BASIS RISK IN INDEX INSURANCE

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Outline

- Why index insurance?
- Architecture of Indian crop insurance
- Coverage: The Numbers
- Basis Risk: Yield Vs Weather
- Weather Index: Product Basis Risk
- Weather Index: Spatial Basis Risk
Index Insurance

**Index (Parametric) insurance** is a type of **insurance** that does not indemnify the pure loss, but **ex-ante** agrees to make a payment upon the occurrence of a triggering event.

‘**Homogenous area**' approach based insurance envisages that in the absence of reliable data of individual farmers and in view of the moral hazard involved in the 'individual approach', a homogenous area comprising villages that are homogenous from the point of view of crop production and whose annual variability of crop production is similar, would form the basic unit, instead of an individual farmer.
Index Based Crop Insurance: Rationale

- Non availability of past record of Yields, Land surveys, Ownership and Tenancy
- Large number of Small sized Farm-holdings (nearly 120 million / 1.2 hectare)
- Low value output per unit
- Difficulty in collection of small amount of premium from large number of farmers
- Prohibitive cost of Manpower and Infrastructure
- Asymmetric Information
- Systemic nature of Agriculture risks
Indian Crop Insurance – Architecture

- Specialty Insurance
- Open-top enterprise with systemic risk
- Credit linkage *(presently compulsory, but need not be in future)*
- Credit institutions also finance the premium (in addition to crop loan)
- Insurance acts as collateral, and lending agencies have the first lien on claim
- Risk covered is based on production cost (safety-net)
- Being ‘index’, claims process is automated
- Multi-Agency Platform *(administratively convenient, but insurer doesn’t have full control)*
- Government provides for about 2/3rd cost of the program
- Being a instrument with social dimension, the government has a larger say
- Private insurance providers are allowed for actuarially priced programs, and enjoy same level of support as public insurer
## Index Based Crop Insurance
### Progress: 2011-12

<table>
<thead>
<tr>
<th>Program</th>
<th>Farmers (Millions)</th>
<th>Hectares (Millions)</th>
<th>Sum Insured (US $ Millions)</th>
<th>Premium (US $ Millions)</th>
<th>Program Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAIS</td>
<td>16.731</td>
<td>22.947</td>
<td>7415.29</td>
<td>219.22</td>
<td>Administered</td>
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<tr>
<td>WBCIS</td>
<td>11.63</td>
<td>15.648</td>
<td>4179.99</td>
<td>370.28</td>
<td>Actuarial</td>
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<tr>
<td>MNAIS</td>
<td>1.084</td>
<td>1.182</td>
<td>730.56</td>
<td>66.67</td>
<td>Actuarial</td>
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<tr>
<td>TOTAL</td>
<td>29.445</td>
<td>39.777</td>
<td>12325.84</td>
<td>656.17</td>
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</tbody>
</table>

Source: Agriculture Insurance Company of India

Index Insurance: Basis Risk

_Difference_ between the value of losses as measured by the _index_ and the value of losses experienced on the _farm_ (by the farmer)
Yield Index Insurance – Basis Risk

Challenges:
Units are administrative (rather than homogenous)
Cost of Yield estimation surveys

Solution:
Lowering the insurance unit
Separate irrigated and rain-fed crop
Satellite imagery
Weather Index Insurance: Basis Risk

Challenges:
- Product Basis Risk
- Spatial Basis Risk
- Weather Station Infrastructure & maintenance

Solution:
- Agronomic models
- Low frequency & High Impact events (Catastrophe events)
- Macro Product
- Increased weather station density
- New Technologies (TOPS etc.)
# Indian Weather Insurance: Growth

<table>
<thead>
<tr>
<th>Agricultural year</th>
<th>Farmers insured</th>
<th>Crop insured (hectares)</th>
<th>Sum insured (INR millions)</th>
<th>Premium (INR millions)</th>
<th>Payouts (INR millions)</th>
<th>Claim ratios (%)</th>
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<tbody>
<tr>
<td>2003-04</td>
<td>1000</td>
<td></td>
<td></td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
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<tr>
<td>2004-05</td>
<td>11300</td>
<td></td>
<td></td>
<td>9.00</td>
<td>4.50</td>
<td>50.00</td>
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<tr>
<td>2005-06</td>
<td>125975</td>
<td>98747</td>
<td>579.00</td>
<td>32.27</td>
<td>2.38</td>
<td>7.38</td>
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<tr>
<td>2006-07</td>
<td>181900</td>
<td></td>
<td></td>
<td>72.00</td>
<td>45.00</td>
<td>62.50</td>
</tr>
<tr>
<td>2007-08</td>
<td>711012</td>
<td>1135186</td>
<td>19910.00</td>
<td>1506.34</td>
<td>1168.02</td>
<td>77.54</td>
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<tr>
<td>2008-09</td>
<td>396870</td>
<td>538826</td>
<td>9661.00</td>
<td>879.33</td>
<td>709.21</td>
<td>80.65</td>
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<tr>
<td>2009-10</td>
<td>2438762</td>
<td>3513379</td>
<td>50161.00</td>
<td>4508.22</td>
<td>3508.02</td>
<td>77.81</td>
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<td>2010-11</td>
<td>9391889</td>
<td>13351994</td>
<td>144848.00</td>
<td>13025.82</td>
<td>6381.47</td>
<td>48.99</td>
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<td>2011-12</td>
<td>11630319</td>
<td>15648189</td>
<td>209165.00</td>
<td>18529.05</td>
<td>11507.85</td>
<td>62.11</td>
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</table>

Source: Collation from various sources, including AIC
Product Basis Risk
Pearson’s correlation coefficient between yield loss and Weather Payouts

<table>
<thead>
<tr>
<th>Product Designs</th>
<th>Correlation (%)</th>
<th>t-value</th>
<th>P-value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KeyFI-Kharif</td>
<td>49.68</td>
<td>3.754</td>
<td>0.56</td>
</tr>
<tr>
<td>ARFI-Kharif</td>
<td>47.38</td>
<td>3.528</td>
<td>0.78</td>
</tr>
<tr>
<td>MARKET-Kharif</td>
<td>30.31</td>
<td>2.086</td>
<td>7.05</td>
</tr>
<tr>
<td>INFOCROP-Kharif</td>
<td>16.91</td>
<td>1.125</td>
<td>29.31</td>
</tr>
<tr>
<td>CRIDA-Rabi</td>
<td>45.23</td>
<td>3.326</td>
<td>1.05</td>
</tr>
<tr>
<td>INFOCROP-Rabi</td>
<td>32.11</td>
<td>2.223</td>
<td>5.69</td>
</tr>
<tr>
<td>MARKET-Rabi</td>
<td>47.58</td>
<td>3.547</td>
<td>0.75</td>
</tr>
</tbody>
</table>
Product Designs: Worst Loss Scenario

**Kharif - worst case scenario**
- 91% Yield loss
- 30% KeyFi
- 26% ARFI
- 20% Market
- 27% INFOCROP

**Rabi - worst case scenario**
- 70% Yield shortfall
- 50% CRIDA
- 50% INFOCROP
- 20% Market

- Rainfall
- Heat (Max. Temp)
Kharif: Scatter plots and Kernel regressions for different sets of products

**Complete WBCIS cover 2011**

- **X-axis:** Tehsil average yield, as percentage of average historical yield 1999-2011
- **Y-axis:** WBCIS claim payouts, as percentage of average historical claim payment

**Complete WBCIS cover 2012**

- **X-axis:** Tehsil average yield, as percentage of average historical yield 1999-2011
- **Y-axis:** WBCIS claim payouts, as percentage of average historical claim payment
Kharif: Linear payout of payout probabilities and yield loss
Spatial Basis Risk
Spatial Basis Risk
Scatter plots for conditional probabilities and distances (spatial basis risk)

Rainy Days

One-Day Max. Rainfall
Scatter plots of standard deviations with distances
**Basis Risk (on Relative Terms)**

<table>
<thead>
<tr>
<th></th>
<th>With Govt. Subsidies</th>
<th>W/o Govt. Subsidies</th>
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</thead>
<tbody>
<tr>
<td><strong>Product Basis Risk</strong></td>
<td>HIGH</td>
<td>LESS</td>
</tr>
<tr>
<td><strong>Spatial Basis Risk</strong></td>
<td>LESS</td>
<td>HIGH</td>
</tr>
</tbody>
</table>
Thanks!