



JIRCAS's Climate Change Initiatives for Monsoon Asia



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JIRCAS



JIRCAS

- Japan International Research Center
for Agricultural Sciences

Functions



The **sole national institute** that undertakes comprehensive research on **agriculture, forestry and fisheries technology** in **developing areas** of tropical and subtropical regions.

Overseas

Domestic



Focal Point Function

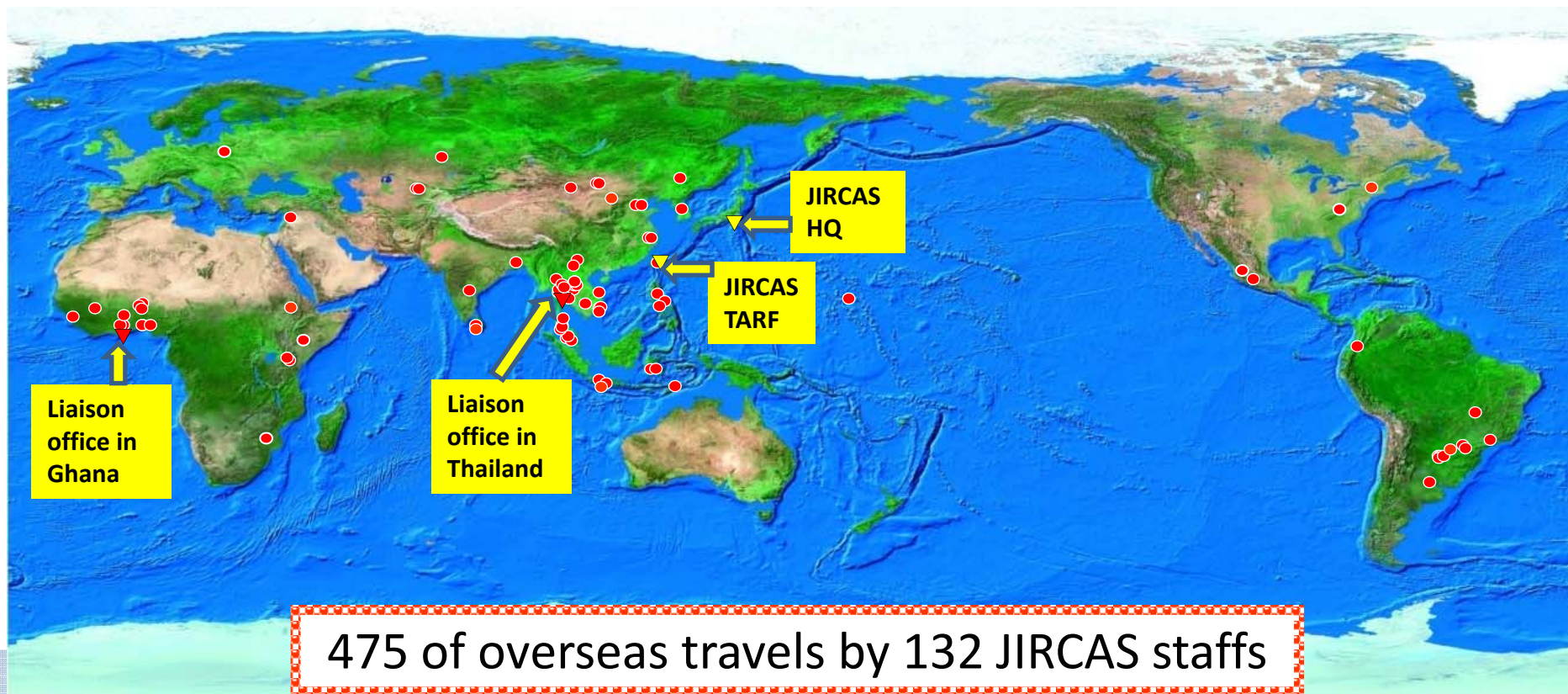
National Center Function

Worldwide Collaborative Research

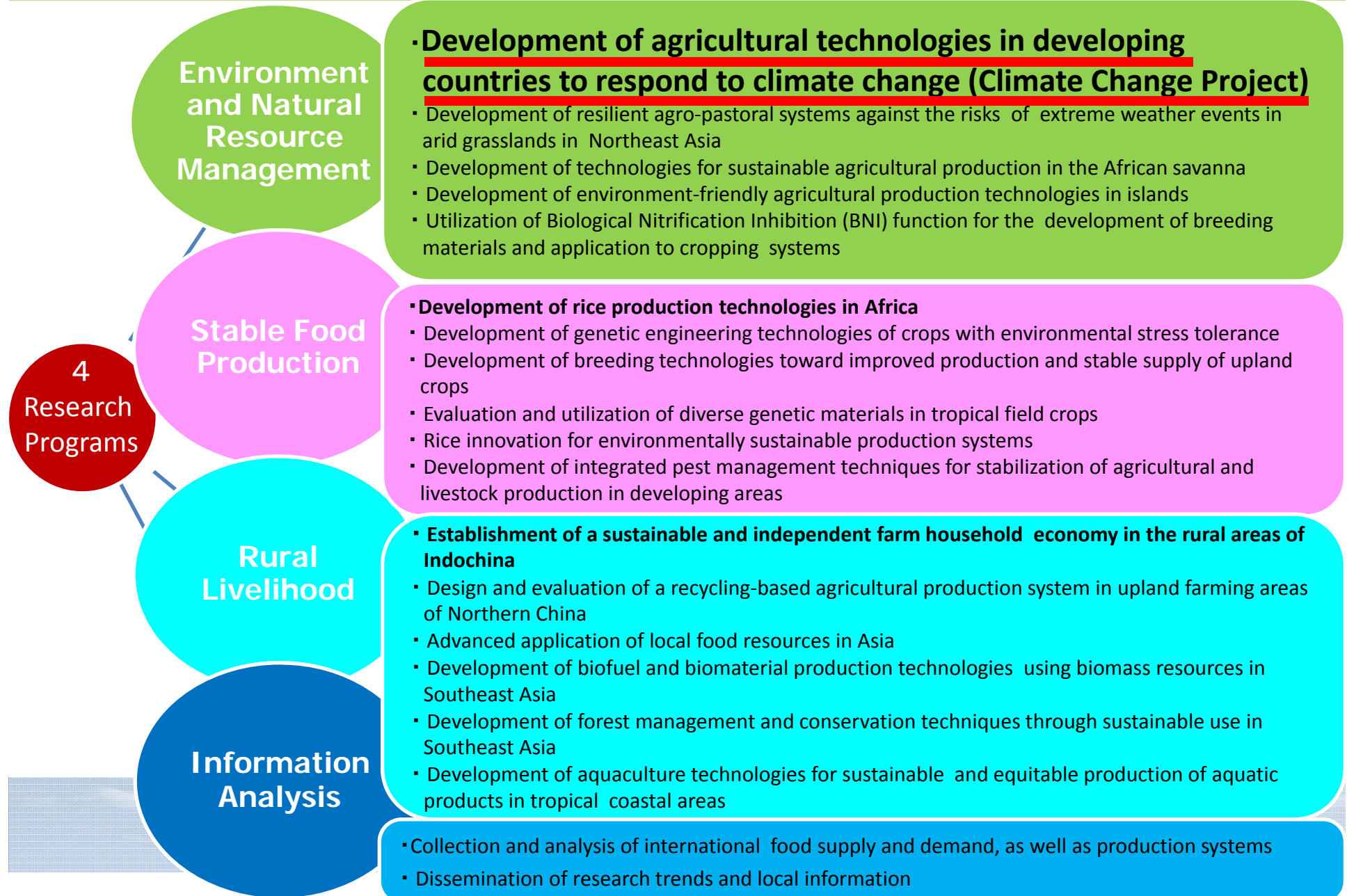


FY 2014

Research activities with 71 research institutes (26 countries)
MOU with foreign research institutes / organizations : 108



Research Programs and Projects



Climate Change Project



Impact Evaluation

- Effect of meteorological disasters on rice production **Bangladesh**
- ✓ • A world food model for the yields of rice, wheat, maize and soybeans **World**

Adaptation

- Drought tolerance/avoidance in rain-fed rice production systems through
 - Breeding **Philippines** **Japan**
Indonesia **Myanmar** **India**
 - ✓ - A decision support system based on seasonal weather forecast
Japan **Philippines** **Indonesia** **Laos**
- Effective use of reservoir networks **Sri Lanka**
- Salinization measures **Uzbekistan**

Mitigation

- ✓ • GHGs from
 - Beef cattle **Thailand** **Vietnam**
 - Rice paddies **Vietnam**
- C sequestration through
 - Afforestation/reforestation/agroforestry **Paraguay**
Ethiopia **Burkina Faso**
 - Soil C enrichment
Thailand **Vietnam** **Indonesia**
- Efficient use of unused resources
 - ✓ - Fuel production with biogas digesters (livestock waste)
↓ **Vietnam**
CDM



World

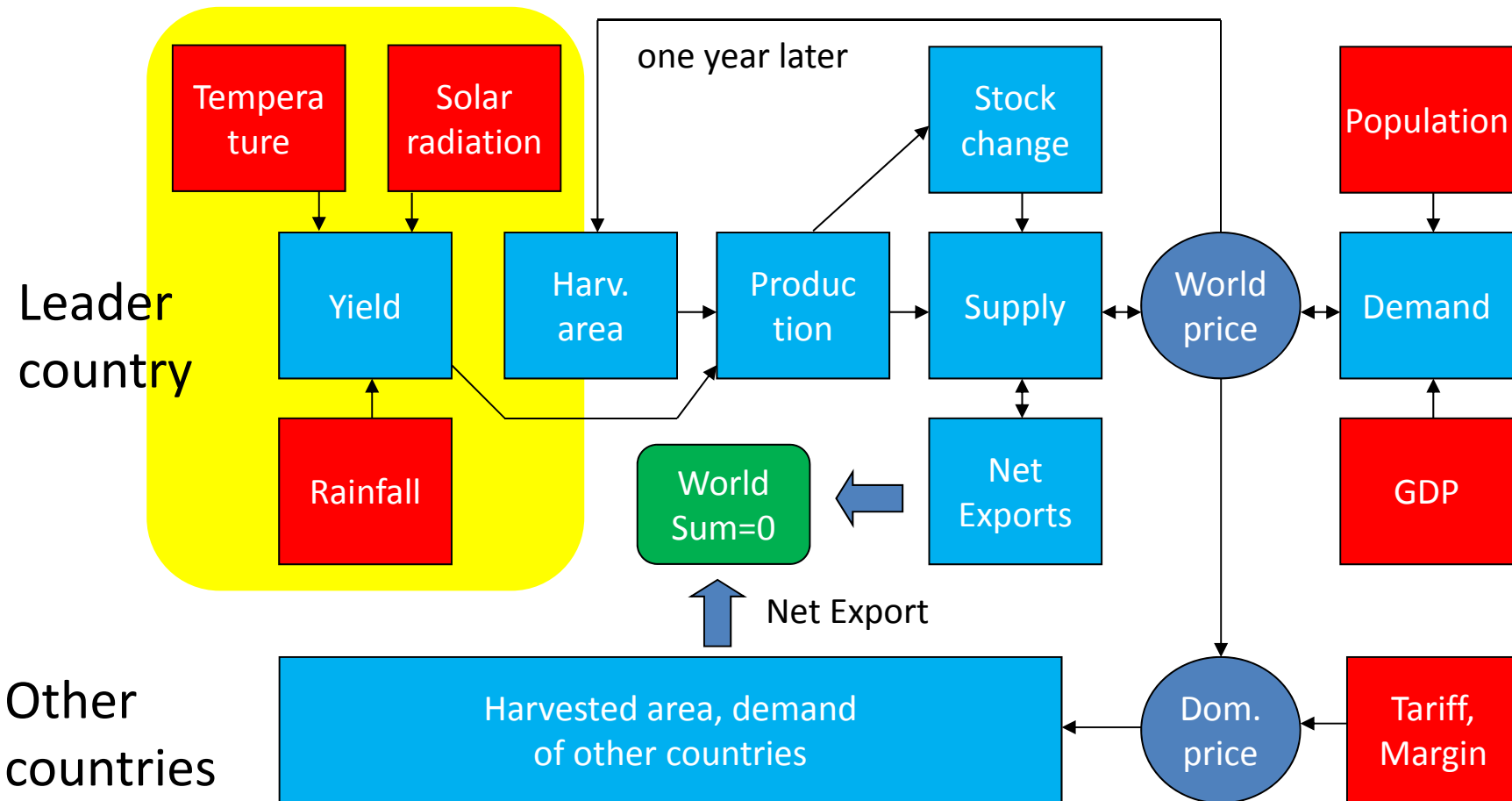


Impacts of Climate Change on Agriculture

- **Analysis using Econometric Models**
including **Climate Variables**



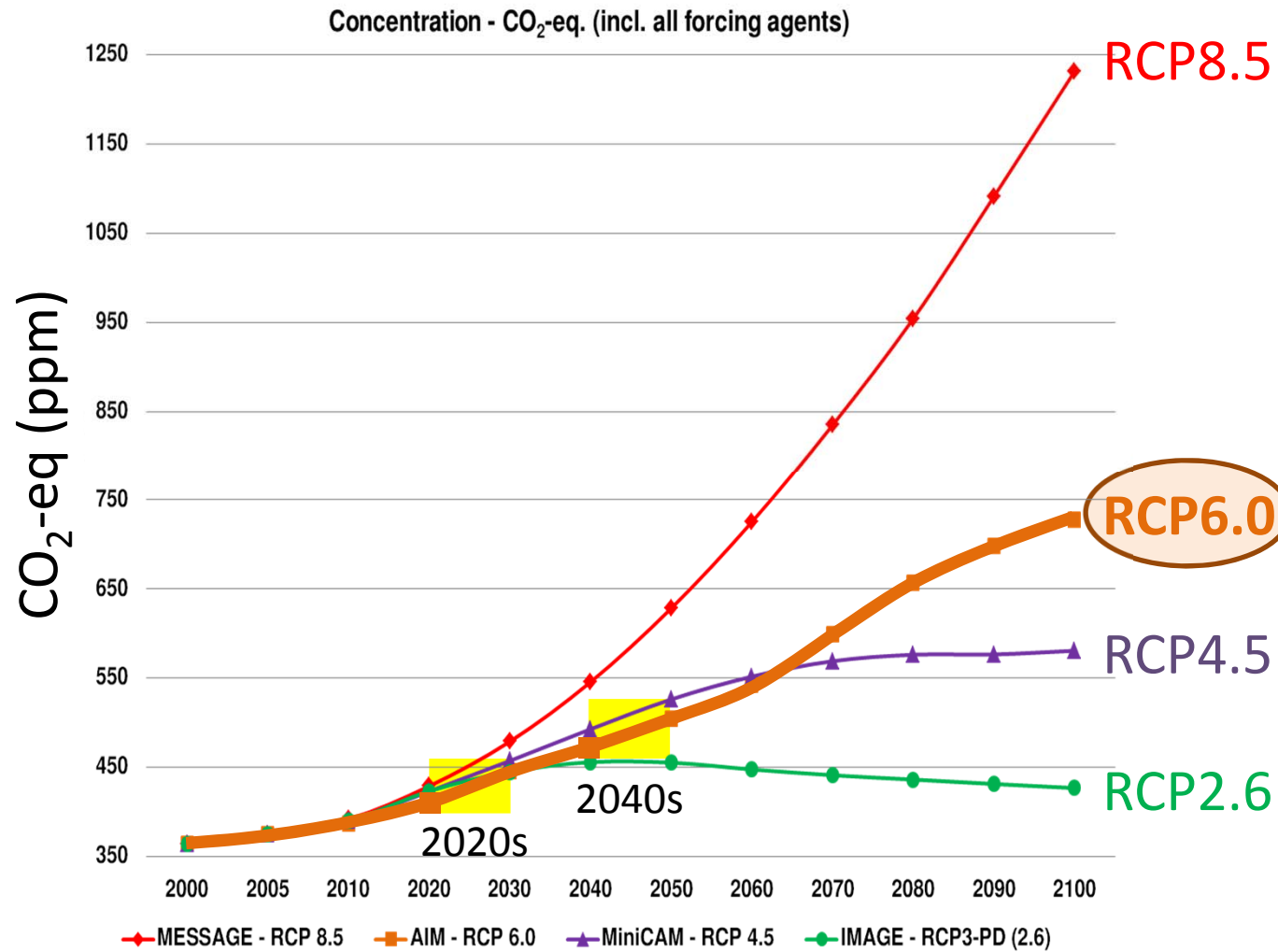
Structure of the World Food Model



Furuya et al. (2015) *JARQ* 49 (2), 187 – 202

http://www.jircas.affrc.go.jp/english/publication/jarq/49-2/49-02-13_187-202_FURUYA.pdf

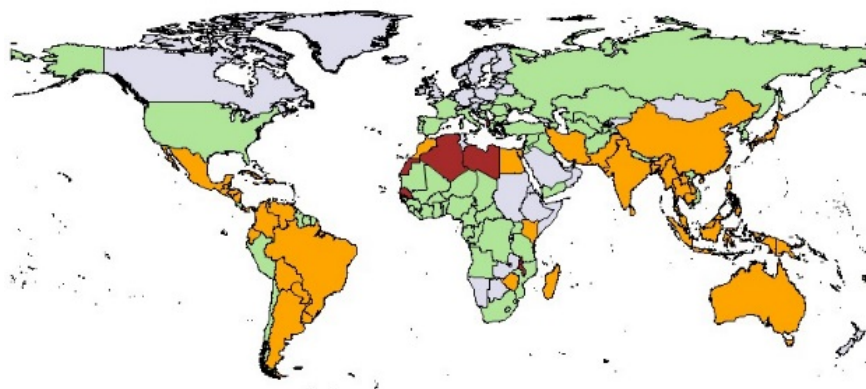
RCP6.0: One of the 4 IPCC Emission Scenarios



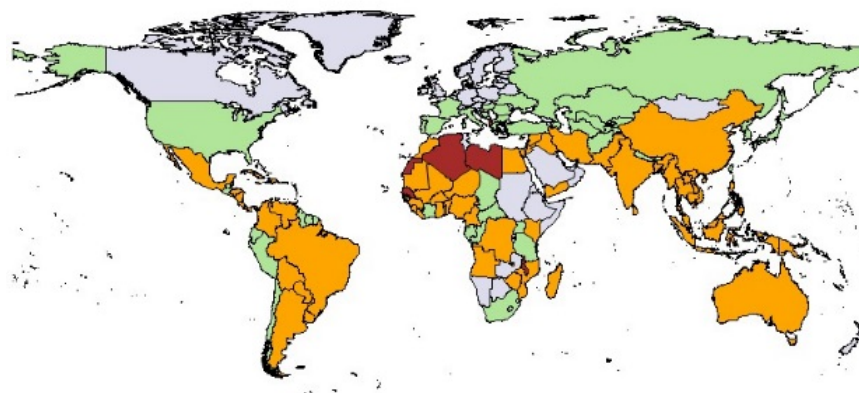
Difference in Yield of Rice between Baseline & RCP6.0



- Rice, RCP6.0 2020s



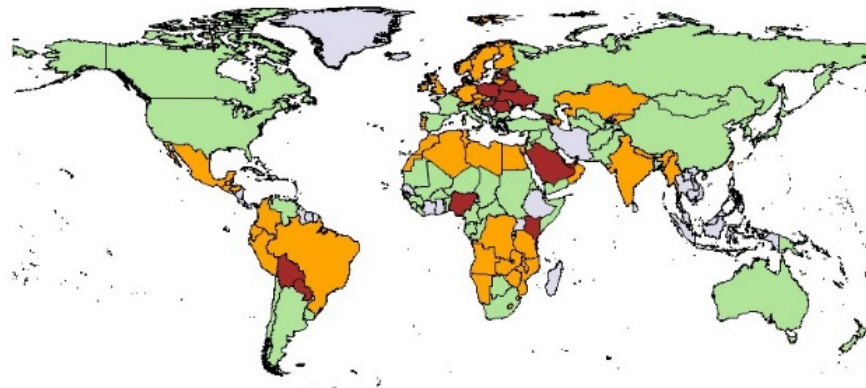
- Rice, RCP6.0 2040s



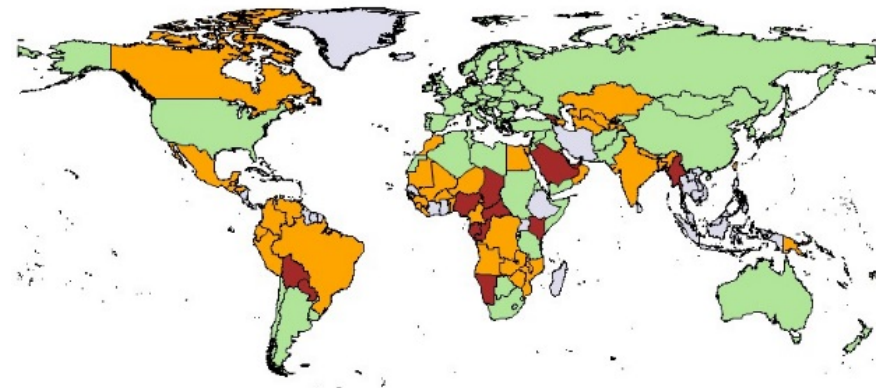
Difference in Yield of Wheat between Baseline & RCP6.0



- Wheat, RCP6.0 2020s



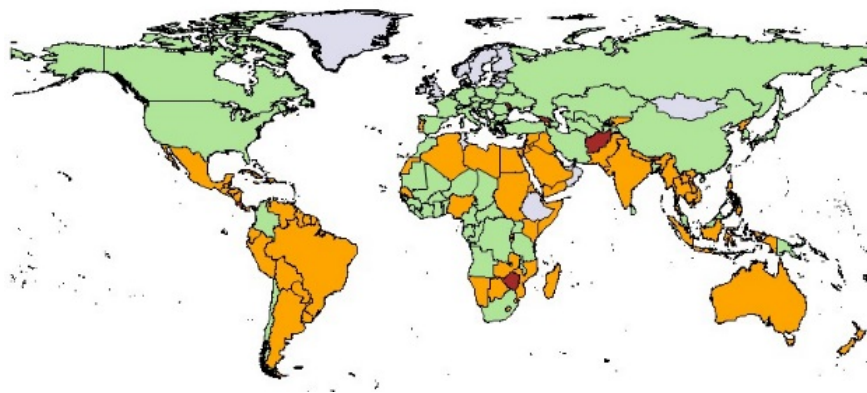
- Wheat, RCP6.0 2040s



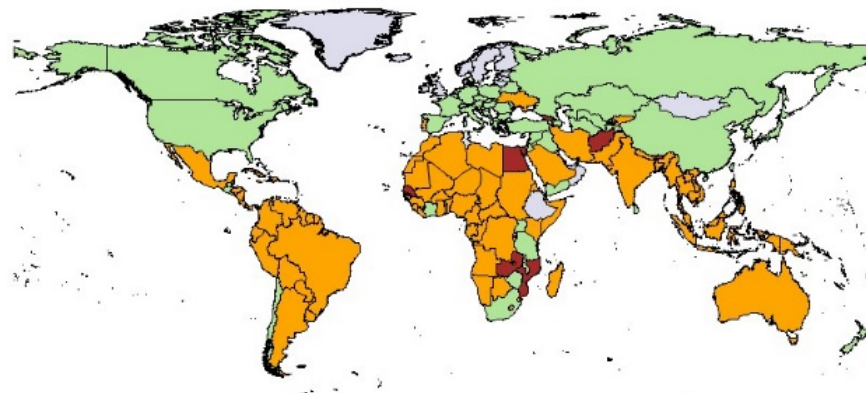
Difference in Yield of Maize between Baseline & RCP6.0



- Maize, RCP6.0 2020s



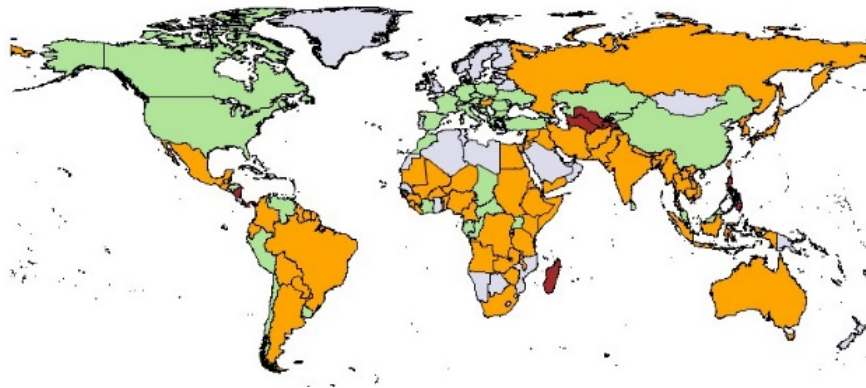
- Maize, RCP6.0 2040s



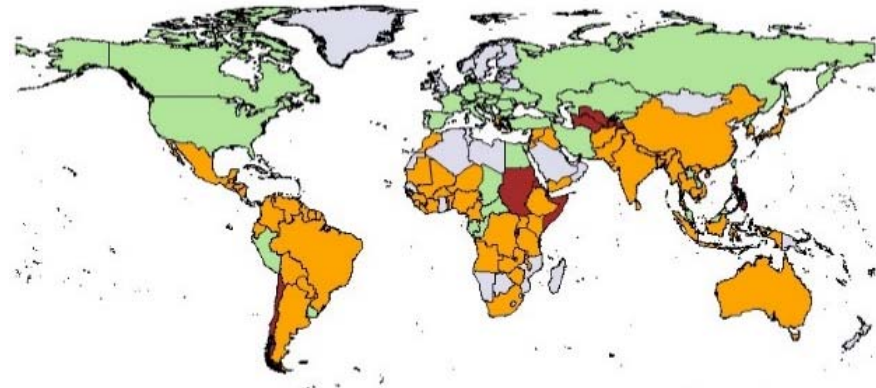
Difference in Yield of Soybeans between Baseline & RCP6.0



- Soybeans, RCP6.0 2020s



- Soybeans, RCP6.0 2040s





Japan

Indonesia

Philippines

Myanmar

India



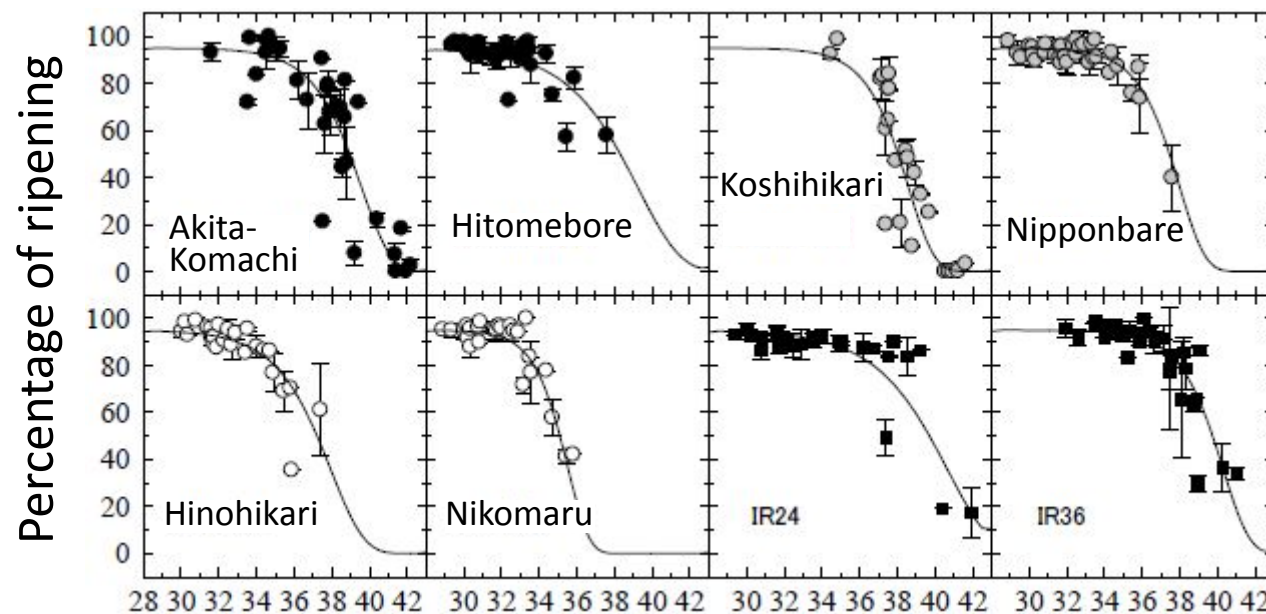
Adaptation Measures for Climate Change

- through **Rice Breeding**

“Early Morning Flowering (EMF)”

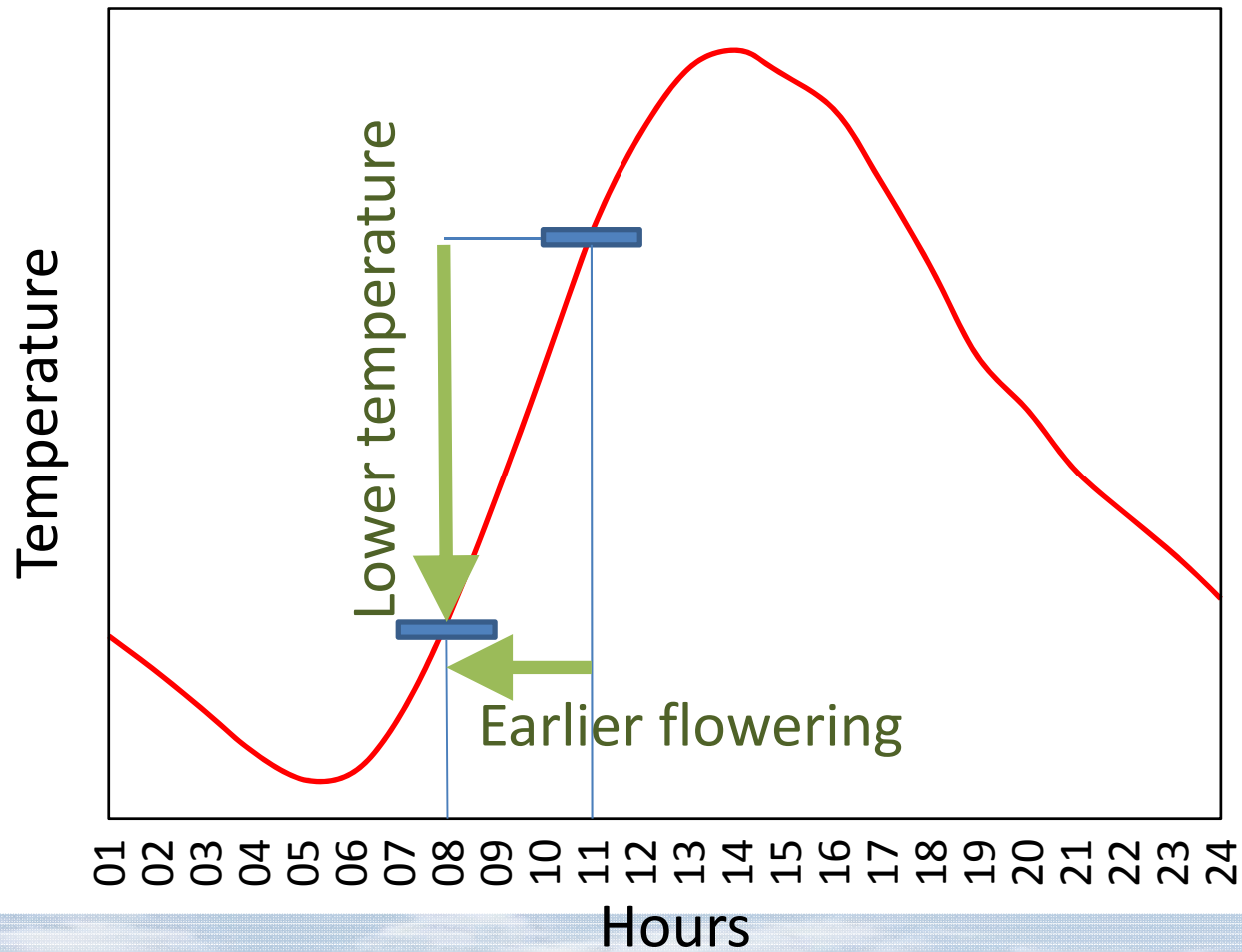


Heat Stress-induced Spikelet Sterility at Flowering



Mean daily maximum temperature for 3 days after heading

Early Morning Flowering (EMF) to avoid high temperature at flowering

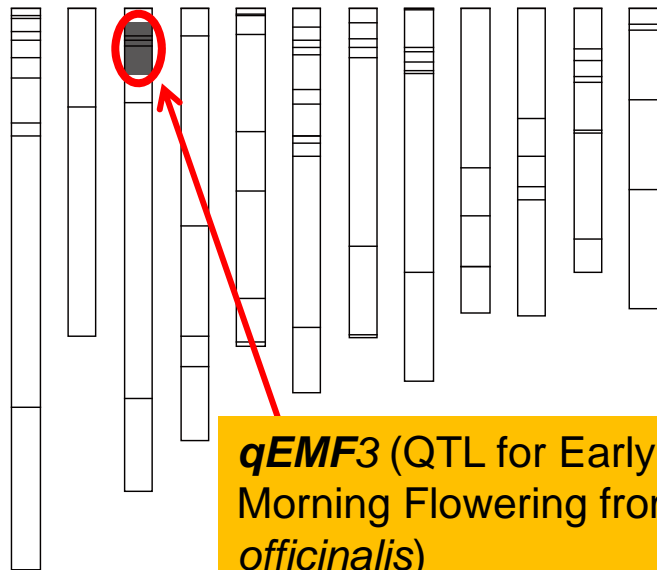


IR64 + *qEMF3* → 2-h Earlier Flowering



Hirabayashi et al. (2015) J. Exp. Bot.

Graphical Genotype of IR64-EMF



90-120 min earlier FOT in NILs than IR64 (recurrent parent)



IR64-NILs are now ready for field testing in the potentially heat-vulnerable regions in the tropics

Tests under Different Temp. Regimes

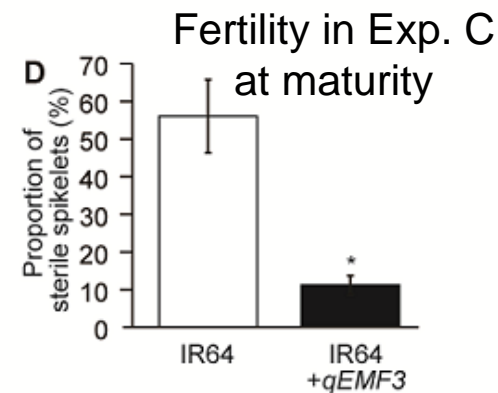
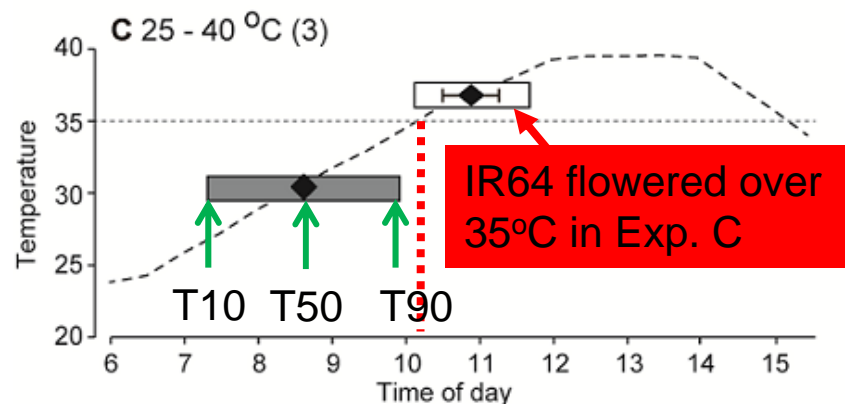
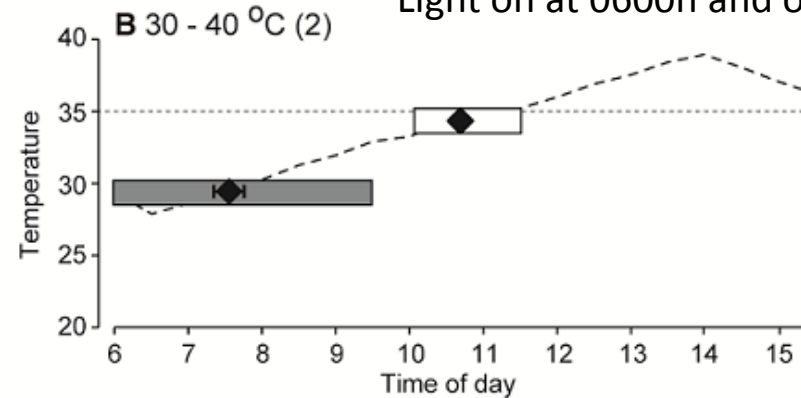
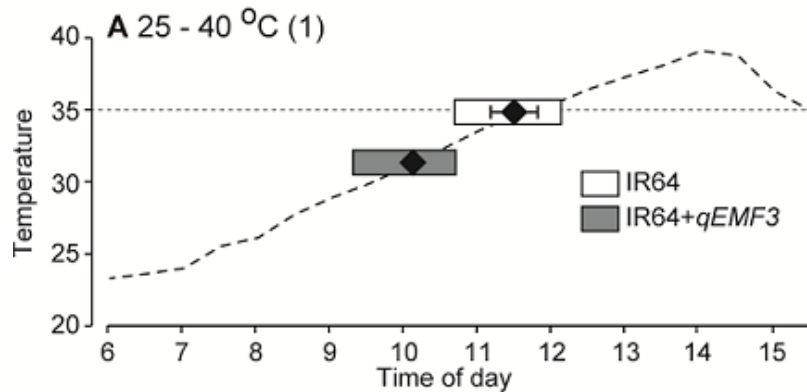


*A pot experiment in an environment-controlled chamber

Humidity: 60% constantly

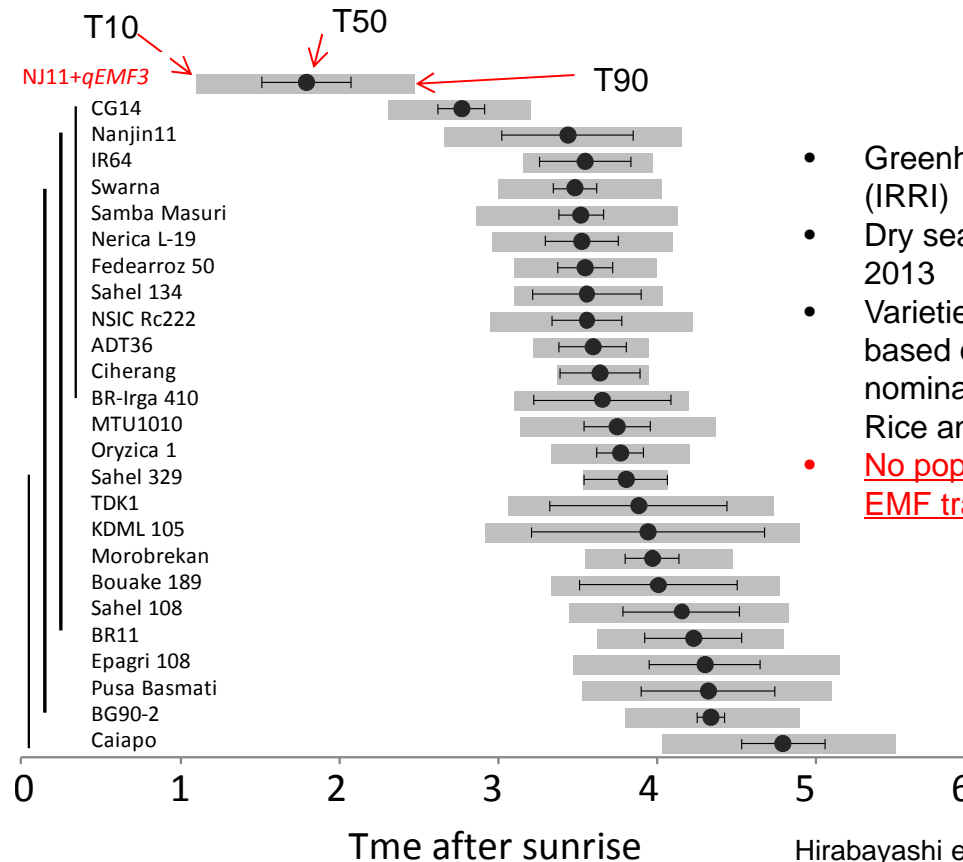
Light; PPFD 1000 $\mu\text{mol m}^{-2} \text{s}^{-1}$.

Light on at 0600h and off at 1900h



qEMF3 shifted the flowering time of IR64 earlier and the temperature at flowering was kept below 35°C.

Comparison with other Popular Varieties



- Greenhouse condition (IRRI)
- Dry season 2012 and 2013
- Varieties are selected based on the breeder's nomination in India, Africa Rice and CIAT.
- No popular variety has EMF trait

Hirabayashi et al (2015) J. Exp. Bot.

Broad application of *qEMF3* to breeding program



Laos

Japan

Indonesia

Philippines



Adaptation Measures for Climate Change

- A Decision Support System
for **Rainfed Rice Farmers**

based on **Seasonal Weather Forecast**



Seasonal Weather Forecast by tuned SINTEX-F



Phailom village, Champon district,
Savannakhet province, Laos



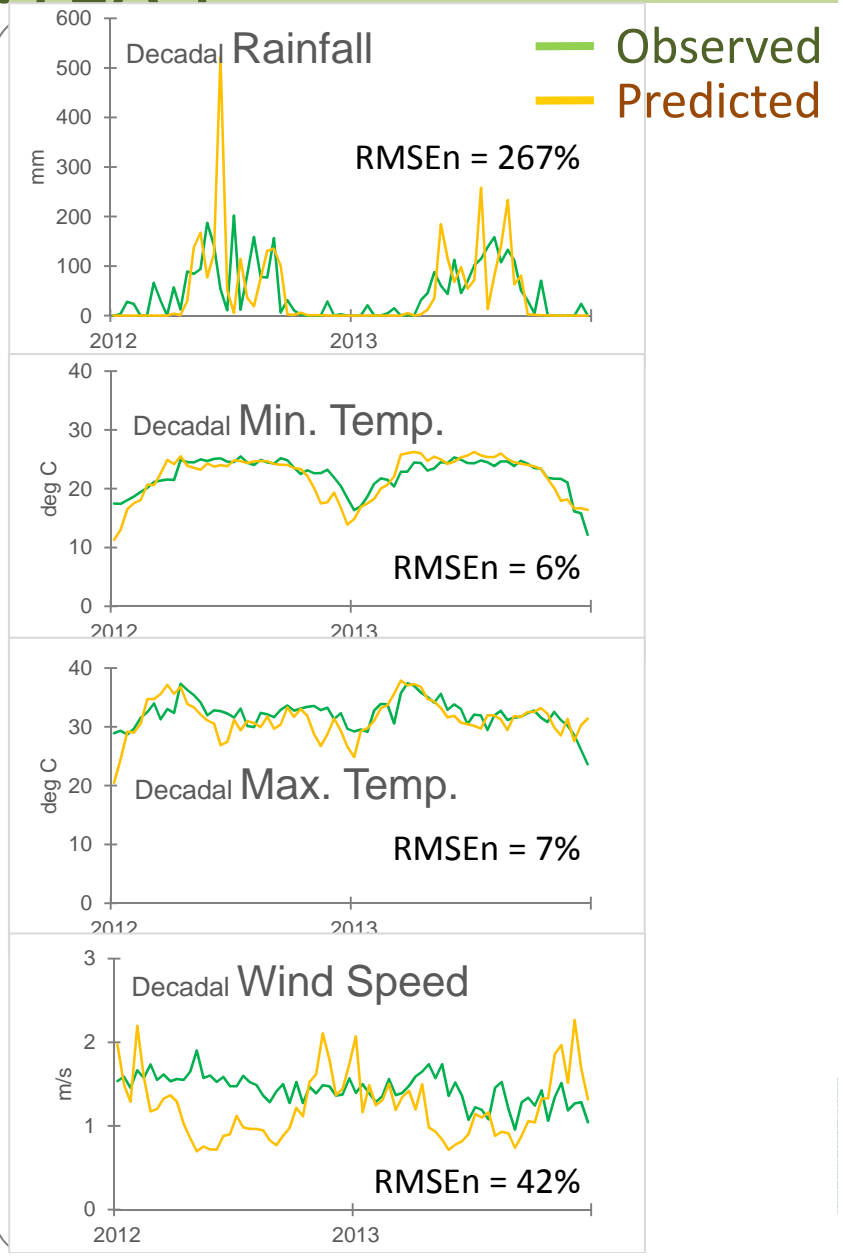
One of the leading models of the world to consistently predict El Nino, etc.

SINTEX-F

Tuning ↑

Long-term observed weather data of a target place

Seasonal weather forecast →



“WeRise” : Decision Support System for Rainfed Rice Farmers



54.254.232.47// <http://54.254.232.47/>

IRRI WeRise About WeRise WEATHER ADVISORY GRAIN YIELD ADVISORY TERMS AND CONDITIONS

IRRI > TOOLS AND DATABASES > WeRise > Home

Select Language Print

WeRise
Decision Support System for Rainfed Rice Production

Weather Advisory

Select Dataset: Indonesia station year: measured variable: [button]

Weather Advisory

IRRI WeRise About WeRise WEATHER ADVISORY GRAIN YIELD ADVISORY TERMS AND CONDITIONS

Chart: Rainfall

forecast Weather Data Station: jakarta

chart notes:

Characteristics of the upcoming rainy season

- start/end of the season
- distribution of rainfall
- expected flood/drought occurrences

WeRise (Weather-rice-nutrient integrated decision support system)

Rainfed rice yields are low and unstable mainly because of uncertainty in rainfall amount and distribution, existence of nutrient stress, and pest occurrence. Climate change poses the grave threat of extreme weather events that could further reduce rice productivity in rainfed areas.

The IRRI-Japan project on Climate Change Adaptation in Rainfed Rice Areas (CCARA) is developing a decision support system (WeRise) to improve the livelihood of rainfed rice farmers under current and future climate scenarios. This system uses a seasonal-weather forecast that provides crucial weather information such as the start and end of the rainy season and rainfall distribution during the crop growing season to farmers. It also advises farmers when to sow and transplant the crop, what variety is appropriate, and how fertilizer and other inputs may be efficiently applied.

Field tests on the WeRise prototype are going on in Indonesia and Lao PDR. The prototype for other countries including the Philippines and Thailand may also be explored. To run the prototype, please click on the weather advisory or grain yield advisory image below or button above. Feedbacks to improve the prototype and/or establish collaboration are welcome.

Weather Advisory

Grain Yield Advisory

Grain Yield Advisory

IRRI WeRise About WeRise WEATHER ADVISORY GRAIN YIELD ADVISORY

Grain Yield Advisory

Select Dataset: Indonesia station year: Top Fertilizer: [button]

Compare to actual set [button] Show Graph [button]

Grain Yield Advisory

Sowing dates
↓
Grain yield predictions



IRRI-Japan Collaborative Research Project

The IRRI-Japan Collaborative Research Projects have been funded by the government of Japan through the Ministry of Agriculture, Forestry, and Fisheries (MAFF) since 1984. CCARA, which is the latest project, was launched in August 2010 and will end in September 2015.

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Grain Yield Advisory

Simulated Alternative Green Yield (t/ha)

Optimum sowing dates for rainfed rice crop

Sowing Date	Yield (t/ha)	Stress
2014-09-01	4.1	Low
2014-09-15	4.2	Low
2014-10-01	4.3	Low
2014-10-15	4.4	Low
2014-11-01	4.5	Low
2014-11-15	4.6	Low
2014-12-01	4.7	Low
2014-12-15	4.8	Low
2015-01-01	4.9	Low
2015-01-15	5.0	Low
2015-02-01	5.1	Low
2015-02-15	5.2	Low
2015-03-01	5.3	Low
2015-03-15	5.4	Low
2015-04-01	5.5	Low
2015-04-15	5.6	Low
2015-05-01	5.7	Low
2015-05-15	5.8	Low
2015-06-01	5.9	Low
2015-06-15	6.0	Low

Advises fertilizer application timings

Predicts a cropping calendar

IRRI WeRise About WeRise WEATHER ADVISORY GRAIN YIELD ADVISORY

Weather Advisory

Select Dataset: Indonesia station year: 2010 Show Advisory [button]

Advisory

- Wet season rainfall is normal.
- Onset of Rain is on Nov-01
- Expected flooding dates: NOV-21, DEC-01, JAN-01, JAN-11, MAR-11, MAY-21
- Expected drought dates: DEC-11, FEB-01, MAR-01

IRRI WeRise About WeRise WEATHER ADVISORY GRAIN YIELD ADVISORY

Forecast Weather Data Station: jakarta

Forecast Weather Data Station: jakarta

Wet Season



Thailand

Vietnam



Mitigation Measures for Climate Change

- Methane Emission from **Beef Cattle**



Methods and Hypothesis



Khon Kaen University

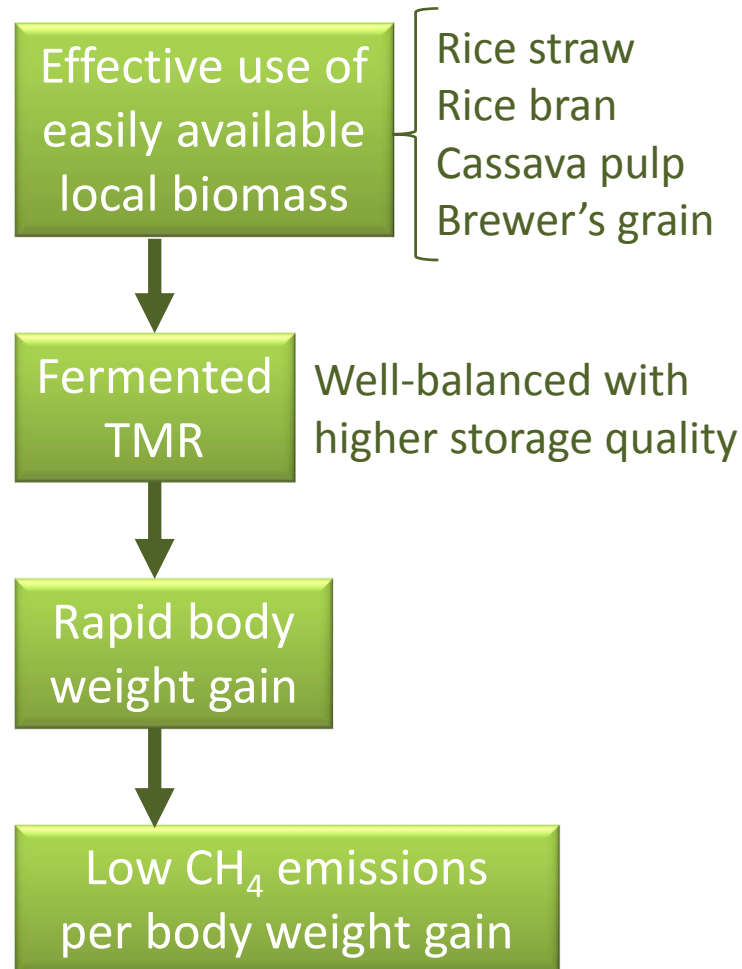
Can Tho University



Front view of head chamber



CH₄ emission monitoring with a head cage method



Thailand

Pangola Grass vs. FTMR



Animals: 8 Thai native male cattle

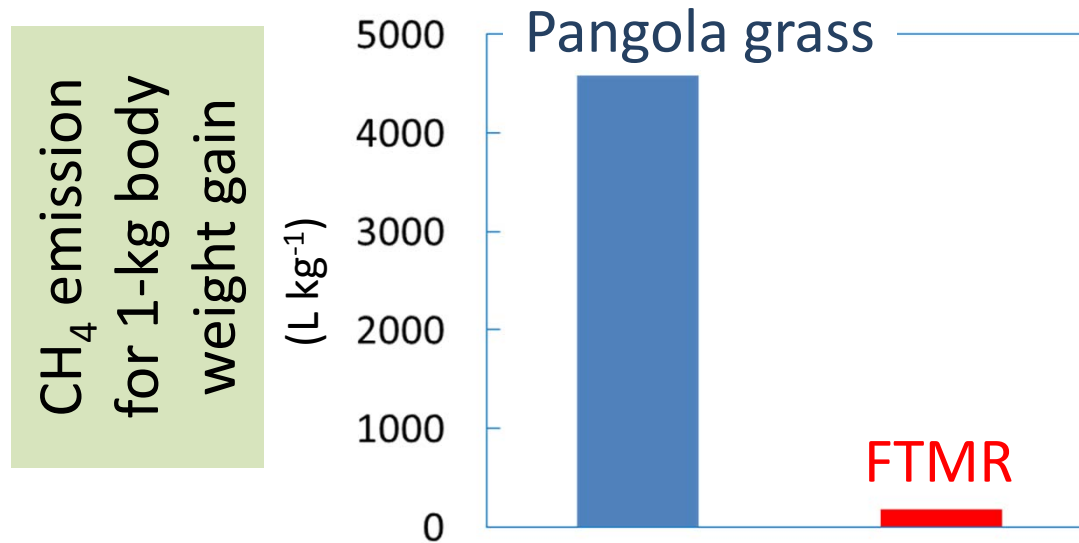
Treatment:

- **Control:** Pangola grass (ad libitum)
- **FTMR:** Fermented TMR (ad libitum)

Measurement: Intake,
body weight, and
CH₄ emission

Experimental period: 5 months







Vietnam



Mitigation Measures for Climate Change

- A Biogas Digester CDM Program

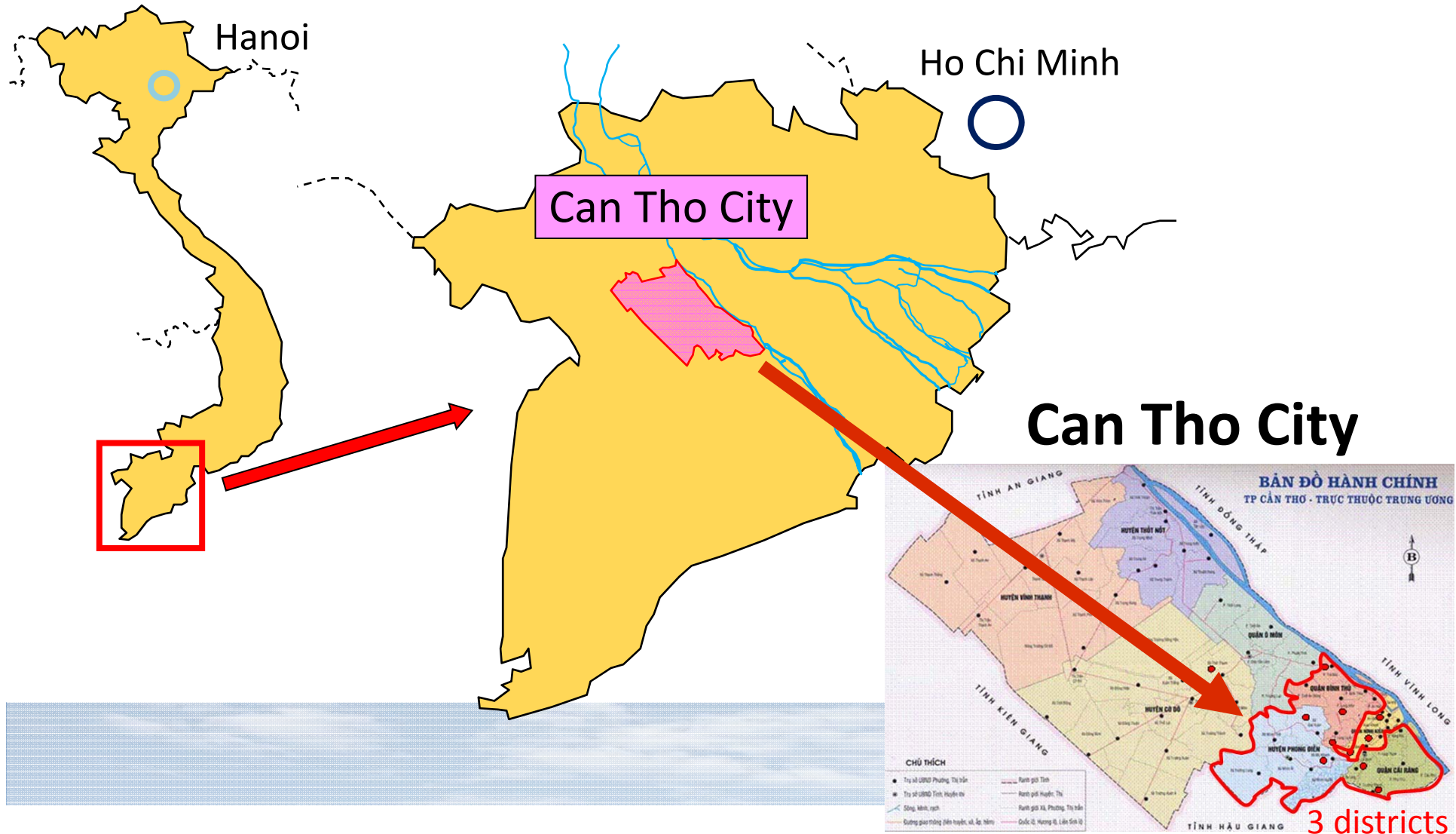


Location of Project Area

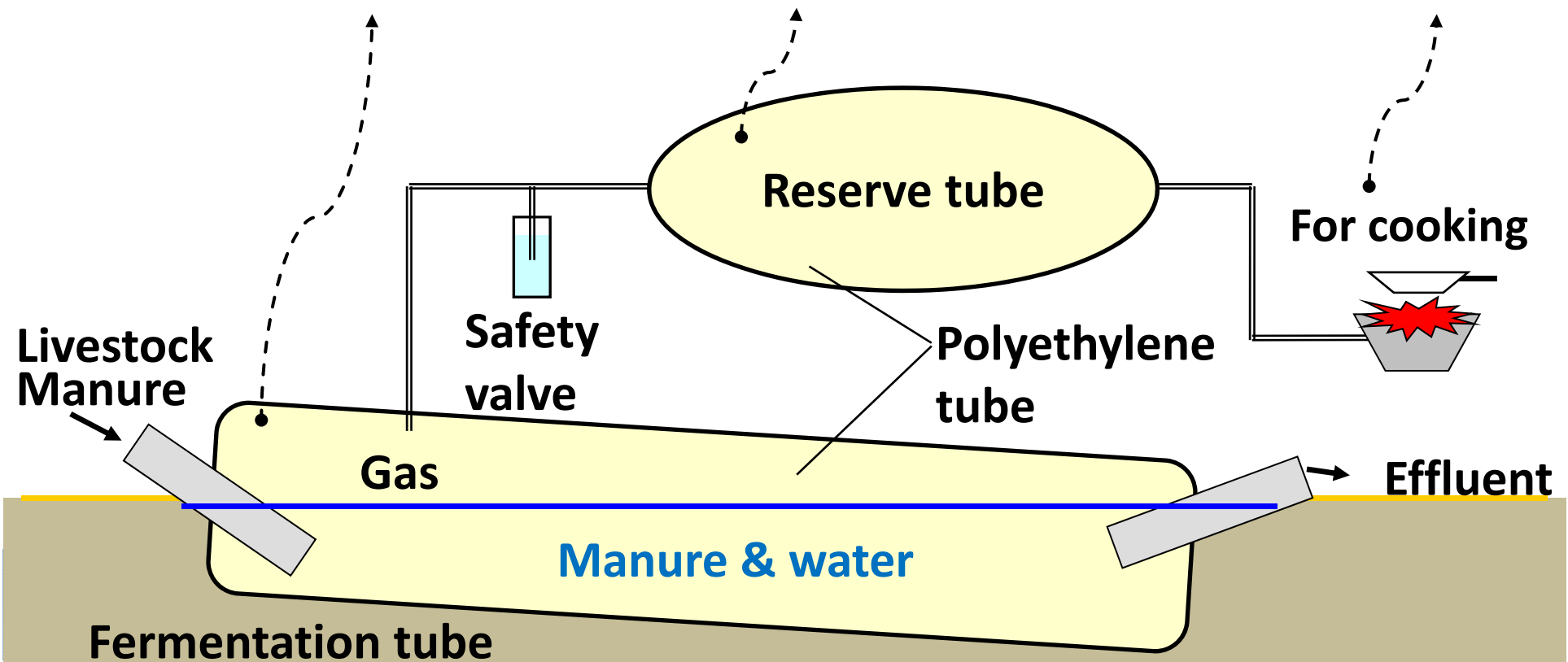


Vietnam

Mekong Delta



Biogas Digester (BD) System



Outline of the Biogas CDM Project



- Title: Farm Household Biogas Project Contributing to Rural Development in Can Tho City
- Duration: 7 years. Monitoring period started on 1 June 2013
- Location: 3 districts in Can Tho City, Viet Nam
- Activity: Introducing around **1,000 units** of biogas digester (BD) system to displace the use of firewood and LP gas with biogas. The estimated total GHG emission reduction is around **1,200 tCO₂/year**
- Remarks: Registered on 15 August 2012 with the **UNFCCC CDM-EB**. First biogas **CDM** project to directly benefit low-income households as well as the environment in Vietnam.

CDM: Clean Development Mechanism

UNFCCC CDM-EB: CDM Executive Board of United Nations Framework Convention on Climate Change

Procedure for obtaining C-credit



Until registration of CDM project

Preparation of Project Design Document (PDD)

Validation of CDM project

Registration in UNFCCC CDM-EB

2008 -

Formulation of project by JIRCAS
Application of CDM methodology

Validation: on 18 - 20 Jan. 2011

- Approval of Gov. of Japan: 12 Sep. 2011
- Approval of Gov. of Vietnam: 15 Feb. 2012

Registration of the project in UNFCCC CDM Executive Board (CDM-EB) on 15 Aug. 2012

Until issuance of carbon credit

Implementation of the project

Monitoring activities

Verification

Approval for issuance of credit by CDM-EB

Issuance of credit

Installation of BD

Monitoring of GHG emission reduction (1st monitoring: 1 Jun. 2013 - 31 May 2014)

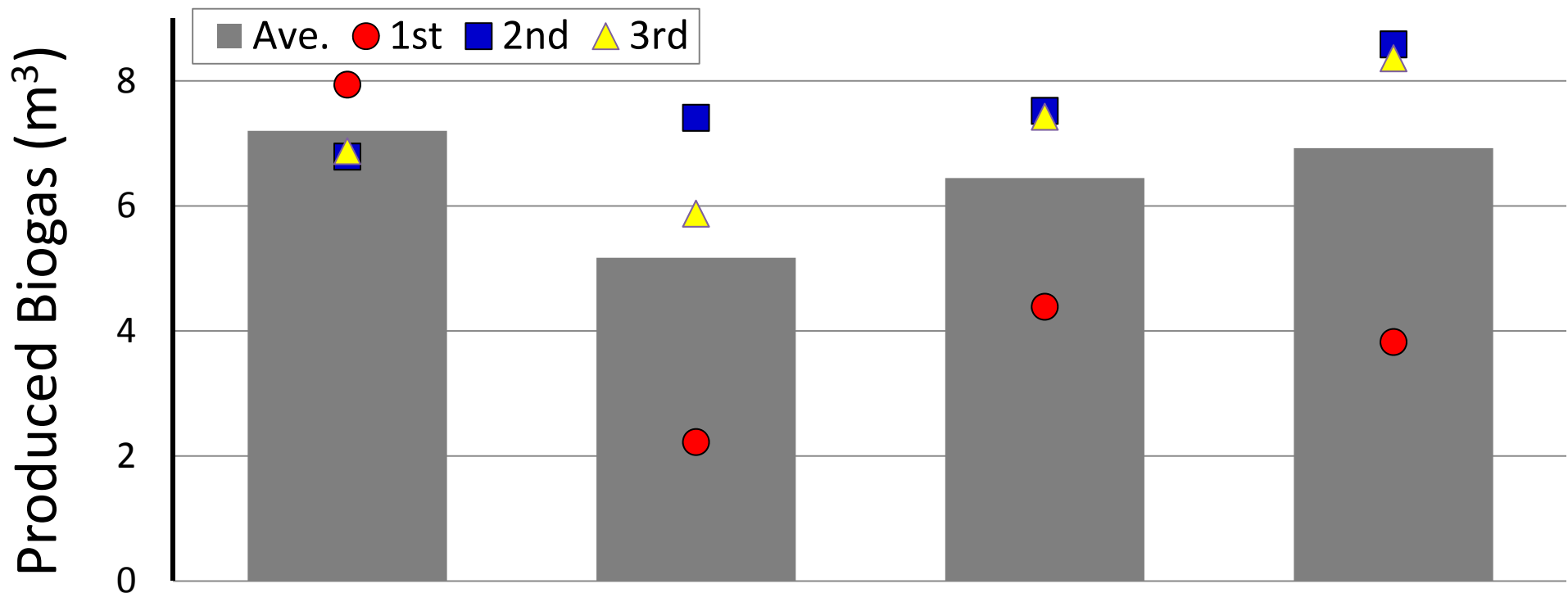
Verification by Designated Operational Entity: on 30 Sep. - 2 Oct. 2014

19 Jun. 2015

Unused Local Biomass instead of Livestock Manure



Experimental conditions: 2.7 kg DW-eq. biomass day⁻¹ for 30 days



Climate Change Project



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 - ✓ - A decision support system based on seasonal weather forecast **Japan** **Philippines** **Indonesia** **Laos**
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 - Soil C enrichment **Thailand** **Vietnam** **Indonesia**
 - Efficient use of unused resources
 - ✓ - Fuel production with biogas digesters (livestock waste) **Vietnam**
- ↓
CDM