Rice Monitoring & Modeling at IRRI : Bringing geospatial & social science communities together for better Agri-food Policy to combat food insecurity and poverty

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OUTLINE

- Contextualizing the problem from a policy standpoint
- The role of remote sensing and geospatial technologies
- The need for an enabling environment and key policy issues
- Take away messages and conclusions

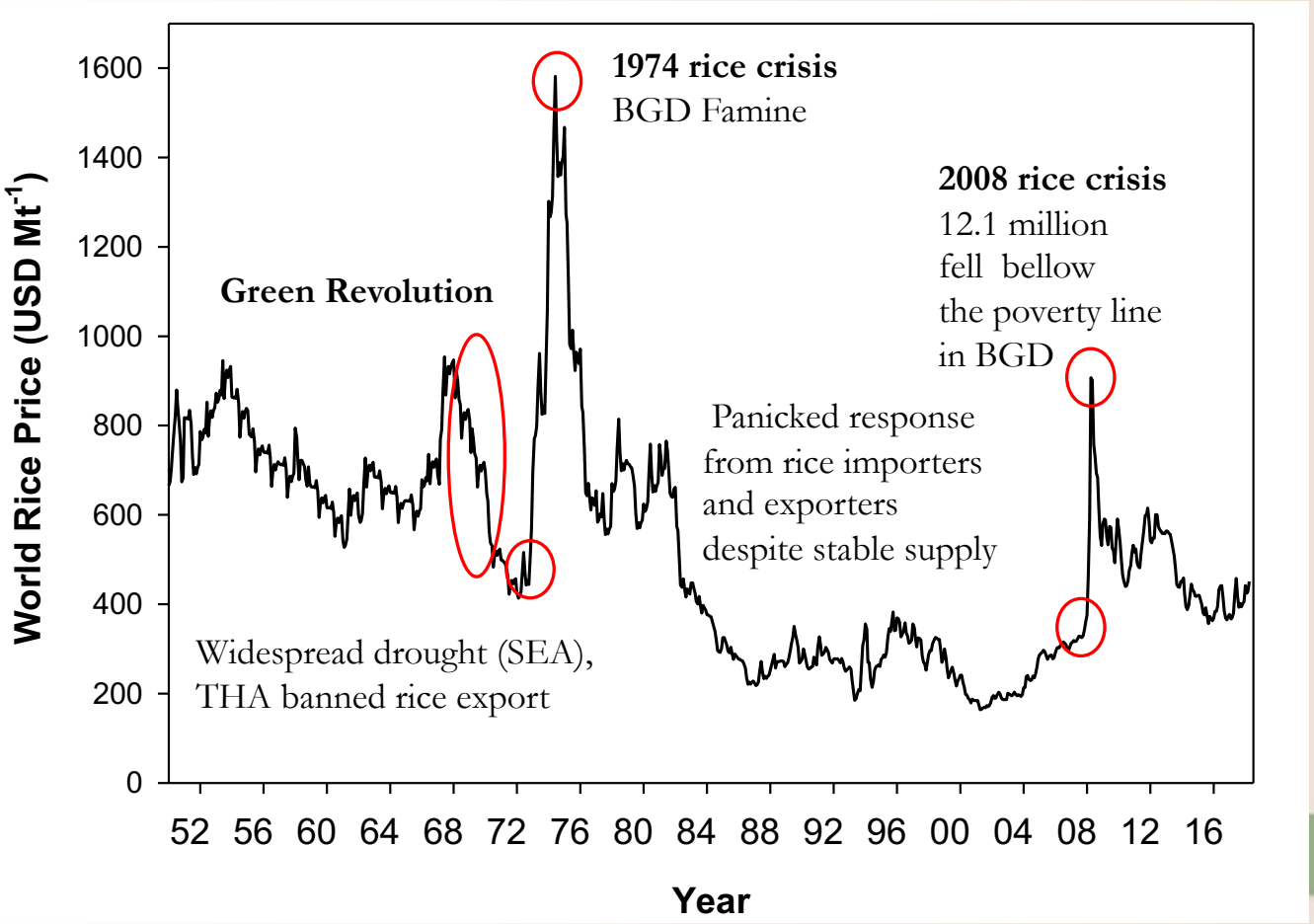
- 90% of rice is produced & consumed in Asia
- Over 70% (900 million) of the world's poor are in Asia
- Smallholder farmers represent 85% of the world's farms

-They face multiple production risks:

- Pest and disease outbreaks
- Extreme weather events
- Market shocks

Which technologies should policies promote to keep rice farmers in business?

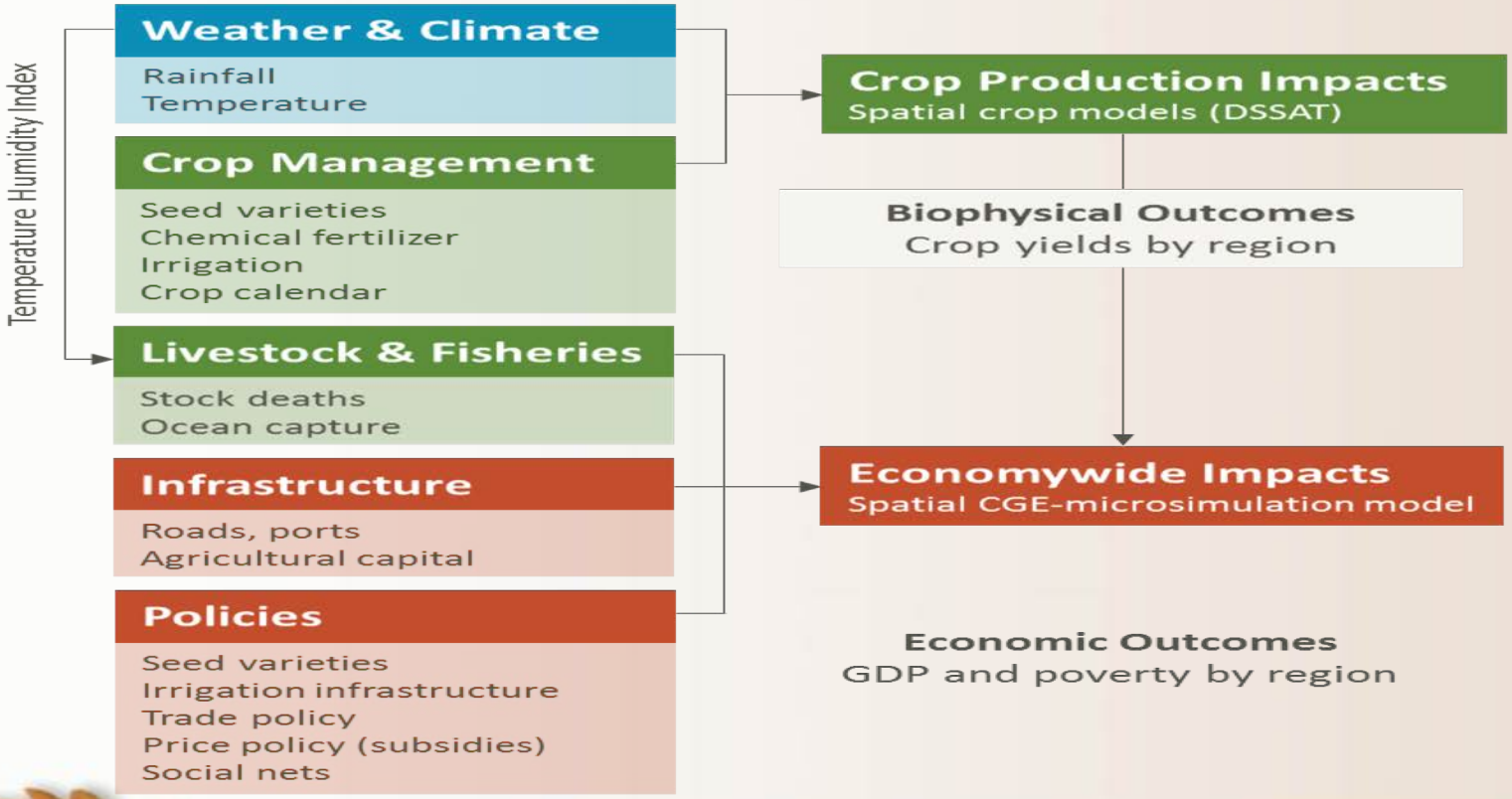
The need for timely reliable rice production information

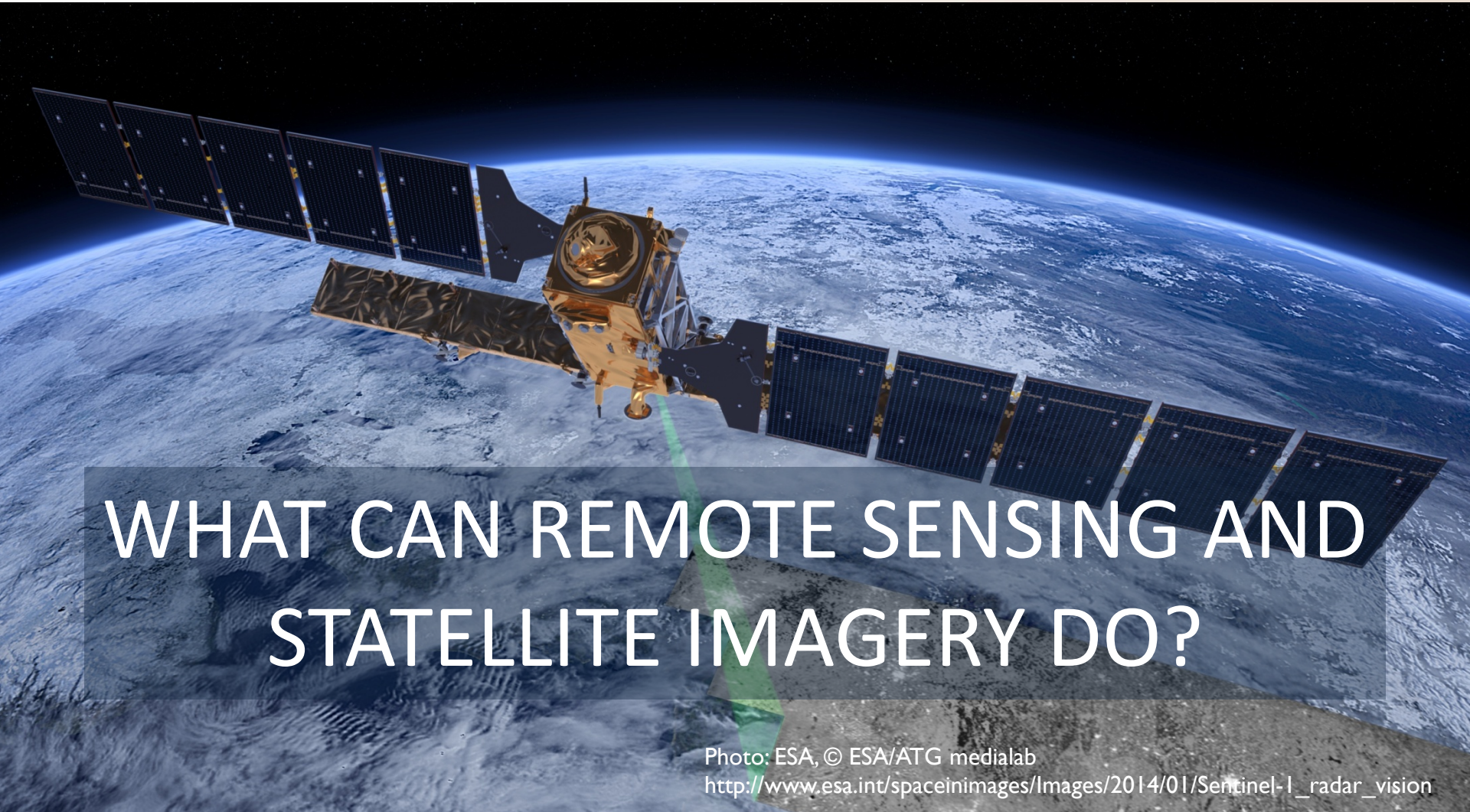


Contextualizing remote sensing technology promotion

- Suppose Asian governments are trying to achieve specific policy goals:
  - Enhance rice productivity
  - Stabilize markets
  - Increase incomes
  - Ensure food security primarily for the poor & vulnerable
- Complex problems with multiple entry points
- Geospatial technologies (RS) are only part of the solution
- Markets & policies shaping behaviors ultimately drive impact
- What are the linkages ?

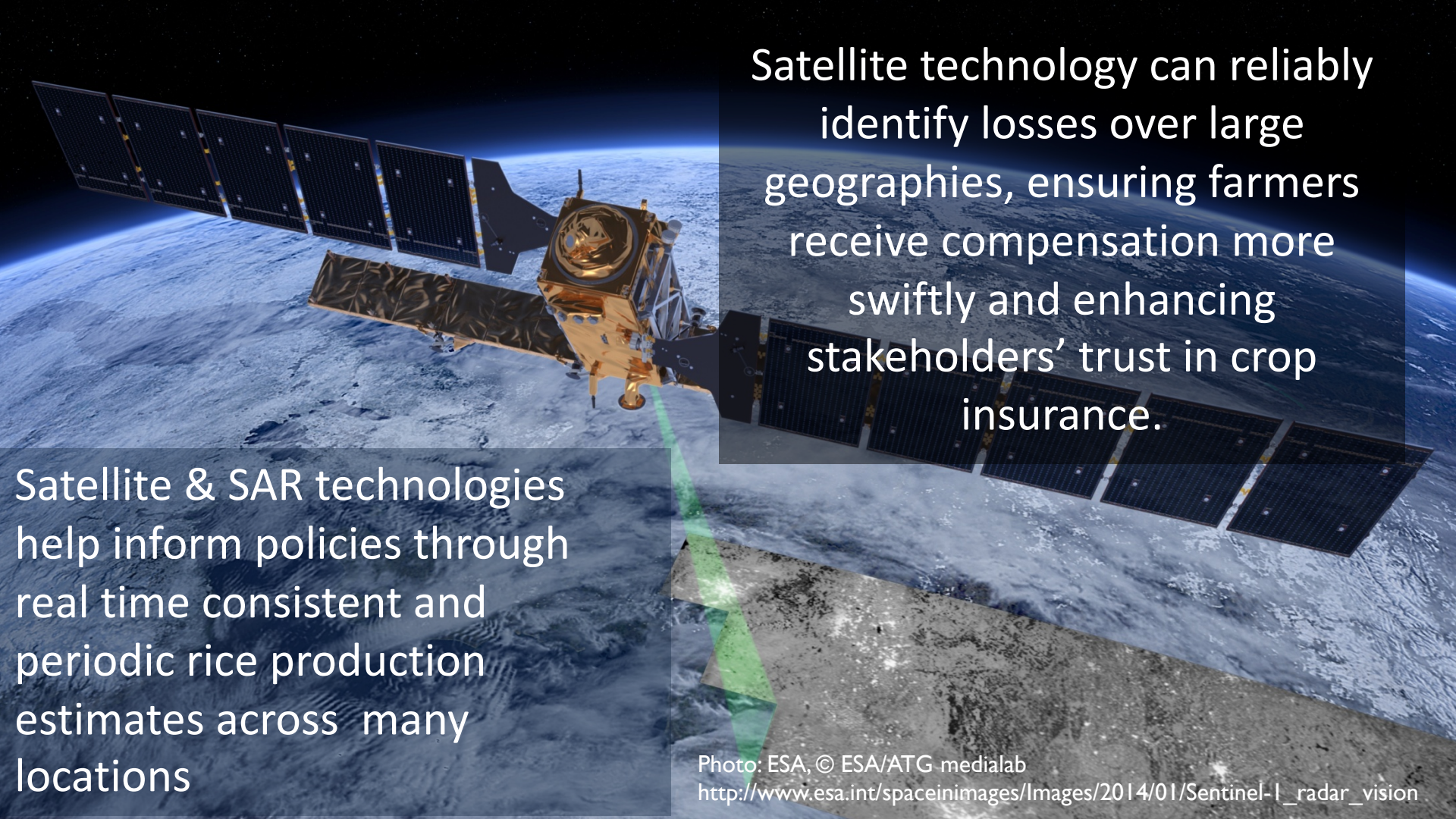
Spatial Agriculture-Economy Models





WHAT CAN REMOTE SENSING AND STATELLITE IMAGERY DO?

Photo: ESA, © ESA/ATG medialab
http://www.esa.int/spaceinimages/Images/2014/01/Sentinel-1_radar_vision



Satellite technology can reliably identify losses over large geographies, ensuring farmers receive compensation more swiftly and enhancing stakeholders' trust in crop insurance.

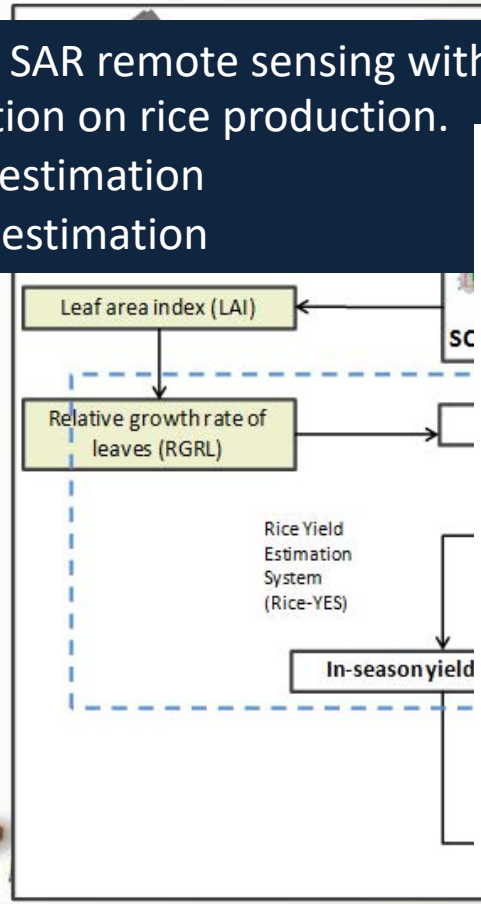
Satellite & SAR technologies help inform policies through real time consistent and periodic rice production estimates across many locations

Photo: ESA, © ESA/ATG medialab
http://www.esa.int/spaceinimages/Images/2014/01/Sentinel-1_radar_vision

SAR+ORYZA Rice Yield Estimation System

Merging SAR remote sensing with Crop Growth Model to provide real time information on rice production.

- Area estimation
- Yield estimation



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Article

Towards an Operational SAR-Based Rice Monitoring System in Asia: Examples from 13 Demonstration Sites across Asia in the RIICE Project

Andrew Nelson [1,*], Tri Setiyono [1,*], Arnel B. Rala [1], Emma D. Quicho [1], Jeny V. Raviz [1], Prosperidad J. Abonete [1], Aileen A. Maunahan [1], Cornelia A. Garcia [1], Hannah Zarah M. Bhatti [1], Lorena S. Villano [1], Pongmanee Thongbai [1], Francesco Holecz [2], Massimo Barbieri [2], Francesco Collivignarelli [2], Luca Gatti [2], Eduardo Jimmy P. Quilang [3], Mary Rose O. Mabalay [3], Pristine E. Mabalot [3], Mabel I. Barroga [3], Alfie P. Bacong [3], Norlyn T. Detoito [3], Glorie Belle Berja [3], Frenciso Varquez [3], Wahyunto [4], Dwi Kuntjoro [4], Sri Retno Murdiyati [4], Sellaperumal Pazhanivelan [5], Pandian Kannan [5], Petchimuthu Christy Nirmala Mary [5], Elangovan Subramanian [5], Preesan Rakwatin [6], Amornrat Intrman [7], Thana Setapayak [7], Sommai Lertna [7], Vo Quang Minh [8], Vo Quoc Tuan [8], Trinh Hoang Duong [9], Nguyen Huu Quyen [9], Duong Van Kham [9], Sarith Hin [10], Touch Veasna [10], Manoj Yadav [11], Chharom Chin [12] and Nguyen Hong Ninh [13]

Improving food security through satellite information

IRRI is leveraging technologies to generate timely, accurate and location-specific information

- **Where**, **when**, and **how much** rice is produced
- **Crop health**
- **Flood** and **drought damage assessments**

RIICE
Remote sensing based
Information and
Insurance for
Crops in
Emerging economies

PRiSM
Philippine Rice
Information System

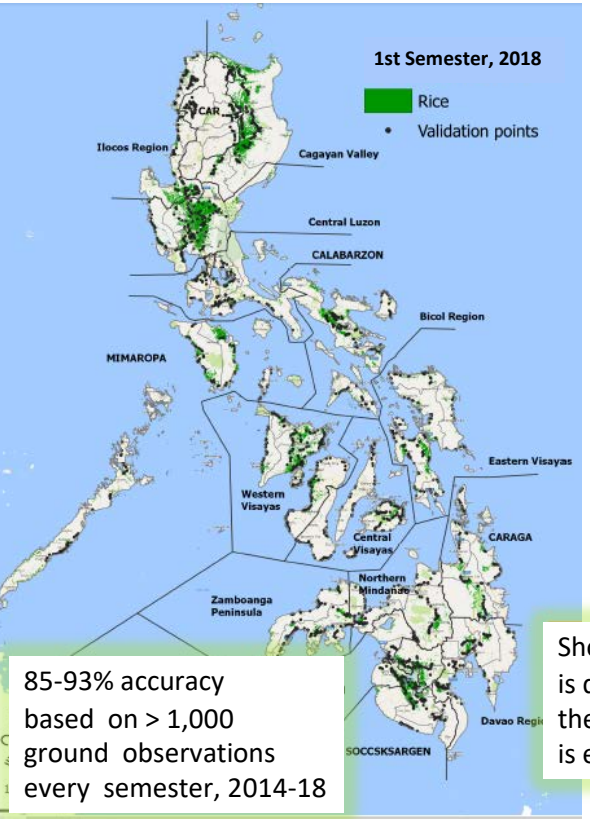
PRiSM
Philippine Rice
Information System

WHERE ...rice is grown

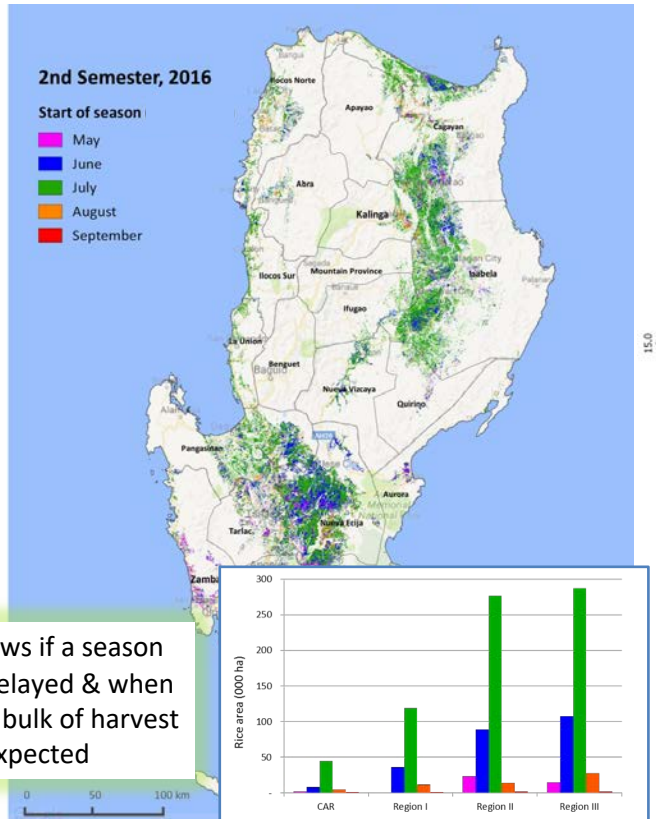
WHEN ...rice is grown

HOW MUCH ....the yield was

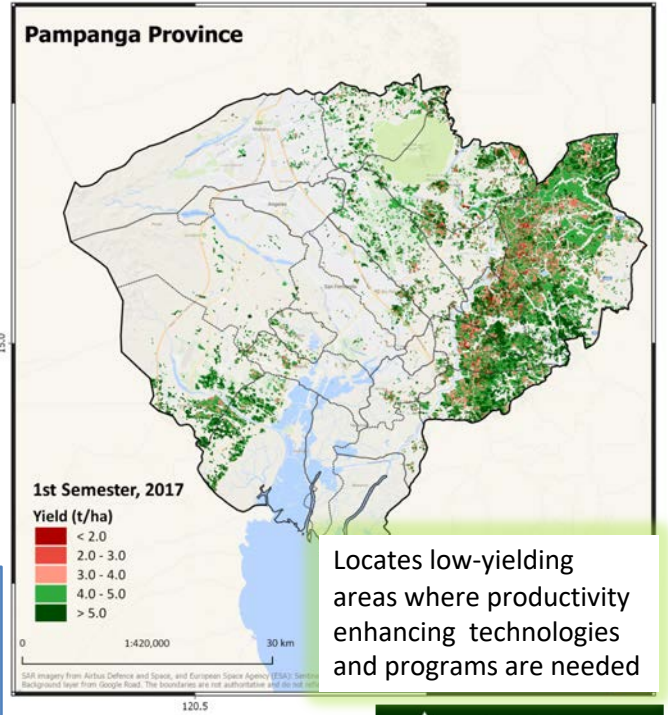
Philippines: 8 seasons of maps and data provided to the Department of Agriculture



85-93% accuracy based on > 1,000 ground observations every semester, 2014-18



Shows if a season is delayed & when the bulk of harvest is expected



Locates low-yielding areas where productivity enhancing technologies and programs are needed

PRiSM Philippine Rice Information System

RIICE Project Overview
Digitizing crop information for insurance

Aims

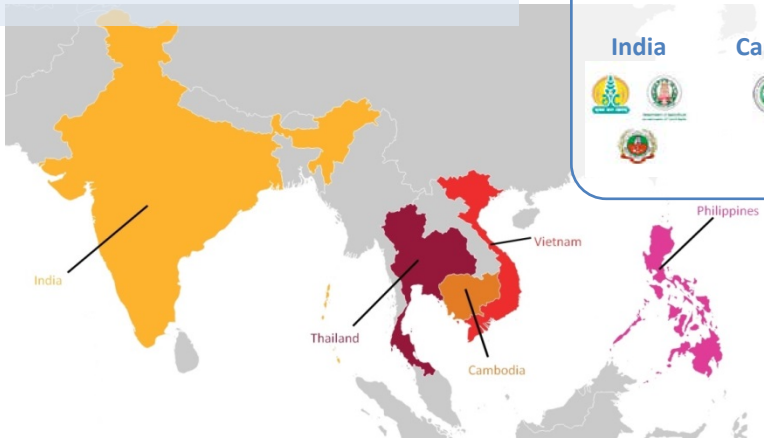
1. **Help Governments to better plan for food crises through better crop monitoring and forecasting**

2. **Increase efficiency and effectiveness of crop insurance solutions**

Timeline

- **2012-2015** — **Test phase**: Establishing technical proof of concept
- **2016-2017** — **Scale-up phase:** Uscaling & collaboration with governments
- **2018-2019** — **Integration phase**: Integrating RIICE solutions in existing crop insurance architecture

PRiSM Philippine Rice Information System



RIICE Partners

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Schweizerische Eidgenossenschaft — Swiss Agency for Development and Cooperation SDC

IRRI International Rice Research Institute

In-country support, implementation and funding (BMZ)

Ground validation & yield modelling

Swiss Re

Insurance product development, access to Reinsurance

sarmap

Satellite data procurement & processing

India | **Cambodia** | **Vietnam** | **Thailand**

BAOVIET

GISTDA

RIICE

RIICE technology value proposition in crop insurance for farmers

1. **Improve management of risk exposure for insurers through…**
   - > Information on rice area and avoid underinsurance
   - > Regular crop portfolio monitoring in target areas
   - > Early identification of losses - adjustment of loss reserves
   - > Flood / draught maps to establish scope of damage

2. **Improve insurance service for smallholder farmers through…**
   - > Product improvements with early/timely payouts in case of total loss or no sowing
   - > Higher transparency on loss and yield assessment

3. **Area Yield Index Insurance:** RIICE-based yield estimates to complement and eventually replace the official yield data

RIICE

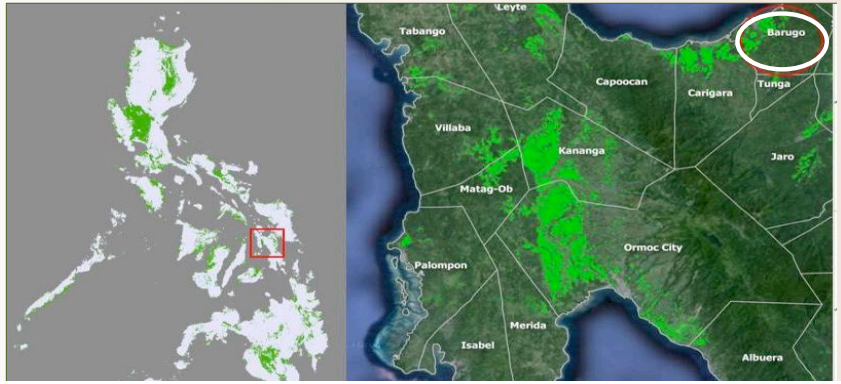
Application for Crop Insurance: Supporting Pradhan Mantri Fasal Bima Yojana(PMFBY) insurance program in Tamil Nadu, India

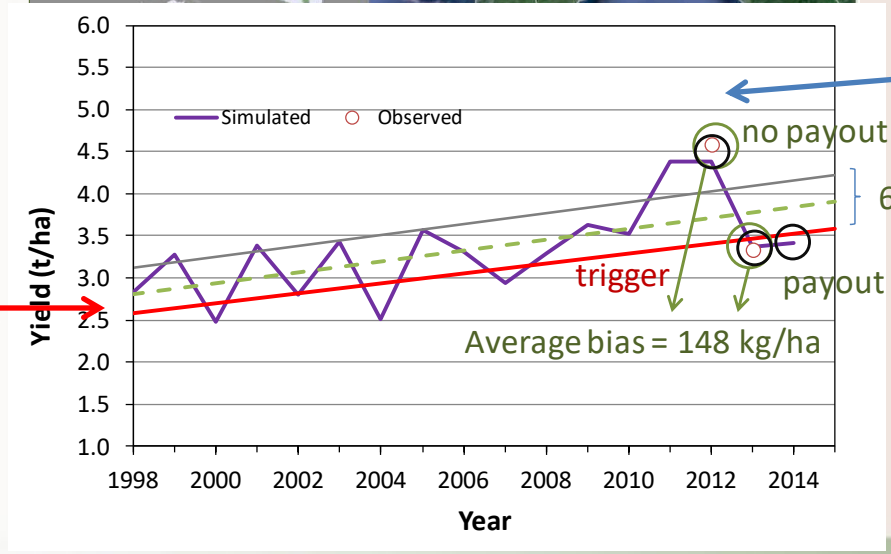
Bi-weekly information on crop growth status, derived by SAR-based Rice Monitoring System

Observations of anomalies in rice cultivation help to decision on **Preventive Sowing/ On Account Payment Cover**

End-of-season yield estimation at village level can guide **Crop Cutting Experiments (“Smart sampling”)**

Application for Crop Insurance: Area Yield Index Insurance



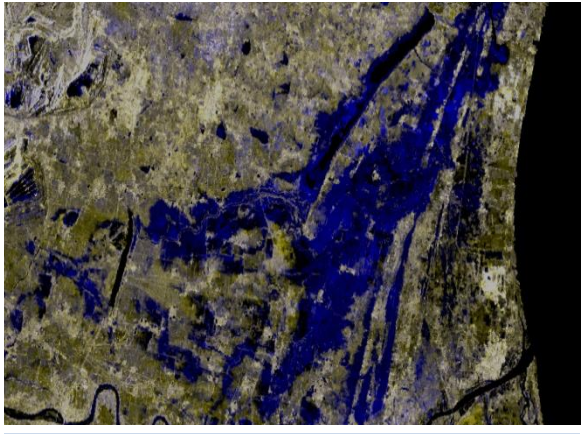


SAR (ex-ante)

Historical Yield

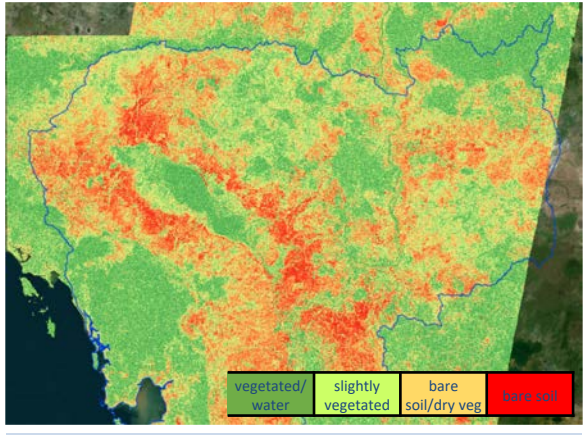
Flood and drought assessment

Tamil Nadu Flood in Nov 2015



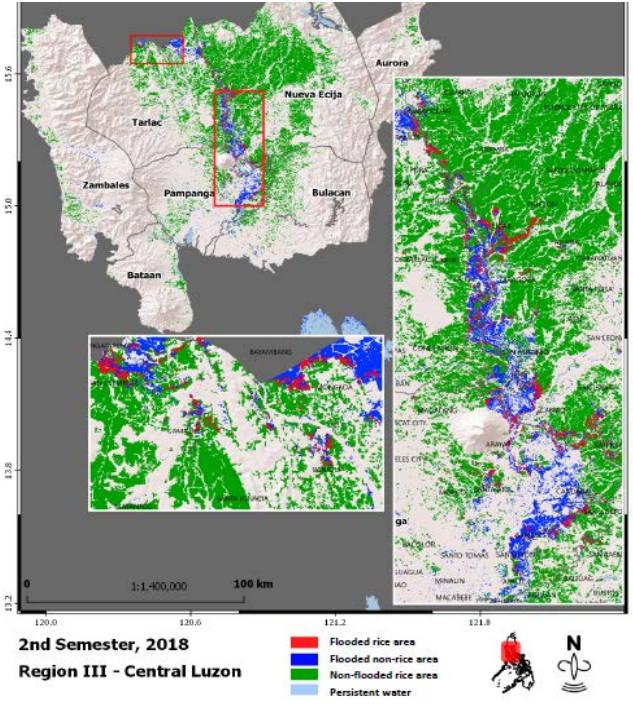
Seeds were distributed to farmers in flood affected areas in Tamil Nadu after analysis based on satellite data had been delivered to the state level emergency authorities.

Cambodia Drought in April 2016

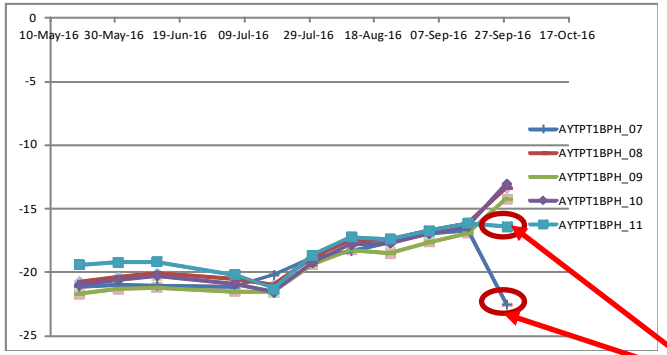


Mid-April data showed a delay of the start of the Early Wet season (EWS) due to drought. Some farmers were not able to plant early wet season rice.

Philippines Typhoon Mangkhut, Sep 2018



Pest and lodging assessment using drones



Field size: 1.76 ha

Expected Yield (ORYZA): 3.80 t/ha

Simulated Yield after BPH damage: 3.38 t/ha

Yield loss due to brown plant hopper (BPH) : 0.42 t/ha (11%)

Anomalies = impact of pest and lodging

3D drone image

PRiSM
Philippine Rice Information System

WHAT CAN THE POLICY LEVEL DO FOR GEOSPATIAL TECHNOLOGIES IN RICE FARMING TO TAKE OFF?

PRiSM
Philippine Rice Information System

From research to operation: Early policy successes

The satellite based rice monitoring system has been institutionalized in some countries

- PRISM has been fully operational since mid 2018 under the Philippine Rice Research Institute (PhilRice)
- Tamil Nadu Agricultural University (TNAU) has been providing regular satellite-based rice information to support PMFBY (government crop insurance scheme)
- Discussions to institutionalize on-going with
  - Ministry of Agriculture and Rural Development (MARD), Vietnam
  - Ministry of Agriculture, Forestry and Fisheries (MAFF), Cambodia

Philippine government supports continued operation of satellite-based...

LOS BAÑOS, Philippines—"We are not done here because we still have a long way to go, and now our project will go into the hands of the real users,"...

NEWS.IRRI.ORG

- Administrative Order creating the PRISM Unit at PhilRice signed by DA Secretary Piñol in August 2017
- Special Order creating Technical Working Group to support operationalization of PRISM
- National and regional sustainability plans developed

Establishing an enabling environment

- Geospatial technologies development fast evolving
- Increased awareness of value of geospatial information & technologies by governments, industry (ag sector) and individuals/farmers
- The main expected benefits in agriculture revolve around:
  - generating timely, accurate and location-specific information for decision making
  - addressing market failures on information asymmetries, achieving economies of scale, increasing efficiency
- An enabling environment necessary to leverage such technologies

Moving to the next step in the enabling policy environment

- Questions about :
  - Entry costs and variable costs → What is the business model? Who pays for what?
  - Access, affordability and equity → What is the distribution of returns? How profitable? For whom?
  - Effectiveness → Does it address real needs of farmers? Which farmers ? Under what conditions ?
- 3 main dimensions to consider
  - Impact pathways: how to achieve policy goals?
    - Capacity development
    - Technology packages
    - Policy & institutions
  - Policy targeting: not the same stakeholders for different products
    - Policies incentives for technology development & upgrading (industry)
    - Policies incentives to support adoption of derived products (farmers)
  - Legal aspects including IPR, privacy etc.

Take away messages and policy implications

Remote-sensing (SAR) and crop modeling (ORYZA) based yield estimation system can provide reliable timely sub-national rice information to support food security policy

A Geospatial Ecosystem where government, industry and the “crowd” (citizens, NGO’s, research organizations, etc.) are collectors and users of geospatial information is possible and needed

However, the goal is Impact on economic & social development

Policy interventions are needed for :

- Public service delivery
  - ✓ Provision of infrastructure and public goods to facilitate access, sharing, use of geospatial information
- Design & implementation of geospatial policies
  - ✓ Identify effective incentives to adoption/use (= make sure that technologies address real needs)
  - ✓ Remove barriers to adoption/use such as over complex licensing or constraints on data sharing and reuse
  - ✓ Address risks and conflicting interest among stakeholders
  - ✓ Social utility. Remote sensing is expensive. Easier to justify if improves understanding of social systems and consequences


Thank You!
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