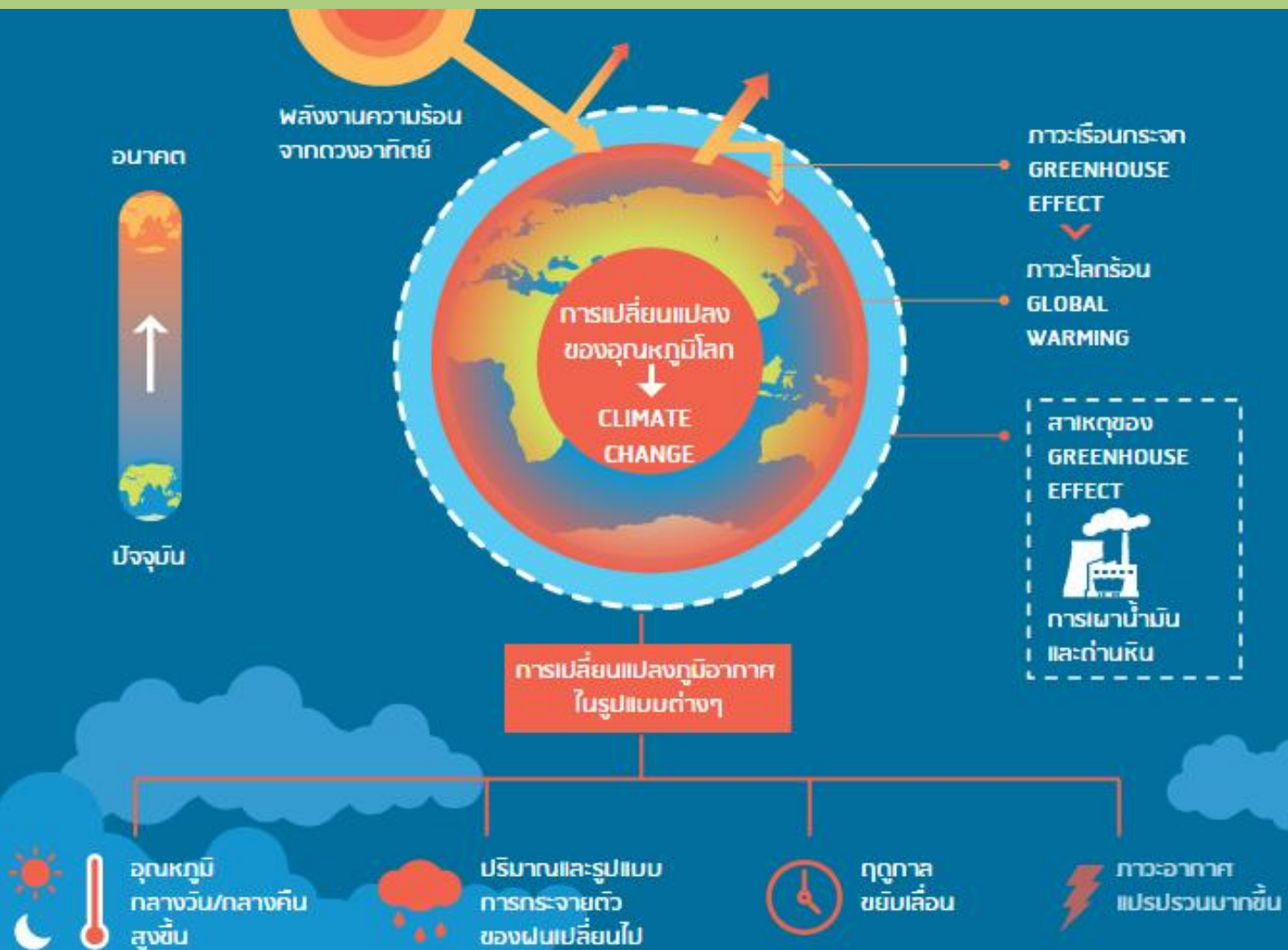




Economics of Adaptation

4th May 2017

Development and Climate Change



How do we know whether climate has changed?

Climate Change

Need to compare between 2 time horizons


Past - present

and


Present - future



Season
change



Change in
the annual
rainfall



Change in
max-temp or
min-temp



Change in
rainfall
pattern

Why Adaptation is Needed?

- Unable to stop the emission of greenhouse gases and continue to rely on fossil fuels that contribute to increased greenhouse gas emissions.
- Global warming is key behind the drastic changes in climate.
- Given that we are unable to stop climate change, it is high time for us to adapt to be resilient to future climate.

Who need to adapt?



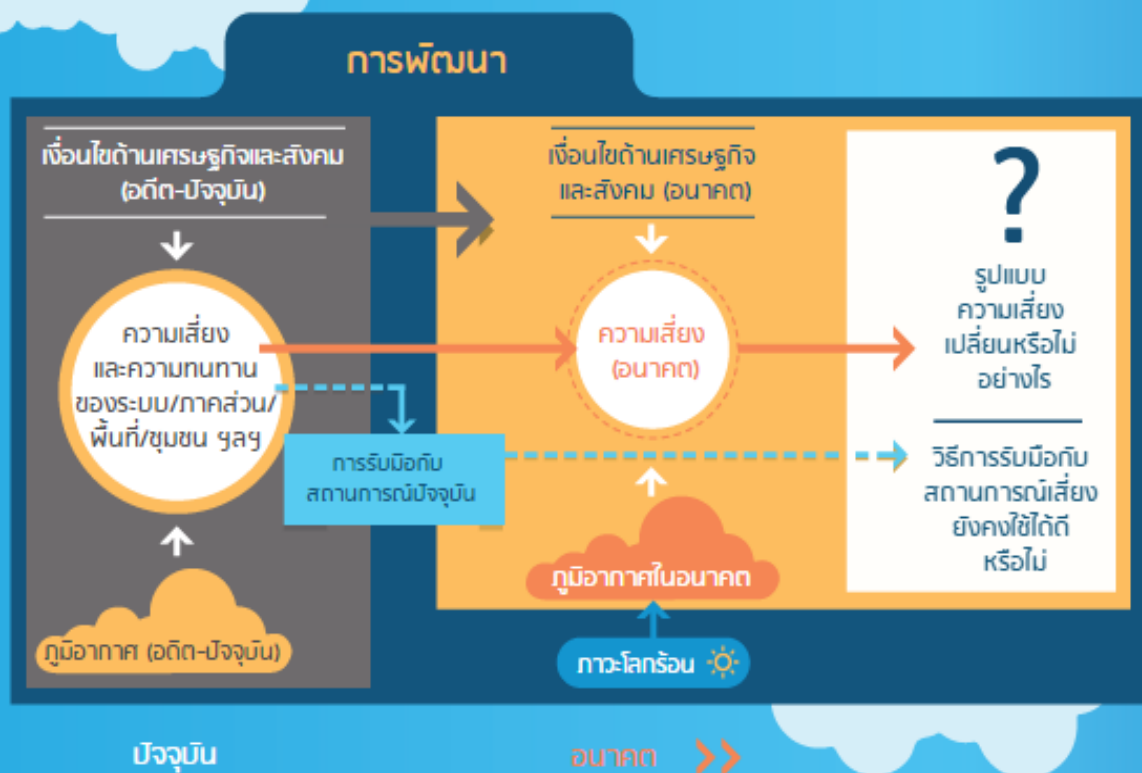
Sector?

Location?

Group of people?



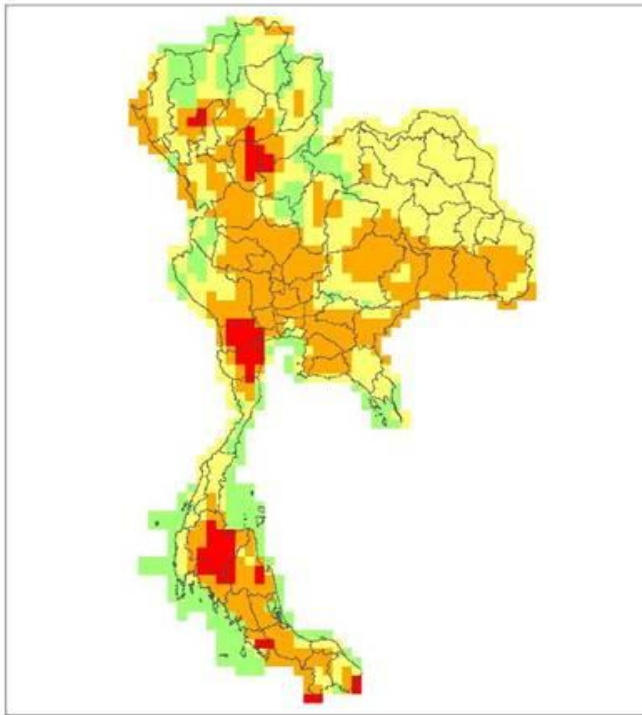
Framework for Climate Change Adaptation



“Maximum Temperature”

from Future Climate Scenarios based on PRECIS

1980-2009

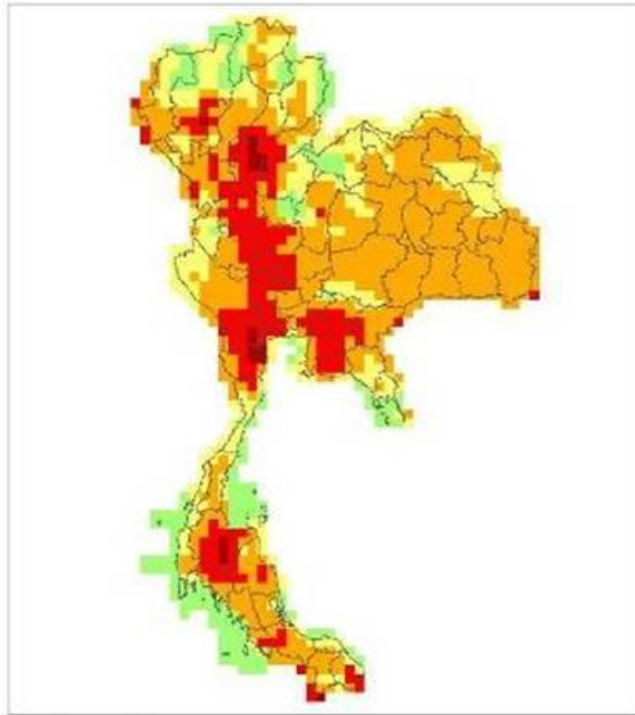


อุณหภูมิเฉลี่ย



อุณหภูมิสูงสุดเฉลี่ยรายวัน ปี ค.ศ. 1980 - 2009 (ปีฐาน)

2010-2039



อุณหภูมิเฉลี่ย



อุณหภูมิสูงสุดเฉลี่ยรายวัน ปี ค.ศ. 2010 - 2039
 SRES B2

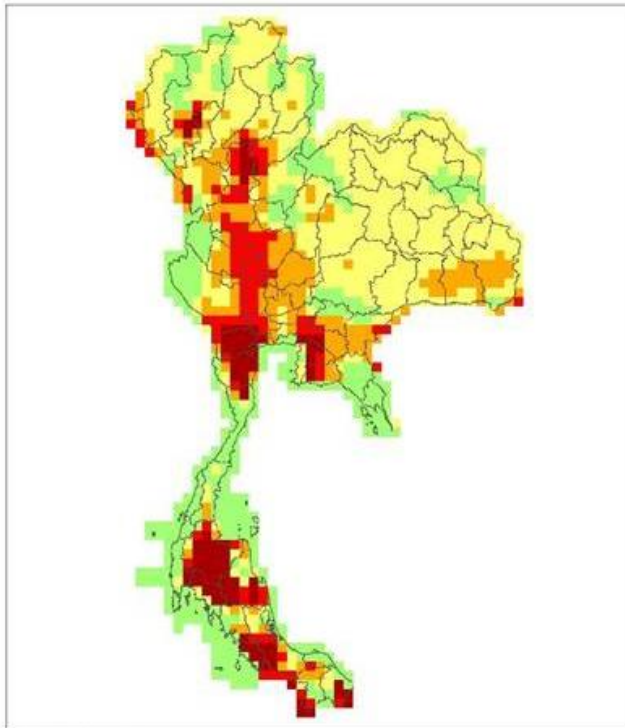
Future climate projection for Thailand shows trend of increasing maximum temperature for Chao Phraya River Basin, Central and Northeastern Part of Thailand

Scenario B2

“Hot Days”

from Future Climate Scenarios based on PRECIS

1980-2009

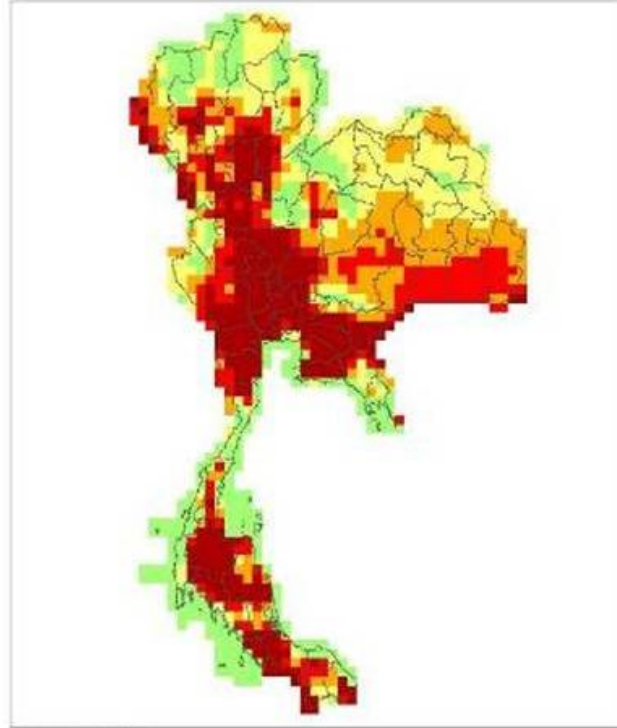


จำนวนวันที่ร้อนจัด



จำนวนวันที่อุณหภูมิสูงสุดสูงกว่า 35 องศาเซลเซียส
ปี ค.ศ. 1980 - 2009

2010-2039



จำนวนวันที่ร้อนจัด

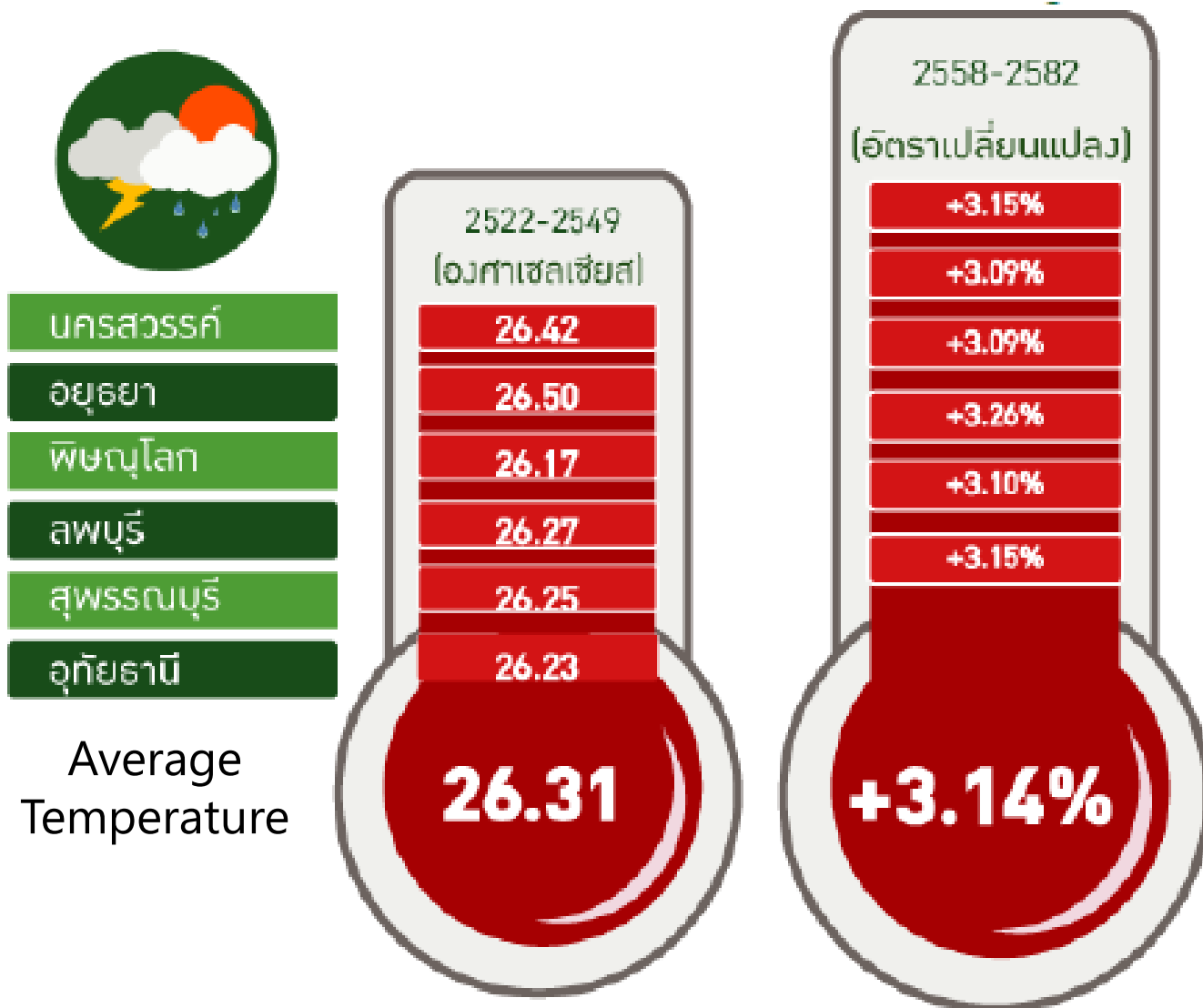


จำนวนวันที่อุณหภูมิสูงสุดสูงกว่า 35 องศาเซลเซียส
ปี ค.ศ. 2010 - 2039
SRES B2

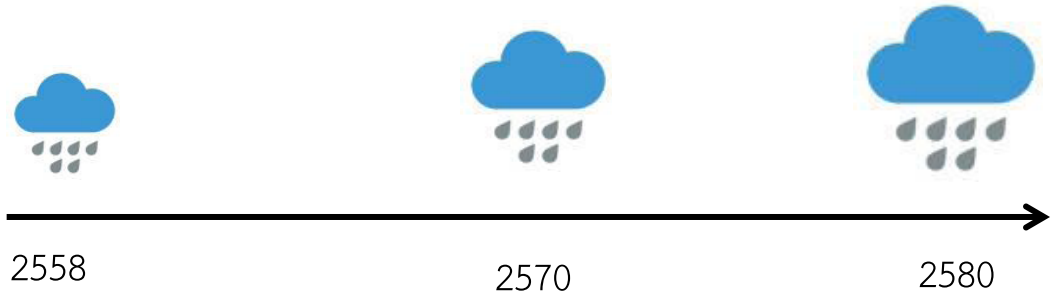
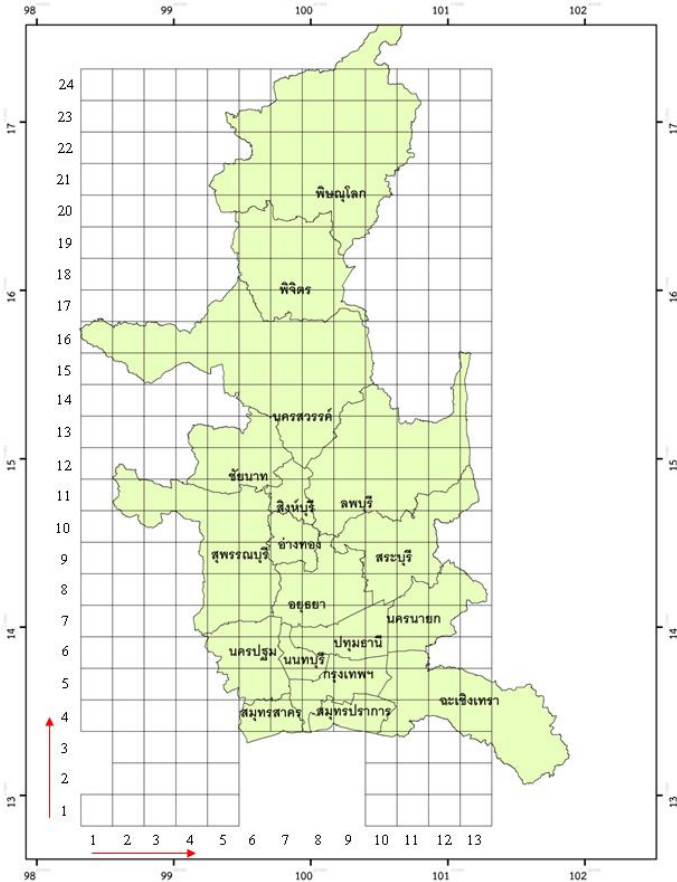
Future climate projection shows trend of increased number of hot days in Chao Phraya River Basin, Central, Northeastern and part of Southern Thailand.

Scenario B2





Trend of Change in Cumulative Rainfall from Heavy Precipitation Event in Chao Phraya River Basin



Higher Risk of Flash Flood and Drought

Higher Temperature

Greater Rainfall Variability

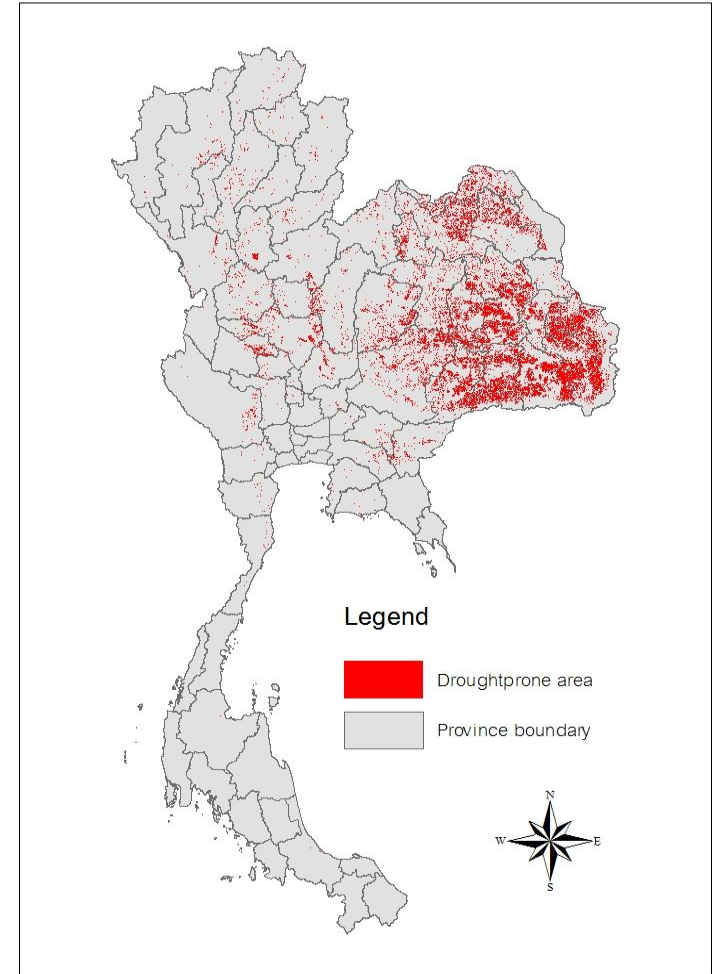
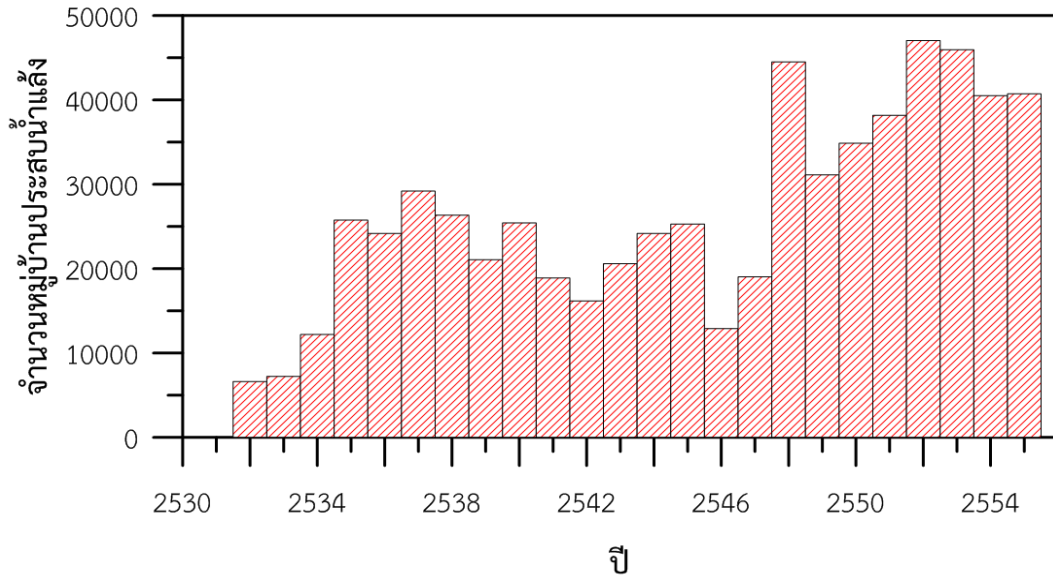
Increase in Number of hot days

+

Greater flood severity and increased heavy precipitation event

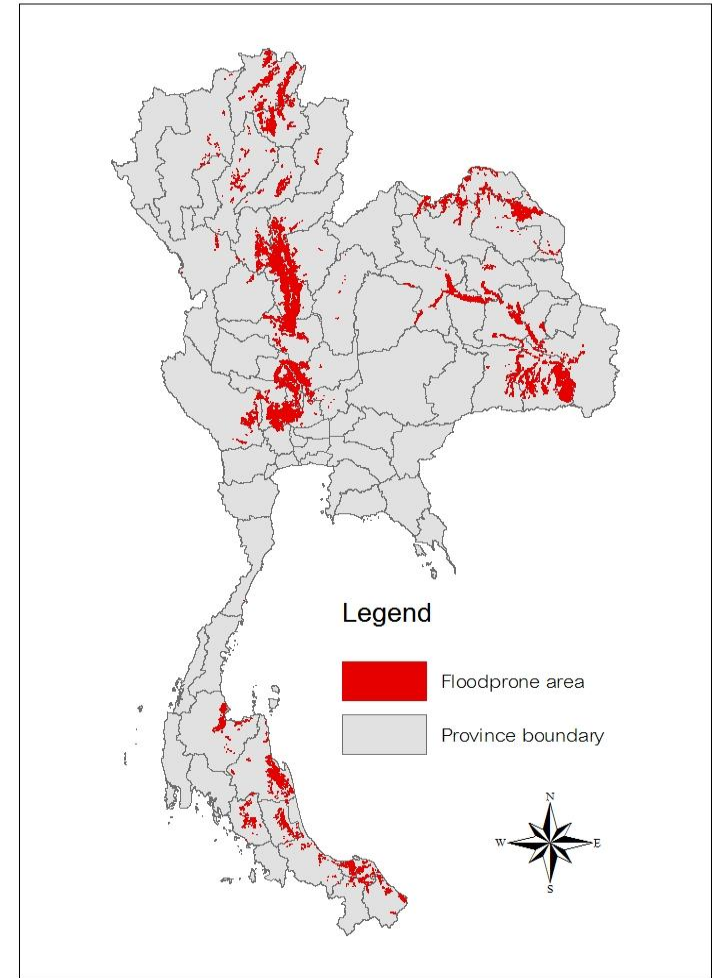
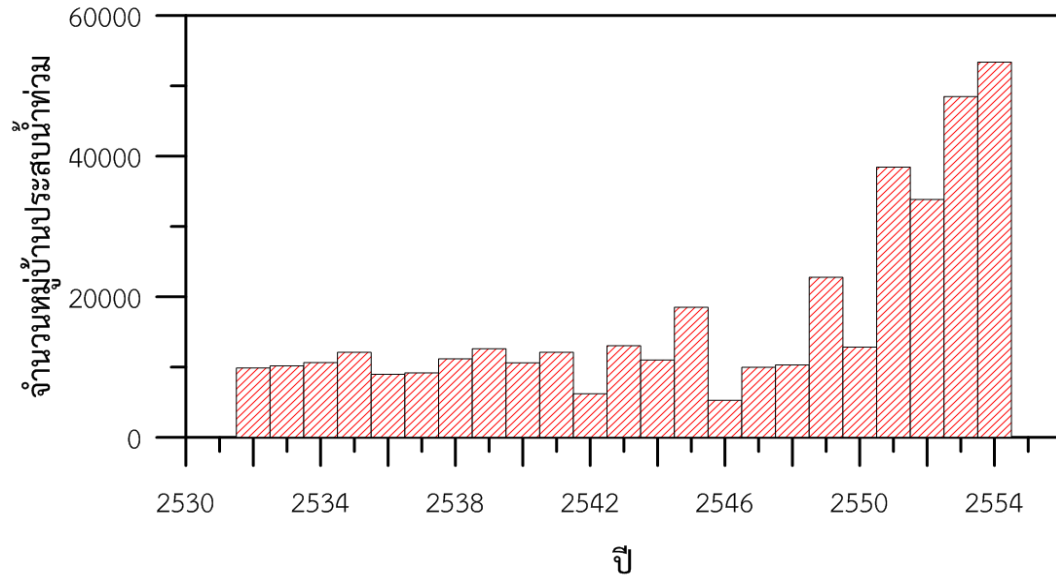


Increase in Drought Affected Areas



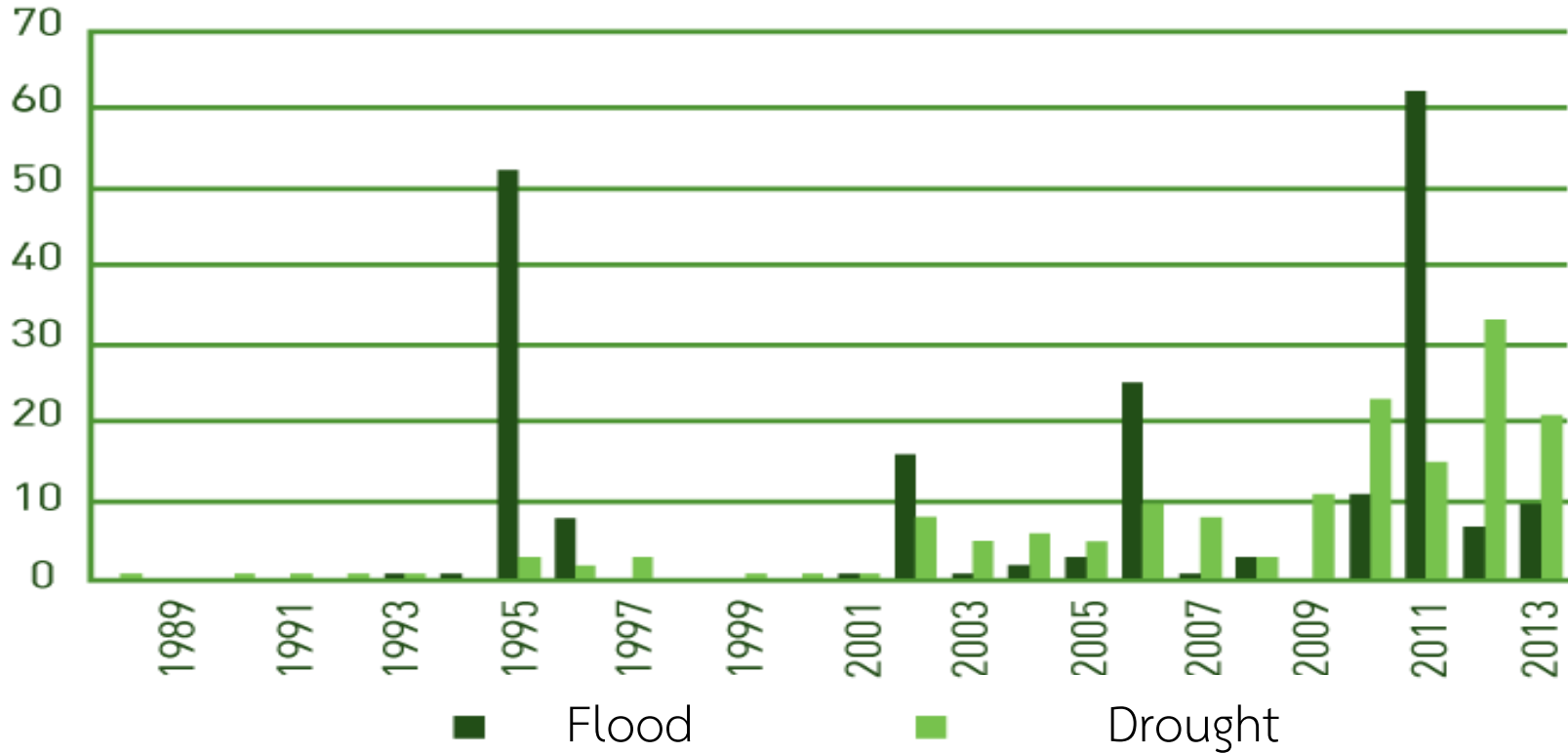
Source: Department of Disaster Prevention and Mitigation and
Buddhaboon (2014)

Increase in Flood Affected Areas

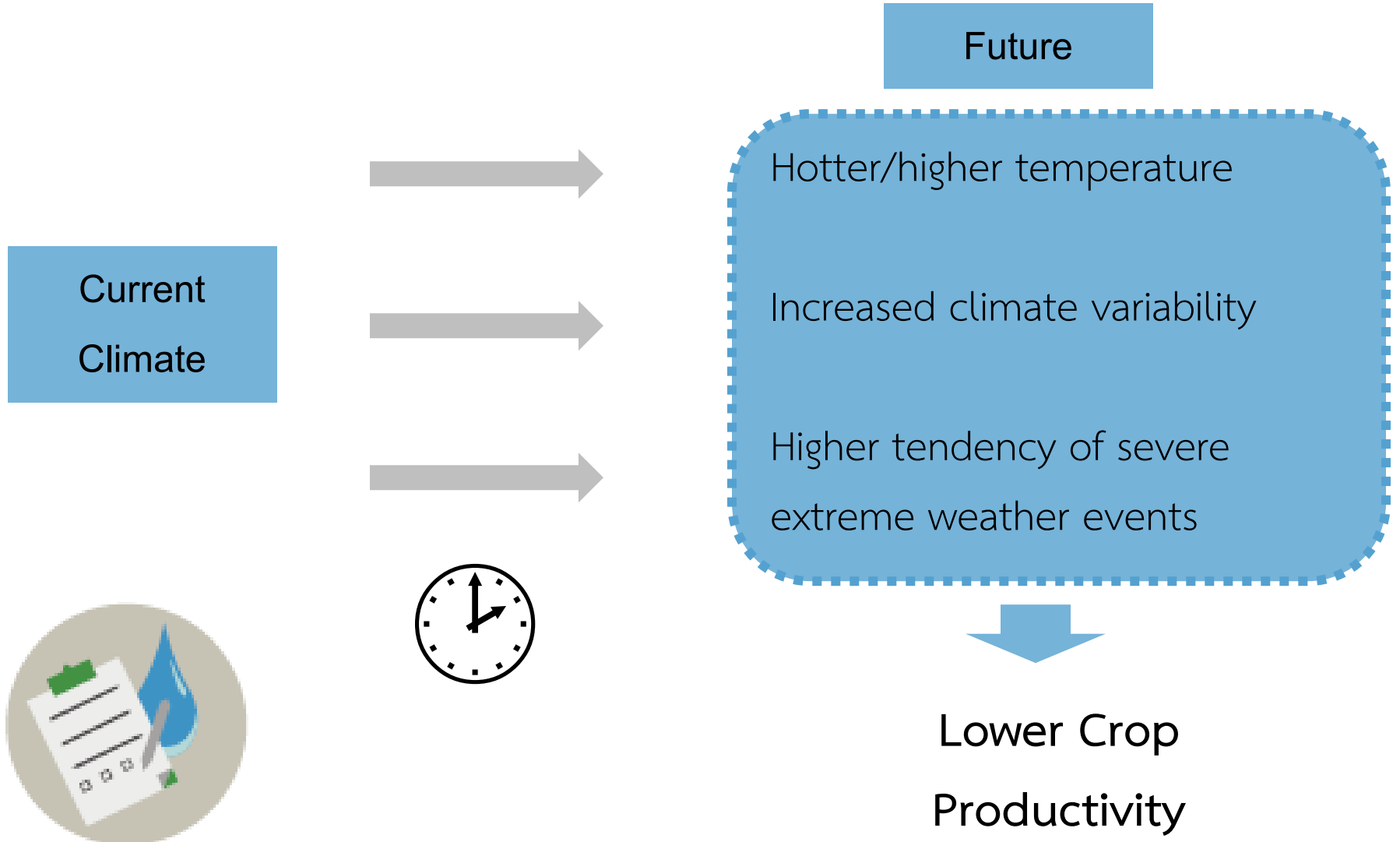


Source: Department of Disaster Prevention and Mitigation and Buddhaboon (2014)

Increased Frequency of Flood and Drought



Why Climate Change Matters?



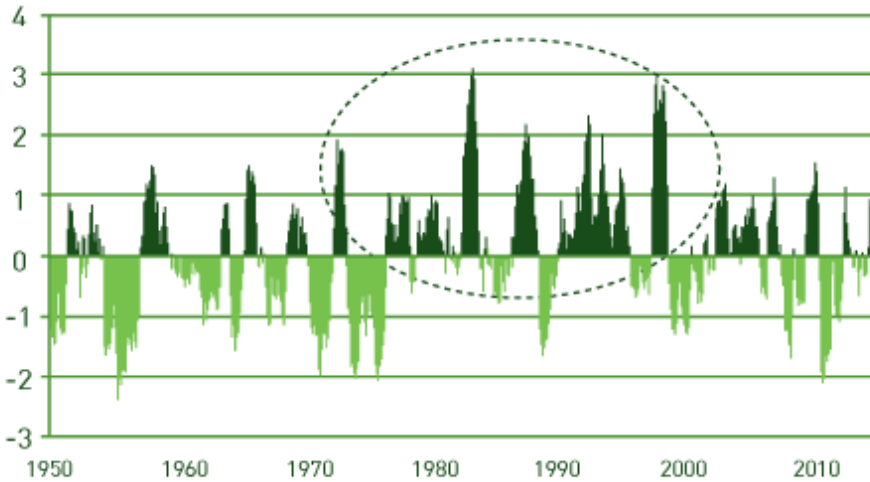


Example: Rice

Too high temperature adversely impacts the photosynthesis process and pollination of rice, resulting in low productivity.

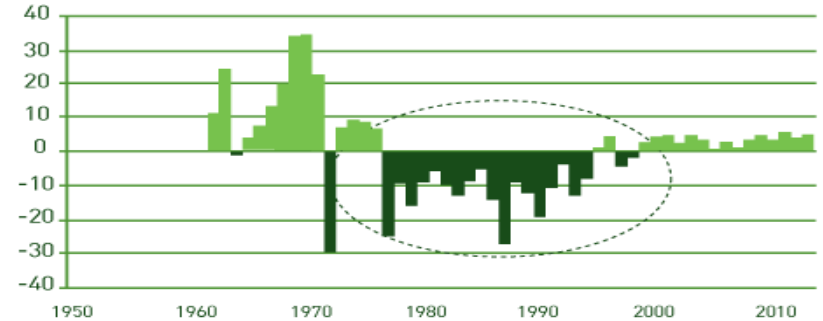


Multivariate ENSO Index

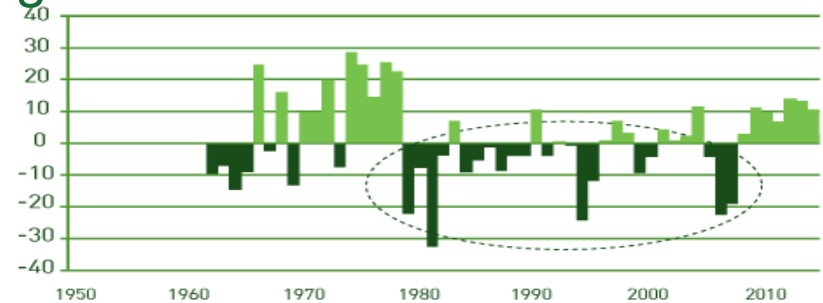


ที่มา: การทำการคำนวณโดยใช้ข้อมูลทั้งหมดมาจาก National Oceanic and Atmospheric Administration (NOAA) และ FAOSTAT (2557).

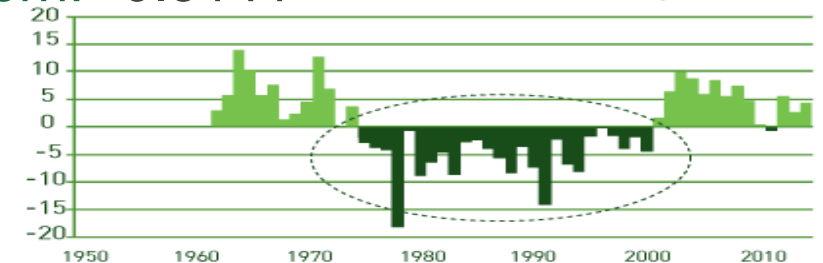
Rice : -0.3670^{**}



Sugarcane: -0.3885^{**}



Corn: -0.5141^{**}



** Coefficient of Variation between Standardized Departure of MEI and Yield Anomaly of main crops; statistical significant at 95%

Source: Thailand Development Research Institute

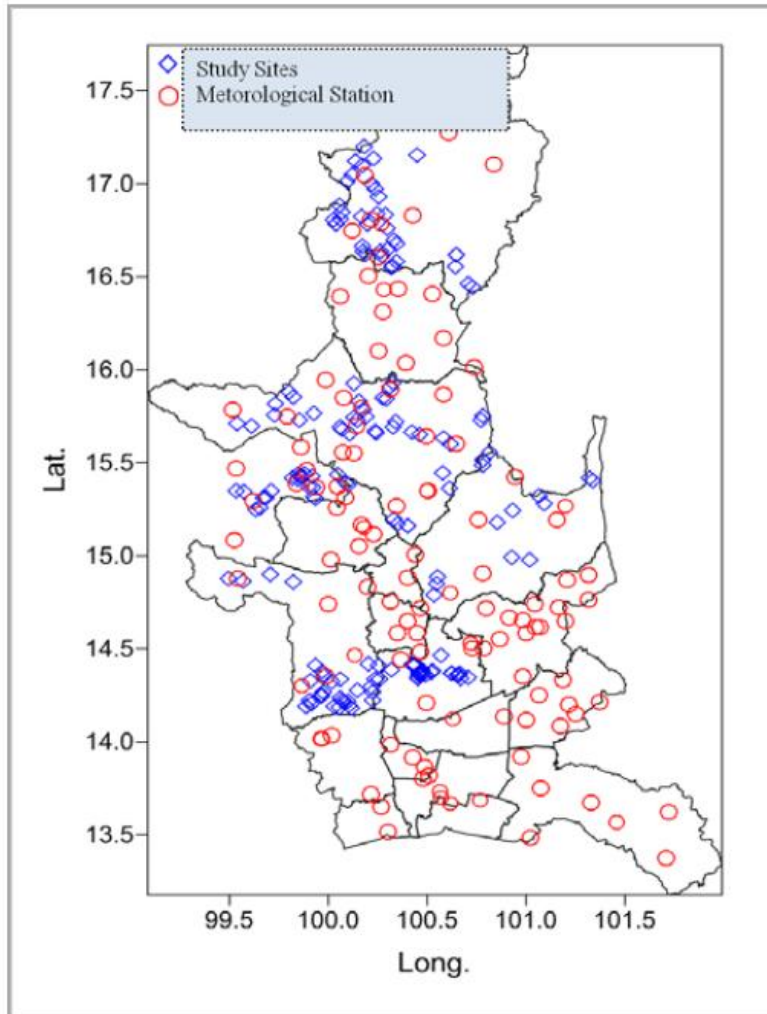
Data from FAOSTAT and NOAA

■ Research Questions:

- Analyze the impacts of adaptation on wet-season and dry-season rice productivity of farm households in the Chao Phraya River Basin
- Analyze the impacts of adaptation on cost of production for wet-season and dry-season rice
- Identify barriers to adaptation



Data and Study Sites



Data used in this part of the study came from Household Survey with sample size of 815 households that reside in 6 provinces in the Chao Phraya River Basin



Two-stage framework is used to model impact of adaptation on crop productivity:

- Stage 1: a selection model for adaptation (to analyze determinants of adaptation)

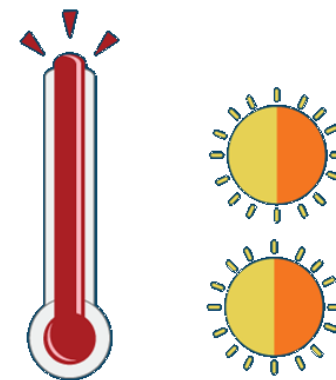
$$I_i^* = Z_i\gamma + \eta_i \text{ with } I_i = \begin{cases} 1 & \text{if } I_i^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

- Stage 2: modeling impact of adaptation on crop productivity

Endogenous switching regression was estimated using maximum likelihood

Regime 1: $y_{1i} = \mathbf{M}_{1i}\boldsymbol{\alpha}_1 + \varepsilon_{1i}$ if $I_i = 1$

Regime 2: $y_{2i} = \mathbf{M}_{2i}\boldsymbol{\alpha}_2 + \varepsilon_{2i}$ if $I_i = 0$



Endogenous Switching Model

$$E(y_{1i}|I_i = 1) = X_{1i}\alpha_1 + \sigma_{1\eta}\varphi_{1i}$$

$$E(y_{2i}|I_i = 0) = X_{2i}\alpha_2 + \sigma_{2\eta}\varphi_{2i}$$

$$E(y_{2i}|I_i = 1) = X_{1i}\alpha_2 + \sigma_{2\eta}\varphi_{1i}$$

$$E(y_{1i}|I_i = 0) = X_{2i}\alpha_1 + \sigma_{1\eta}\varphi_{2i}$$

Subsamples	Decision Stage		Treatment Effects
	To Adapt	Not to Adapt	
Farm households that adapted	(9a) $E(y_{1i} I_i = 1)$	(9c) $E(y_{2i} I_i = 1)$	TT
Farm households that did not adapt	(9d) $E(y_{1i} I_i = 0)$	(9b) $E(y_{2i} I_i = 0)$	TU
Heterogeneity effects	BH ₁	BH ₂	TH

Estimation Results

Subsamples	Decision Stage		Treatment Effects
	To Adapt	Not to Adapt	
Farm households that adapted	(a) 695.81 (13.3797)	(c) 664.46 (14.8840)	TT = 31.35 ^{***} (2.2934)
Farm households that did not adapt	(d) 669.79 (13.8864)	(b) 575.69 (22.6851)	TU = 94.10 ^{***} (3.0151)
Heterogeneity effects	BH ₁ = 26.02 ^{***} (2.2072)	BH ₂ = 88.77 ^{***} (3.0788)	TH = -62.75

Wet-Season
Rice

Subsamples	Decision Stage		Treatment Effects
	To Adapt	Not to Adapt	
Farm households that adapted	(a) 700.63 (22.5415)	(c) 725.83 (6.5547)	TT = -25.21 ^{***} (4.4544)
Farm households that did not adapt	(d) 941.90 (108.6289)	(b) 734.16 (13.0725)	TU = 207.74 ^{***} (9.4084)
Heterogeneity effects	BH ₁ = -241.27 ^{***} (10.0742)	BH ₂ = -8.33 ^{***} (2.6213)	TH = -232.95

Dry-Season
Rice

- ❑ There are differences in wet-season rice productivity between the farm households that adapted to flood and those that did not adapt to flood. Adapted households have of 31 kilograms per rai higher wet-season rice productivity than households that did not adapt. In exchange for such benefits, the results of our analysis show that the farm households that adapted need to face higher cost of production.
- ❑ The effect of adaptation to drought on dry-season rice productivity is ambiguous. However, we found that the costs of dry-season rice production are higher among the adapters than the non-adapters.



- Barriers to adaptation: lack of knowledge and information on appropriate adaptation options, lack of awareness and lack of capital.
- The relevant government agencies, such as the Department of Agricultural Extension, need to encourage farm households to adopt appropriate adaptation options and provide necessary assistance such as new crop varieties, suggestion about cropping pattern, etc.
- In the case of drought, since it is not clear whether adaptation raises dry-season rice productivity, so farm households should be encouraged to find alternative sources of income (e.g. seek for job outside agricultural sector).
- Given that adapting is costly, the Government can perhaps help farm households overcome barriers to adaptation by providing financial assistance, such as soft loans through BAAC.



