in premiums due to nation-wide coverage, actuarial pricing (replacing earlier claims subsidy scheme) and higher SI
- Coverage: yield shortfall, prevented sowing, post-harvest losses and localized calamities
- Reinsurance: substantial risk transfer to reinsurers, 75% proportional cession / stop loss protection on retention



PMFBY

- Yield-index based component
- Geographical areas divided into Insurance Units (IUs)
- Claims processed on the basis of yield data received at IU level
- IU can be village/ tehsil/ block/ district

Restructured WBCIS

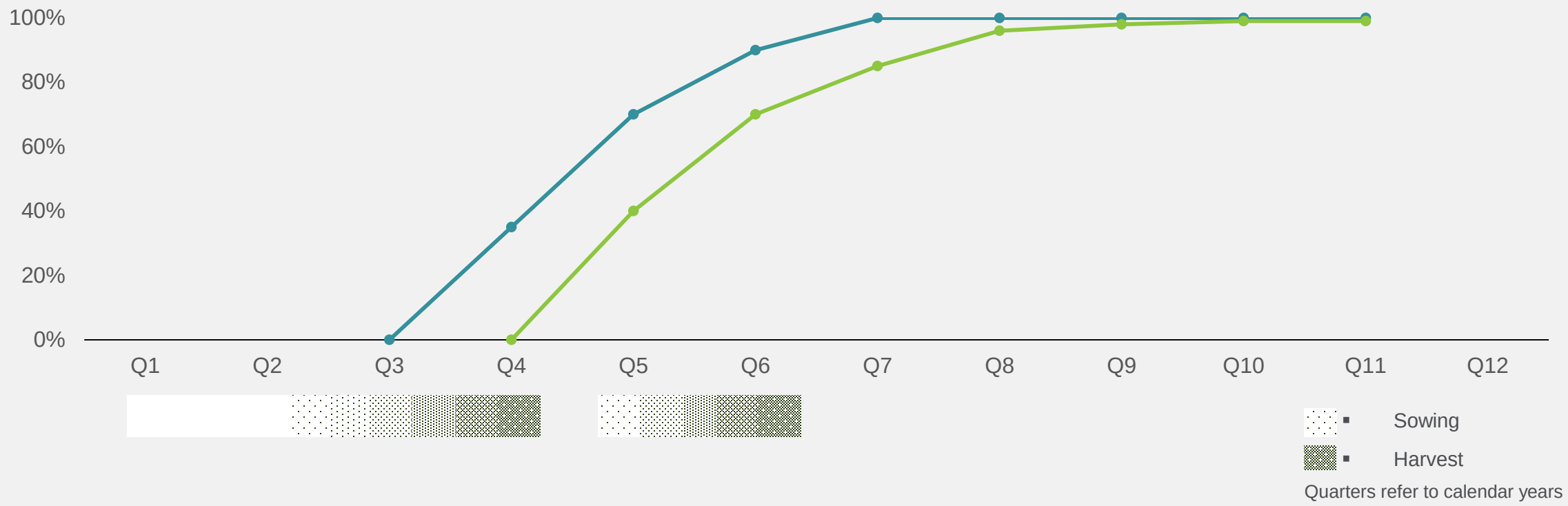
- Weather-index based component
- Claims processed on the basis of weather data gathered from notified AWS
- Each AWS typically covers an area of 12-15 km radius
- Horticulture crops like fruits and vegetables are usually insured under this

* Estimated as season is still in progress

Pricing Methodology

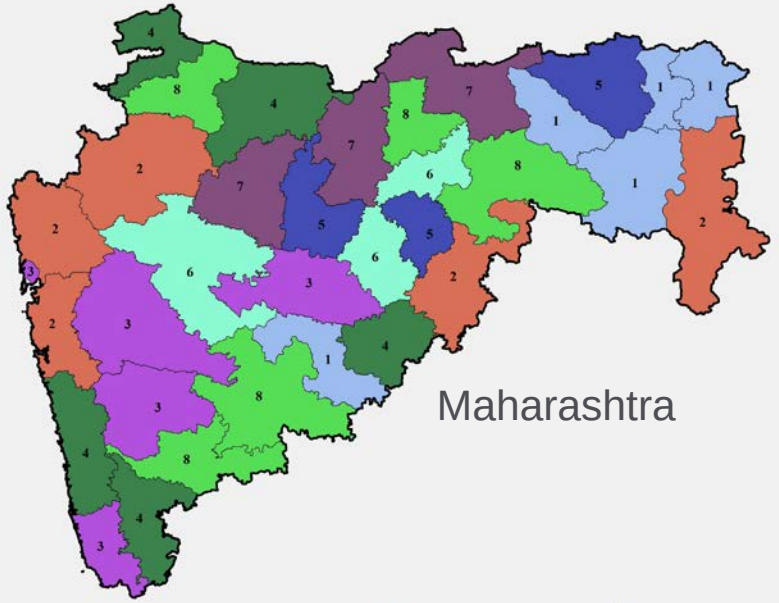
Pricing Concerns

- Retention of ICs is 20% - 25%, lower than other line of businesses which means most of the risk is transferred to Reinsurance companies
- NAIS was implemented from year 1999-00 till 2015-16 (33 seasons), total claims paid = INR 55,440 crore, total sum insured = INR 4,67,169 crore and the Loss Cost was 11.86% - pricing deficiency can lead to long term unsustainability
- W.r.t agriculture in India major peril is drought. More than 80 districts have a return period less than 5 for moderate drought and 30 districts have a return period less than 10 for severe drought. Unlike property severe events happen with small return period that makes appropriate pricing necessary
- Delay in premium reduces the investment income which has a bearing on the overall profitability of Agro business

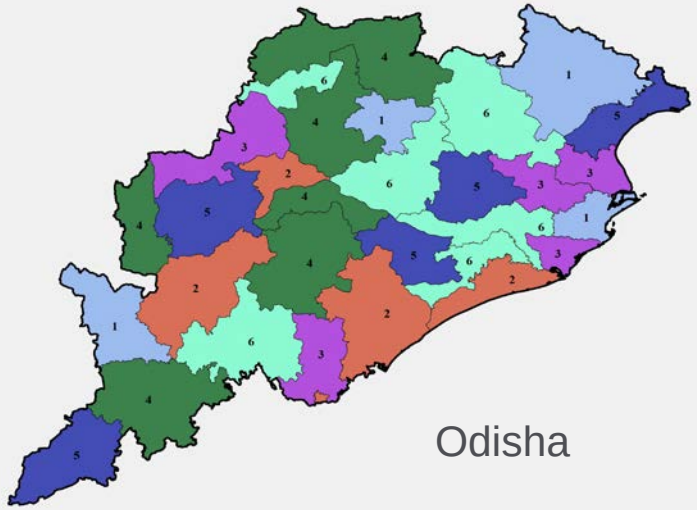


Cluster formation process by State Govt.

- State is divided into multiple clusters for tendering process
- Cluster formation done on the basis of -
  - Mix of districts with different agro-climatic zones ensuring similar risk profile in each cluster
  - Each cluster has 1-8 districts depending on the exposure volume
- Clustering to ensure low ESI (Expected Sum Insured) and even risk distribution all across and making all clusters palatable for insurers
- Crop-wise risk profiling is also factored in the process – however, it might always not be possible to increase diversification in all areas
- Cluster composition generally remains the same; insurance contracts can vary from 1 year to 3 years depending on the State Govt
- Risk Analysis of districts based on -
  - Historical yield data – provides burn cost and variability in the long term yield
  - Availability of long term satellite and weather data (at least 15 years) – used to assess year on year variations



Maharashtra



Odisha

Pricing Methodology

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Market pricing methodology

- **Data Collection –** minimum 10 years data necessary for appropriate pricing
- **Threshold Yield –** average of best 5 years data out of past 7 years considered
- **Detrending –** linear detrending applied using t-test or R^2 method
- **Burning Cost –** Percent Shortfall of actual yield from TY
- **Heterogeneity –** applied where granularity of data availability and claim settlement is different
- **Other loadings –** cat loading, data uncertainty, pre-post harvest, long term contracts
- **Final Premium Quotation –** PLR of 75% to be maintained at both tender and portfolio level

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- **Data Collection –** minimum 10 years data necessary for appropriate pricing
- **Threshold Yield –** average of best 5 years data out of past 7 years considered
- **Detrending –** linear multiplicative approach used on block level and capped at +/-5% per year
- **GP Downscaling –** deals with the higher volatility shown by lower admin levels
- **CAT Loading –** cat threshold set at 50% yield loss
- **Prevented sowing and post-harvest losses –** range from 0.25% to 1%
- **Risk Rates –** no PLR considered; admin and cost of capital loading applied on this

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Yield Data

Data collection and validation; pricing data received from the client

Cluster Selection

Cluster selection using exposure analysis, premium distribution across districts and crops, historical LRs, agro-climatic zones, client past experience

Rate Calculation

Rate calculations using market pricing and REVA – outputs from both approaches compared

Rate benchmarking

Benchmarking both the rates using estimated SI given in the tender and actual SI of the previous year;

Loading/ Discounting using soft factors

Apply loading/ discounting using various parameters like weather forecasting, on-ground expertise, irrigation facilities, government handling etc.

Final Loading/ Discounting

Apply admin and cost of capital loading

Final Quoting Rates

Apply commercial loading / discounting to arrive at the final rates to be quoted

Cluster selection

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Need for De-trending

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What Is Detrending

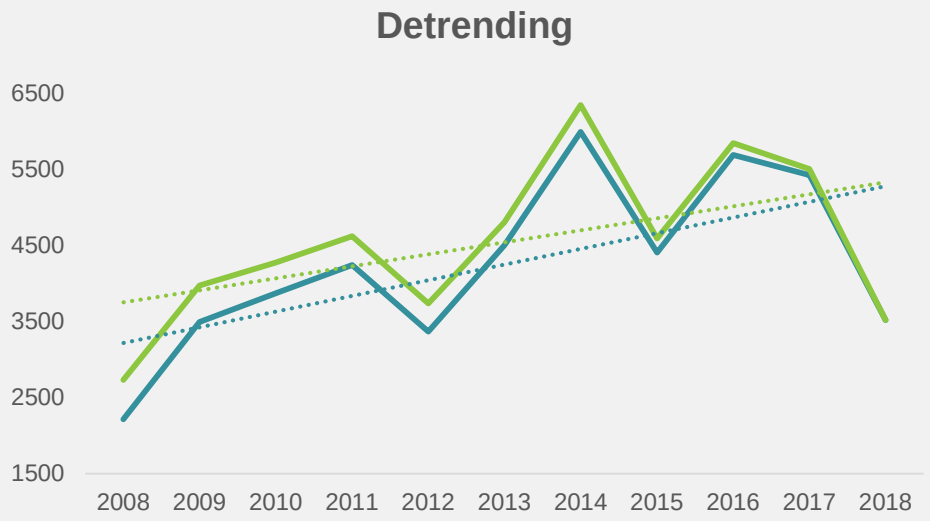
Detrending is removing a trend from a time series; a trend usually refers to a change in the mean over time. When we detrend data, we remove an aspect from the data that we think is causing some kind of distortion.

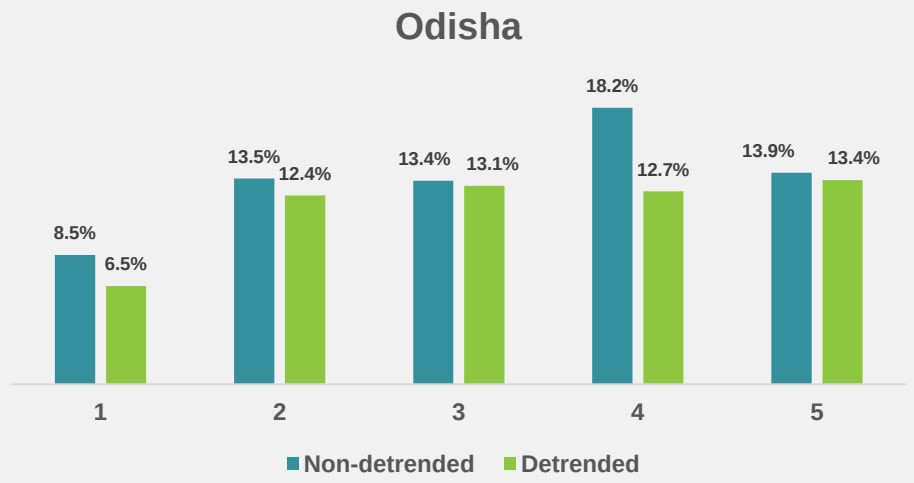
Reason of trends in Yield data

- Positive trend is observed in case of –
  - Technological improvements in farming practices
  - Increasing use of quality inputs
- Negative trend is observed in case of –
  - Any region or crop severely impacted by some major calamity consistently
  - In the absence of appropriately gathered data at IU level

How detrending is done

- The detrending done will be linear multiplicative detrending on block level.
  - Calculate block averages across all years
  - Linearly detrend and find the ratio of detrended yield and block average yield
  - Multiply the ratios to GP yield to respective years
- Both negative as well as positive trends will need to be detrend, if they are significant at 5% significance level, based on F test.
- To avoid large impacts from outliers at the end or beginning of the time series the trend is capped to +- 5% per year





F- Test in Detrending

A straight line is fitted to the yield data using least squares regression

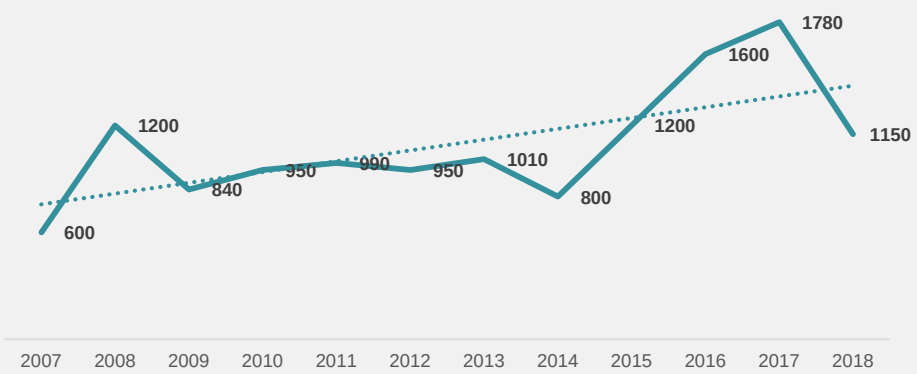
F test is done to determine whether the trend is significant or not using a null hypothesis H_0 m = 0 where m is the slope of regression line

P value is calculated,if P value is less than 5% then detrending is done otherwise not

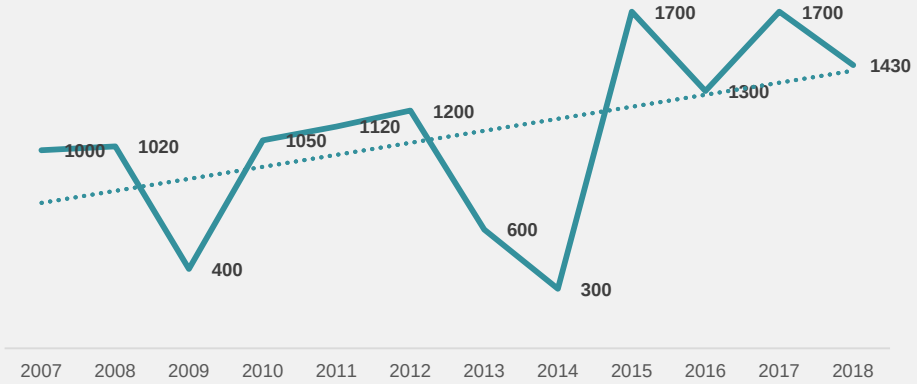
The P value depends on:

- The variability of data around the trend line
- The magnitude of the trend
- The length of the time series

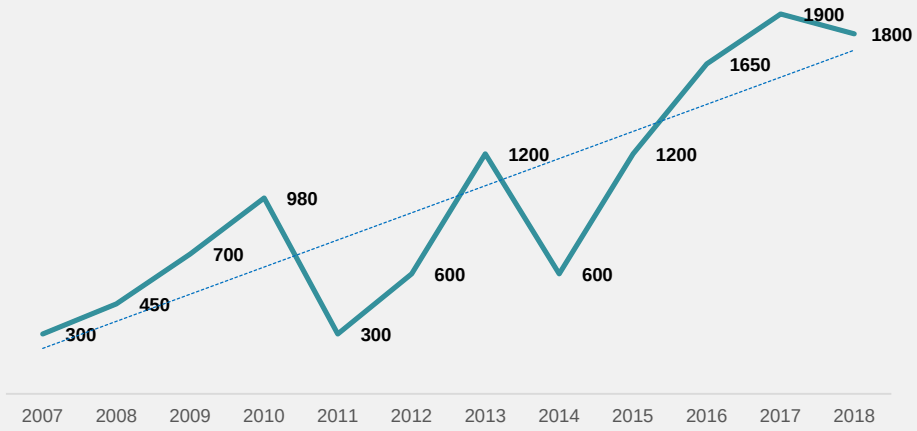
Slope 60 , P-value 1.95%



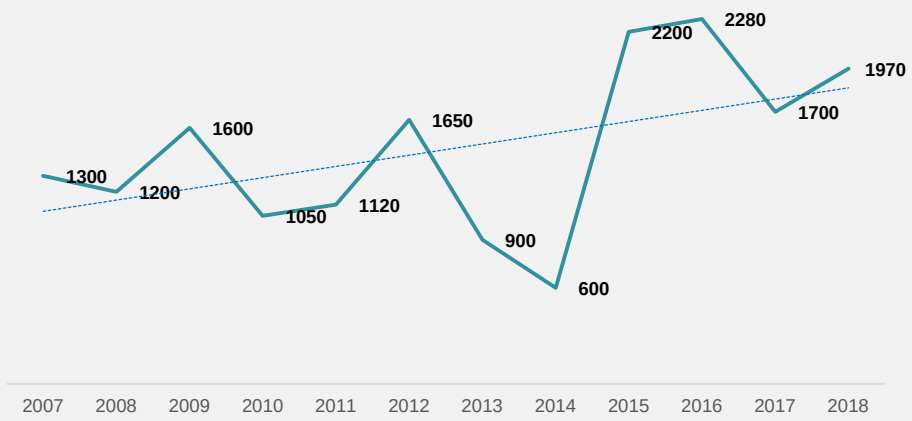
Slope 60 , P-value 11.28%



Slope 135 , P-value .05%



Slope 70 , P-value 11.20%



Heterogeneity in crop insurance pricing

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What Is Heterogeneity

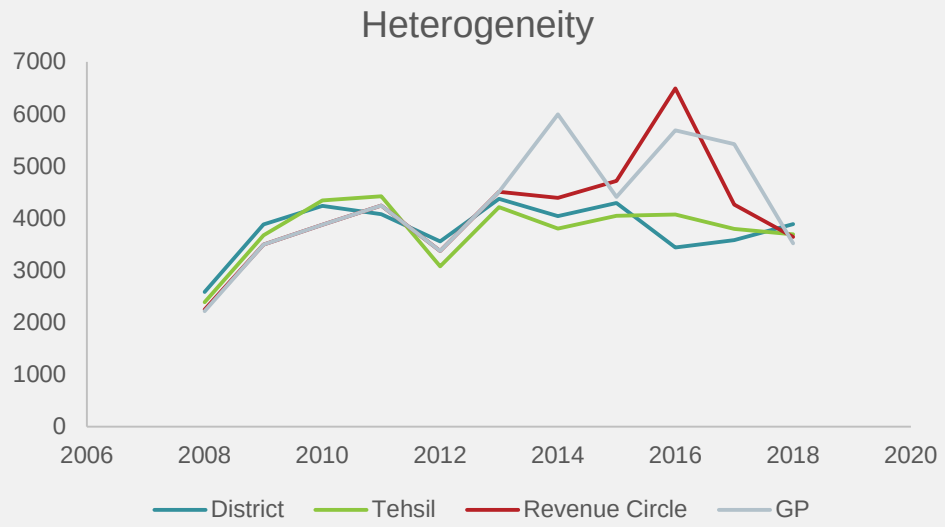
- Heterogeneity risk arises due to difference in the granularity of data used for pricing the contracts and settlement of claims
- For instance, if the data is available at Block level for pricing and settlement unit is Gram Panchayat (GP)

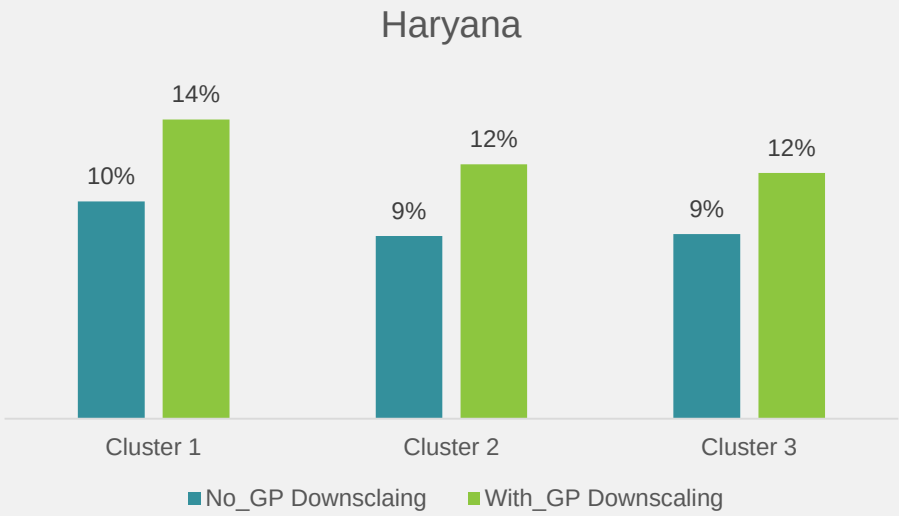
How it impacts

- Smaller administrative units tend to show higher volatility than higher aggregation levels the reason is when we average the data to calculate the higher level yield negative deviations are offset by positive deviations, This reduction in volatility leads to under pricing of risk

Solution for Heterogeneity

- To compensate the under-pricing heterogeneity loading or GP down scaling is done
- The downscaling procedure involves the following steps for each GP:
  - Calculate block averages across all years
  - Flag years that show difference between yield values and block averages. Those years are interpreted as GP level
  - Calculate the ratio between GP and Block values for flagged years
  - Calculate the average and the standard deviation of the ratios over the flagged years.
  - Use those to simulate 100 GP values for each year based on a normal distribution. The minimum and maximum standard deviations of the rations for the simulations are 0.1 and 0.5, respectively. Average ratios are capped between p2 and p98 to exclude outliers.
  - If a year is flagged as GP, duplicate the yield value 100 times, otherwise multiply values of step 5 by the block average





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Thank You..!!

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