Agro-disaster Assessment with Satellite Data for Crop Insurance Payments

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“A superior person cares justice and morality, while a villain keeps his mind only on benefits”.

• Confucius
Outline

• Agriculture Insurance in China
• Agro-disaster Assessment
  – Maize Floods
  – Cotton Floods
• Conclusion
Agriculture Insurance in China

- Chinese government emphasized the importance of agriculture and published 9 documents of “No.1 Central Document” since 2004.

- The government canceled all agricultural tax in 2006.
Agriculture Insurance in China

- Policy agricultural insurance in China was officially launched in 2006. The central finance 50% of the premiums, provincial and county finance 10-30%, the rest is paid by the farmers. For example, in Shandong province, the farmers will paid premiums like:

<table>
<thead>
<tr>
<th>crop</th>
<th>Premium</th>
<th>Payment</th>
<th>Disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>10 RMB <strong>per mu</strong></td>
<td>320 <strong>per mu</strong></td>
<td>Fire, hail, windstorm, freezing disaster, floods, drought, pest</td>
</tr>
<tr>
<td>Maize</td>
<td>10 RMB <strong>per mu</strong></td>
<td>300 <strong>per mu</strong></td>
<td>Hail, floods, windstorm</td>
</tr>
<tr>
<td>Cotton</td>
<td>18 RMB <strong>per mu</strong></td>
<td>450 <strong>per mu</strong></td>
<td>Hail, floods</td>
</tr>
</tbody>
</table>
The agriculture insurance industry include serious risk factors

- Adverse selection, moral hazard, low efficiency of indemnity after disasters, high transactional costs, and large damage assessment errors.
- “Premium rates for the national agriculture insurance programs are negotiated between the insurers and provincial governments.”
Remotely Sensed agriculture insurance models have been developed to overcome the effects of adverse selection and moral hazard in traditional insurance models; Remote sensing information will facilitate fair negotiations, and the affected farmers will get compensation.
The study area were affected by rainstorm and typhoon-storms in the end of 2012 July and in early August.
Disaster Reasons

- Crop was in key growth phase and sensitive to flood.
- In addition, typhoon enhanced crop loss.

Cropland in Low plain: it was easy accumulated by water

Extremeness weather:
- Rainstorm
- “Dawei” Typhoon

Crop in key growth phase
Technology flow include

Identify: Crop distribution

Give: Payments

Do: Loss assessment

Do: Investigation

Identify: Crop distribution
Parcel extraction based on High resolution satellite data
Corn spatial distribution was extracted based on multi-temporal HJ-1 satellite imagery (pre-disaster)
Corn spatial distribution was extracted based on HJ data (post-disaster)
Damage Threshold: no harvest corn

Vegetation

Bare land
The crop growth rate can reduce the impact of crop phenology.

The greater the growth rate, indicating that the crop, the better!
Growth rate = \frac{NDVI_{post} - NDVI_{pre}}{NDVI_{pre}}

\[
\begin{align*}
\text{Damage:} & & \frac{\text{Growth rate (this year)}}{\text{Growth rate (Historical years) } - \sigma} < 1 \\
\text{No damage:} & & \frac{\text{Growth rate (this year)}}{\text{Growth rate (Historical years) } - \sigma} \geq 1
\end{align*}
\]
About 5 million mu have no harvest, it means that 30,000 farmers living received threat!!
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The average growth rate in 2010: 13.91%
The average growth rate in 2011: 22.46%
The average growth rate in past two years: 18.18%
Cotton Damage Threshold by remote sensing

- **normal**, slightly affected, severely affected, and no harvest

- **Severe**: NDVI (in boll peak period) < NDVI (in blooming period).

- **Affected**: the growth rate in 2012 is less than the mean for the past 2 years (excluding severe and no harvest).

- **No harvest**: The cotton fields were vegetation before flood and in the end of September is bare land or water.
The statistical histogram of cotton growth rate

- Severe
- Affected

NDVI change

Pixels (Thousand)
The thematic map of cotton loss by floods
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Conclusion

• crop phonology is very important!

• Remote sensing information will facilitate fair negotiations.
Questions?
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THANK YOU