Remote sensing for index insurance in smallholder agriculture

Findings and lessons from testing in Senegal

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Overview of the project
Remote sensing for index insurance

• IFAD-WFP WRMF project, financed by AFD and BELSPSO, from 2012 to 2017

• Evaluate feasibility of remote sensing for index insurance to benefit smallholder farmers at village level

• Develop, test, validate, evaluate opportunities and constraints of indices created by different remote sensing methodologies

• Test-case Senegal, but results to be disseminated across the industry, and feed into IFAD and WFP programmes
Remote sensing for index insurance

• “Traditional” insurances
  • Damage assessment by experts
  • Expensive

• “Index insurances”
  • Pay-out based on a “regional” index
## Remote sensing for index insurance

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Transparency</td>
<td>Basis risk</td>
</tr>
<tr>
<td>No on-farm loss adjustment</td>
<td>Limited perils</td>
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<tr>
<td>Eliminates adverse selection</td>
<td>Technical capacity and expertise</td>
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<tr>
<td>Eliminates moral hazard</td>
<td>Lack of data</td>
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<td>Low operational and transaction costs</td>
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<td>Rapid pay-out</td>
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Remote sensing for index insurance

- Central Senegal
- 3 sites in: Diourbel, Nioro, Koussanar
- 20 km * 20 km test sites
- Groundnut; Millet; Maize
## Remote sensing for index insurance

<table>
<thead>
<tr>
<th>RSSP</th>
<th>Type of product/approach</th>
<th>Remote sensing data used</th>
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<tbody>
<tr>
<td>EARS</td>
<td>Relative evapotranspiration</td>
<td>MSG based relative ET (3km x 3km)</td>
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<tr>
<td>FewsNet</td>
<td>Actual evapotranspiration</td>
<td>MODIS based actual ET (1km x 1km)</td>
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<tr>
<td>Geoville</td>
<td>Radar-based estimation of soil moisture</td>
<td>ERS (50km x 50km)</td>
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<td></td>
<td>SoS based on Soil Water Index</td>
<td>METOP ASCAT (50 km × 50 km; 25 km × 25 km resampled to 10 km × 10 km)</td>
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<tr>
<td>IRI</td>
<td>Rainfall Estimates</td>
<td>NOAA based RFE2 ARC (10km x 10km)</td>
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<tr>
<td>ITC</td>
<td>Vegetation indices (NDVI)</td>
<td>SPOT-VGT NDVI (1km x 1km)</td>
</tr>
<tr>
<td>VITO</td>
<td>Vegetation indices (NDVI and fAPAR)</td>
<td>SPOT-VGT NDVI / fAPAR (1km x 1km)</td>
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<tr>
<td></td>
<td>SoS based on Rainfall Estimates</td>
<td>TAMSAT rainfall estimates (4 km × 4 km)</td>
</tr>
<tr>
<td>sarmap</td>
<td>Radar crop maps and SoS indicators</td>
<td>CosmoSkyMed (15m x 15m)</td>
</tr>
<tr>
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<td>Sentinel 1A (20m x 20m)</td>
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</table>
Remote sensing for index insurance

A useful distinction is to classify remote sensing methodologies in “Input-based” and “Output-based”

• **Input-based** methodologies focus on measuring specific inputs to the production process (e.g. rainfall); other sources of production risk (e.g. pests and diseases) are not captured by the indices. *Rainfall Estimates and Soil Moisture are considered “Input-based”*

• **Output-based** methodologies measure variables connected to the production output (e.g. amount of vegetation, evapotranspiration) and, therefore, are likely to more closely match yield variations generated by drought and by other sources of risk. *Evapotranspiration, Vegetation Indices and SAR are considered “Output-based”*
Remote sensing for index insurance

The performance assessment of the index structures developed by the RSSPs is composed of two parts:

1. **Historical Performance Analysis**: to show how well the methodologies can replicate crop loss over past years in specified areas. It indicates the effectiveness of design and calibration.

2. **Product Testing**: gauges how well the methodologies can “predict” losses, analysing and assessing their performance in comparison with data specifically collected by the project (unfortunately limited observations available).
Conclusions and recommendations
Conclusions/recommendations

OPERATIONAL APPLICABILITY

1. Availability of *expertise and dedicated service providers* is a key challenge
2. Knowledge of land use, local farming practices, agronomy and agro-meteorology is necessary
3. Remote sensing data are increasingly available, but there are *constraints on supplementary data* in terms of availability and cost
4. The insurance *regulatory authorities* need to be involved and have, generally, been supportive of initiatives for remote sensing index insurance, provided consumer interests are properly protected
5. *Consumer education* will be a key component of success
Conclusions/recommendations

Technical Features

1. **Yield variability** between individual farmers in the ROIs can create challenges in operating index insurance.

2. **Input-based and output-based methodologies offer different options** for index insurance.

3. **Ground signal is complex** for output-based remote sensing interpretation of smallholder farms.

4. **The methodologies cannot discriminate** between yield performance of different crop types in highly mixed cropping areas at a local (village) level.

5. **Basis risk remains the main concern** to both insurers and insured farmers.
Conclusions/recommendations

PERFORMANCE (1/2)

1. The lack of appropriate yield data and ground information is one of the primary challenges in designing and testing index insurance.

2. Product design has a critical influence on performance.

3. Project analyses show that, overall, the historical performance of the index insurance structures (i.e. their ability to replicate the past history of losses to be covered by the insurance proposition) is suboptimal.

4. Crop maps and masks can improve performance.
Conclusions/recommendations

PERFORMANCE (2/2)

5. Methodologies based on vegetation indices seemed to track loss histories more accurately (may be due to the use of crop maps and masks, and the combination of remote sensing approaches).

6. Product testing activities indicate that the index structures developed would not have tracked yield variability to a satisfactory level.

7. Performance of the remote sensing methodologies developed for the project varies across different crops and areas.

8. Remote sensing methodologies can be usefully adopted for identifying key stages of the crop life such as the start of season (SoS) or the end of season (EoS) date.
THANK YOU

remotesensing.vito.be