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Adaptation strategies for rainfed rice production under climate change scenarios in the Songkhram River Basin, Thailand

(TA144-1)

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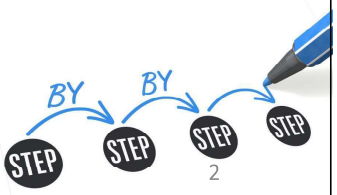
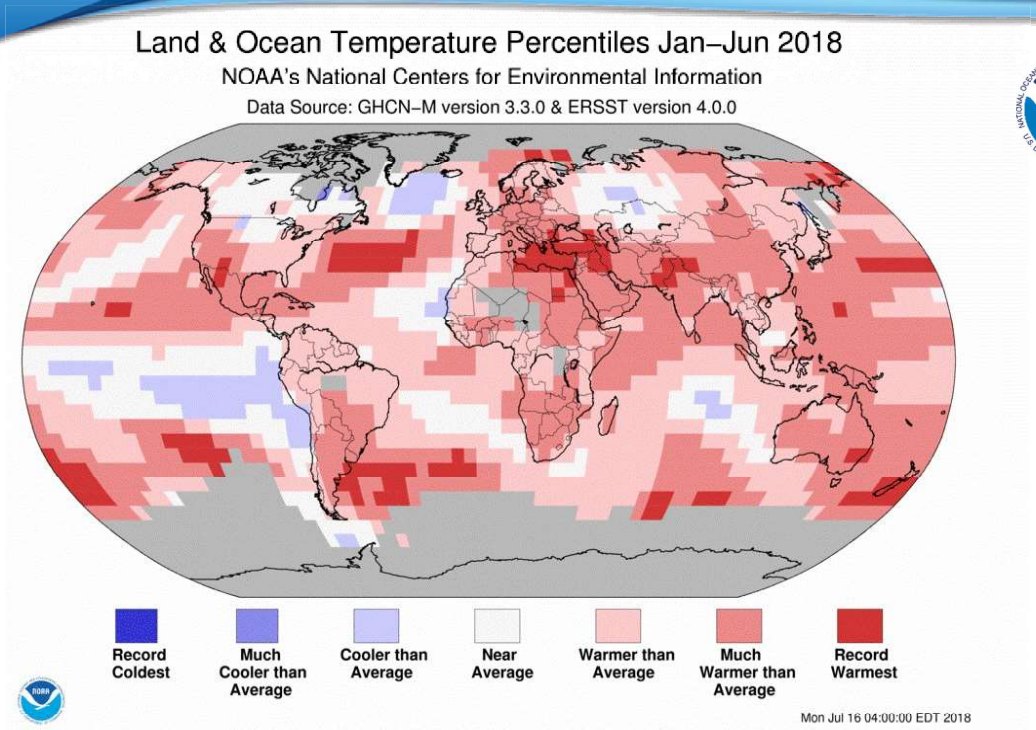


Introduction: Change in global temperature



- The combined land and ocean surface temperatures for the globe during January–June 2018 was 0.77°C above the 20th century (1961-2010) *(NOAA, 2018)*.
- The hottest year on record was 2016, followed by 2015 and 2017 *(NOAA, 2018)*.
- Future temperature is expected to rise up to 4.8°C by the end of 21st century *(IPCC,2014)*

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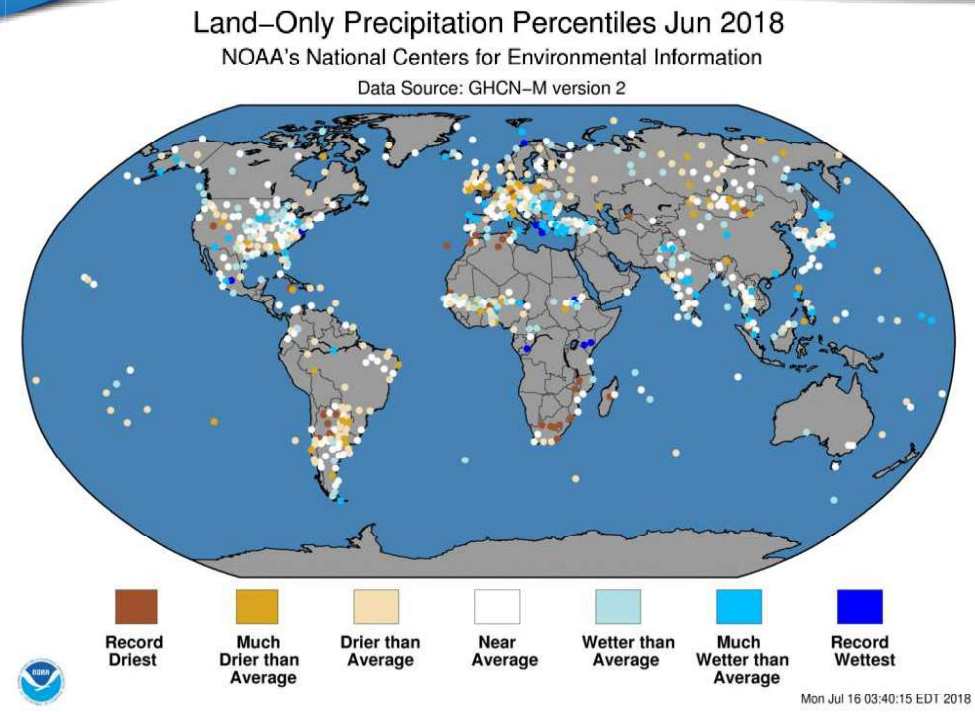
Introduction: Change in global rainfall



- The precipitation in Thailand was near average of a base period (1961-1990) *(NOAA, 2018)*.
- Future global precipitation may increase at high latitude & equator, but decrease at mid-latitude *(IPCC, 2014)*.

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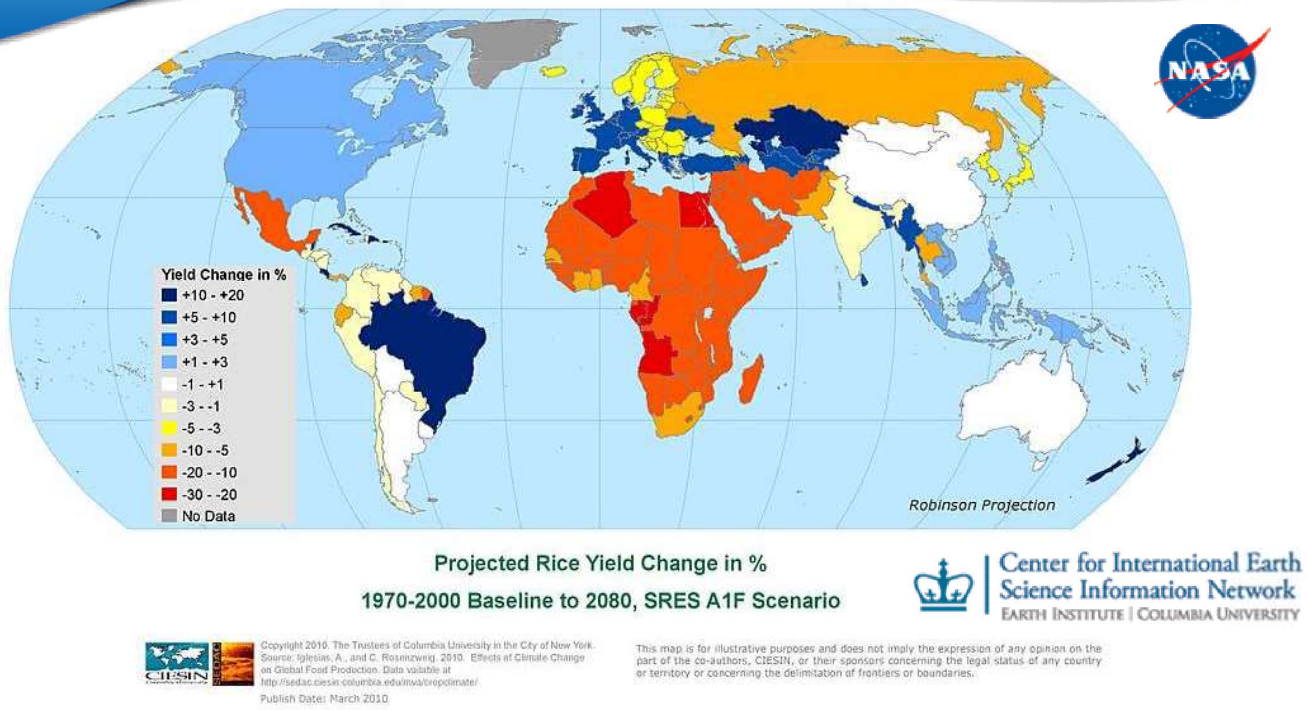
Introduction: Impacts of climate change on global rice yield



Projected change in rice yield (%) for 2080 compared with baseline period (1970-2000)

Scenarios	A1F	A2A	A2B	A2C	B1A	B2A	B2B
Change in rice yield (%)	(-6) – (-10)	1 - 3	(-1) – 1	(-1) - 1	1 - 3	1 - 3	3 - 5

Introduction: Impacts of climate change on CWR, IWR, CWP, WA

- Climate change has negative impacts on agricultural sectors. Changes in the magnitude and patterns of temperature and rainfall can cause high vulnerability of crops.
- Temperature rise and change in rainfall patterns can significantly **increase crop water requirement** (CWR) *(Fishcer et al., 2007)*.
- Climate Change would **increase irrigation water requirement** (IWR) by 23% (A2) and 13%(B2) in Sri Lanka *(Silva et al., 2007)*.
- Climate change can lead to **lower rice yield** in Thailand (*Shrestha et al., 2017; Babel et al., 2011)*.

Methodology

Objectives:

- To investigate the impact of climate change on rice yield, crop water requirement (CWR) and water availability, and
- To evaluate adaptation strategies for farm water management on rice fields for the period 2020-2044 under RCP4.5 and RCP8.5 scenarios

Daily weather data (Tmax, Tmin, Rainfall) (1980-2004)

Regional Circulation Models (RCMs) Historical: 1980-2004 2030s: 2020-2044

Soil data Weather data Rice and agronomic management

Filled missing data Temp.: Linear interpolation Rainfall: APHRODITE's

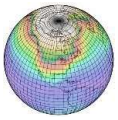
Bias correction (Quantile Mapping)

Crop simulation model (DSSAT)

DSSAT

Future climate projection under RCP4.5 and RCP8.5 scenarios

Model performance evaluation & Impact assessment



Adaptation strategy

ADAPTATION STRATEGIES

Study area: Songkhram River Basin, Thailand

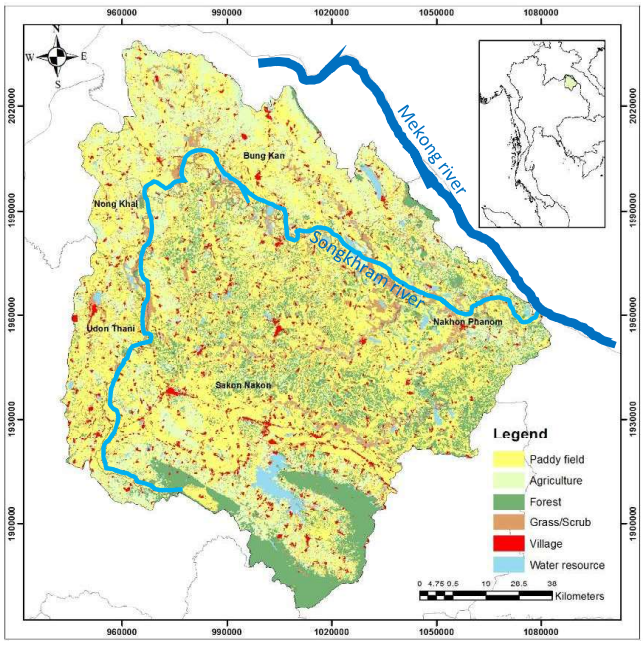


Figure 3.3.5 Land use and land cover of Songkhram River Basin

Basin: Songkhram River Basin

Location : Northeast Thailand

Catchment area: ~ 12,700 km²

River origin: Phu Phan Nataional Park at Sakon Nakhon

River meet: Mekong river at Nakon Phanom

River length: ~ 420 km

Temperature: 16 to 35 °C

Annual rainfall: 1,600 – 2,400 mm

Population: 1,940,572 in 2000

Discharge: 300 - 533 m³/s

Economic crop: Rice

Topography: Flood plain

Land use:

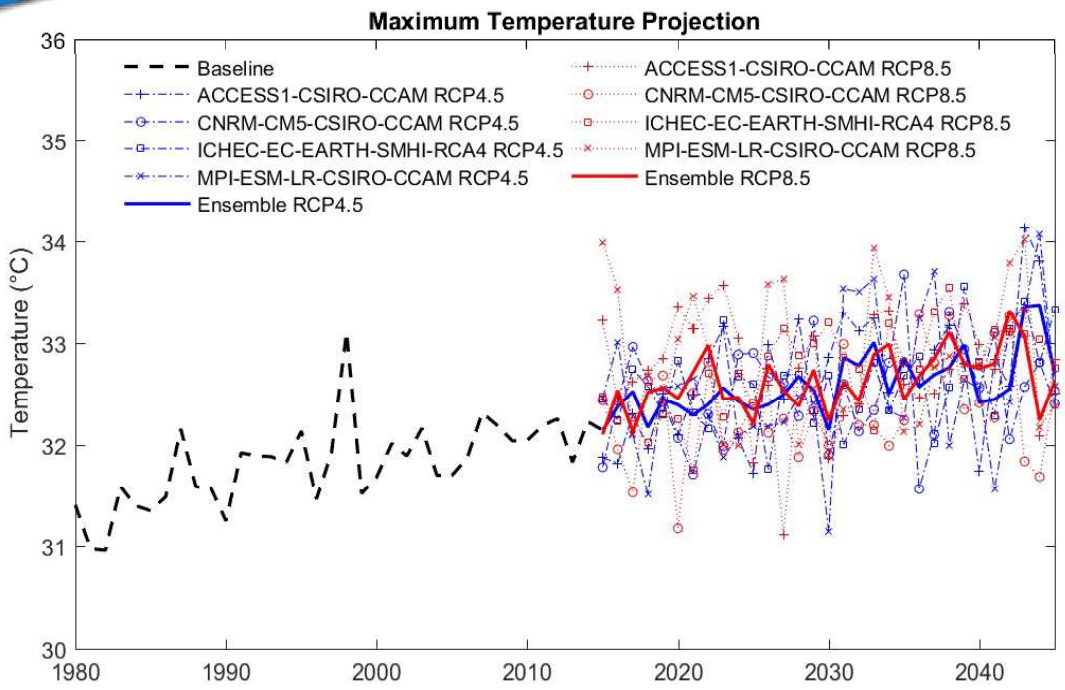
~ 70 % of catchment area is agricultural area
~ 68 % of agricultural area is paddy fields

Issues:

Floods in wet season: high rainfall density + water effect from Mekong river

Water shortage: topography & soil properties

Future climate projection: Maximum temperature



- Future maximum temperature is expected to increase by
  0.9ºC under RCP4.5 scenario and
  1.0ºC under RCP8.5 scenario

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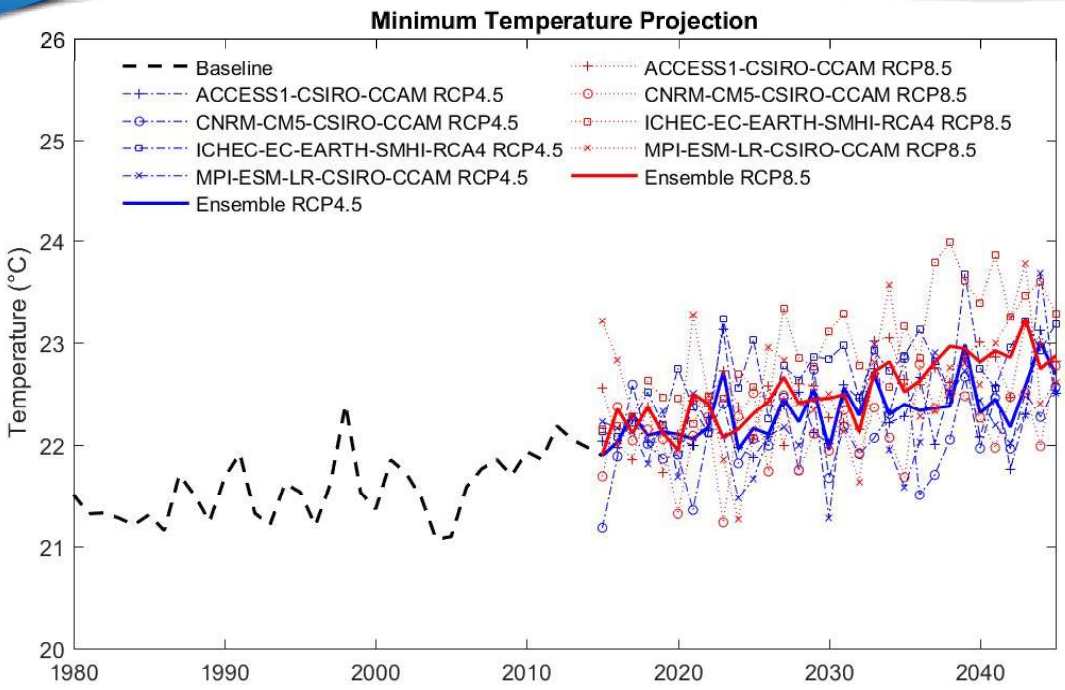
Future climate projection: Minimum temperature



- Future minimum temperature is expected to increase by
  0.9ºC under RCP4.5 scenario and
  1.1ºC under RCP8.5 scenario

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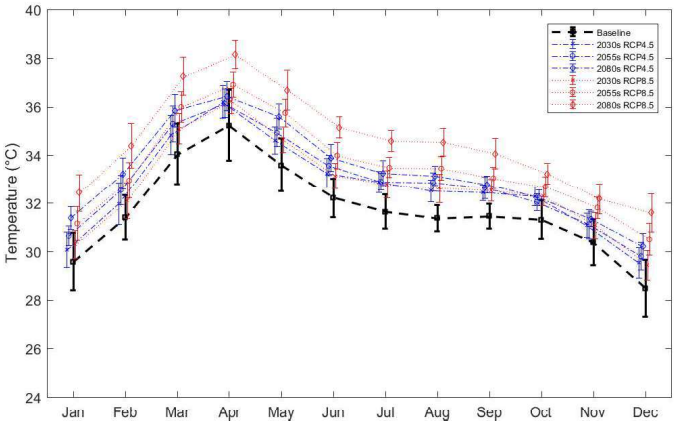
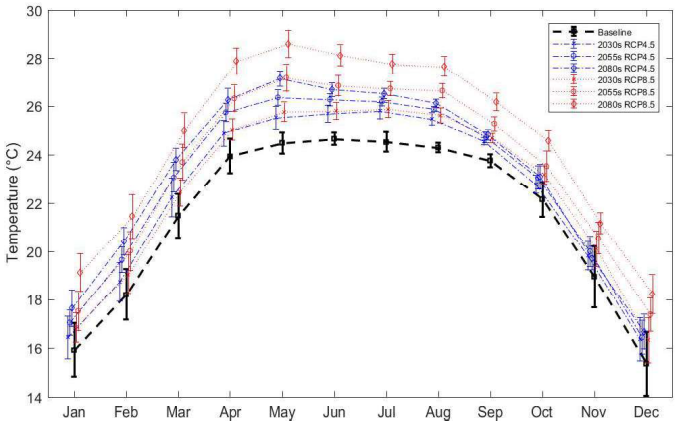
Future climate projection: Monthly maximum & minimum temperature

Monthly maximum temperature



Monthly minimum temperature



- Future maximum and minimum temperature is expected to increase for all seasons under climate change scenarios.

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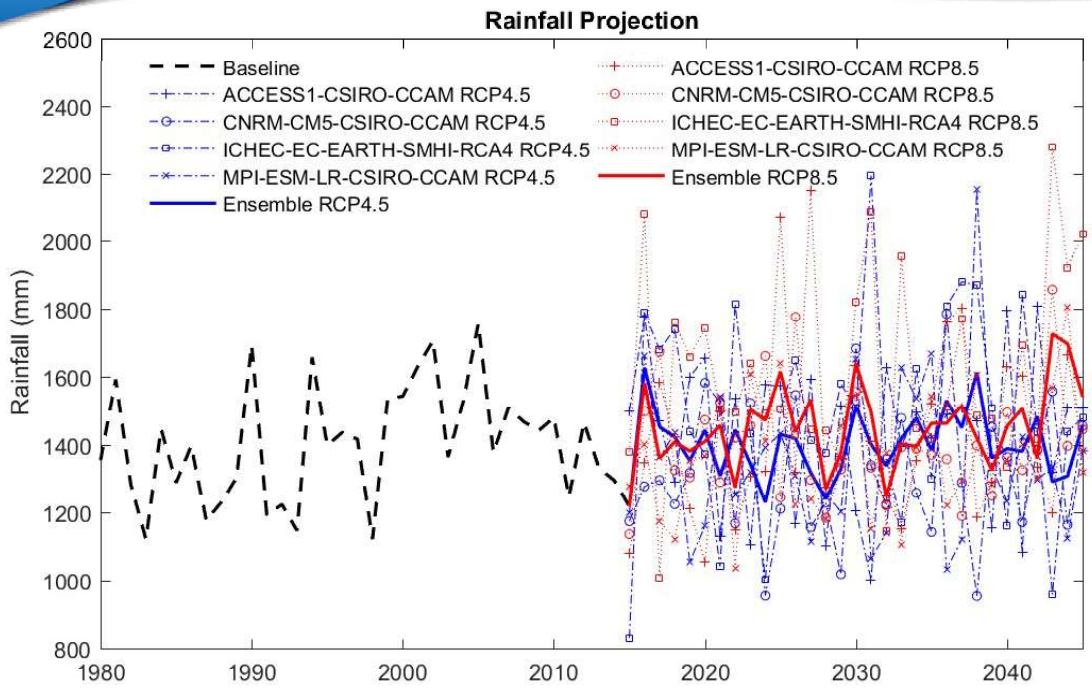
Future climate projection: Rainfall



- Future annual rainfall may not be changed in future under climate change scenarios.

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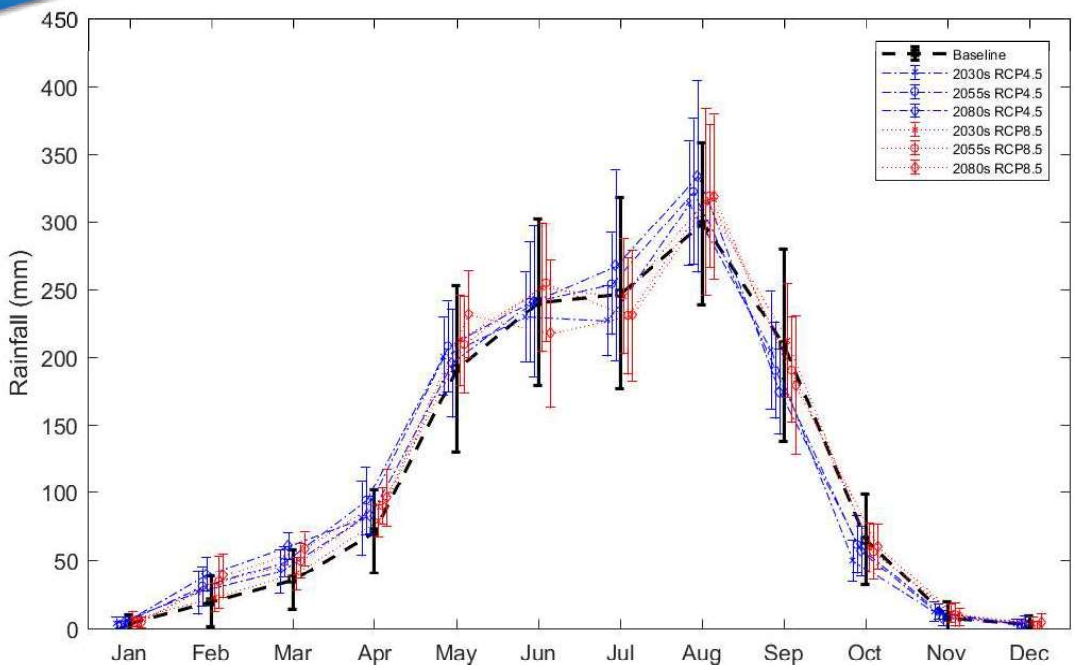
Future climate projection: Rainfall



- Rainfall may:
  - increase during summer season (February to May)
  - not change during middle of year (May to September)
  - decrease during end of the year (October to November)

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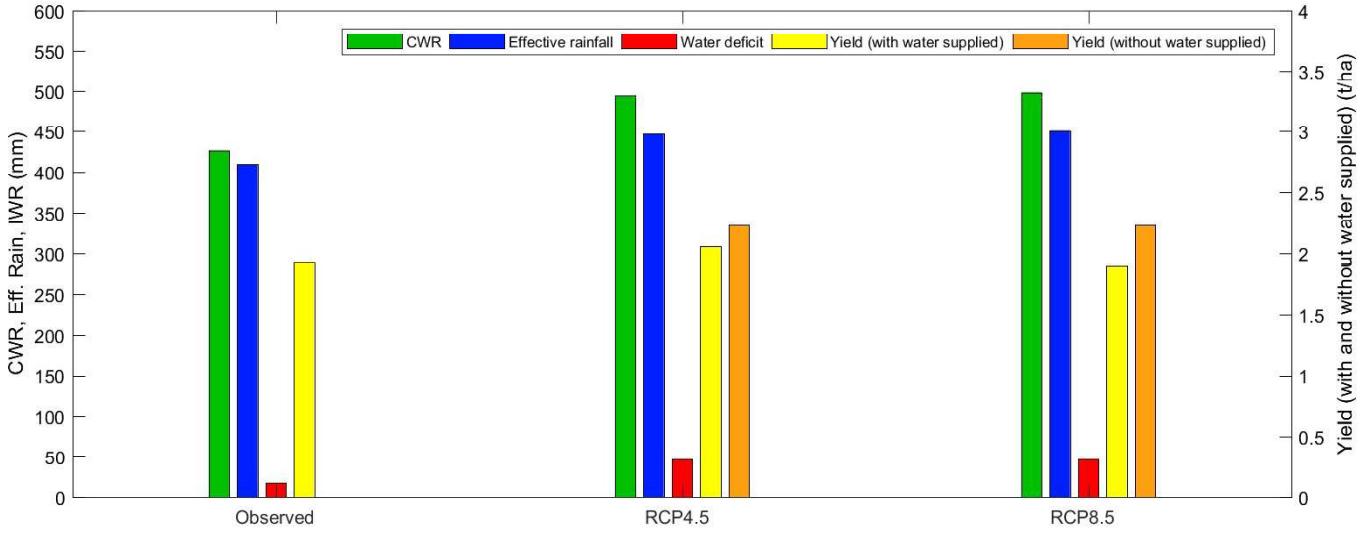
Climate change impacts on rice production



- The crop water requirement (CWR) may increase by 16% and 17% under RCP4.5 and RCP8.5 scenarios;
- Supplying water can reduce the water stress and increase rice yield to meet the potential rice yield;
- The potential rice yield for KDML105 is 2.27 t/ha (363 kg/rai) *(Rice Department, 2018)*.

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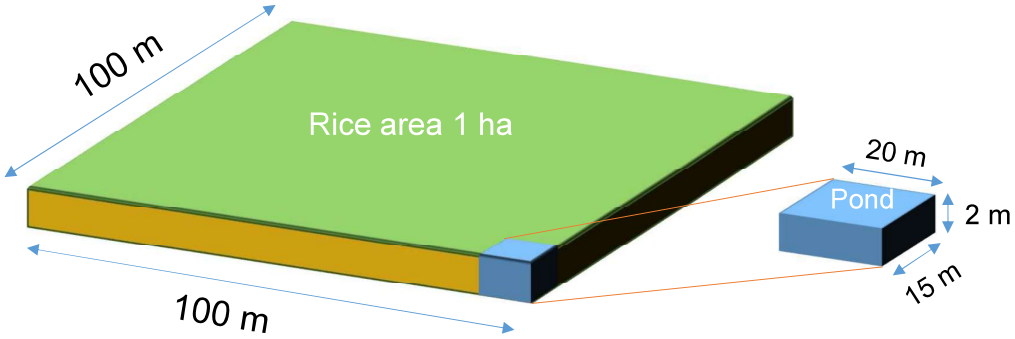
Adaptations: Farm water management for rice fields



- A pond with 600 m³ capacity or dimension 20 m length, 15 m width, 2 m depth is enough for one ha of rice area to meet the CWR in 2030s under climate change scenarios.

Variables	Unit	Value
Irrigation water requirement (IWR) for 2030s (2020-2044)	mm	47 (RCP4.5), 47 (RCP8.5)
Assuming total losses 20%	mm	9.4
Water requirement	mm	56.4
Water requirement for 1 ha (10000 m³) of rice	m³	564

Conclusions

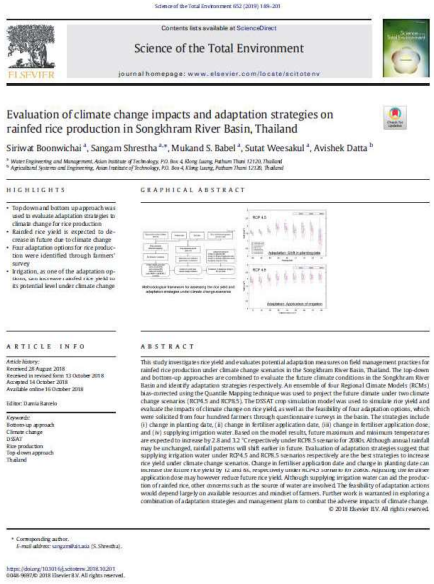
- The future maximum and minimum temperatures are expected to rise, while rainfall unchanged under both RCP4.5 and RCP8.5 scenarios for 2020-2044.
- Crop water requirement (CWR) is expected to increase, but the future rice yield may decrease under climate change scenarios.
- The pond (600 m³ or 20x15x2 m capacity) to store water for each ha of rice to overcome water deficit and reach the potential rice yield.

References

- Boonwichai, S., Shrestha, S., Babel, M.S., Weesakul, S., & Datta, A. (2019). **Evaluation of climate change impacts and adaptation strategies on rainfed rice production in Songkhram river basin, Thailand.** *Science of the Total Environment, 652, 189-201.*
- Boonwichai, S., Shrestha, S., Babel, M.S., Weesakul, S., & Datta, A. (2018). **Climate change impacts on irrigation water requirements, crop water productivity and rice yield in the Songkhram river basin, Thailand.** *Journal of Cleaner Production, 198*, 1157-1164.

Journal of Cleaner Production

Climate change impacts on irrigation water requirement, crop water productivity and rice yield in the Songkhram River Basin, Thailand



Science of the Total Environment

Evaluation of climate change impacts and adaptation strategies on rainfed rice production in Songkhram River Basin, Thailand

Thank you for your attention

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