# MWCropDSS Data Requirement as a Tool for Impact Assessment Studies & Regional Climate Change Scenarios: Thailand cases

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Venue: Ramkhamhaeng University, Bangkok, Thailand

9 – 10 June 2014

Photo credit: http://www.theatlantic.com/infocus/2011/10/worst-flooding-in-decades-swamps-thailand/100168/

# Topics

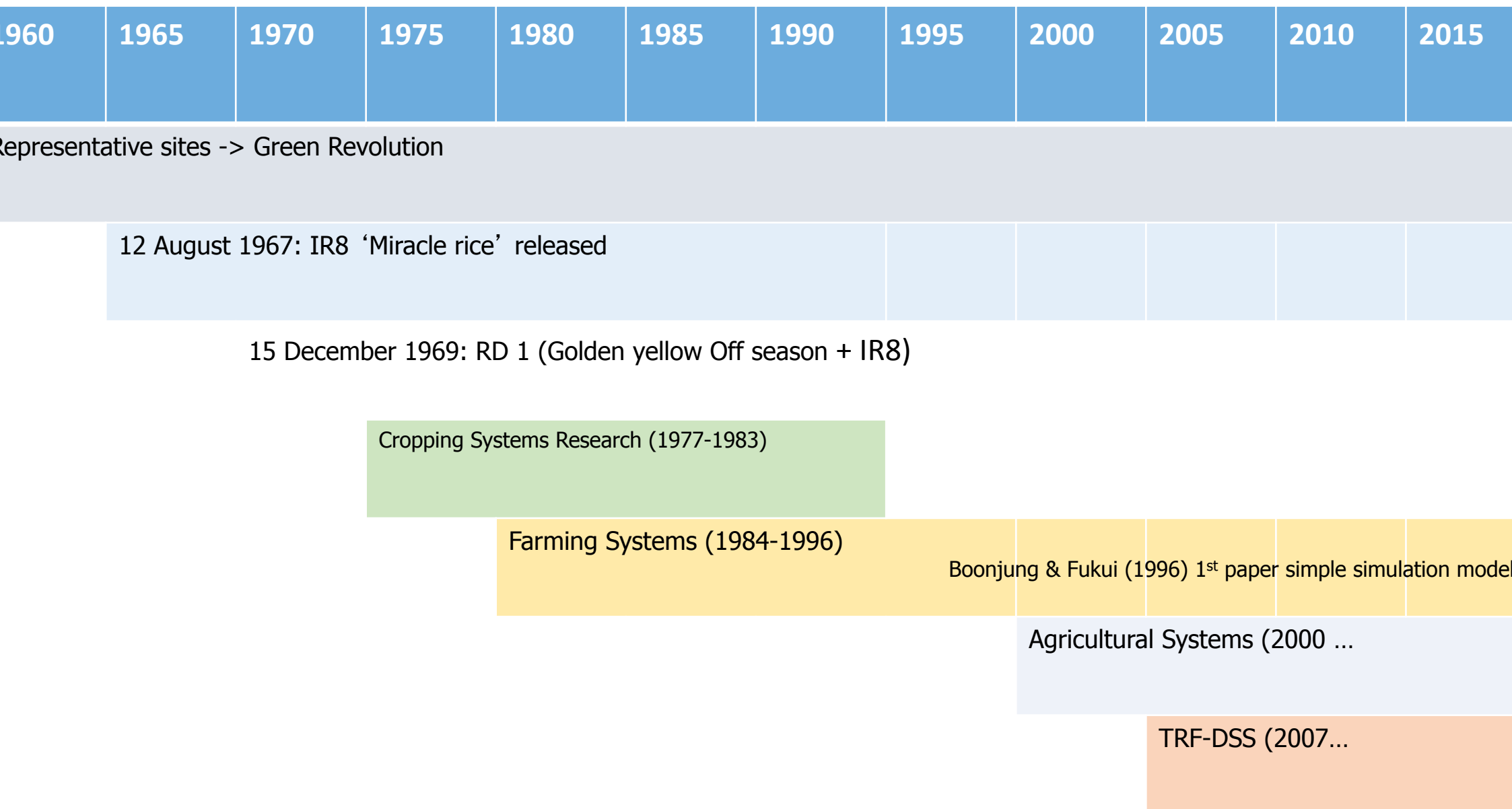Various Agricultural R&D models in Thailand

DSS Concepts
- TRF-DSS Network activities (Research Funding, Conferences, Training Workshops)

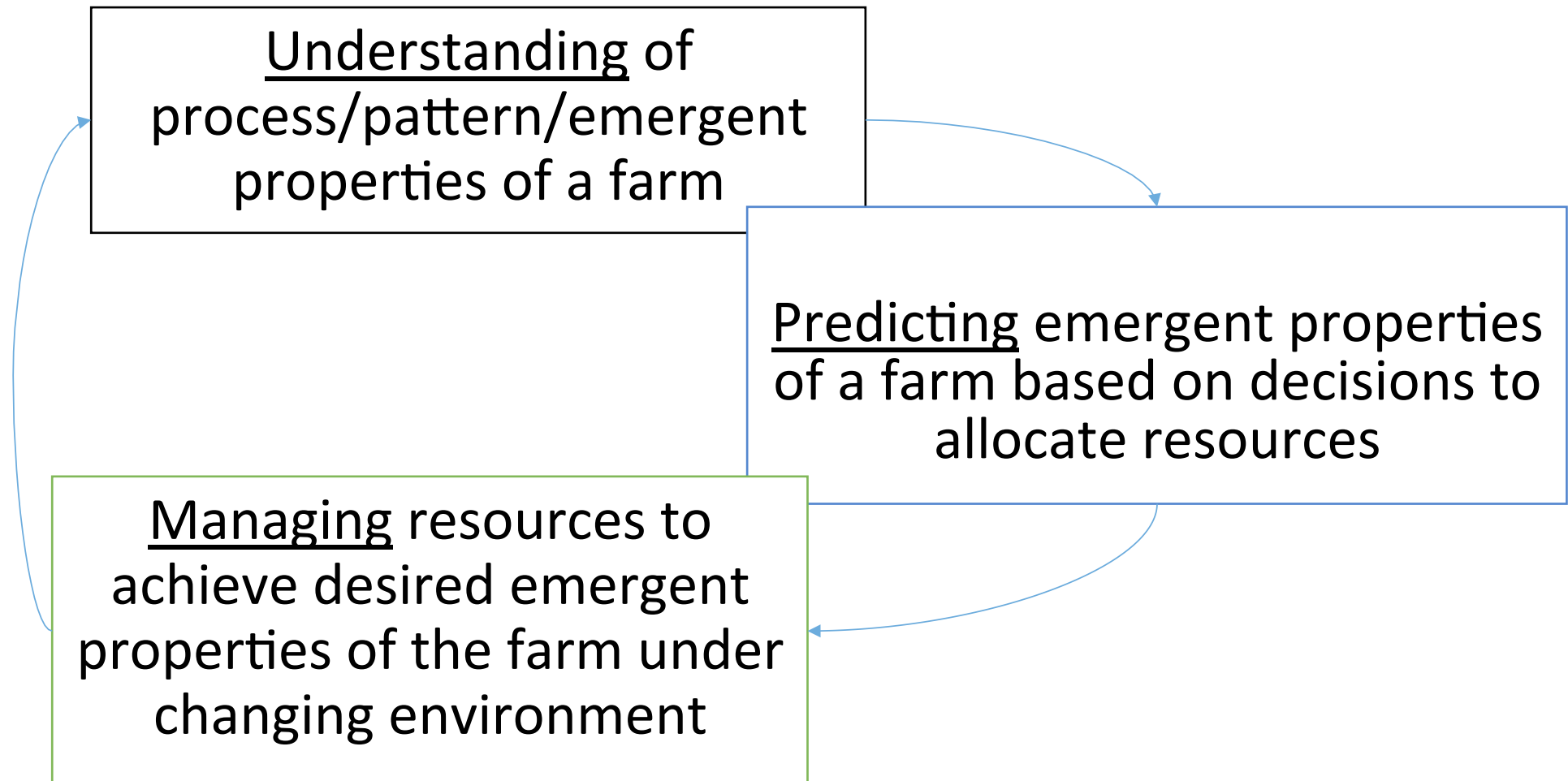MWCropDSS structure and data requirements

Conclusion

# Various Agricultural R & D collaboration models in Thailand

| 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 |
|------|------|------|------|------|------|------|------|------|------|------|------|

Representative sites -> Green Revolution

12 August 1967: IR8 'Miracle rice' released

15 December 1969: RD 1 (Golden yellow Off season + IR8)

Cropping Systems Research (1977-1983)

Farming Systems (1984-1996)

Boonjung & Fukui (1996) 1st paper simple simulation model
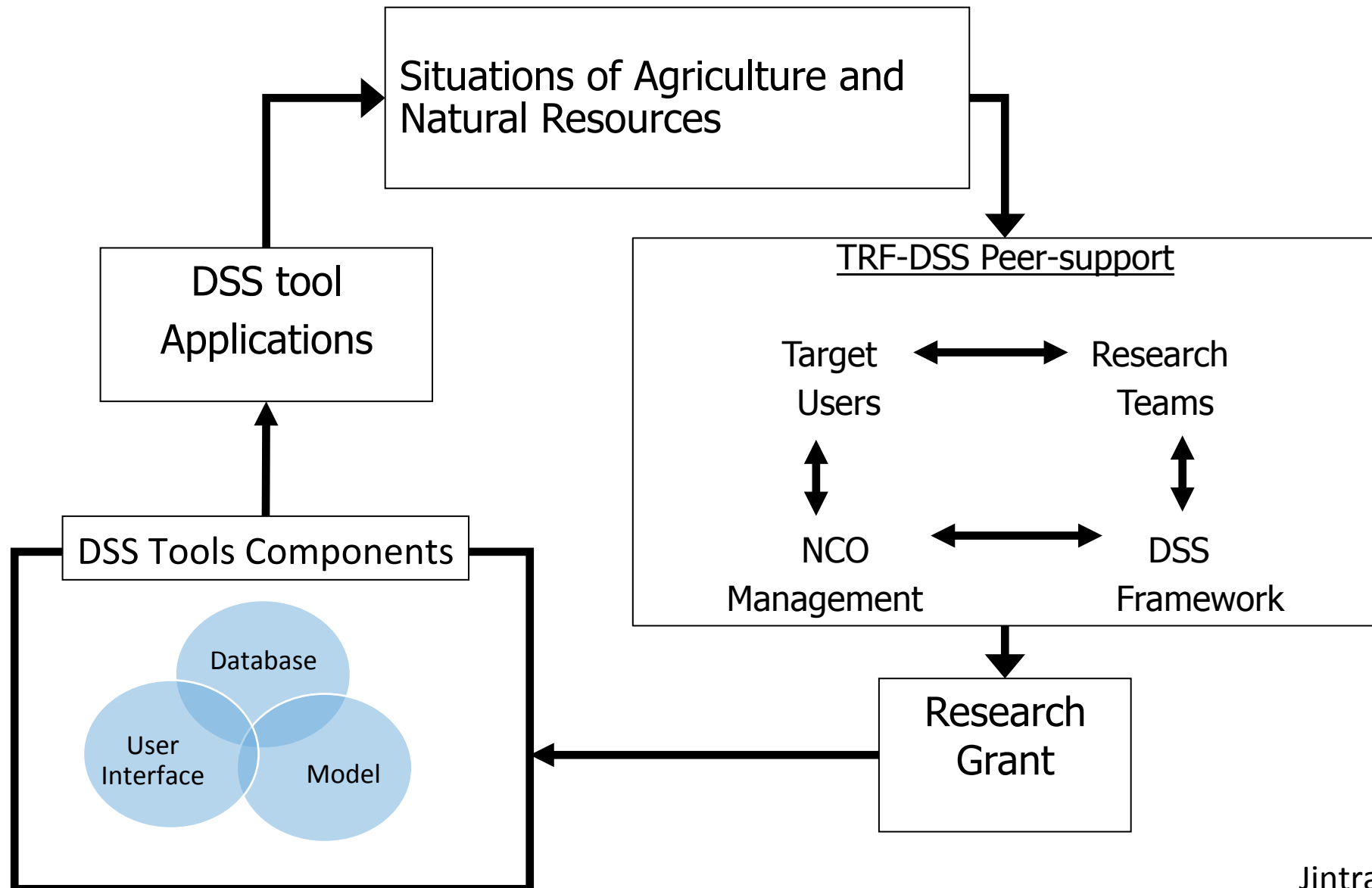
Agricultural Systems (2000 …

TRF-DSS (2007…

# DSS?

- An infotechnology, consists of modelbase, database, and user interface to allow visualization of consequences of a decision.

- Decision will have a medium and long-term effects.

- Stakeholders are;
  - Facing with an un-structured situation, i.e., many cause-and-effect
  - Facing with 'What-if?' questions to allocate resources to improve situation
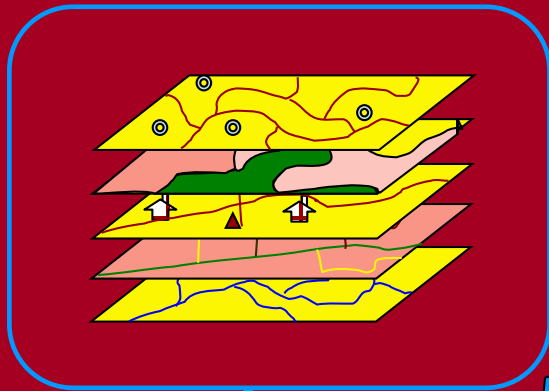
# Promoting collaboration in AEC using DSS

Understanding of process/pattern/emergent properties of a farm

Predicting emergent properties of a farm based on decisions to allocate resources

Managing resources to achieve desired emergent properties of the farm under changing environment

Uehara, 1994 & 2002

# TRF-DSS Peer-Support Concept & Practice



Jintrawet *et al.*,

# DSS =?

**Decision Support System**

**Spatial Database**

**Knowledge Databases**

Basic

Socio-economic

Natural Resources

Production Systems
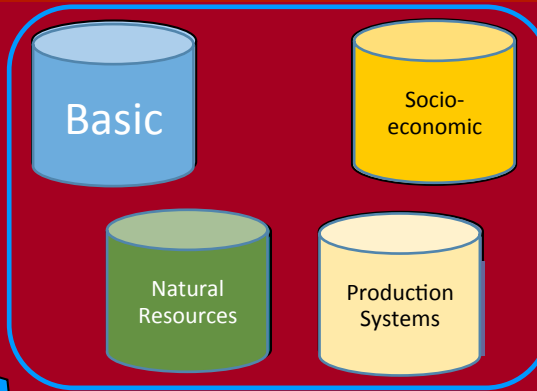
**Data analysis & Simulation**

**User's Interface**

Kovanich, 2009

**Computer programs for:**

- Stakeholder share common resources

- Facing "What if?" situations.

- Based on DBMS, MSMS, UI

- Support collective decision making to manage resources t deal with situation.

# Connecting components



Infosystems with a core unit
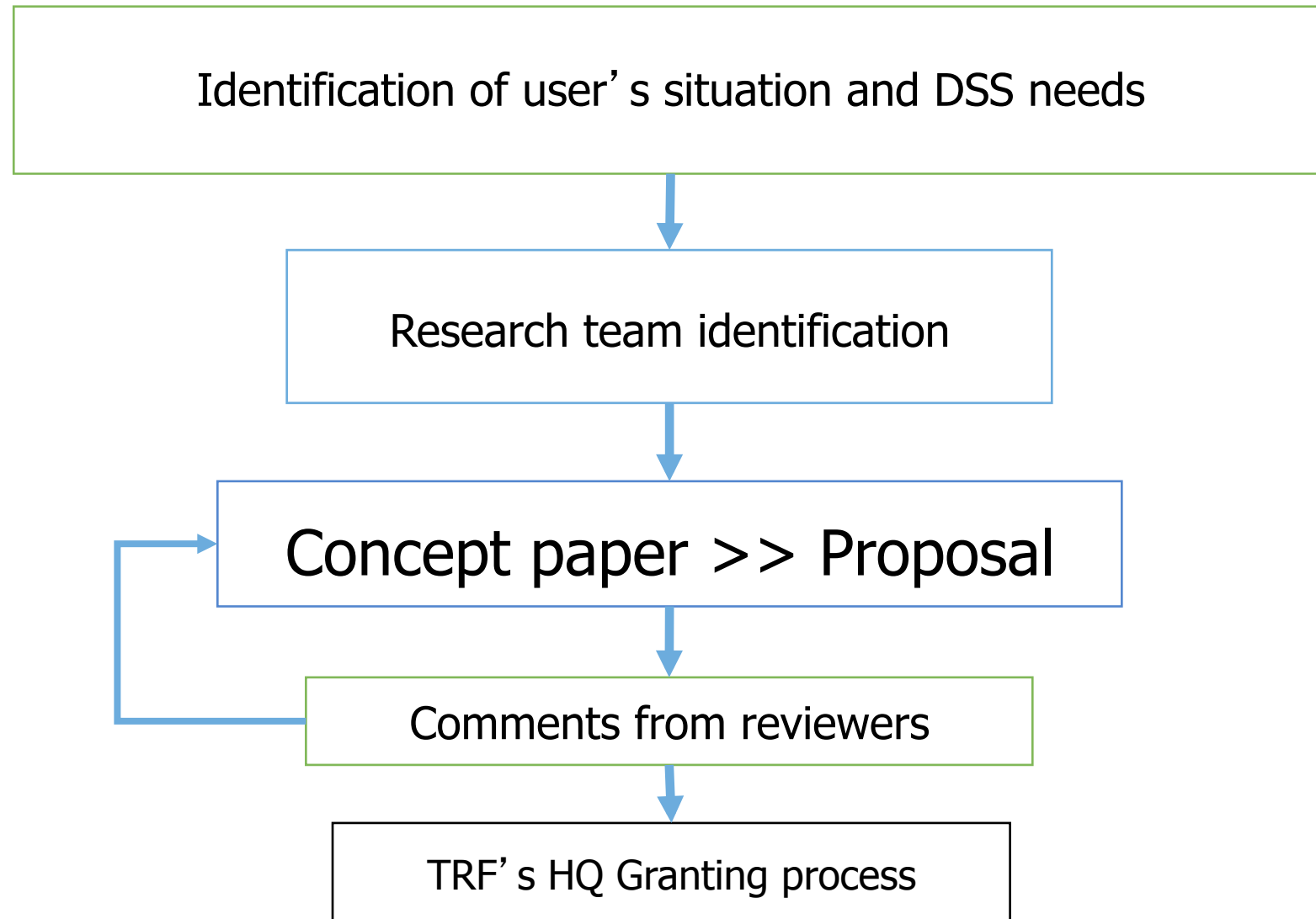
Modules feed data for the Core
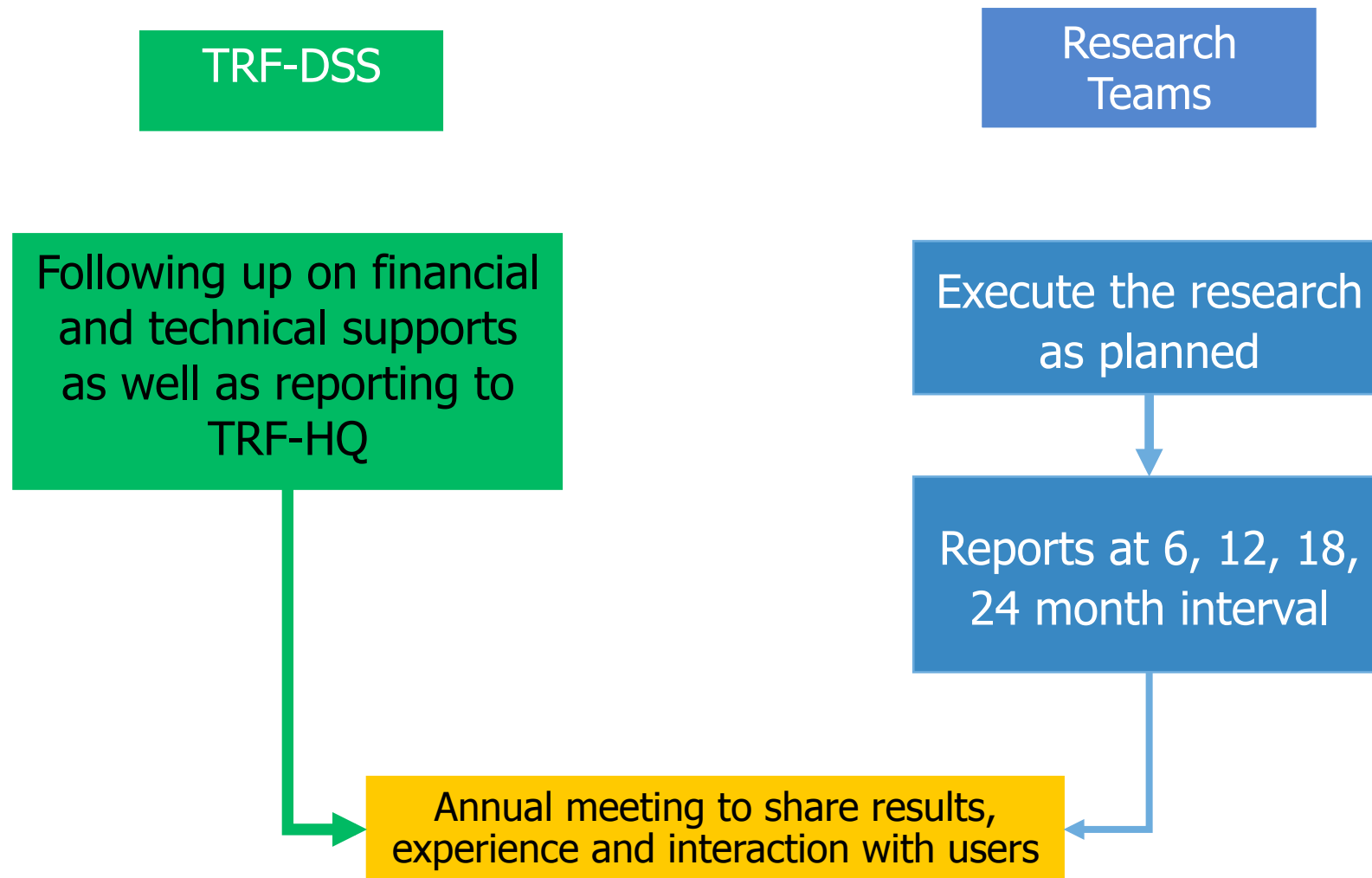
Kovanich, 2009

# DSS Tools development

## For four type of users

1. Administrative boundary
2. Cross or natural boundary
3. Ad hoc situations
4. <u>DSS Human Resource Development</u>

# Research project initiation

Identification of user's situation and DSS needs

Research team identification

## Concept paper >> Proposal

Comments from reviewers

TRF's HQ Granting process

# Peer-support during research operation

**TRF-DSS**

**Research Teams**

Following up on financial and technical supports as well as reporting to TRF-HQ

Execute the research as planned

Reports at 6, 12, 18, 24 month interval

Annual meeting to share results, experience and interaction with users

Goals: Efficient Resource Utilization, Poverty Reduction (job creation), Environmental-friendly Production & Consumption Systems

Joint recommendations/Solutions

Assessing Production Alternatives

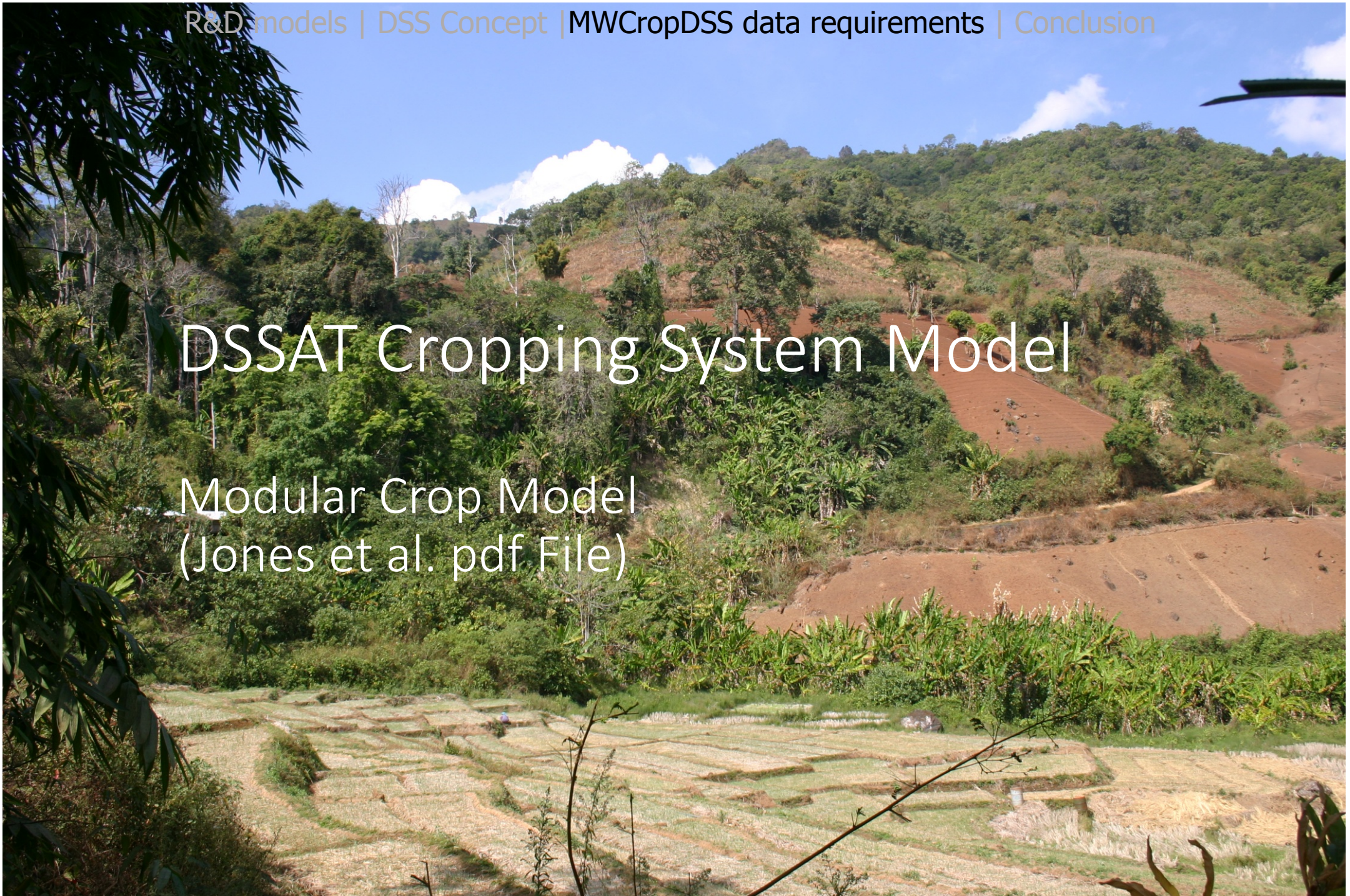DSS tools

Resource databases (Attribute & spatial)

Simulation models (Process-based and empirical, LCA, etc.)

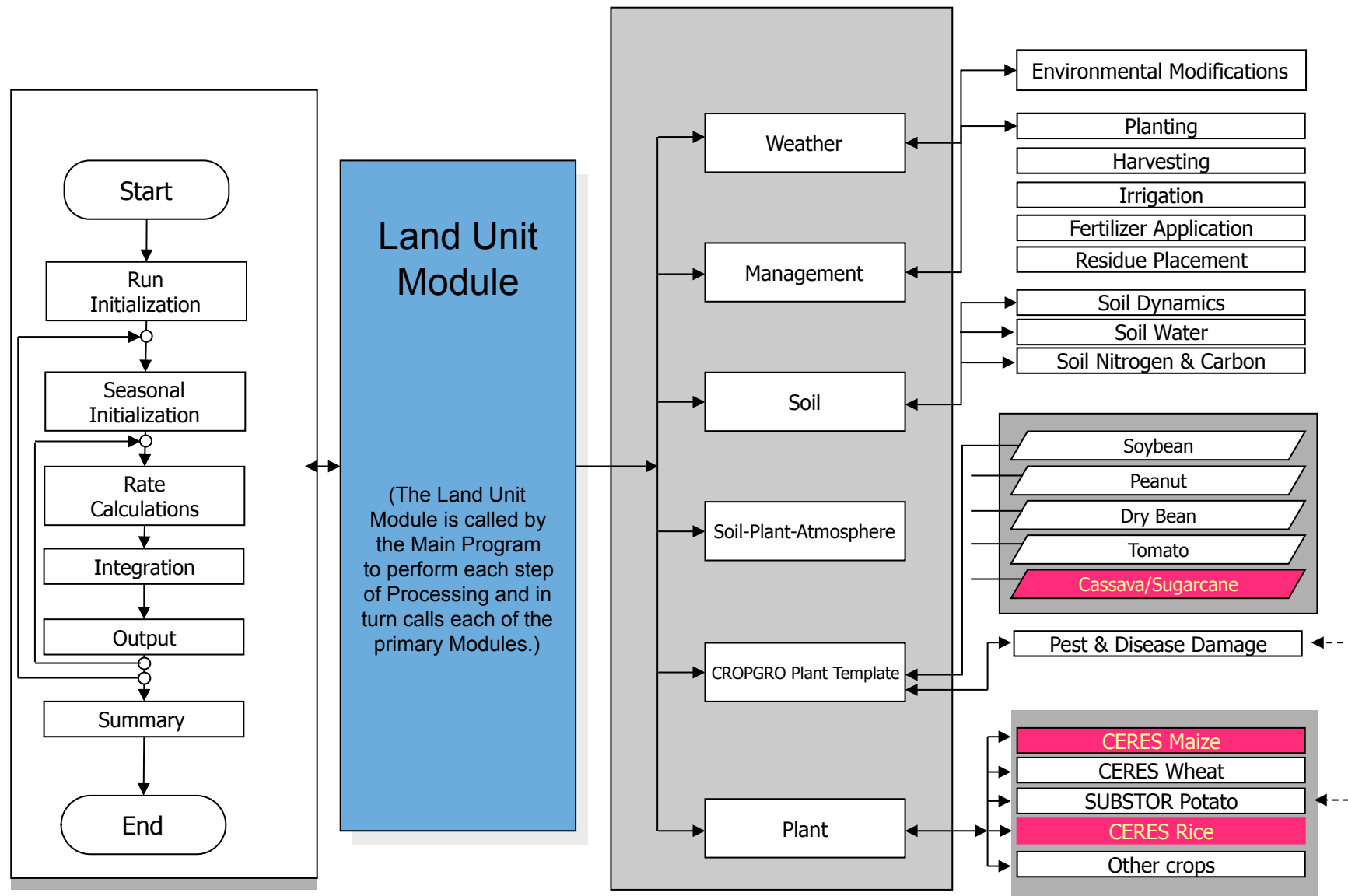Resource Inventory (Real Survey by agencies & farmers, Remote Sensing)

Basic research

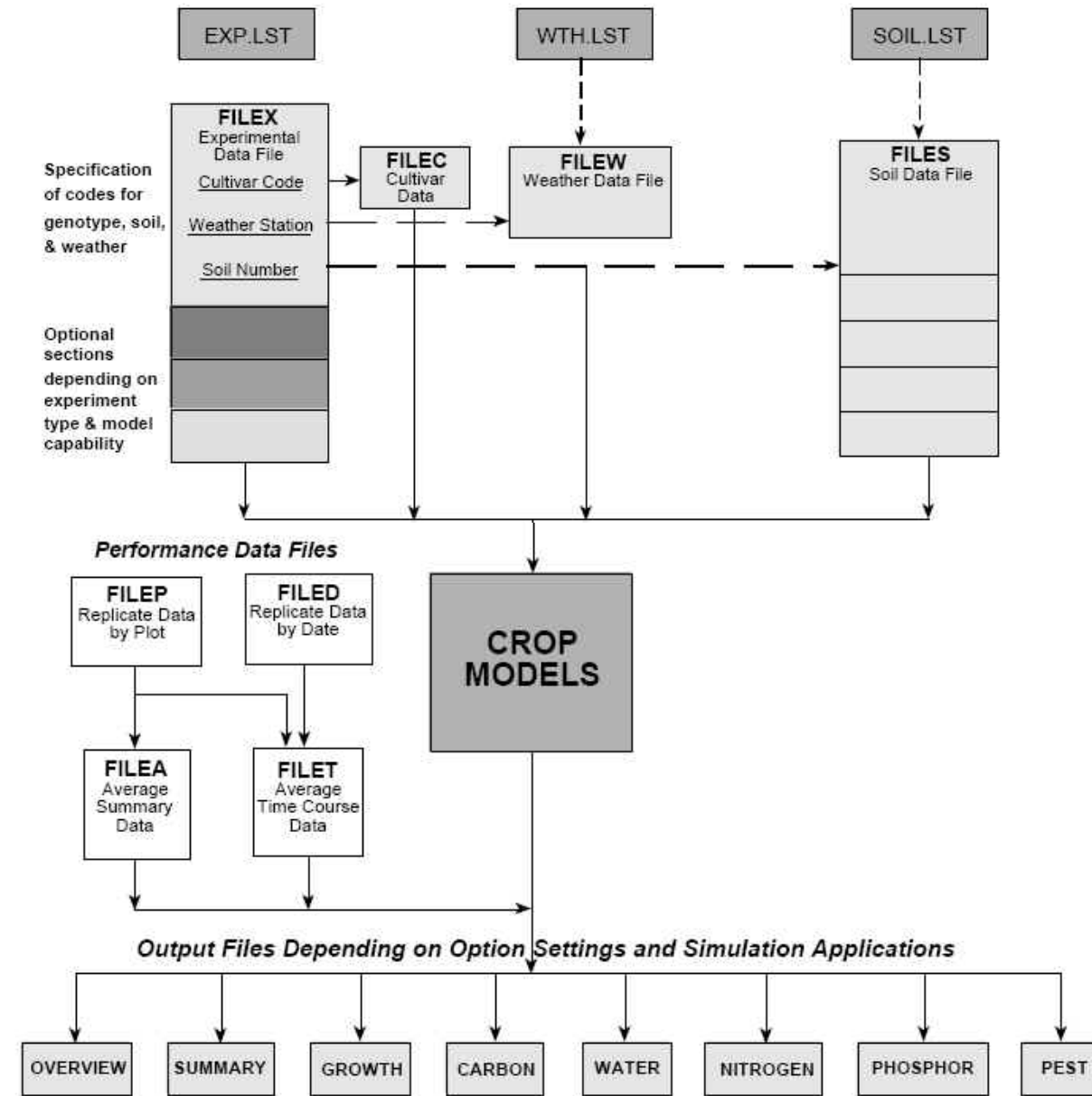Uehara (1998); Kovanich (2009); Jintrawet *et al.* (2012)

# DSSAT Cropping System Model

Modular Crop Model
(Jones et al. pdf File)

## Overview of the components and modular structure of DSSAT-CSM



Hoogenboom *et al*., 2003.

DSSAT46
Data flow
and

MDS

# Three different levels of data for computer model operation:

- **Level 1:**
  - Minimum data to be able to run the model for a particular experiment or application

- **Level 2:**
  - Minimum data required for model testing or model evaluation

- **Level 3:**
  - Minimum data required for model development

# Level 1 data:
# Computer Operation

nvironmental:
- Daily weather data
  - Maximum temperature
  - Minimum temperature
  - Precipitation
  - Solar radiation

```
*WEATHER  DATA :KKFCRC

@ INSI         LAT        LONG  ELEV    TAV    AMP  REFHT W
   DTKK     16.780    102.950 210.0   25.0    3.0    2.0

@DATE   SRAD   TMAX   TMIN   RAIN
99001   12.2   30.5   24.9    0.0
99002    9.6   31.0   24.5    0.0
99003    9.8   30.0   22.6    0.0
99004   10.0   28.8   21.6    0.0
99005   10.7   28.8   21.2    0.0
99006   10.8   28.6   21.0    0.0
99007    9.4   28.0   22.8    0.0
99008    8.8   27.7   21.5    0.0
99009   10.2   28.8   22.4    0.0
99010    9.0   29.0   24.0    0.0
99011    5.3   27.7   25.5    0.0
```

Level 1 data:
Computer Operation

- Environmental:
  - Soil data
    - Soil surface information:
      o Slope, color, permeability, drainage, stones
    - Soil profile information:
      o Water holding characteristics, nitrogen, organic matter, (phosphorus)

# Level 1 data:
# Computer Operation

- Crop management:
  - Crop
  - Cultivar
  - Planting date
  - Row and plant spacing
  - Irrigation
    - Dates and amount of irrigation
  - Fertilizer:
    - Dates, amount and type of fertilizer
  - Other applications (chemical) and operations (tillage)

# Level 2 data:
# Model Evaluation

- Level 1 input data for environmental conditions and crop management for your particular experiment

- Crop measurements:
  - Yield and yield components:
    - biomass, seed number, seed size, etc.
  - Phenology:
    - Dates of flowering (50%), physiological maturity, harvest maturity, first seed, etc.
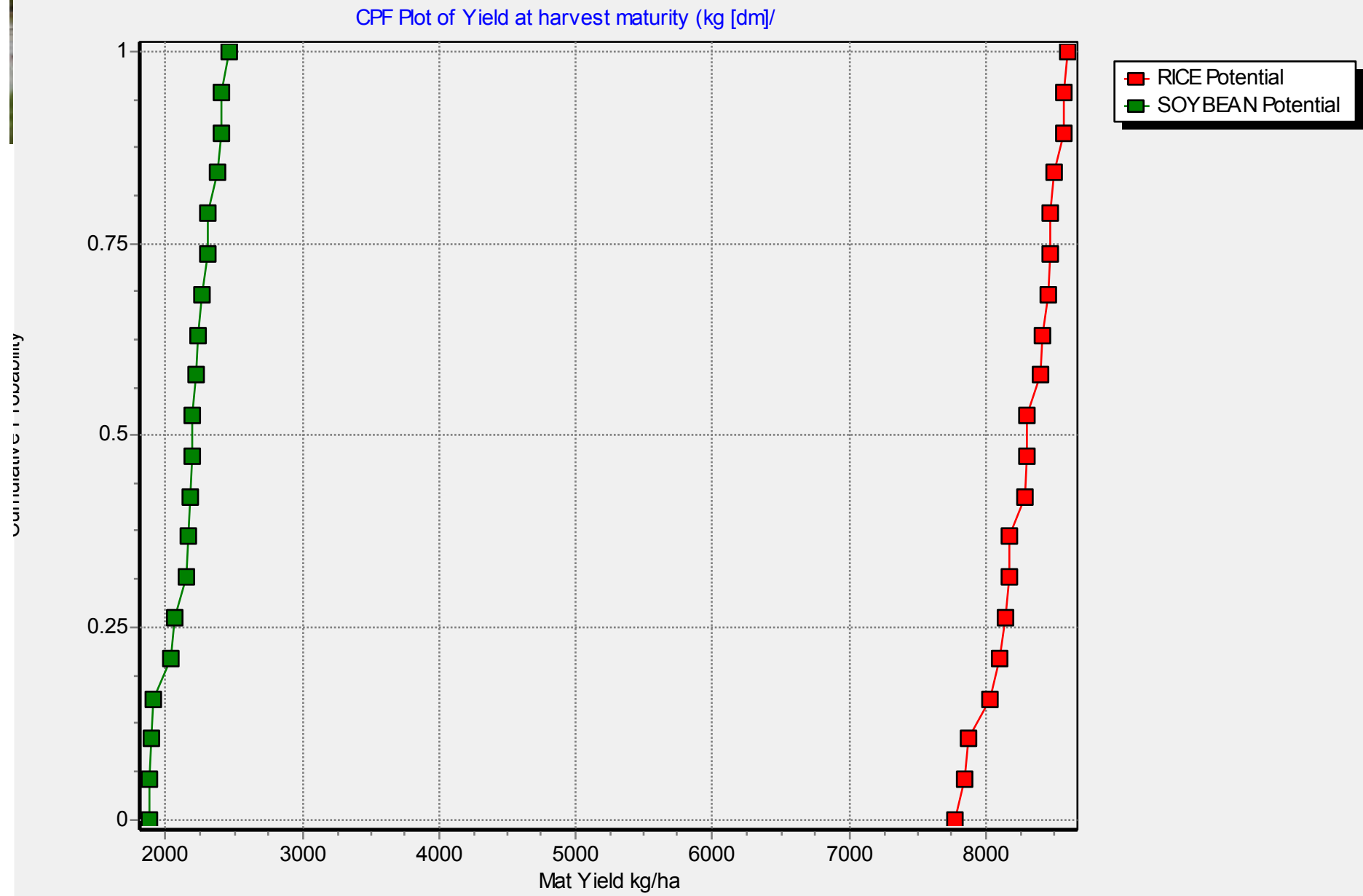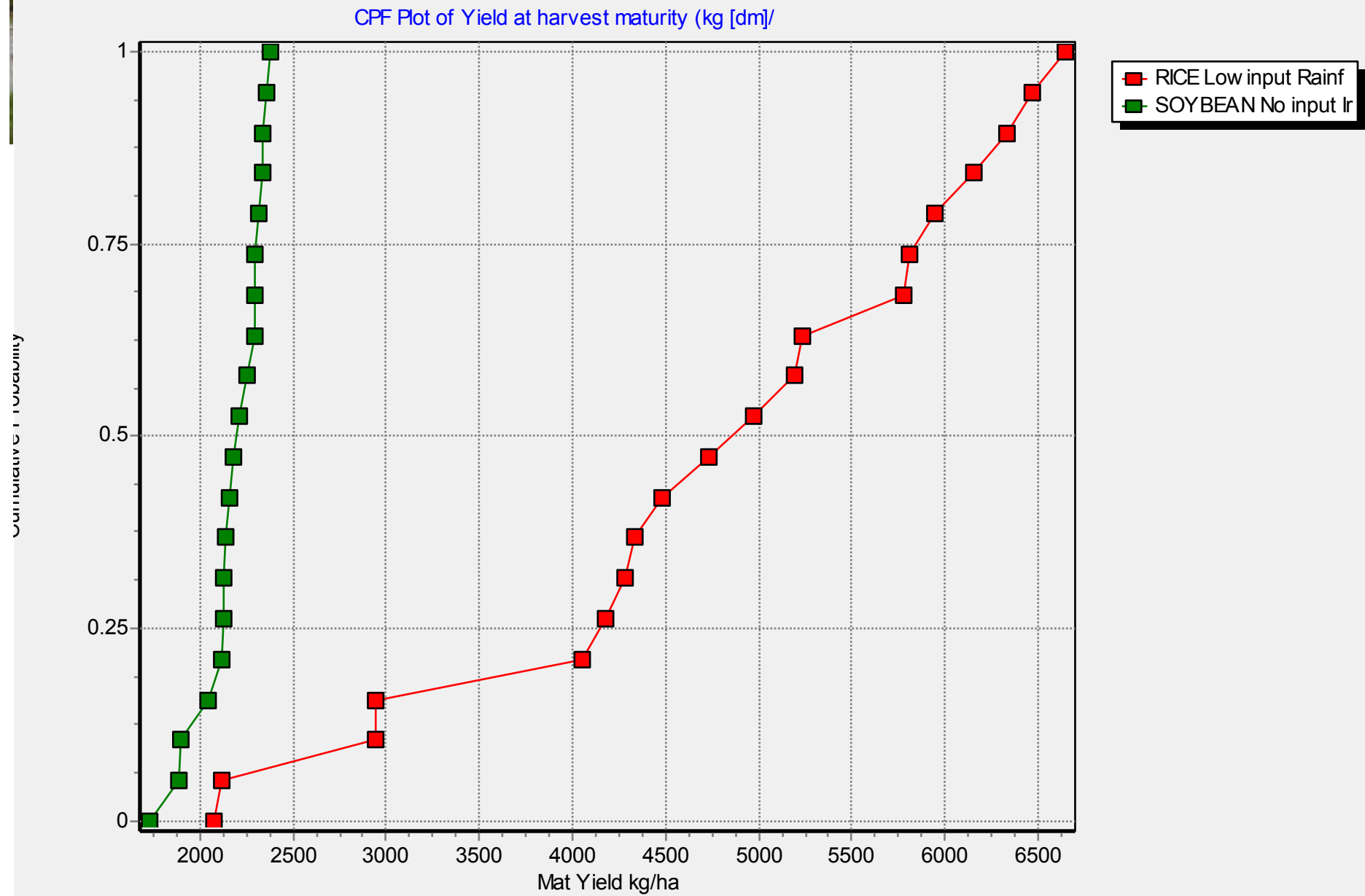
Level 2 data:
Model Evaluation

- Crop measurements:
  - Growth analysis:
    - Biomass components (leaf, stem, seeds/ grains, etc.) at regular time intervals
  - Soil moisture at different depths over time
  - Soil nitrogen/carbon/phosphorus at different depths over time

# Level 3 data:
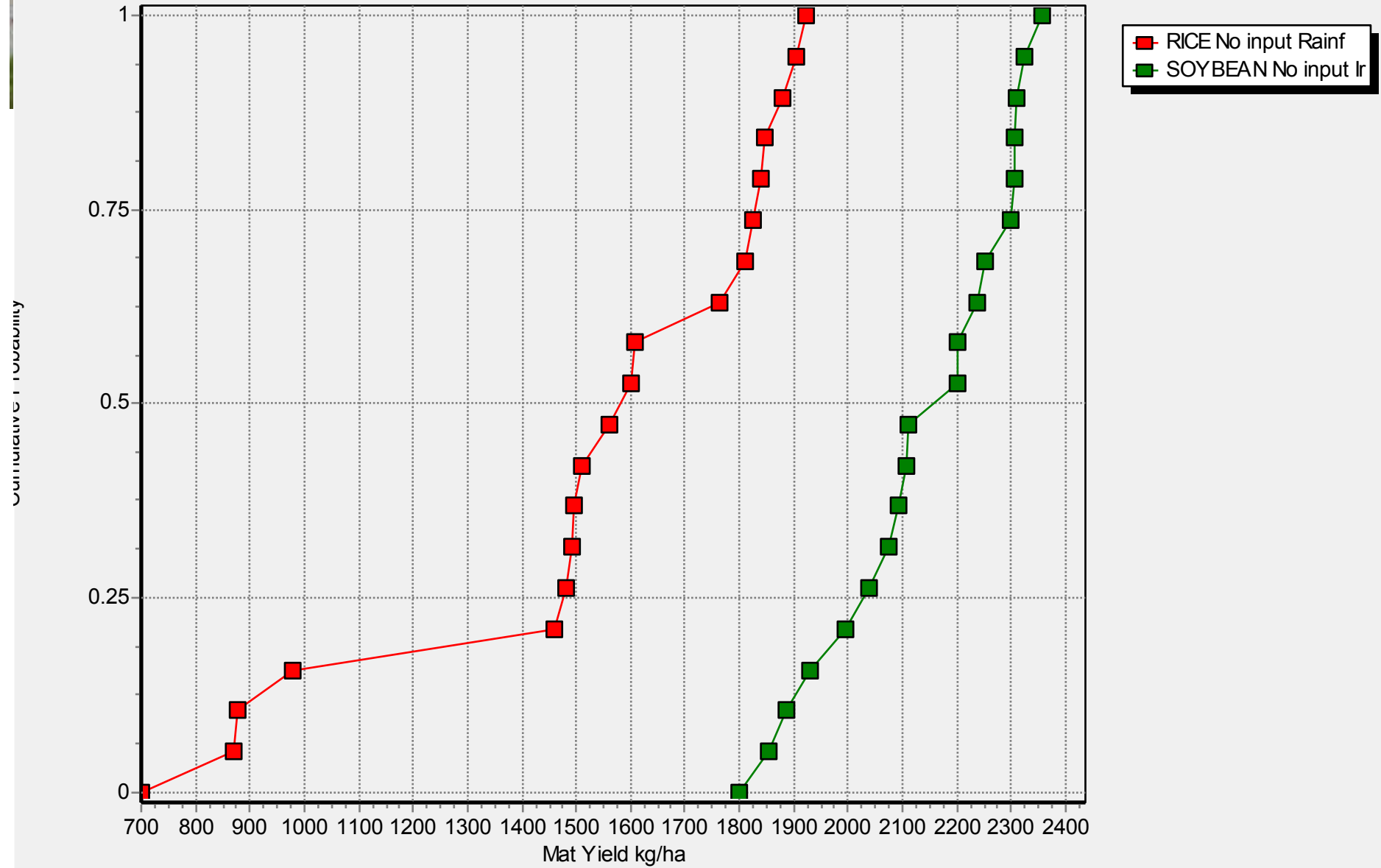# Model Development

- Level 2 data for model evaluation
- Research reports/publications
- Detailed experiments including
  - Response to temperature, water, nitrogen and other factors
- Specific experiments to address "knowledge gaps."

CPF Plot of Yield at harvest maturity (kg [dm]/



Legend:
- RICE Potential
- SOYBEAN Potential

Y-axis: Cumulative Probability
X-axis: Mat Yield kg/ha

CPF Plot of Yield at harvest maturity (kg [dm]/



Legend:
- RICE Low input Rainf
- SOYBEAN No input Ir

Y-axis: Cumulative Probability

X-axis: Mat Yield kg/ha

CPF Plot of Yield at harvest maturity (kg [dm]/



- RICE No input Rainf
- SOYBEAN No input Ir

Mat Yield kg/ha

# MWCropDSS structure and components



Jintrawet, 2009

**SDBMS**
- Admin. boundary
- Crop areas
- Soil Series
- Climate zone

Roi Et Series TH01370001

CMMC KKKU ECHAM4

2011: HadCM3 & MRI-GCM

- DEM
- Logistics
- Population

**MBMS**

2003-2010

Since 2011

Since 2

- DSSAT 4.5 FILE-X & OTHER INPUTS
- Production Scenarios
- 24 Crop models
- OUTPUT FILES

Decision Support System for Agrotechnology Transfer

G. Hoogenboom, J.W. Jones, P.W. Wilkens, C.H. Porter, K.J. Boote, L.A. Hunt, U. Singh, J.L. Lizaso, J.W. White, O. Uryasev, F.S. Royce, R. Ogoshi, J. Koo, V. Shelia and G.Y. Tsuji.

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DSS V4 BET

**ANALYSIS PROGRAMS**

**Indicators Display**
- Yield
- Irrigation
- Margin
- Environment parameters

# Rainfed, 60 kg of Urea per ha



**Rice yield 60 kg Urea/ha**

- ☐ Provincial boundary
- ■ > 70000
- ■ 6000 - 7000
- ■ 5000 - 6000
- ■ 4000 - 5000
- ■ 3000 - 4000
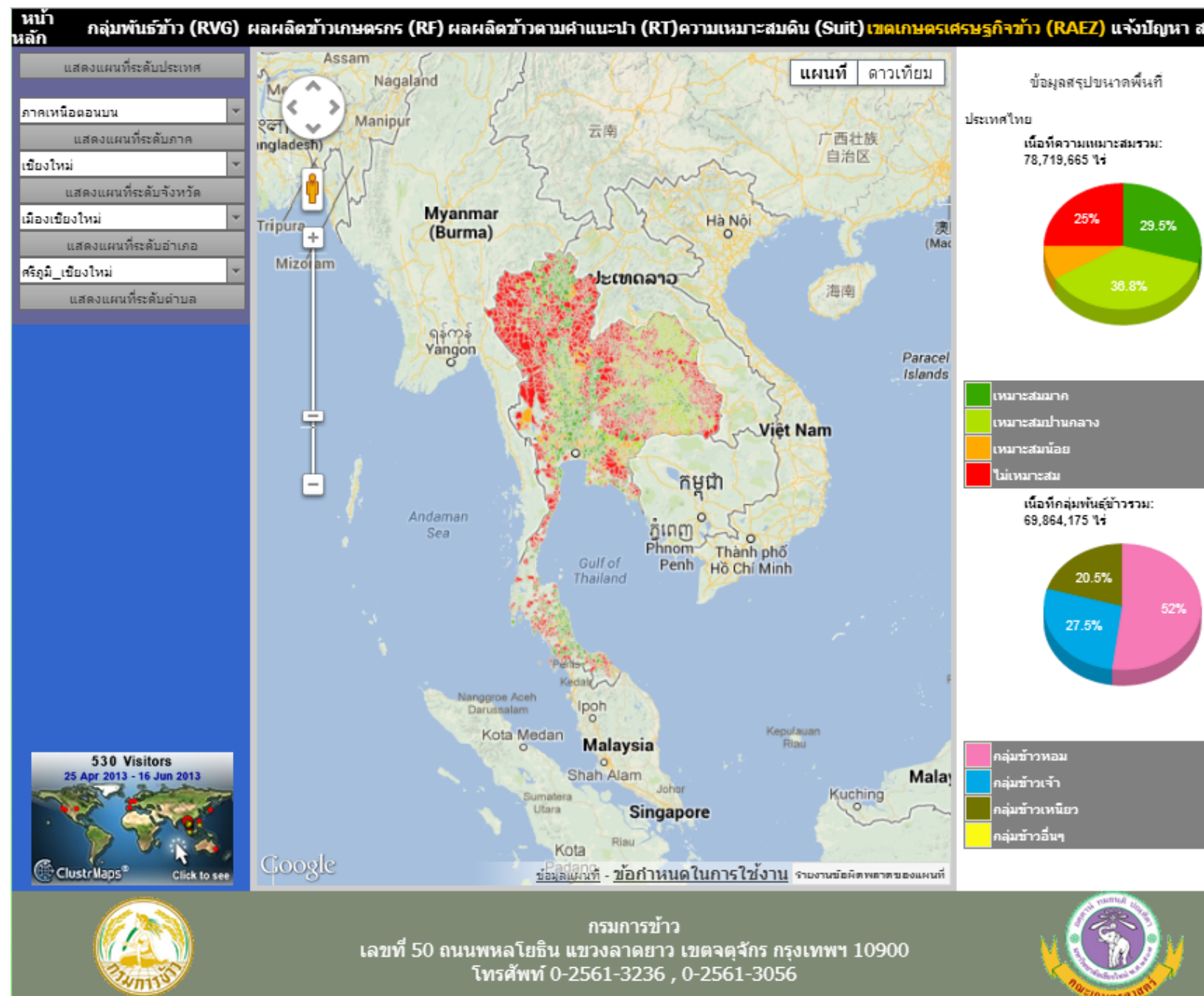- ■ 2000- 3000
- ■ 1000 - 2000
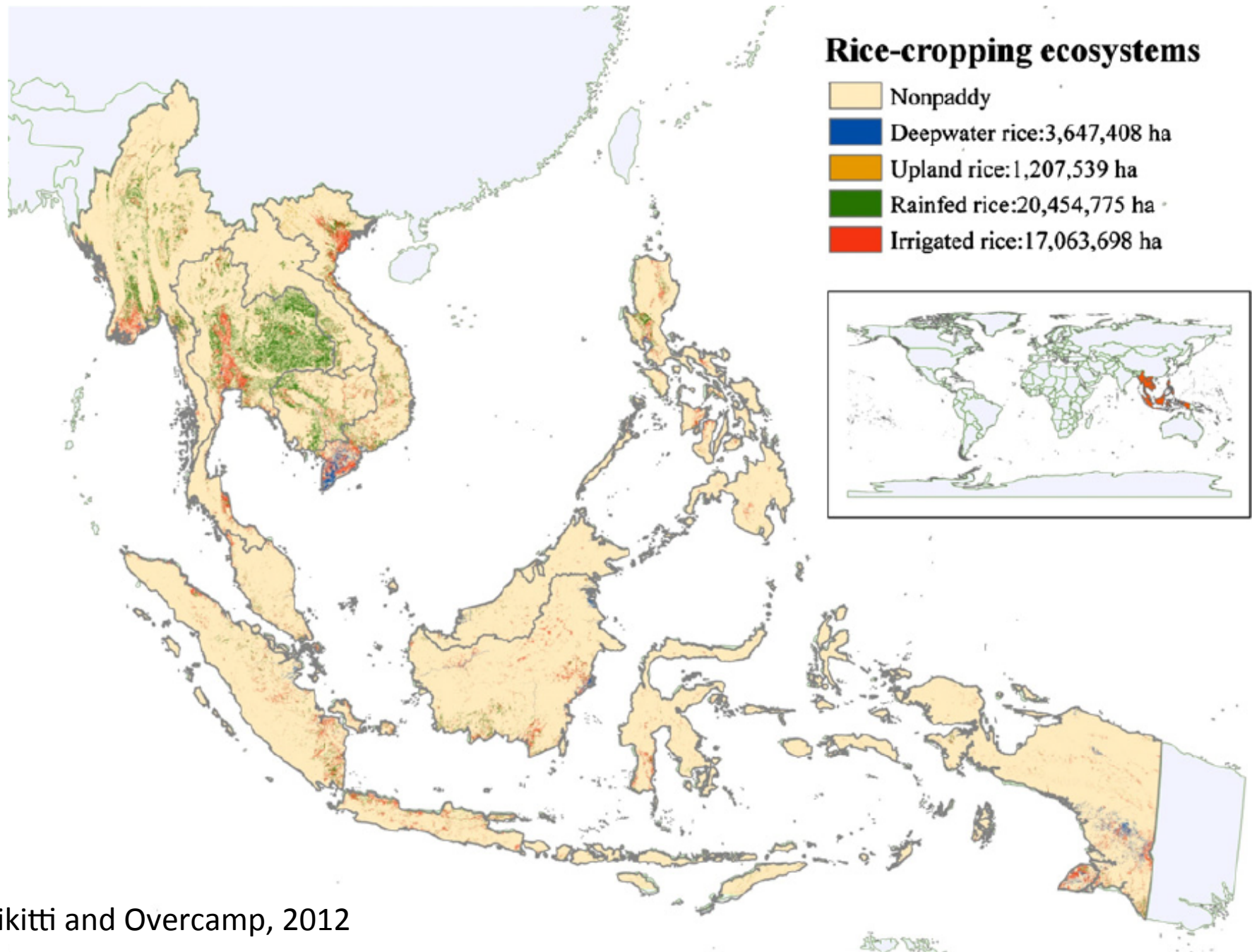- ■ < 1000
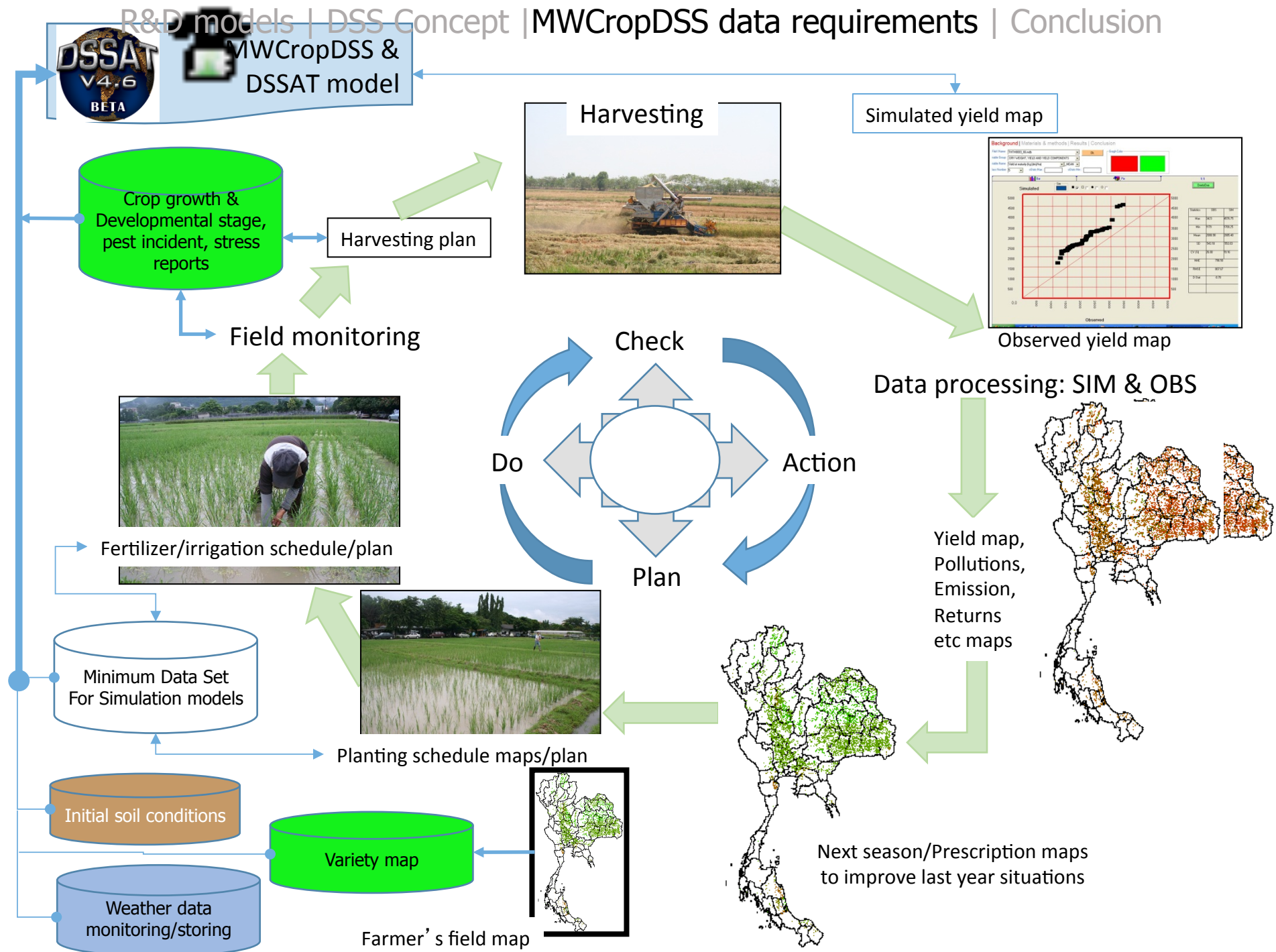
0    87.5    175    350 Kilometers

N
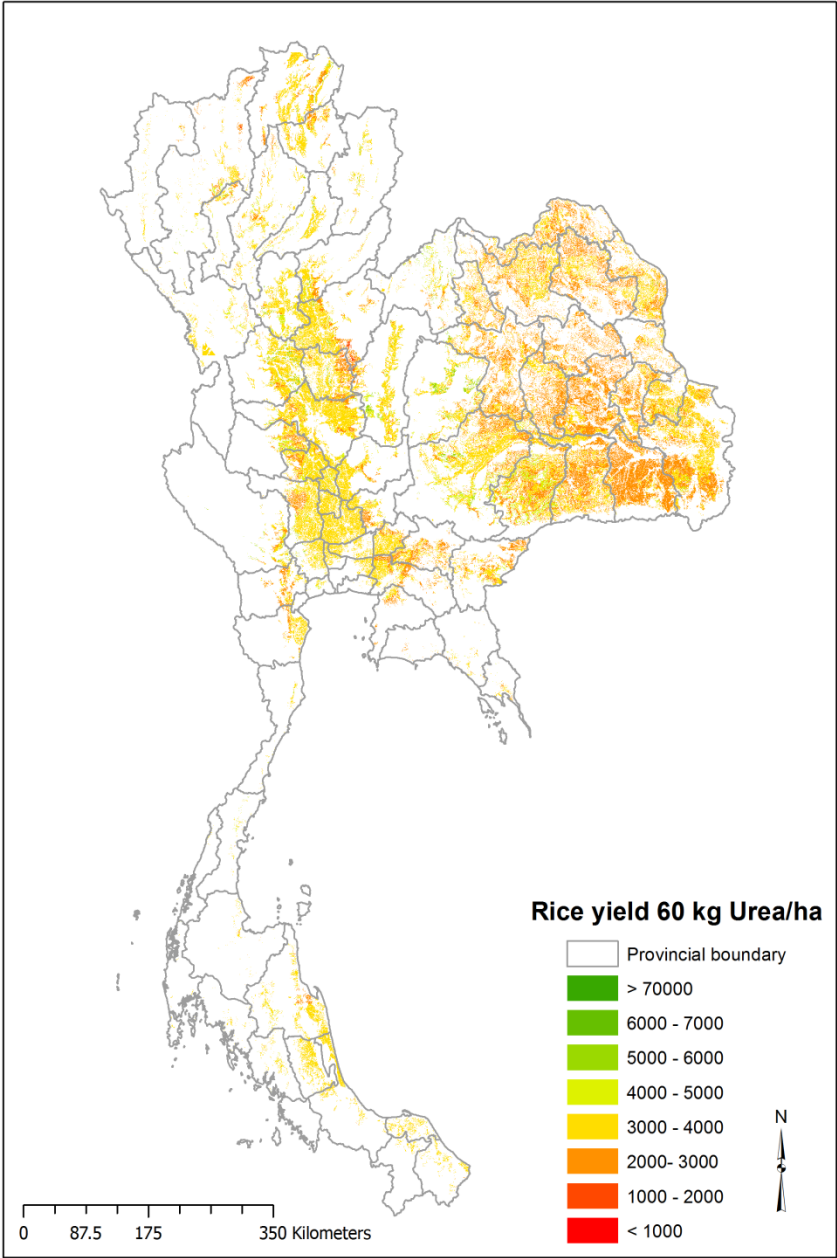
Jintrawet & Chinvanno, 2011

"interactive Rice Zoning" Information System on the Internet

Funded by the Thailand Rice Research Department

or
e
systems
SEAN

**Rice-cropping ecosystems**

Nonpaddy
Deepwater rice:3,647,408 ha
Upland rice:1,207,539 ha
Rainfed rice:20,454,775 ha
Irrigated rice:17,063,698 ha

Bridhikitti and Overcamp, 2012

MWCropDSS & DSSAT model

Harvesting

Simulated yield map

Crop growth & Developmental stage, pest incident, stress reports

Harvesting plan

Field monitoring

Observed yield map

Check

Data processing: SIM & OBS

Do

Action

Fertilizer/irrigation schedule/plan

Plan

Yield map, Pollutions, Emission, Returns etc maps

Minimum Data Set For Simulation models

Planting schedule maps/plan

Initial soil conditions

Variety map

Next season/Prescription maps to improve last year situations

Weather data monitoring/storing

Farmer's field map

# 9th NAG Conference 9 (2557 | 2014); 45 papers; May 21-23 @College of Local Administration, KKU, Khon Kaen



e: http://www.mcc.cmu.ac.th/seminar/

# Publications (2010-2013)

## M.S.

.Mr. Khomko THAMMAVONG @2nd National Soil and Fertilizer, May 11-13, 2011, Mae Jo University

.Mr. Nguyen Ngoc Son Hai, published an article in *Vietnam Soil Science Journal*.

.Mr. Phouthasack PHOUMMASONE presented in the 1st ASEAN Plus Three Graduate Research Congress (AGRC 2012), 1-2 March 2012

.Mr Anongsak  PHACHOMPHONH @8th National Agricultural Systems Conference, September -7, 2012, Nakhon Phanom University

## Ph.D.

.Mr Bounthanh  KEOBOUALAPHA, published 2 articles in *Southeast Asian Studies Journal*, Kyoto University, Japan.

.Mr Saythong VILAYVONG, published an article in *Australian Journal of Crop Science*.

# Regional Conferences

1st TRF-DSS International Conference (Thailand & Lao) September 10-11, 2013

"Decision Support System as a collaborative platform towards VIC for collective management of agricultura and natural resources"

@Nakhon Phanom University & Savannakhet, Lao PDR

2nd DSS International Conference (Vietnam) January 15-18, 2014

"Decision Support System as a collaborative platform towards VIC for collective management of agricultural and natural resources"

@Nong Lam University & Danang flood-prone areas

3rd TRF-DSS International Conference (Thailand, Lao, Vietnam) May 21-23, 2014

"Decision Support System as a collaborative platform towards VIC for collective management of agricultura and natural resources"

@Khon Kaen University, Thailand.

# International Training

2003-12-1_11: **TRF**-supported (27 participants)

2004-06-28 07-09:  Global Change Impact Studies Centre (GCISC), Islamabad, Pakistan-supported (20 participants)

2007-11-26_12-07: **TRF**-, Rockefeller Foundation, self-supported (27 participants)

2009-03-29_04-11: UKM, Malaysia (35 participants)

2013-02-11_22: TICA-supported (32 participants)

2014-02-10_21: TICA-supported (15 participants), set-supported (10)

2015, 2016, 2017 submitted a proposal to TICA to fund 20-25 participants from ASEAN members.

"Assessing Crop Production, Nutrient Management, Climatic Risk and Environmental Sustainability with Simulation Models and DSS Tools"
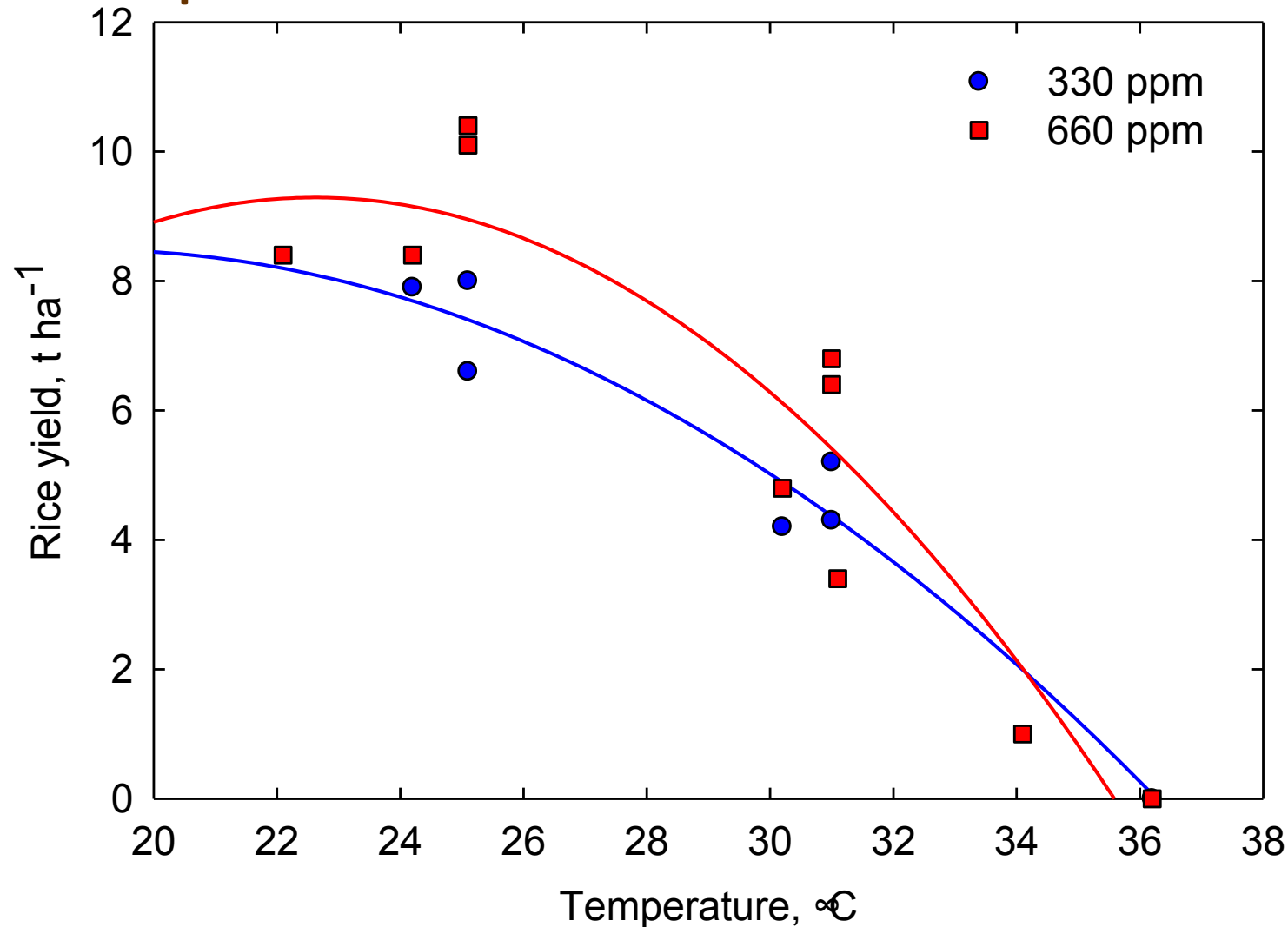
# Climate Change and Crop Productivity Temperature and CO2 – Rice Growth



20% more at 660 than at 330
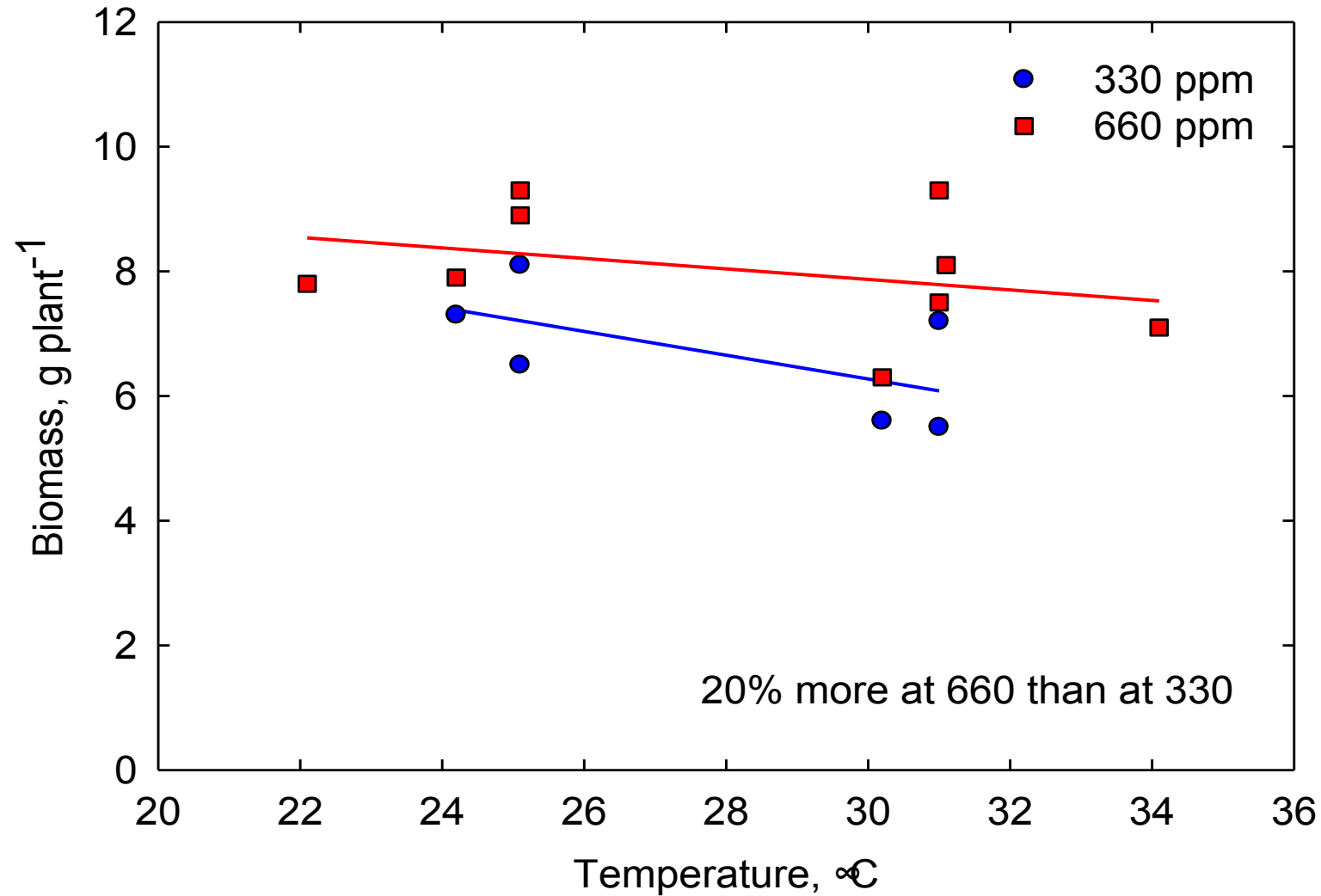
Baker and Allen, 1993

# Climate Change and Crop Productivity Temperature and CO2 – Rice Growth



Baker and Allen, 1993

# Take home messages

Our Global society have been very lucky in the past 30-40 years of human records that the climate has been relatively stable.  However, based on evidences, the future climate may not be so kind to us.  So, let's collaborate to jointly prepare.

Networking is a 'civil society' & 'collaboration model' for sustainable environment & society in ASEAN

Networking is a mechanism to gain better understandings and predict the behavior of systems, which will lead to collective decision making to manage limited resources for SES.

I welcome your comments and your leadership and support your guidance to implement R&D networks for the sustainability of our environment and society.