Application to the rice production in Southeast Asia

research project:
“Modeling rice growth and paddy ecosystem responses to climate change and risk assessment of rice production”
Period: FY2006-2010
Funded by Agriculture, Forestry and Fisheries Research Council Secretariat, MAFF

Rice Production Research Program
Agro-meteorology Division
National Institute for
Agro-Environmental Sciences

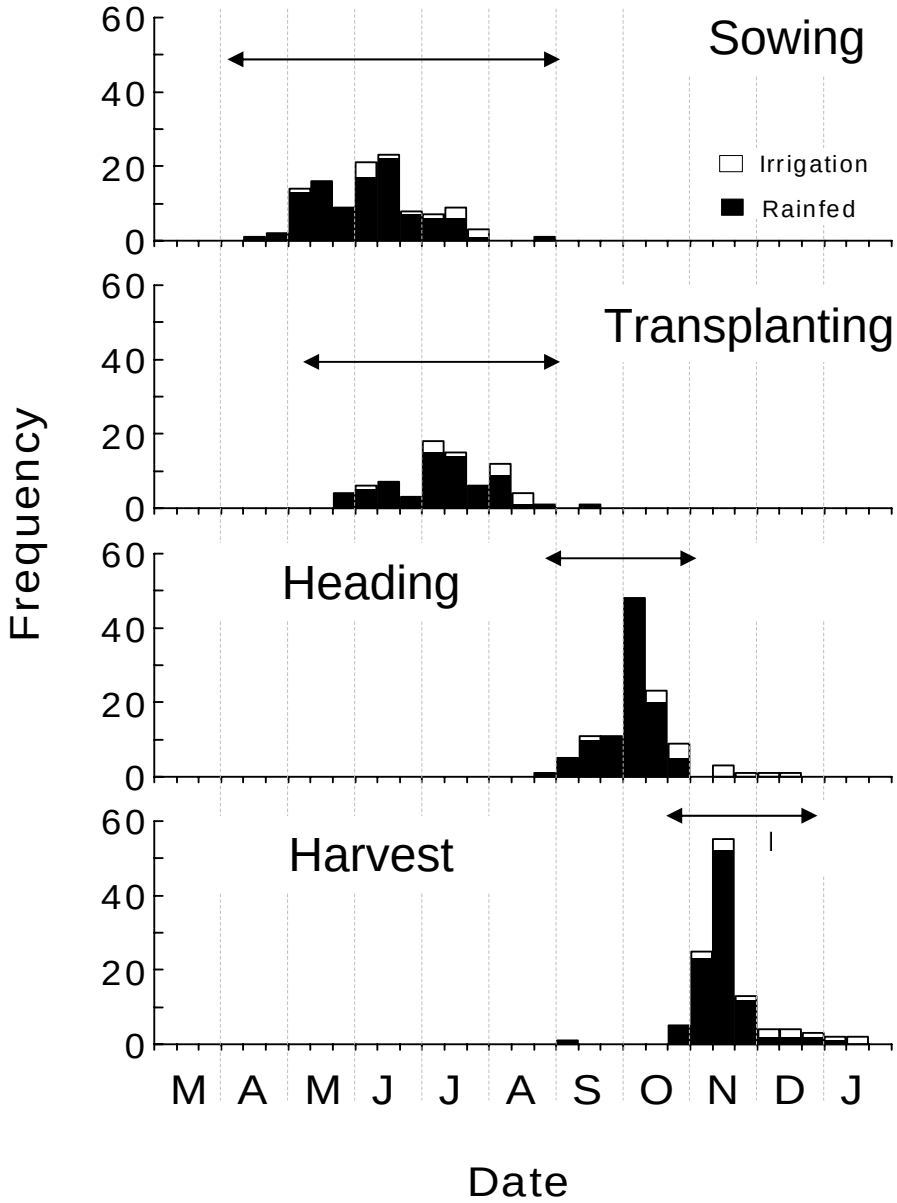
Our purpose within the framework of MAHASRI activities

- To model rice growth and paddy ecosystem responses to water conditions due to intraseasonal, seasonal, and annual changes of the amount of precipitation brought about by the effect of the Asian monsoon variation.
- To develop the method of prediction of rice production on the regional scale in South-Eastern Asia.

Our target area

Northeastern Thailand (mostly rain-fed lowland with large spatial variation in precipitation, soil and hydrological conditions).

•Frequency distribution of major cultural and developmental events in NE Thailand



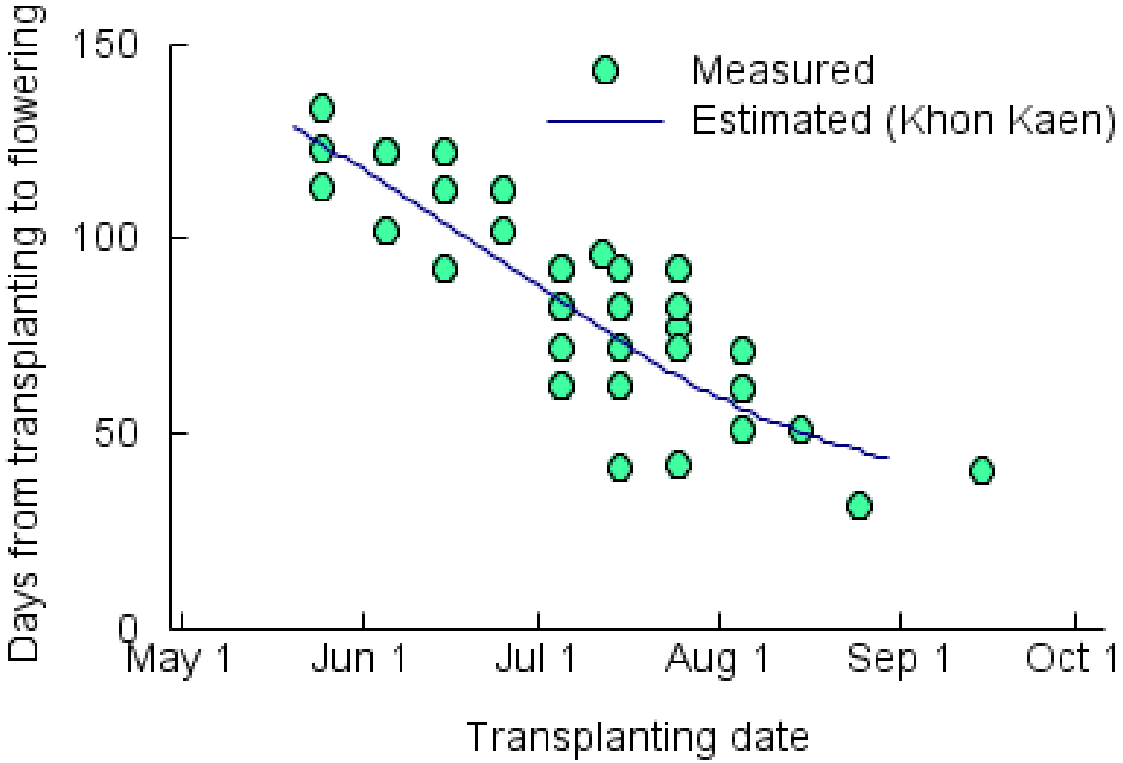
Wide sowing and transplanting windows.

vs

Narrow heading and harvest windows.

- 90% of paddy field are rainfed
- Transplanting date is decided by water condition
- highly photosensitive cultivar(RD6, KDML105, etc.) developing according to day length planted

•Transplanting date and heading (flowering) date



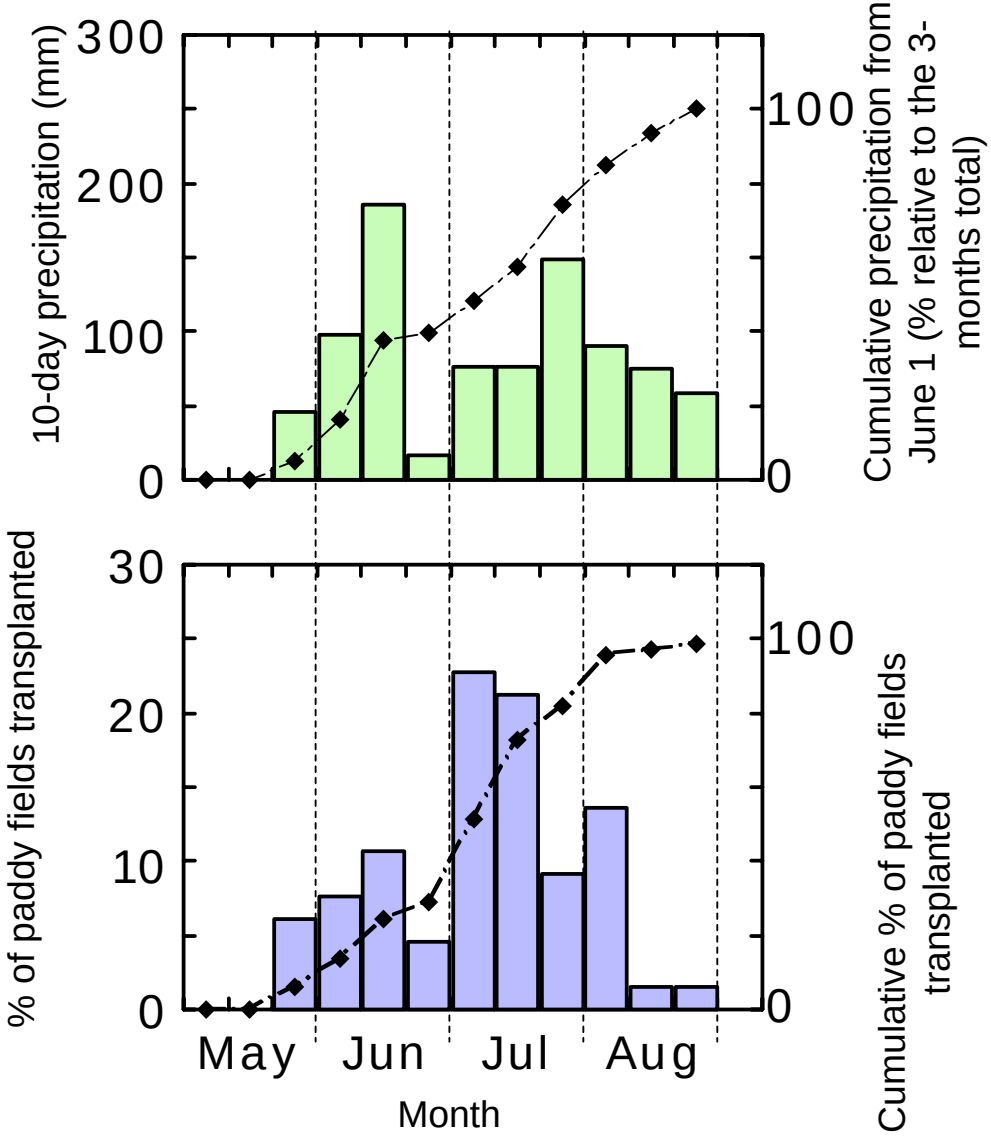
Growth duration to flowering expressed by the growing degree days (GDD) corrected by a daylength factor (DF).

$$GDD_{DF} = \sum \left(T - T_{base}\right) \times DF$$

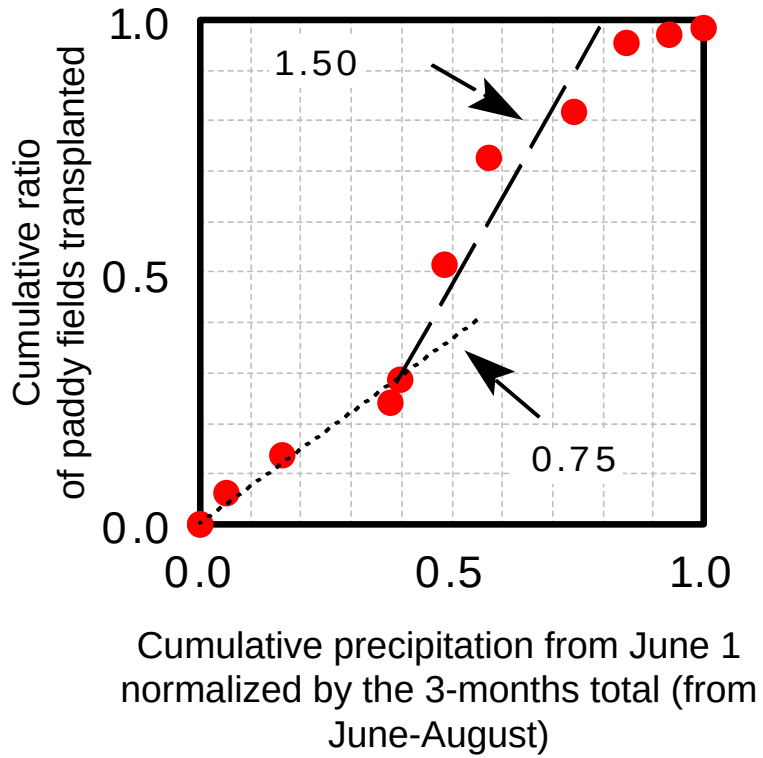
$$DF = 1 - \exp\left[\alpha\left(DL - DL_c\right)\right]$$

Because highly photosensitive cultivars are planted, delay in transplanting date results in shorter growth duration, and thereby limits the productivity.

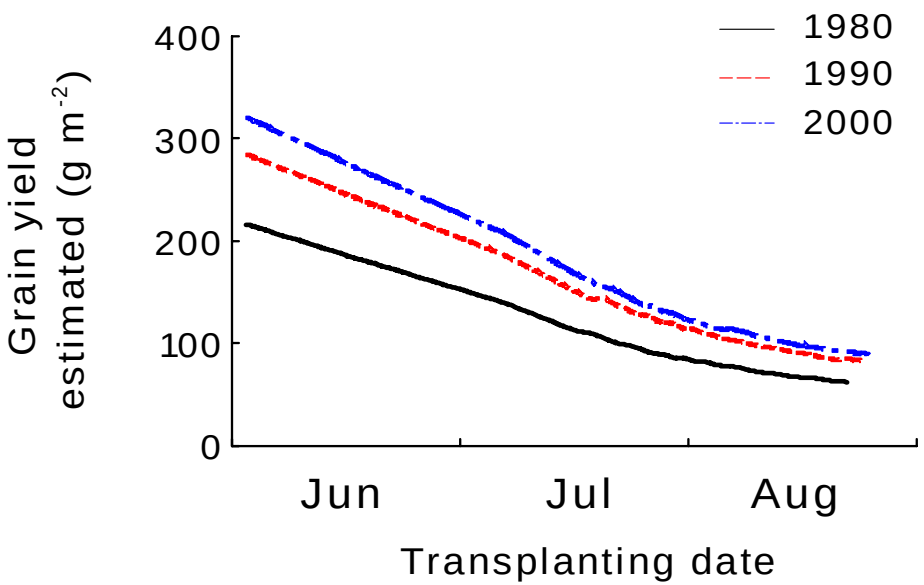
•Estimating transplanting date and expansion of transplanting area

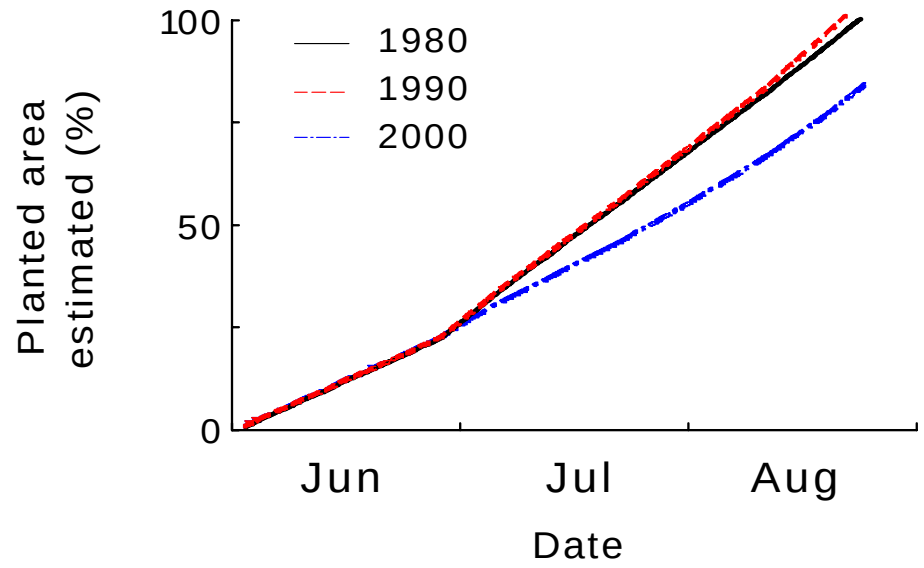


% of paddy fields transplanted follows a similar pattern to cumulative precipitation



•model description





$$Yi = Biomass \times HI$$

$$Biomass = WUE \times \Sigma Tr$$

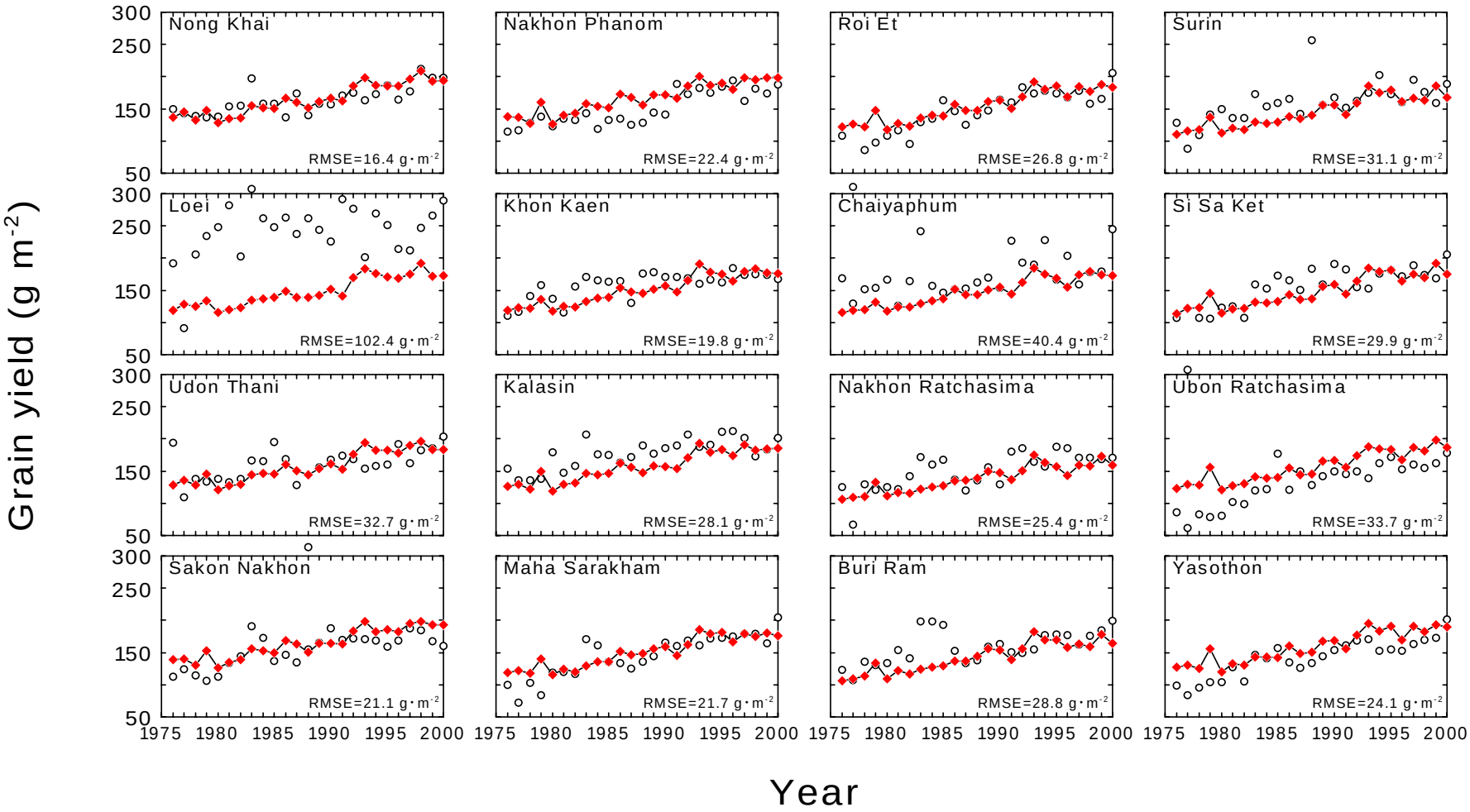
$$Tr = FCC \times Ep$$

Yi; yeld obtained at specific transplanting date (*i*)
HI; harvest index
WUE; water use efficiency
Tr; transpiration
Ep; potential evapotranspiration (Penman-Monteith method)
FCC; fraction of canopy cover as a function of N input and GDD (growing degree day)
Finally, regional yield ***YR*** is obtained as;

$$YR = \sum (p_i \times Yi)$$

P_i; planted area obtained at specific transplanting date (*i*)

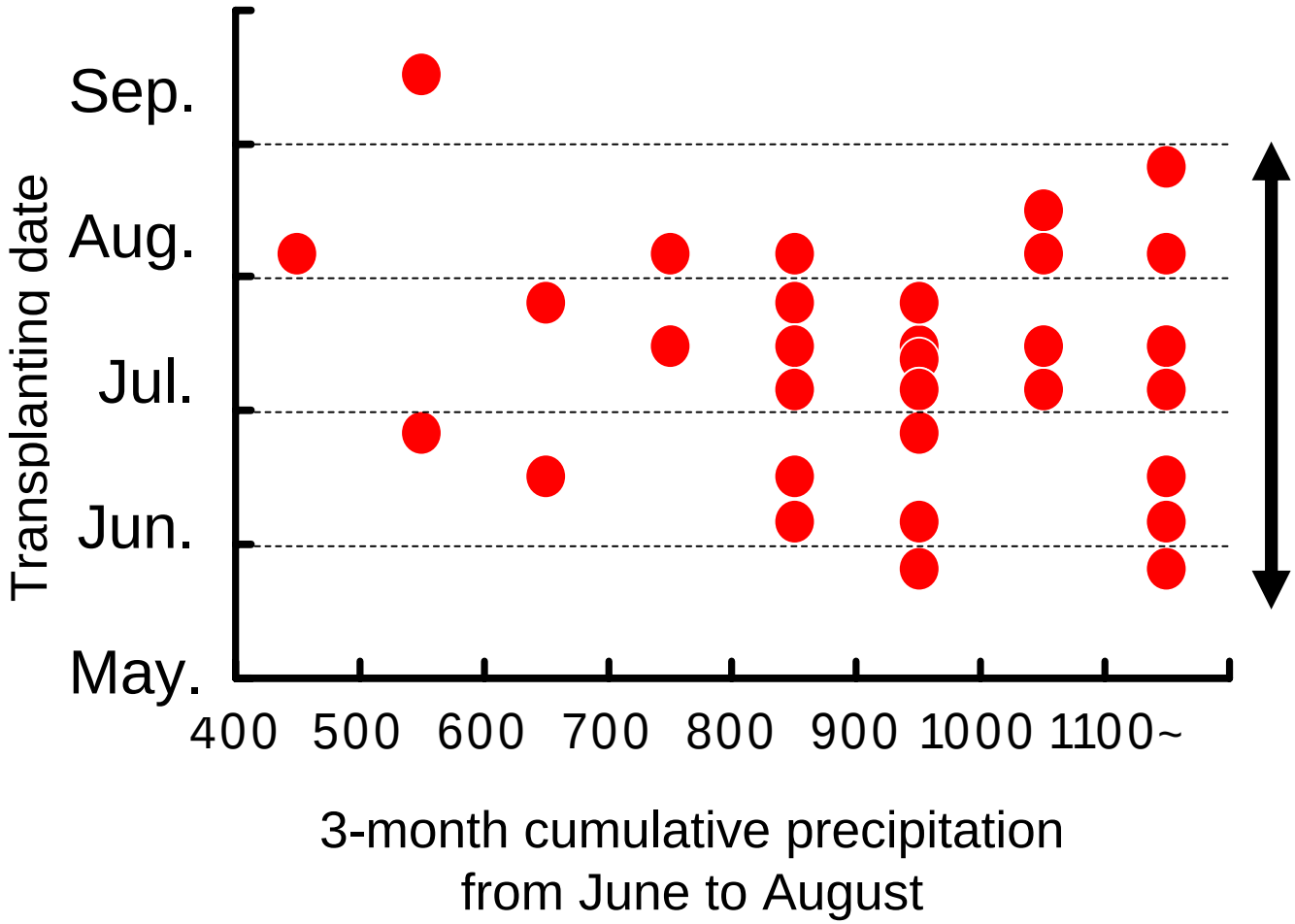
•Simulated and actual grain yields of sixteen provinces in Northeast Thailand between 1976 and 2000



•Actual yields (in white circle) were from Agricultural Statistics in Thailand.

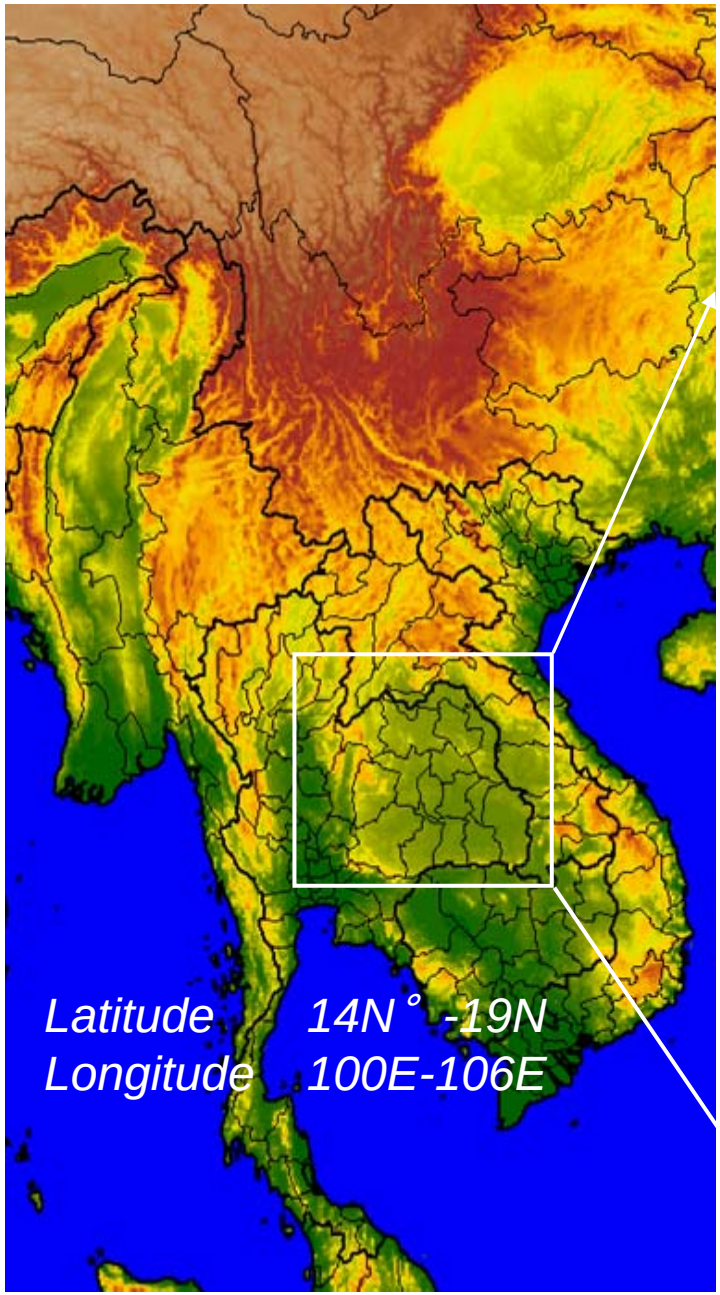
•Weather data were from The Climate Resource Unit dataset.

•Transplanting date vs 3-month cumulative precipitation

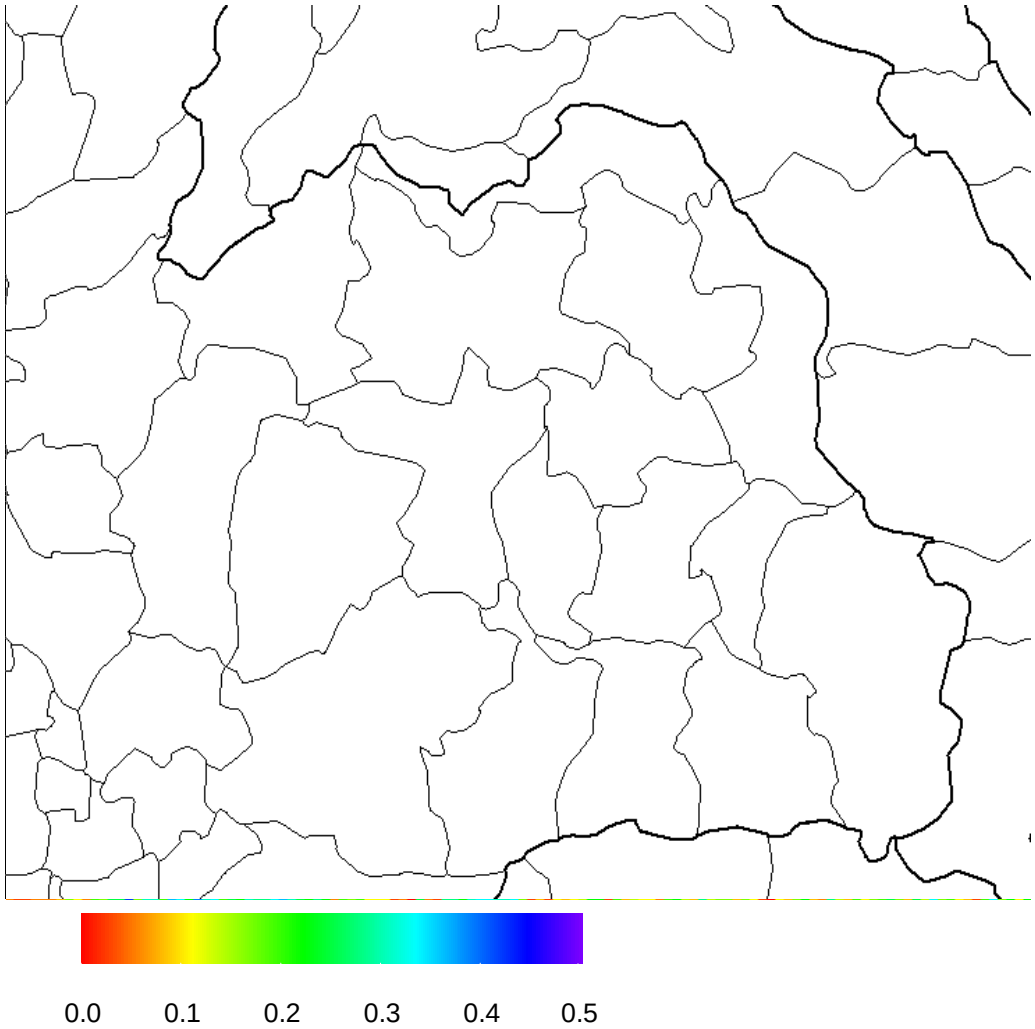


•Large spatial variation exists in Northeastern Thailand.
•Large variation in transplanting date exists even at the same precipitation level.

Next step



*A preliminary attempt to estimate **submerged (water saturated) area** by the simple water balance model (Ishigooka unpublished)*



Our experimental filed established in Khon Kaen (16°27’44.30”N, 102°32’22.33”E) to make clear the water condition in paddy field(2004.11.)

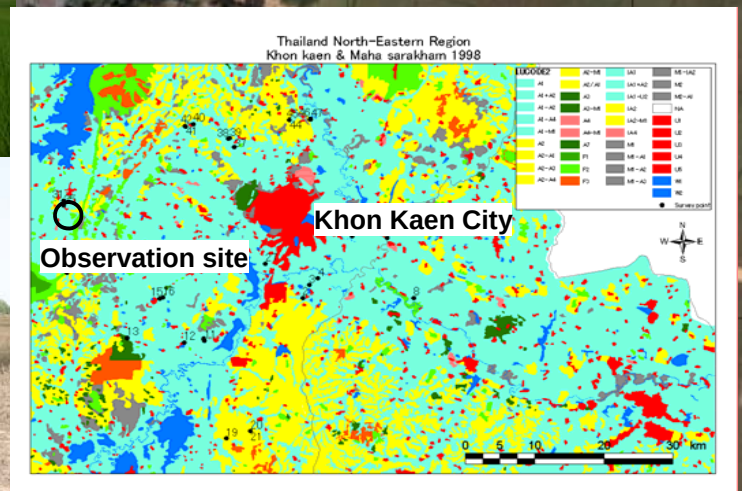
upper

middle

lower

Meteorological observation (lower)
- ✓air temperature and humidity
- ✓solar radiation and precipitation
- ✓soil temperature (6 depth)
- ✓wind direction and speed

Hydrological observation (lower, middle, and upper paddy)
- ✓Water table
- ✓Water content in soil



Thank you
for your attention!!