

Impact and Adaptation Assessment of Climate Change on Rice Production in Indonesia

23rd AIM WS@NIES

28 Nov. 2017

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Ibaraki University

Collaboration with



Funded by



Background

- Mr. Abe, the prime minister of Japan, promised to support adaptation planning and actions in developing countries in his speech of the UN Climate Summit 2014
 - “Japan’s Adaptation Initiative”
- **Indonesia** was selected as the first country implemented the initiative.
- A Japanese research team was organized and the project has started in Jun. 2015.
 - three year project (until Mar. 2018)
 - will be extended...



@UN Climate Summit 2014



Support adaptation
planning and actions

Mr. Abe

Objectives of our activity

- Support regional adaptation planning
 - in collaboration with local researchers and stakeholders
 - ① create scientific evidence on regional future CC impacts
 - ② develop effective adaptation scenarios
- Capacity building for sustainable planning and actions on adaptation
- Develop adaptation planning guideline
 - to apply our approach to other countries and regions

Team members



- **The University of Tokyo:**

- ✓ Coordination of the and communication with MOEJ
- ✓ Impacts assessment on [health impact](#)



- **National Institute for Environmental Studies (NIES):**

- ✓ Future climate projections based on climate models



- **Ibaraki University:**

- ✓ Impact assessments on [agriculture](#)

NIPPON KOEI

Challenging mind, Changing dynamics

- **Nippon Koei:**

- ✓ Overall coordination and guideline development
- ✓ Impact assessments on [water resources](#)



Udayana University



BOGOR AGRICULTURAL
UNIVERSITY
Advancing and Serving The Best

- **Local consultants (Profs. Pasaribu and Osawa):**

- ✓ Support and coordination of field survey etc.

Approach : "Interactive"

1st step: Impact assessment (*done*)



2nd step: Discussion with stakeholders (*done*)



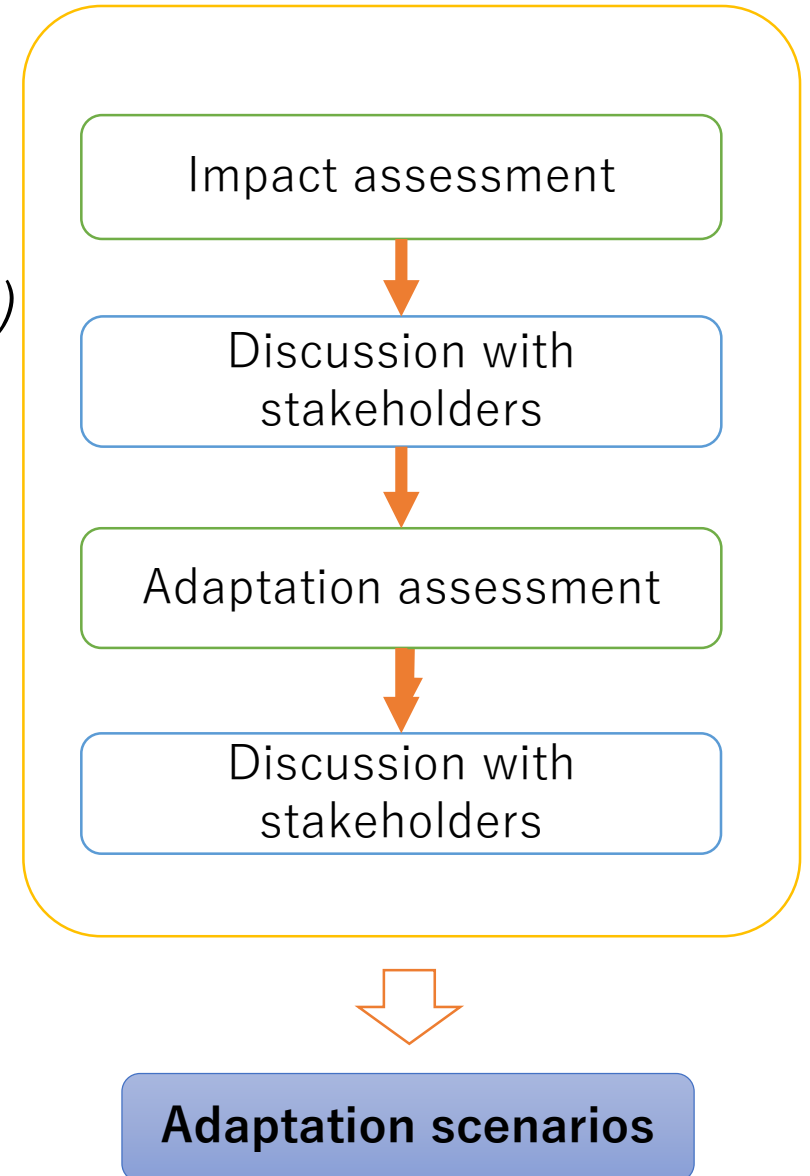
3rd step: Adaptation assessment (*running*)



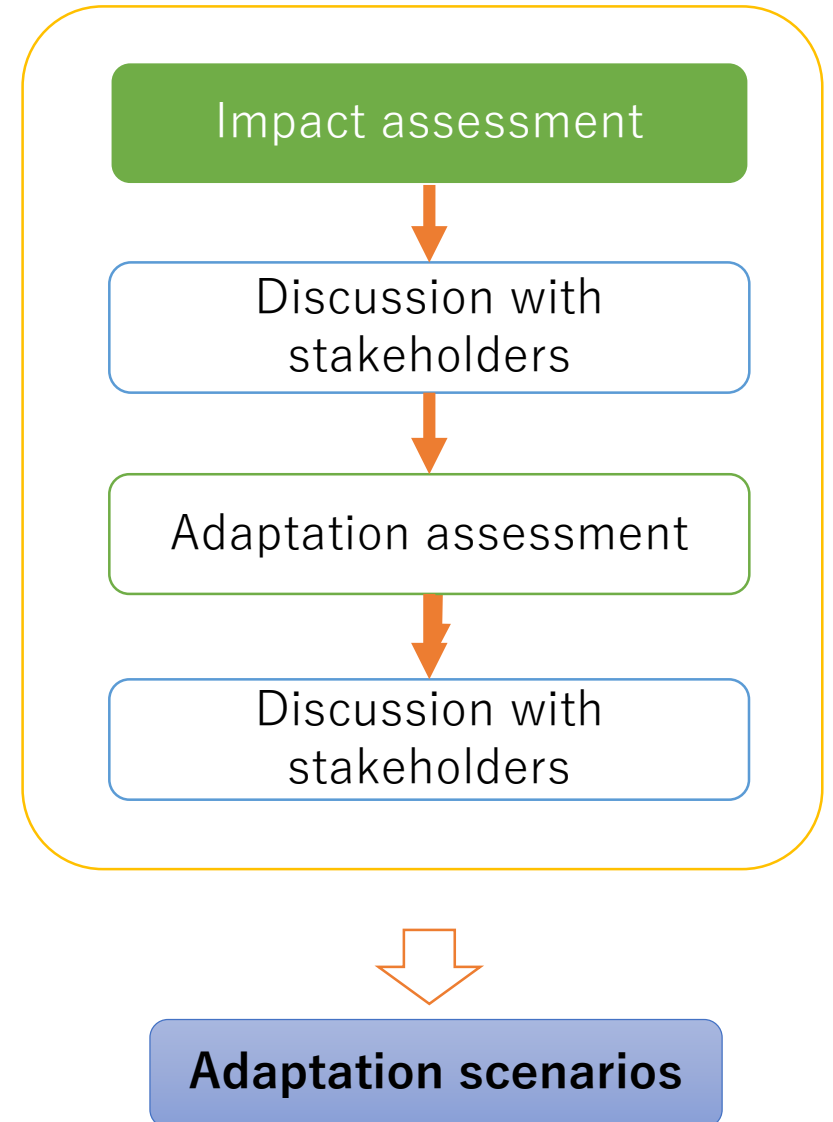
4th step: Discussion with stakeholders



5th step: Making adaptation scenarios



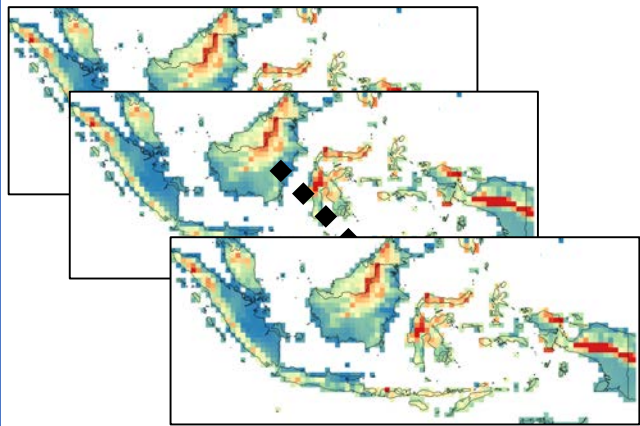
1st step: Impact assessment



Method

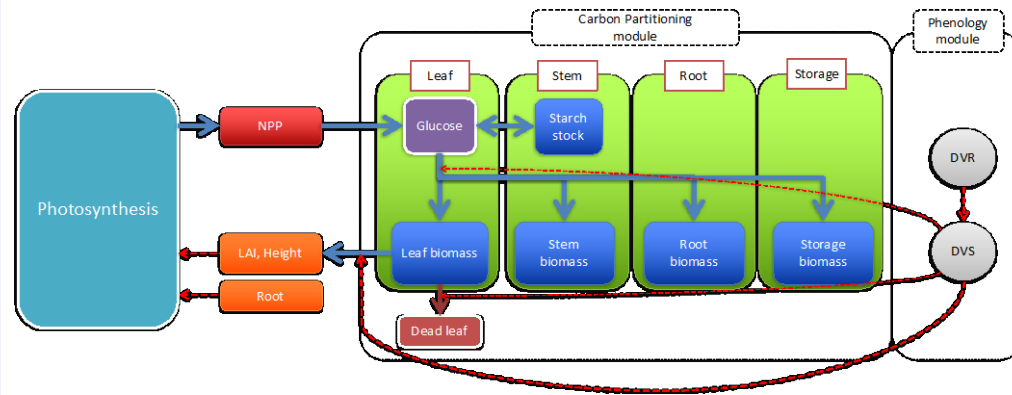
① Input

Future climate projections



② Impact model

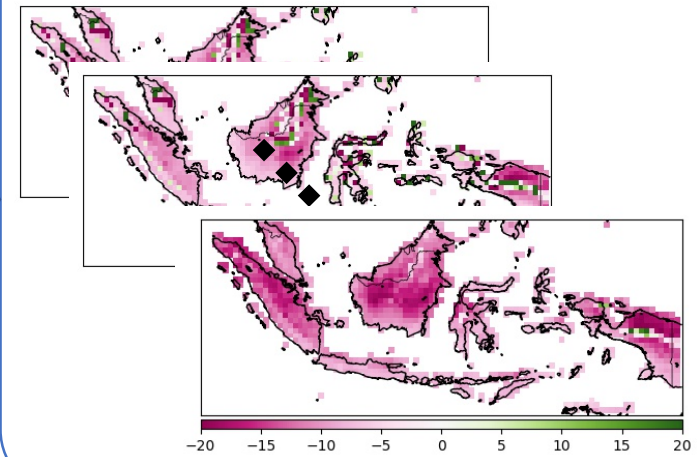
Crop Growth Simulation Model : **MATCRO**



Masutomi et al. (2016a,b)

③ Output

Change in rice yield [%]



Base years: 1981-2005

Assessment years: 2018-2042



Decrease

Or



Increase

Selection of future climate projections

Indonesia (whole)		Western Indonesia		Central Indonesia		Eastern Indonesia	
N°	Climate Model	N°	Climate Model	N°	Climate Model	N°	Climate Model
1	ACCESS1-0	1	ACCESS1-0	1	ACCESS1-0	1	BNU-ESM
2	BNU-ESM	2	ACCESS1-3	2	BNU-ESM	2	CanESM2
3	CNRM-CM5	3	BNU-ESM	3	CanESM2	3	CNRM-CM5
4	FGOALS-g2	4	CNRM-CM5	4	CNRM-CM5	4	GFDL-CM3
5	GFDL-CM3	5	FGOALS-g2	5	FGOALS-g2	5	GFDL-ESM2M
6	GFDL-ESM2M	6	HadGEM2-AO	6	GFDL-CM3	6	HadGEM2-AO
7	IPSL-CM5A-LR	7	IPSL-CM5A-LR	7	GFDL-ESM2M	7	inmcm4
8	IPSL-CM5A-MR	8	IPSL-CM5A-MR	8	IPSL-CM5A-LR	8	IPSL-CM5A-LR
9	IPSL-CM5B-LR	9	IPSL-CM5B-LR	9	IPSL-CM5A-MR	9	IPSL-CM5A-MR
10	MIROC5	10	MIROC5	10	IPSL-CM5B-LR	10	IPSL-CM5B-LR
11	NorESM1-M	11	MIROC-ESM	11	MIROC5	11	MIROC5
		12	MIROC-ESM-CHEM	12	MRI-CGCM3	12	NorESM1-M
		13	MRI-CGCM3	13	MRI-ESM1		
		14	MRI-ESM1	14	NorESM1-M		
		15	NorESM1-M				

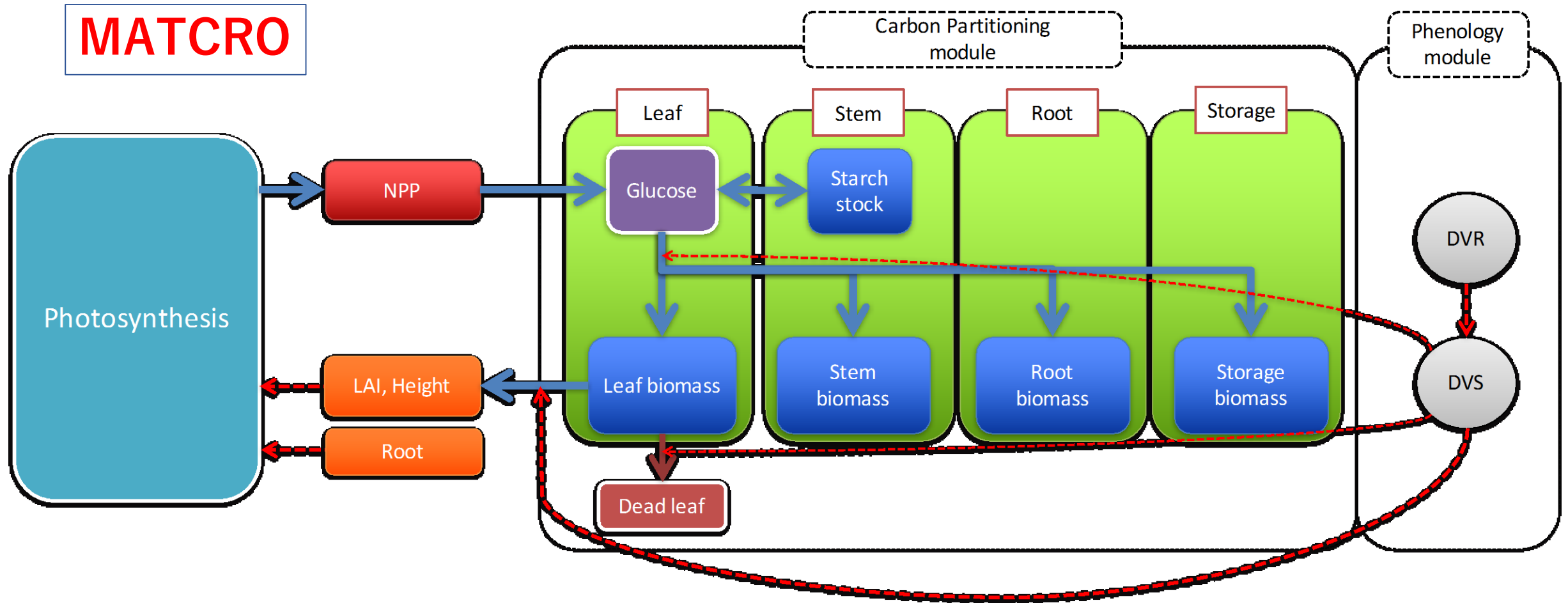
- We selected 6 climate models with high performance over Indonesia

1. CNRM-CM5
2. IPSL-CM5A-LR
3. IPSL-CM5A-MR
4. IPSL-CM5B-LR
5. MIROC5
6. NorESM1-M

- 21 future climate projections

- Each model has 2-4 RCP scenarios

②Impact model



Crop growth simulation model based on crop physiology
(Masutomi et al. 2016a,b)

Local rice cultivars

	Cultivars	Planted area(ha)	%	type
1	Ciherang	5,034,657	37.1	Indica
2	Mekongga	1,135,893	8.4	Indica
3	Situ Bagendit	1,013,659	7.5	Indica
4	IR 64	964,241	7.1	Indica

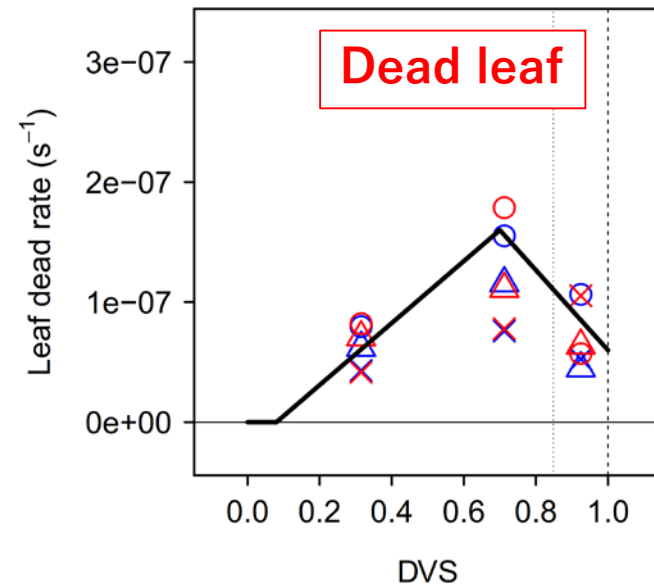
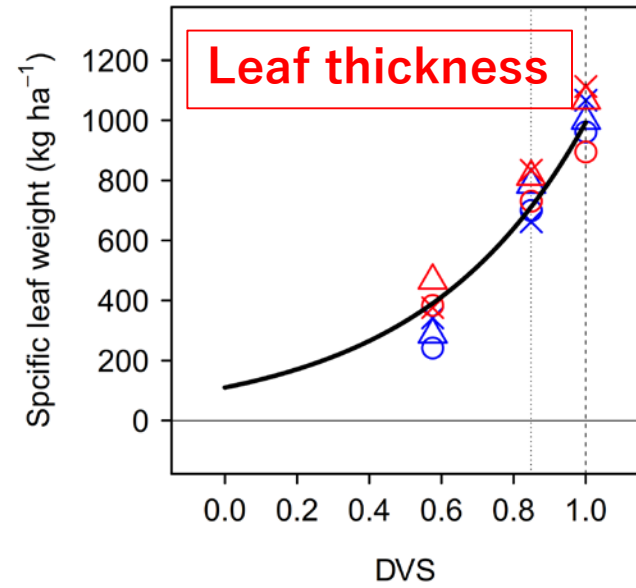
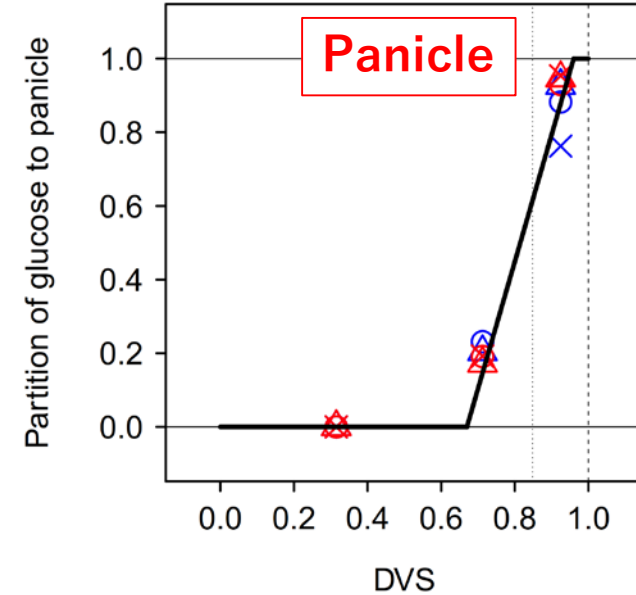
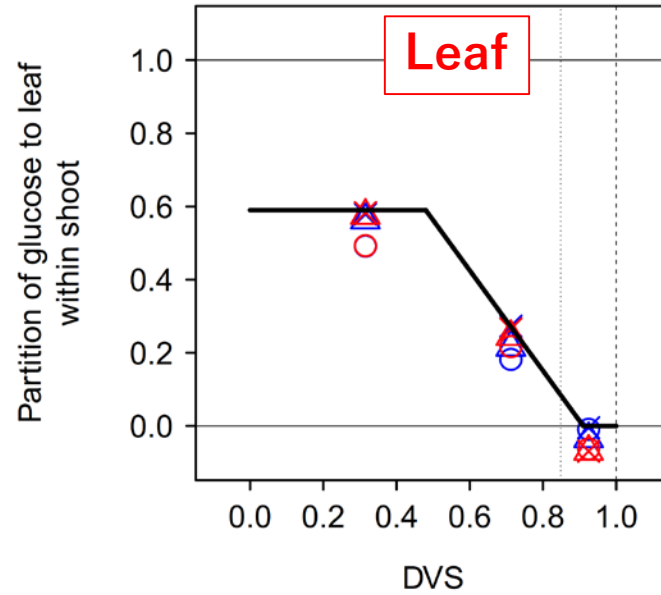
Source IAARD

We focused on “Ciherang” in this study

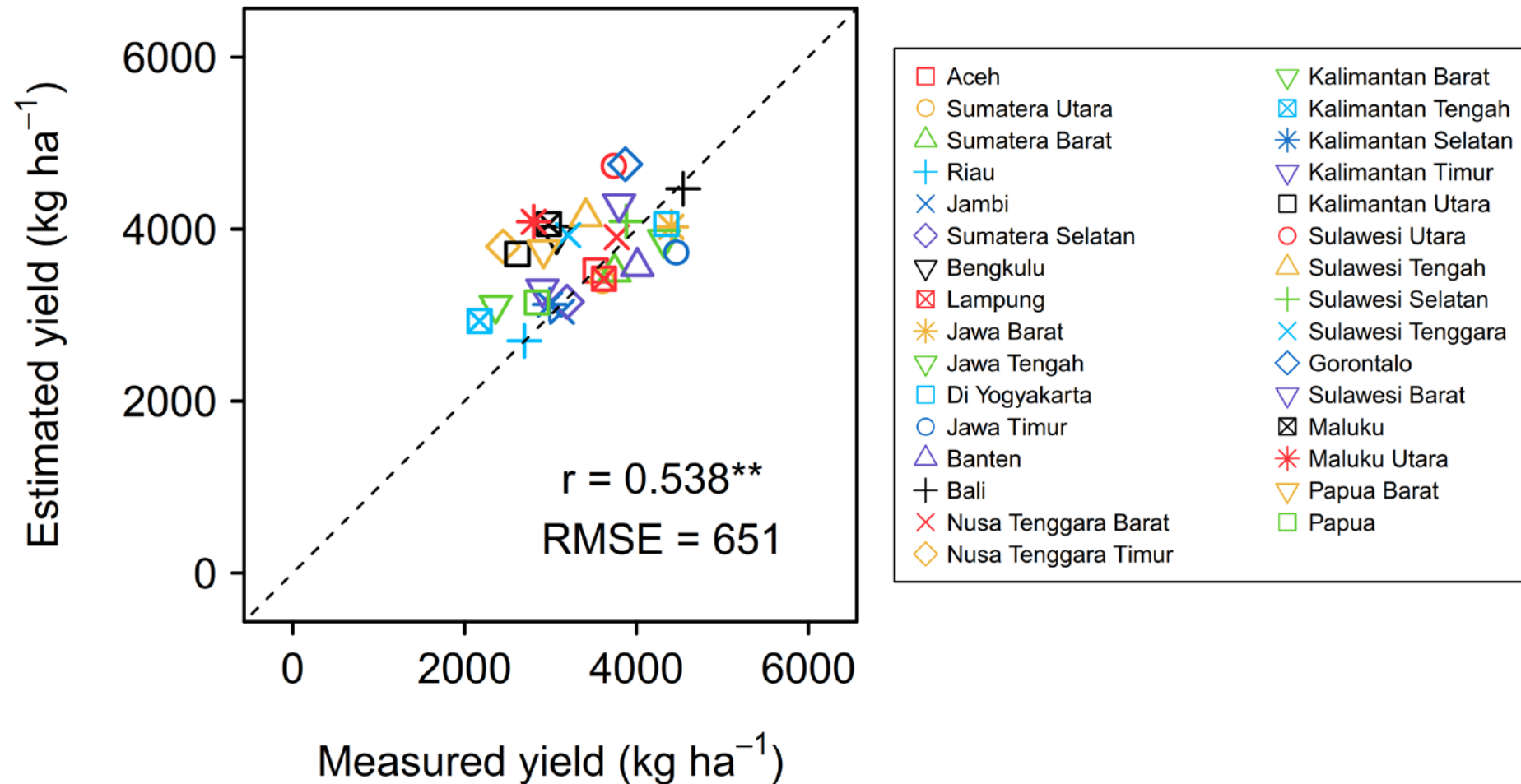


Ciherang

Model Parameterization for “Ciherang”, using field experimental data



Comparison of yields between observations and simulations by provinces



MATCRO can highly reproduce observed rice yields.

③Output

Change in Rice Yields [%]

Assessment years: 2018-2042



Decrease

Or

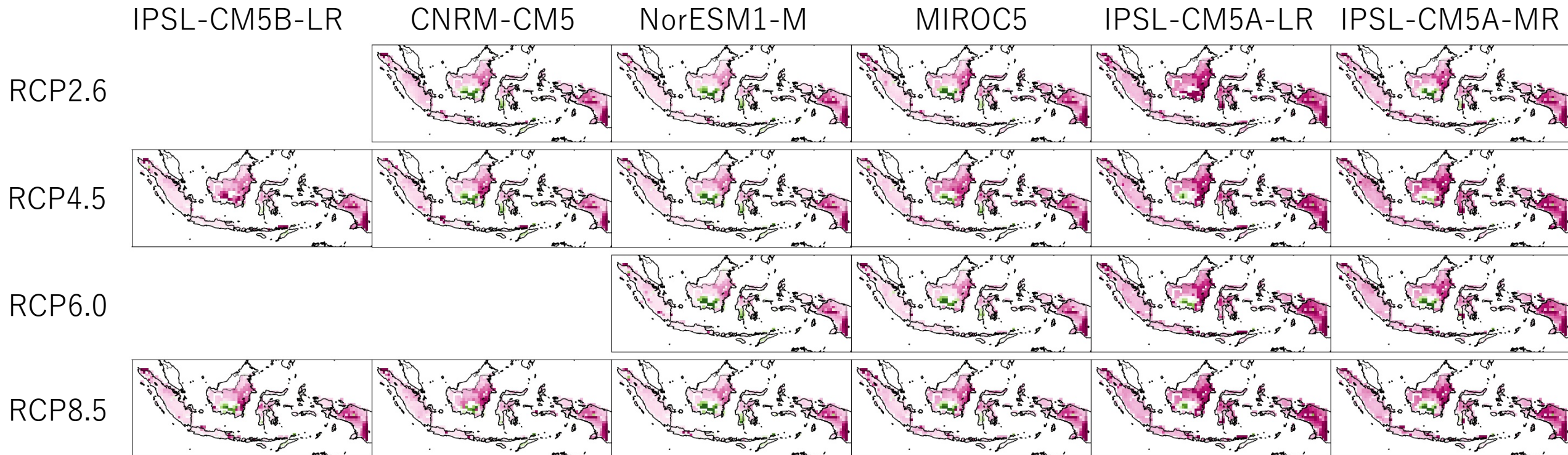
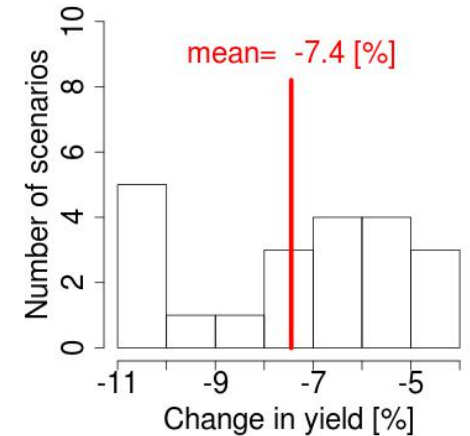
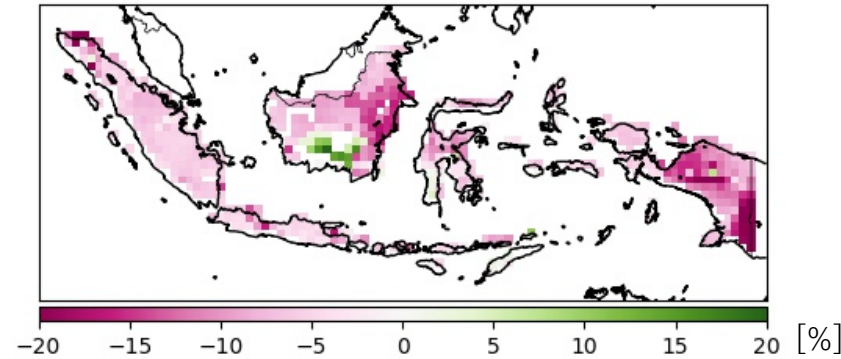


Increase

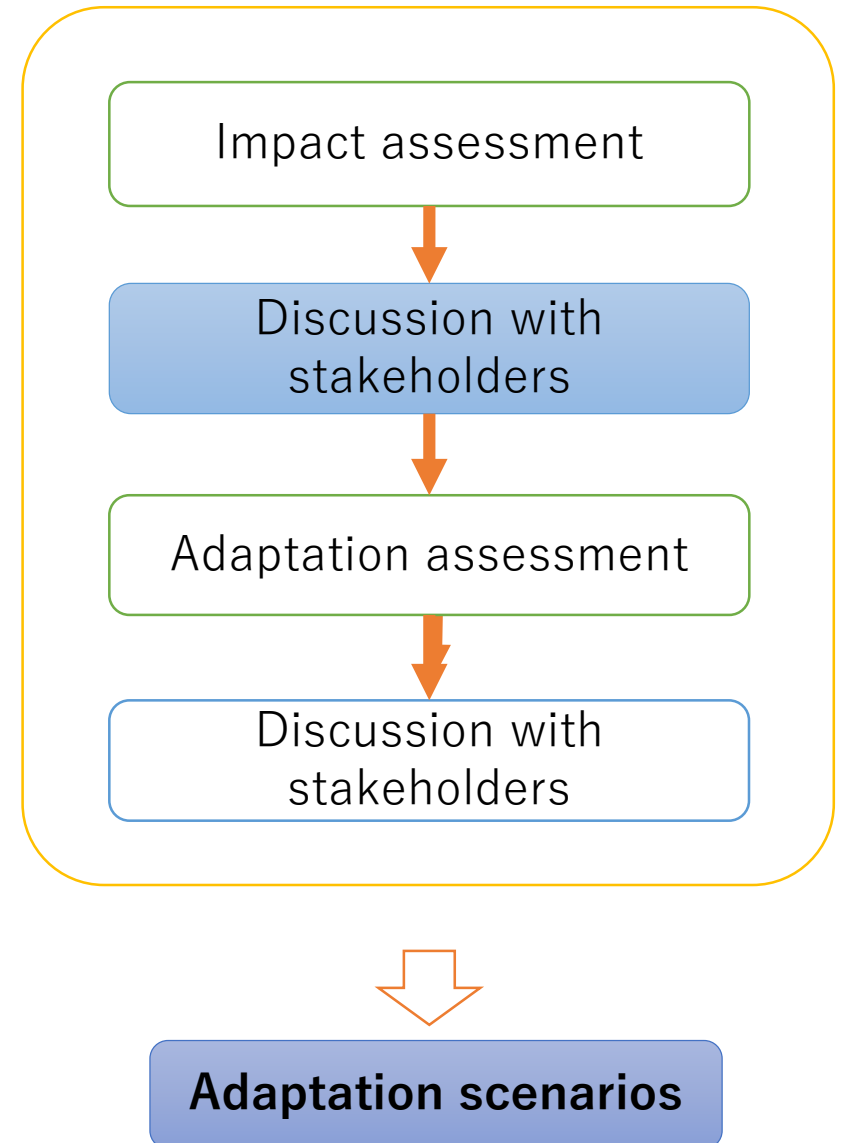
Impact assessment of global warming on rice yield

Average change in rice yield in 2018-2042
compared to 1981-2005

Global warming will have
negative impact over Indonesia



2nd step; Discussion with stakeholders

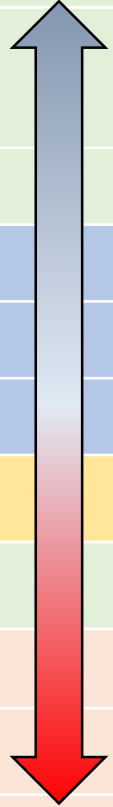


The objective of the discussion

- To prioritize adaptation options, based on the impact assessment
 - The effect of the prioritized adaptation options are assessed in Step3.
- We had two workshops with stakeholders.
 - Mar. 7, 2017@Medan, North Sumatra
 - Mar. 9, 2017@Surabaya, East Java
 - about 30 participants
 - BAPPEDA, BMKG, university researchers, etc.



Menu for adaptation options on agriculture

No	Menu		Cost	Effect	Actor			
					Gov.	Scientist	Farmer	Company
1	Change in variety (existing variety)		Low	Low			✓	
2	Change in agricultural management (e.g., planting date, fertilizer, etc.)		Low	Int.			✓	
3	Change in planting crop		Low	Int.			✓	
4	Real time monitoring system		Int.	Int.	✓	✓		(✓)
5	Early warning system		Int.	Int.	✓	✓		(✓)
6	Seasonal forecasting system		Int.	Int.	✓	✓		(✓)
7	Climate and agricultural insurance		int.	Int.	(✓)		✓	✓
8	Change in variety (new variety)		Int.	High	✓	✓	✓	✓
9	Change the postharvest system		Int.	High	✓		✓	✓
10	Development of irrigation system		High	High	✓			✓
11	Land use change		High	High	✓			✓

Category :

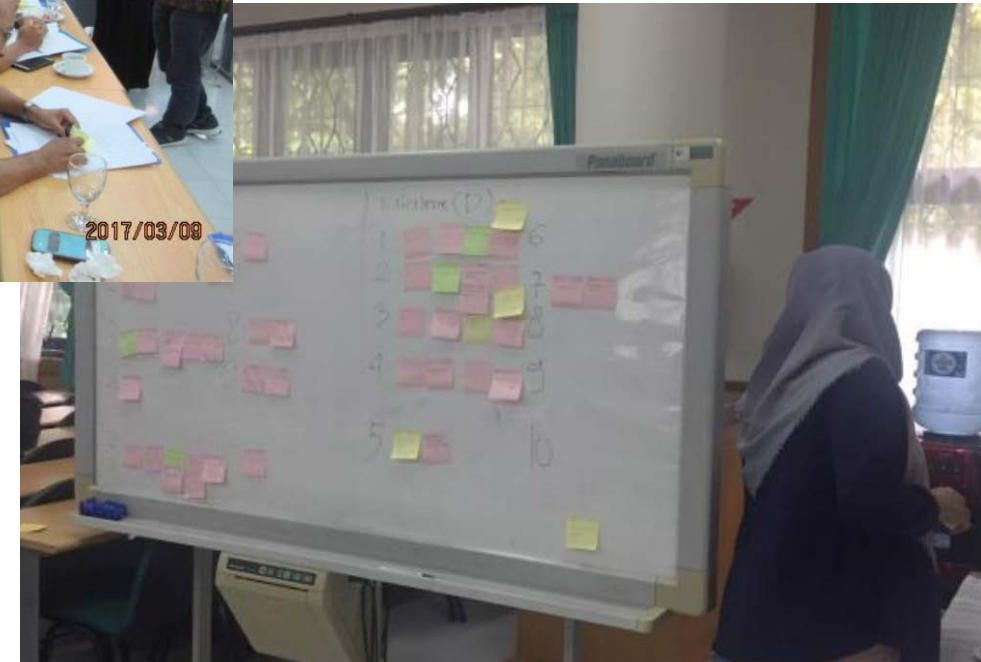
Agricultural
technology

ICT and smart
agriculture

Agricultural
finance

Infrastructure

Discussion....



Summary of the discussion with stakeholders (Step2)

No	Menu		Cost	Effect	Actor				PRIORITY	
					Gov.	Scientist	Farmer	Company	NS.	EJ.
1	Change in variety (existing variety)	Easy 	Low	Low			√			5
2	Change in agricultural management (e.g., planting date, fertilizer, etc.)		Low	Int.			√		4	1
3	Change in planting crop		Low	Int.			√			
4	Real time monitoring system		Int.	Int.	√	√		(√)	5	
5	Early warning system		Int.	Int.	√	√		(√)		4
6	Seasonal forecasting system		Int.	Int.	√	√		(√)	2	2
7	Climate and agricultural insurance		int.	Int.	(√)		√	√		
8	Change in variety (new variety)		Int.	High	√	√	√	√	3	
9	Change the postharvest system		Int.	High	√		√	√		
10	Development of irrigation system		High	High	√			√	1	3
11	Land use change	Difficult	High	High	√			√		

Category :

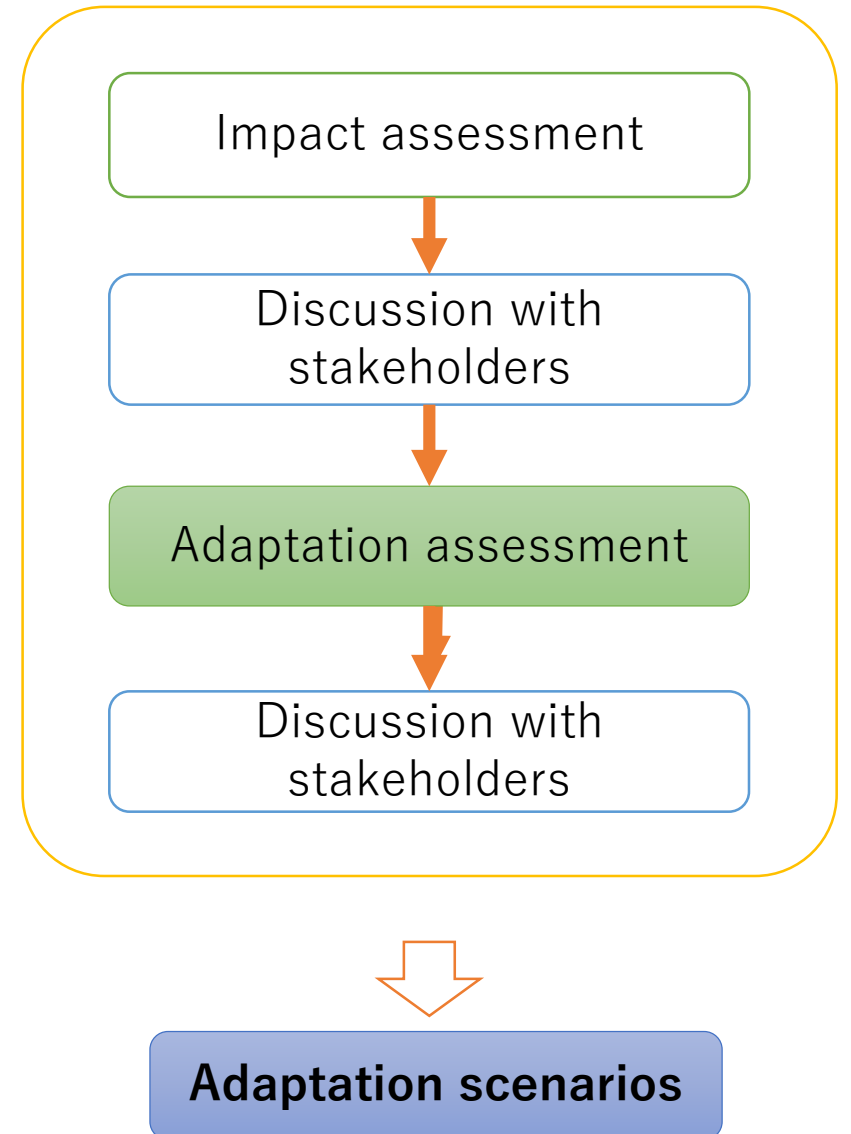
Agricultural
technology

ICT and smart
agriculture

Agricultural
finance

Infrastructure

Step3: Adaptation assessment

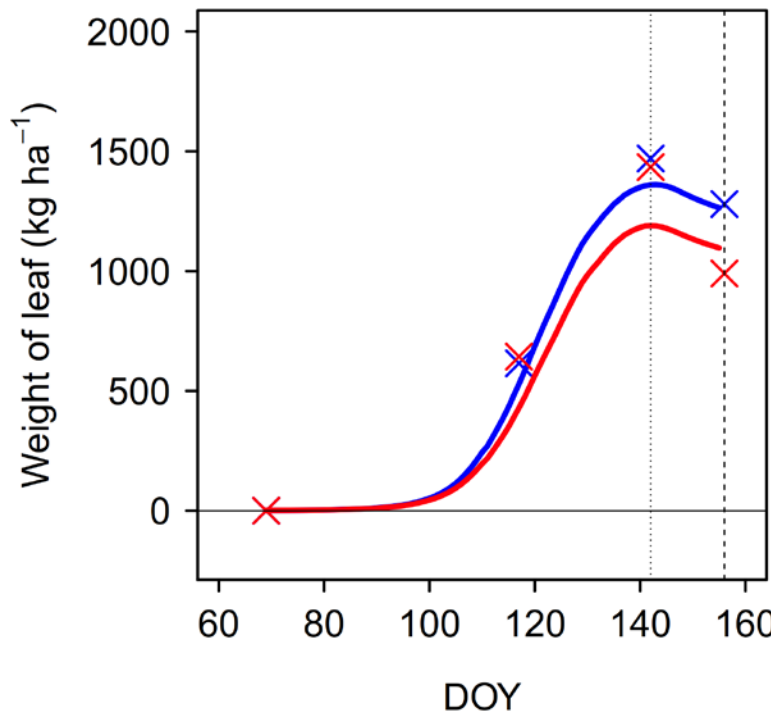


Validation with field experimental data

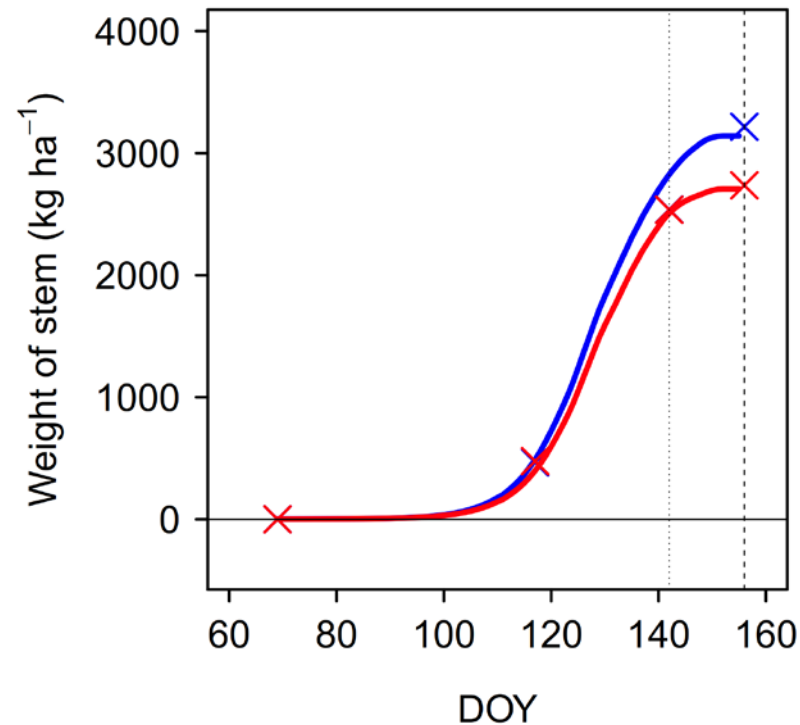
Plot : Measured value
Line : Estimated value

Irrigation No Irrigation
× N120 × N120

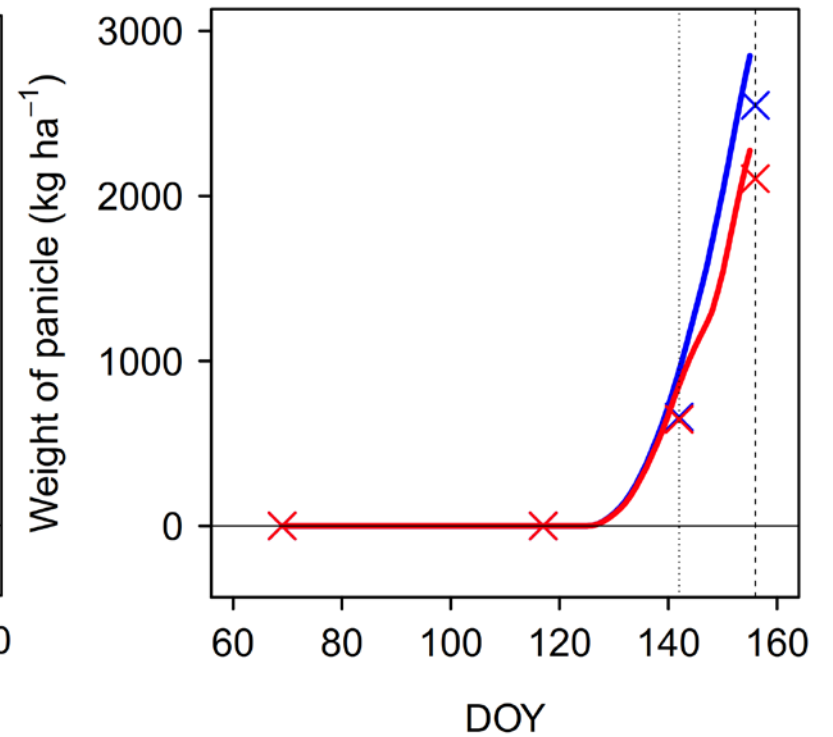
Leaf



Stem

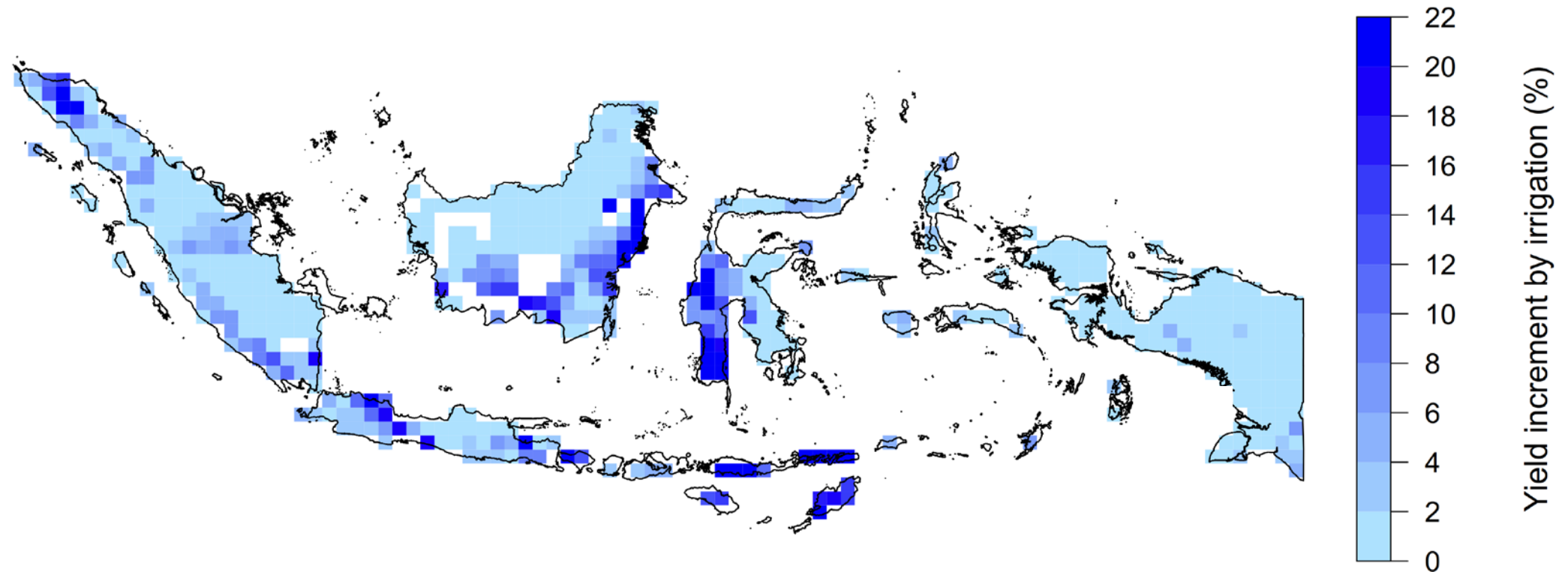


Panicle



MATCRO can accurately simulate the effect of irrigation.

The effect of irrigation in the future



- The effect of irrigation is positive over Indonesia.
- The effect of irrigation is largely different across regions.
 - This information is useful for developing effective adaptation plans.

Summary

1. The Japanese research team is trying to support regional adaptation planning in Indonesia.
2. The results show global warming will have large impact on rice production over Indonesia.
 - Average change in rice yield will be **-7.4%**
3. The installation of irrigation system will positive effect over Indonesia, but the effect is largely different across regions.
4. We will develop effective adaptation plans through discussions with Indonesian stakeholders

Thank you for you attention



Nov. 26, 2017



Enjoy Tsukuba!