Remote Sensing-based Information and Insurance for Crops in Emerging Economy

Improving Crop Production Monitoring and Agricultural Insurance Solutions through Satellite Technology
Feeding seven billion people requires a 70% increase of food production until 2050.

**Crop insurance** helps to decrease the vulnerability of smallholder farmers and better **crop growth information** helps Governments and NGOs to mitigate the impact of food shortages.
RIICE project set-up: targets, tasks, partners & timeline

**Aims**

1. Helping Governments and NGOs to better plan for food crises through better crop monitoring.

2. Increasing efficiency and effectiveness of crop insurance solutions and turn it into a viable business also in emerging markets.

**Partner**

- **sarmap**
  - Satellite data procurement & processing
  - Ground validation & yield modelling

- **giz**
  - In-country support in three countries; implementation, access to policymakers,

- **IRRI**
  - Ground validation & yield modelling

- **Allianz**
  - Insurance product development

**Timeline**

- **Phase I: Test phase**
  - Technical proof of concept; «dry-test» of satellite-supported insurance products
  - 02/2012

- **Phase II: Scale-up phase**
  - Nation-wide upscaling of yield monitoring in collaboration with governments.
  - Implementation of insurance solutions.
  - 05/2015
  - 04/2018
Help Governments and NGOs to better plan for food crises through better crop monitoring.
Information on rice production and losses

- How much area was planted this season?
- What was the yield in each town or province?
- Was production more or less than last year?
- Was the harvest early or late?
- Was there a storm, flood or drought?
  - Where and how much area was affected?
  - How many tons of rice were lost?
Users of this information

• **National governments** at regional and national level at frequencies matching national reporting requirements, i.e. every quarter.

• **Traders** at national level with sufficient lead time, i.e. 60 or 30 days before harvest

• **Insurance providers** at local level and immediately after the season is completed

• **Disaster response** local level of detail, frequency is as needed.
What is the advantage of SAR remote sensing?

RIICE uses SAR data free of charge from ESA (European Space Agency) Sentinel 1 mission: 20m resolution, 12 day repeat frequency

- **Passive sensors** do not emit their own radiation, but receive natural light and thermal radiation from the earth's surface.
- Can not be operated in the night and in the case of cloud coverage (often during cropping season)

- **Active sensors** are weather and sunlight independent: artificial microwave radiation can penetrate clouds, light rain and snow.
- Hardly affected by clouds, dust, fog, wind and bad weather conditions
Rice Field from Optical and Radar RS

Image from optical satellites
(=> cloud coverage)

Image from radar satellites
(=> clear image)
**RIICE** has been demonstrating the technology in 13 sites of 6 Asian countries for the last three years.
Close-up look: Validating remote sensing data on the ground

- Green = Full developed rice
- Red = Flooded rice (losses)
- Blue = Soil covered partially with water before rice flooding

Soc Trang Province, 7 September 2012
What information can be delivered: Rice area estimates

Where?:

Rice map classification accuracy (%) is based on comparison against 100 ground truth points per footprint. Consistently above 85% in all 13 RIICE sites.

Nam Dinh in the Red River Delta

Soc Trang in the Mekong River Delta
What information can be delivered

**When?** Start of the season

Start of Season (SoS) is an important variable for yield estimation. It also reveals any heterogeneity in planting, which has crop health and management implications. It also shows if a season is early or delayed which has implications for imports/exports and also for distribution of crop insurance (e.g. sales cut off).
Yield forecasts during the season and final estimates are the most important variable for food security monitoring and the input variable for crop insurance solutions, i.e., the trigger variable which determines a payout. Compared against crop cut experiments (CCE), the yield accuracy at district level was 91% in Soc Trang and 97% in Nam Dinh.
Post-disaster information on rice crop losses after typhoon Haiyan were submitted by RIICE within few days to the Department of Agriculture of the Philippines: The satellite-generated map shows that flooding (in blue colour) has affected about 1,800 hectares of standing rice crop (in green colour) across 15 municipalities.
... Increase efficiency and effectiveness of crop insurance solutions and turn it into a viable business also in emerging markets.
The rice crop is observed by remote sensing and fieldwork through the season, resulting in rice crop status maps.

The remote sensing data is linked to a crop growth model to estimate and forecast rice crop yield by district or village.

Area, and yield information are used to develop insurance products that cover the farmer’s shortfall in production due to natural disasters.

Distribution channels (rural lending banks, cooperatives, rice mills) are being identified and trained to roll out the insurance product.

In some countries government is providing compulsory insurance cover for farmers. In some countries local insurers sell the product through a distributor on a voluntary basis.
RIICE Business Model: Multi-stakeholder partnership to deliver crop insurance

Government provides insurance premium subsidies (up to 100%) motivated to
a.) stabilize farmers incomes
b.) keep national budget less volatile

International reinsurance market provides risk capacity

Local insurance company issues policies and administers the insurance claims

Aggregator (rural bank or commune) manages distribution of insurance policies

Allianz develops insurance product

IRRI provides yield data

GIZ and SDC build capacity and facilitate policy dialogues

sarmap provides remote sensing technology
How can the RIICE technology be used in crop insurance: Area-yield index insurance (AYII)

**Concept**
- RIICE delivers satellite-based yield estimates.
- This figure can be used in operating an AYII product. Other than the known weather index-insurance which uses rainfall estimates as a proxy for yield results, AYII directly operates with yield estimates.
- Farmers in a particular district are indemnified, if this season’s average district yield is below a certain percentage of the average historical yield of the district

**Coverage**
- Perils: All perils covered that affect average district yield
- Farmer can buy optional coverage levels (typically between 50% -90%) of the historic average yield

**Claims assessment**
- No timely and costly field inspections necessary
- Use of satellite-based estimation of crop yields for claims assessment
How can the RIICE technology be used in crop insurance: Area-yield index insurance (AYII)

Satellite-based yield loss estimates can be used as a trigger for insurance payouts

The area-yield index insurance product in this example indemnifies the farmer if the average district yield is below the threshold of 500 kg/rai (80% of the historical yield).

This product does not operate on an individual field level, but takes the district yield as a proxy.

SAR data is used to provide accurate and timely estimates of district yield.

=> There would have been a payout in 2006 and 2011.
Growing Asian crop insurance market

RIICE offers governments and insurance providers in the RIICE countries to operate their existing or newly planned crop insurance schemes / disaster relief schemes on the basis of SAR-delivered information on:

- Rice area: Where?
- Start and status of the season: When?
- Yield forecast, yield estimates and yield loss estimates: How much?

Through RIICE, crop insurance programmes can be made more efficient, accurate and transparent to ensure timely payouts to farmers in the case of extreme weather events.
Scaling up...

**Sentinel-1a**
- Launched 3\textsuperscript{rd}/April/2014 by ESA
- 12 day repeat frequency
- 20m resolution
- Free and open access to imagery
- SAR sensor – perfect for rice
- A second satellite - Sentinel-1b - will further increase monitoring capabilities, one image every 6 days