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Advancing Co-Design of Integrated Strategies with AdaPtation to Climate Change in Thailand  
2016-2021

**Regional Training Workshop on  
“Climate Change Adaptation: climate Change Adaptation National Plan  
Formulation, Implementation and Framework of Monitoring and Evaluation”**

5<sup>th</sup> September 2019, at Mecure Bangkok Siam, Bangkok, Thailand

*Associate Professor Dr. Thanya Kiatiwat*

# Experiences of IMPAC-T and ADAP-T

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## ADAP-T

Advancing co-Design of integrated strategies  
with AdaPtation to climate change in Thailand

2016-2021



IMPAC-T

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Integrated study on Hydro-Meteorological Prediction  
and Adaptation to Climate Change in Thailand

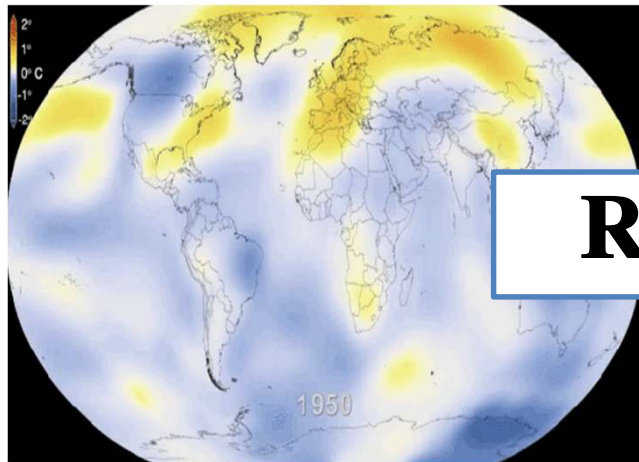


2009-2014



# IMPAC-T

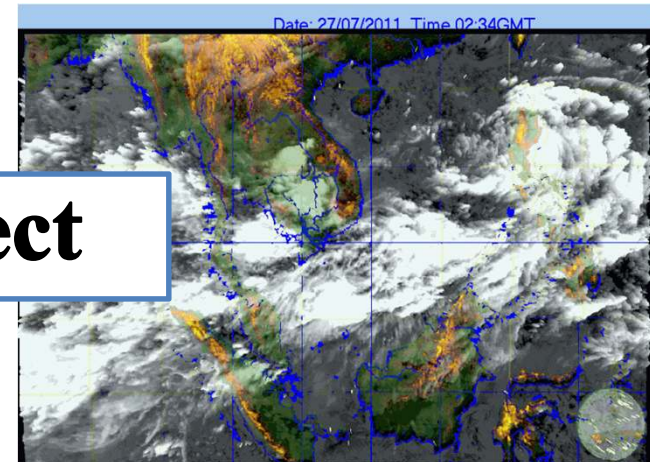
**Integrated study on Hydro-Meteorological Prediction and Adaptation to Climate Change in Thailand  
2009-2014**



**Climate Change**



**Hydro (Water)**



**Meteorology**

**Research Project**



# ADAP-T

**Advancing Co-Design of Integrated Strategies with AdaPtation to Climate Change in Thailand  
2016-2021**

# **ADAP-T's GOAL**

**“Development of resilient and sustainable solutions  
for climate change in Thailand”**

# OBJECTIVES

1. Determine appropriate adaptation technology and measures due to CC to support Thailand adaptation to climate change strategies.
2. Support and review National Adaptation Plans (NAPs) of Thailand.
3. Support related action plans for the corresponding government agencies.
4. Transfer technologies and knowledge based on adaptation to cc from Japanese researchers.
5. Develop Thai researchers through the adaptation to cc Issue.

# EXPECTED OUTCOMES

1. Information and basic knowledge related to climate change are collected and shared
2. Appropriate adaptation measures to climate change in six sectors – freshwater, forest, rural planning, urban, coastal and sediment disaster – are formulated and implemented.
3. A portfolio of co-designed integrated strategies for adaptation to climate change are reviewed, evaluated for local implementation.

# Development of resilient and sustainable solutions for CC

Advancing co-design of integrated strategies with adaptation to CC in Thailand

**Government  
(implement/operational agencies)**

Support policy making

**Government  
(NESDB, ONEP etc.)**

Input to CC action plan

## ST2 Assessment of adaptation measures to CC

Fresh water

Sediment

Coastal

Rural

Forest

Urban

Action plans/good practice

**ST3  
Knowledge sharing for  
planning comprehensive  
strategy to CC**

Knowledge sharing

**Assessment of adaptation measures to CC**

Impact/damage assess. of adaptation to CC

Possible adaptation ways

B/C analysis

Value judgment

Feasibility and good balance  
under various limitations

Rain estimation

Future scenario

IT

Groundwater

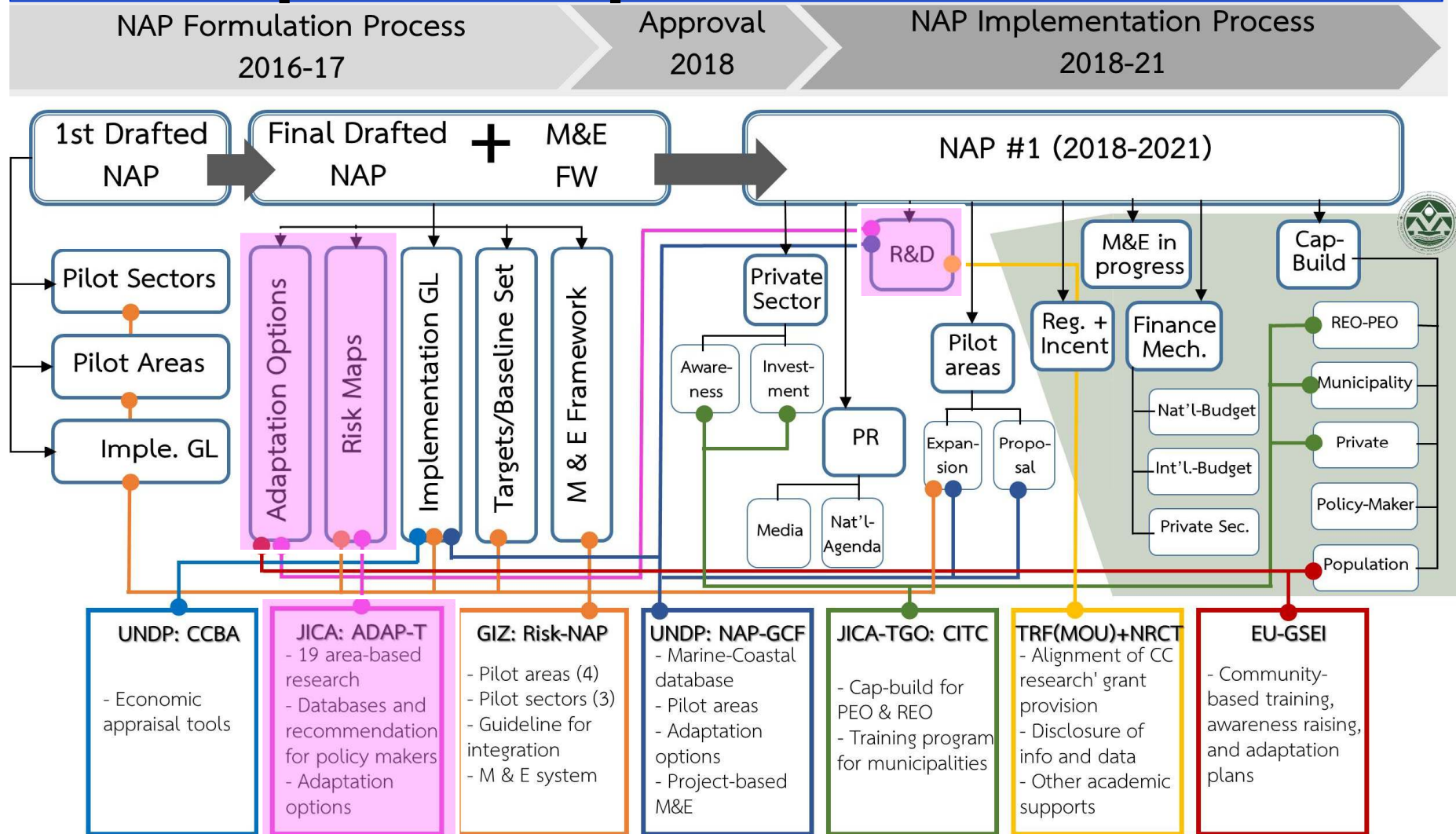
Seasonal forecast

**ST1 Development of knowledge base for  
climate change**

Heritage of IMPAC-T  
Climate Change Data Center @KU



# The Overview of Climate Change Adaptation Operation in Thailand



Reference from ONEP, Working Group on Integration of Climate Change Adaptation, July 12, 2017.



# ADAP-T'S ST1 :

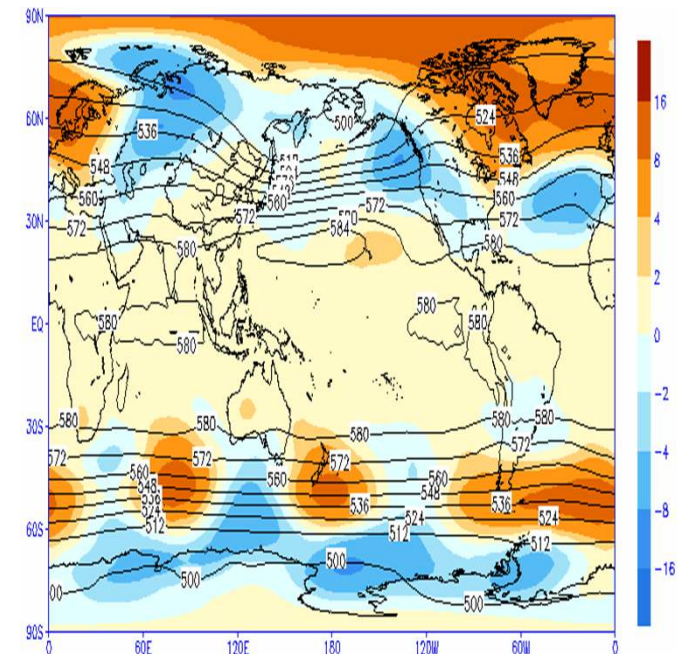
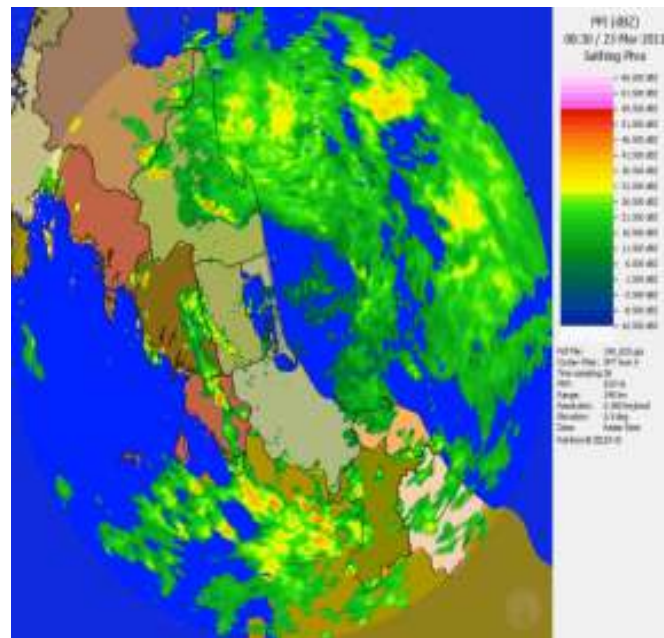
## Development of Knowledge Base for Climate Change

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1) IT

2) Rain Estimation

3) Seasonal Forecast

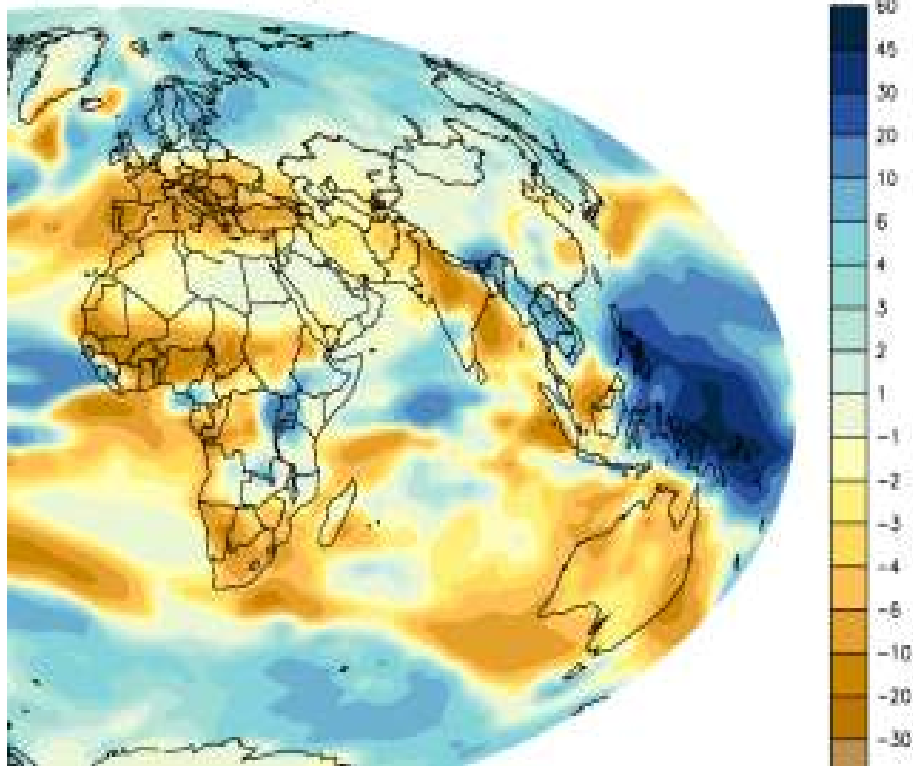


# ADAP-T'S ST1 :

## Development of Knowledge Base for Climate Change

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### 4) Future Scenario



### 5) Ground Water



# ADAP-T'S ST2 :

## Assessment of Adaptation Measures for Climate Change and Development of Co-Design methods

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### 1) Freshwater



### 2) Forest



### 3) Rural



# ADAP-T'S ST2 :

## Assessment of Adaptation Measures for Climate Change and Development of Co-Design methods

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### 4) Urban



### 5) Coastal



### 6) Sediment



# **ADAP-T'S ST3 :**

## **Knowledge Sharing for Planning Comprehensive Strategies to Climate Change**

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**1. Support and Review National Adaptation Plans (NAPs) of Thailand**

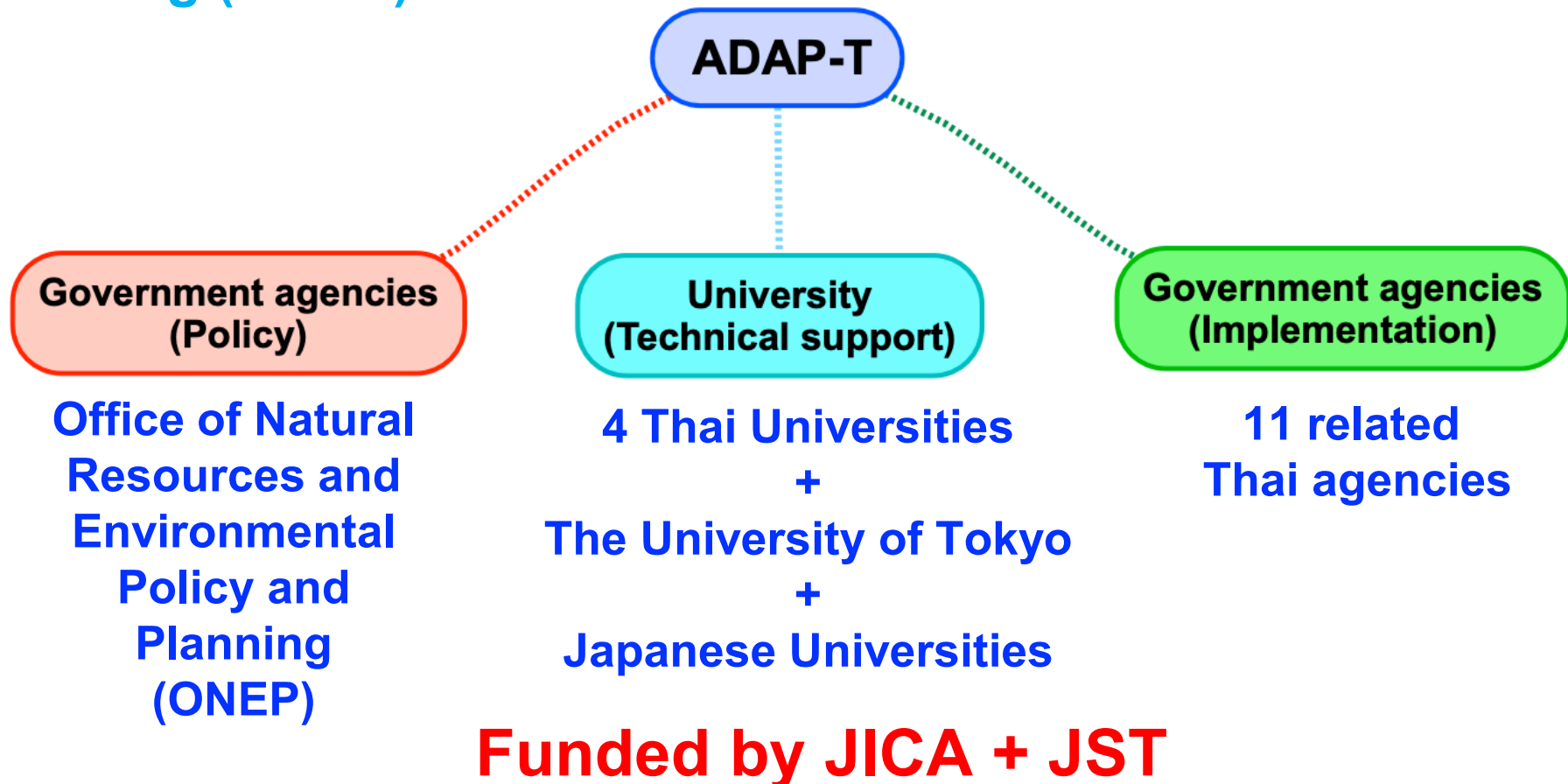
**2. Output/Outcome**

**Portfolio of co-Design of integrated strategies based upon Adaptation to CC**

# CORRESPONDING WORKING AGENCIES

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**Core agencies** ⑨ **Kasetsart University (KU)** + **Royal irrigation department (RID)** + **Thai Meteorological Department (TMD)** + **Office of Natural Resources and Environmental Policy and Planning (ONEP)**



# **CORRESPONDING RESEARCHERS**

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## **Thai Researchers (79 Researchers)**

- 15 related Thai Agencies (46 Researchers)**
- 4 Thai Universities (33 Researchers)**

## **Japanese Researchers**

- The University of Tokyo + Japanese Universities**

# CORRESPONDING WORKING AGENCIES

| Category   | Working Agencies  | Corresponding Agencies  |
|--|---|---|
| (3) Knowledge sharing                                | <b>Knowledge sharing</b><br>OAE, ONEP, RID, TMD, DWR<br>Representative of each sector | <br>Nagoya U |
|  | <b>Integration</b><br>FoE, KU   | EDITORIA, UTokyo  |
| (2) Assessment/adaptation & development of co-design | <b>Freshwater</b><br>DGR, TMD, DDPM, RID, CU, KMUTT, NU                               | NIES, NagasakiU, KyotoU   |
|  | <b>Forest</b><br>DNP, RED, FoE, KU  | FoA, UTokyo   |
|  | <b>Sediment</b><br>KMUTT, DMR, RID, FoE, KU   | TohokuU   |
|  | <b>Coastal</b><br>DMCR, FoE, KU   | TohokuU   |
|  | <b>Urban</b><br>BMA, FoE, KU, KMUTT   | Nagoya U  |
|  | <b>Rural</b><br>OAE, LDD, FoA, KU, DOAE, ALRO, KKKU, FoE, KU                          | IbarakiU, Tohoku U, TohokuTcch  |
|  | <b>Groundwater</b><br>LDD, FoE, KU, FoS, KU   | Ibaraki U   |
|  | <b>Precip. prediction</b><br>KU, TMD  | Nagasaki U  |
| (1) Knowledge base for CC                            | <b>Seasonal forecast</b><br>RID, TMD, KMUTT   | TokyoTech., Hokkaido U  |
|  | <b>Future scenario</b><br>RID, TMD, FoE, KU   | TokyoTech., NagasakiU   |
|  | <b>IT</b><br>RID, TMD, FoE, KU  | EDITORIA, UTokyo  |

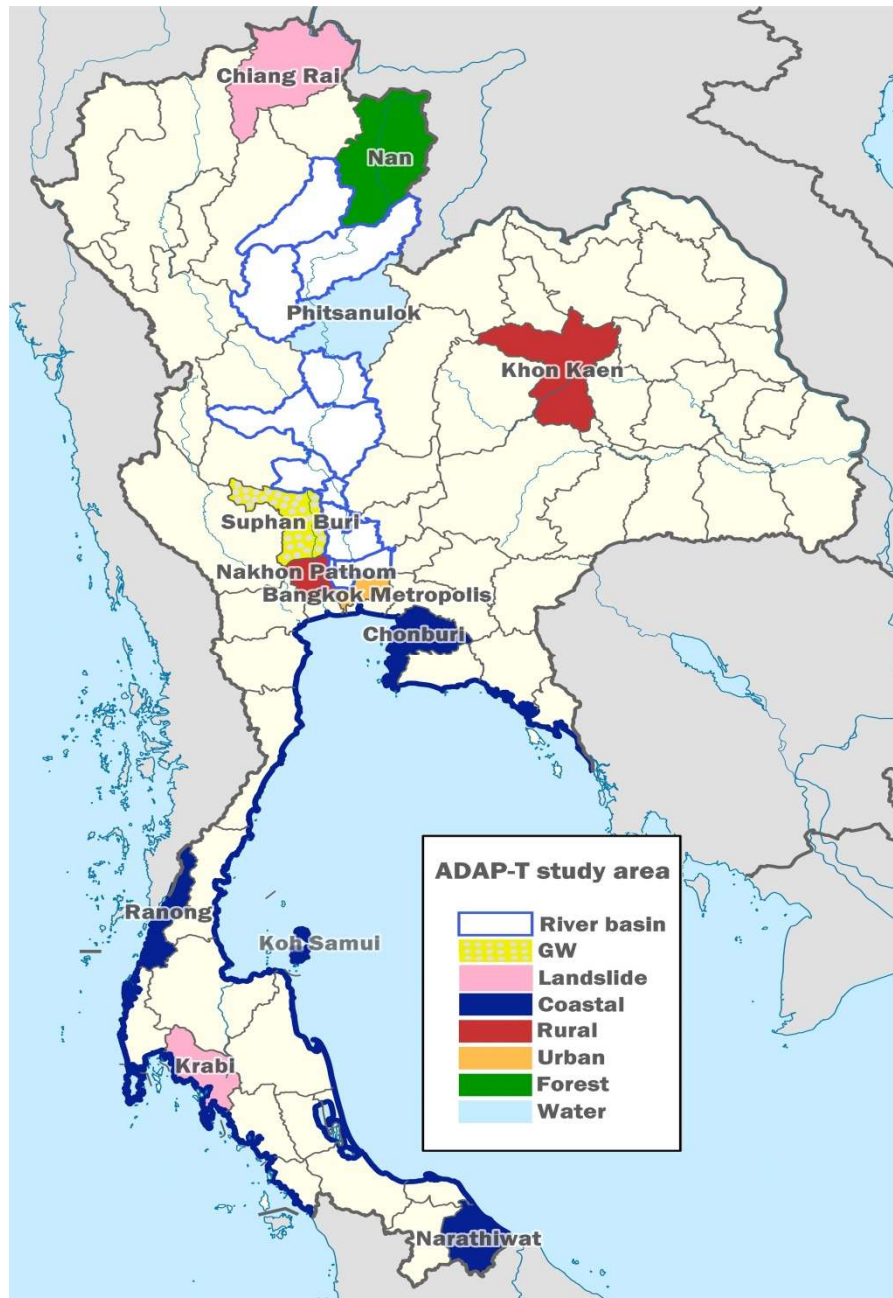
Kasetsart University

IIS, The University of Tokyo





# CORRESPONDING WORKING AREAS



Sector 1: **Freshwater** → Central & Northeastern part of Thailand

Sector 2: **Sediment disaster** → Northern part of Thailand

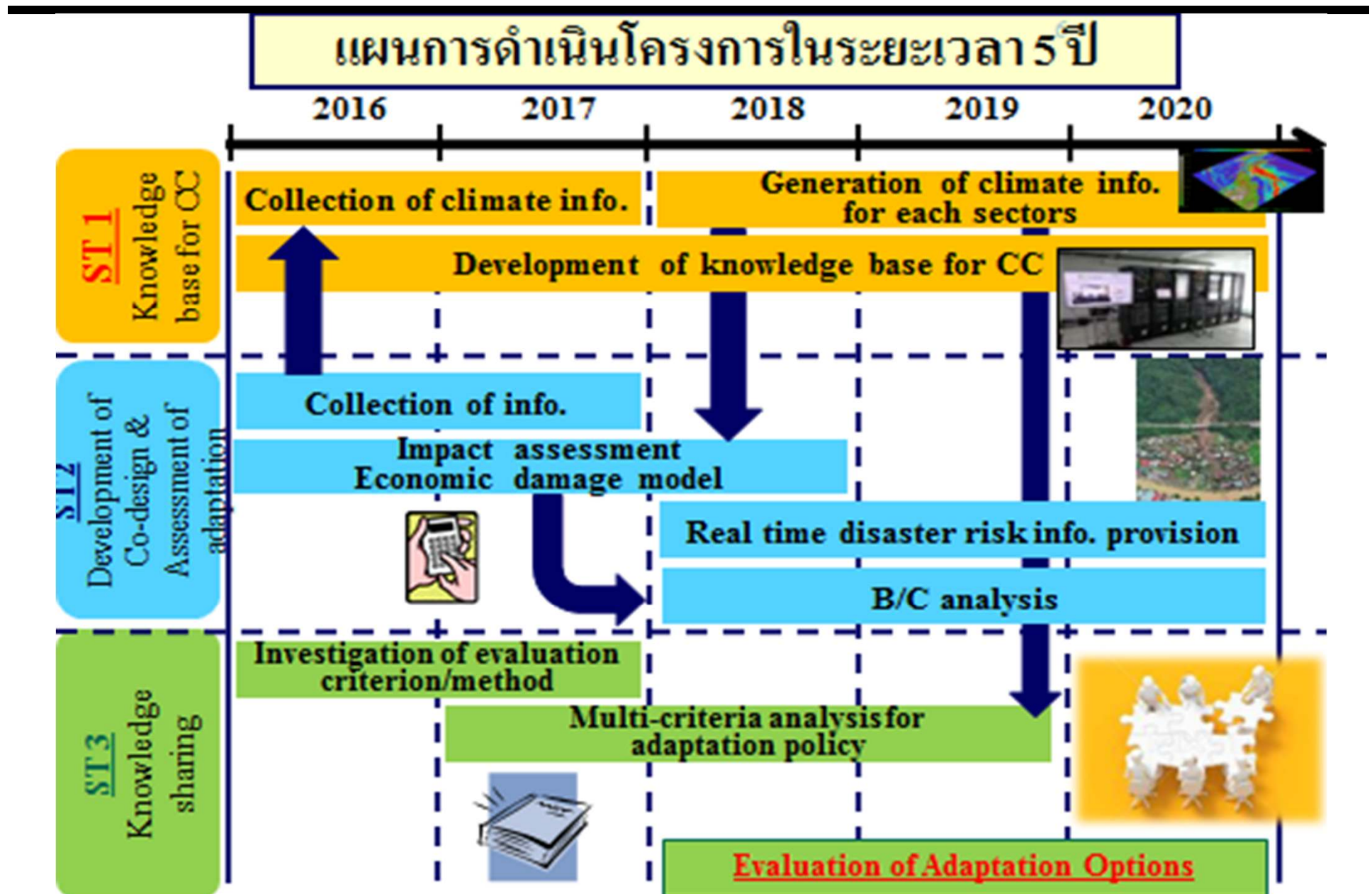
Sector 3: **Coastal** → Gulf of Thailand and Andaman Sea

Sector 4: **Rural planning** → Central & Northeastern part of Thailand

Sector 5: **Forest** → Northern part of Thailand

Sector 6: **Urban** → Bangkok and its neighborhood

# CORRESPONDING WORKING PLAN



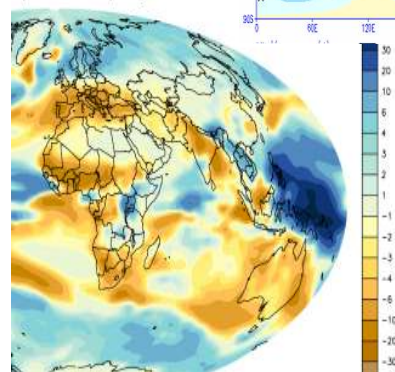
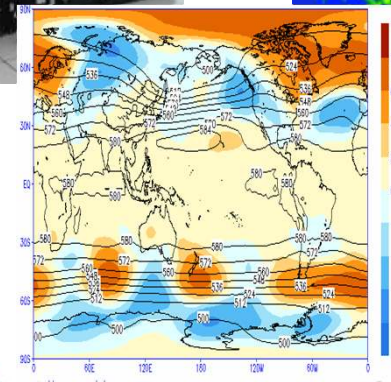
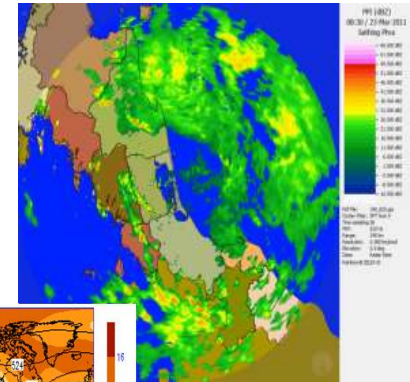
## **ADAP-T Project:**

**The Dissemination of Climate Change Risk  
Information and The Integration to NAP of  
Thailand**

# ADAP-T's ST1 :

## Development of Knowledge Base for Climate Change

- ST1-1 IT
- ST1-2 Seasonal Forecast
- ST1-3 Future Scenario (Meteorological)
- ST1-4 Future Scenario (Economics)
- ST1-5 Groundwater
- ST1-6 Precipitation



# **Output & Outcome**

## **Data set provide a basis for adaptation**

- **Seasonal forecast**
- **Flood/drought risk from H08 model**
- **Expected damage ( $10^6$ THB/km<sup>2</sup>/yr), Probability of Return Period 100yrs (%)**
- **Groundwater Assessment**
- **CLUES model (land use change prediction), SWAT model (runoff from rain data etc.)**

# ADAP-T's ST2

## Assessment of Adaptation Measures for Climate Change and Development of Co-Design methods

- ST2-1 Forestry
- ST2-2 Rural 1
- ST2-3 Rural 2
- ST2-4 Rural 3
- ST2-5 Water 1
- ST2-6 Water 2
- ST2-7 Water 3
- ST2-8 Urban 1
- ST2-9 Urban 2
- ST2-10 Sediment
- ST2-11 Coastal



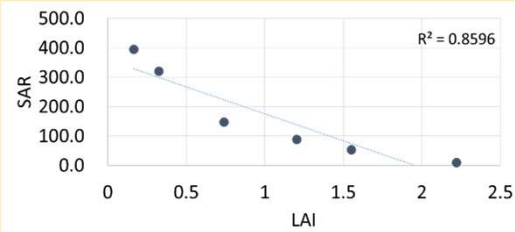
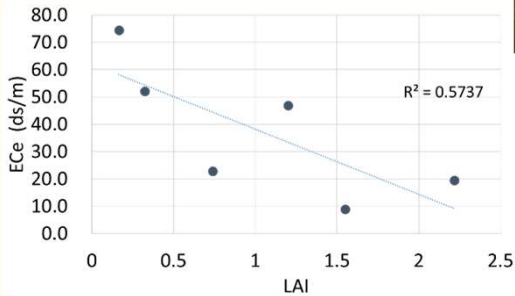
# Scientific knowledge

Salinity Soil



Poor growth

## Field Experiment



Info.

# Rural

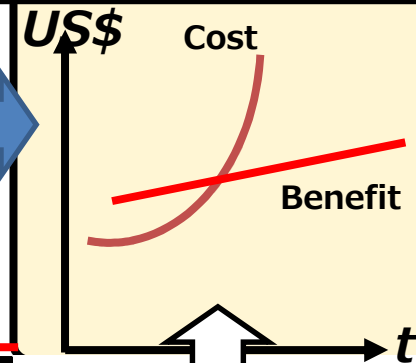
Government

ONEP

Good practice: **Plant breeding & Management of nutrients and organic substances in soil, & Reforestation**

Implementation Agencies: LDD, RID, DOAE, OAE, DNP

Benefits by counter measures



## Considerable measures

| Adaptation measures   | Cost function |   | requirement |   | Cost   |
|-----------------------|---------------|---|-------------|---|--------|
| Salt tolerant variety | ○ US\$/ha     | × | ○ ha        | = | ○ US\$ |
| Drainage construction | ○ US\$/km     | × | ○ km        | = | ○ US\$ |
| Reforestation         | ○ US\$/ha     | × | ○ ha        | = | ○ US\$ |
| Anything else?!       |               | × |             | = |        |

# Scientific knowledge

## Rice Production

### Regression Analysis (Production vs rainfall)

| (Province)        | (Month) | May-Jul | Jun-Aug | Jul-Sep | Aug-Oct | Sep-Nov | Oct-Dec |
|-------------------|---------|---------|---------|---------|---------|---------|---------|
| Buriram           |         | 0.30    | 0.32    | 0.30    | 0.13    | -0.11   | -0.13   |
| Chaiyaphum        |         | 0.28    | 0.26    | 0.13    | 0.04    | -0.14   | -0.11   |
| Kalasin           |         | 0.42    | 0.49    | 0.37    | 0.13    | -0.05   | -0.05   |
| Khon Kaen         |         | 0.38    | 0.53    | 0.53    | 0.54    | 0.45    | 0.35    |
| Loei              |         | 0.39    | 0.45    | -0.30   | 0.08    | -0.04   | 0.48    |
| Maha Sarakham     |         | 0.15    | 0.45    | 0.54    | 0.42    | 0.32    | 0.25    |
| Mook Zehnder Hahn |         | 0.05    | 0.33    | 0.34    | 0.22    | 0.06    | -0.15   |
| Nakhon Phanom     |         | 0.00    | -0.12   |         |         |         |         |
| Nakhon Ratchasima |         | 0.27    | 0.35    |         |         |         |         |
| Nong Khai         |         | 0.02    | -0.12   |         |         |         |         |
| Roi Et            |         | 0.36    | 0.49    | 0.31    | 0.09    | -0.18   | 0.11    |
| Sakon Nakhon      |         | -0.01   | 0.02    | 0.17    | 0.44    | 0.35    | 0.17    |
| Sisaket           |         | 0.05    | 0.13    | 0.02    | -0.04   | -0.29   | -0.32   |
| Surin             |         | 0.38    | 0.47    | 0.34    | -0.01   | -0.49   | -0.48   |
| Ubonratchathani   |         | 0.27    | 0.24    | 0.14    | 0.08    | 0.12    | 0.21    |
| Udon Thani        |         | -0.12   | 0.26    | 0.48    | 0.26    | 0.17    | -0.20   |
| Yasothon          |         | 0.26    | 0.06    | -0.12   | -0.18   | -0.21   | 0.07    |



Info.

# Rural

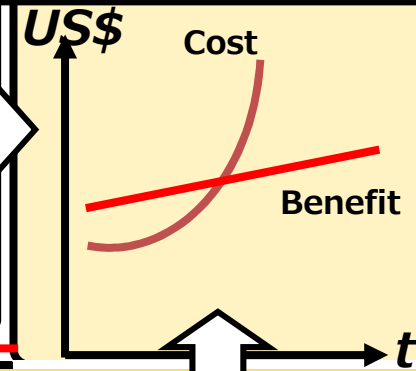
## Government

ONEP

Good practice: **Modification of planting time, & Local weather forecast, & Groundwater**

Implementation Agencies: OAE, RID, TMD, DGR

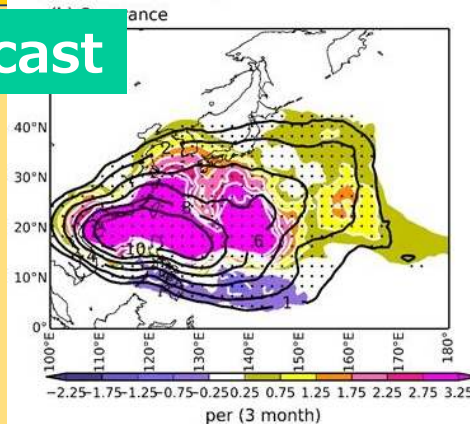
Benefits by counter measures



## Considerable measures

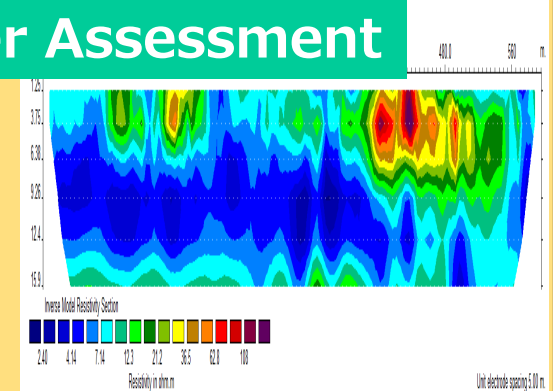
### Seasonal forecast

Singular Value Decomposition analysis; SVD



### Groundwater Assessment

2D-Imaging Resistivity Survey

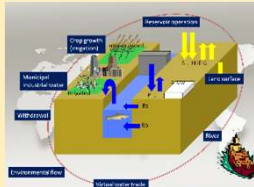




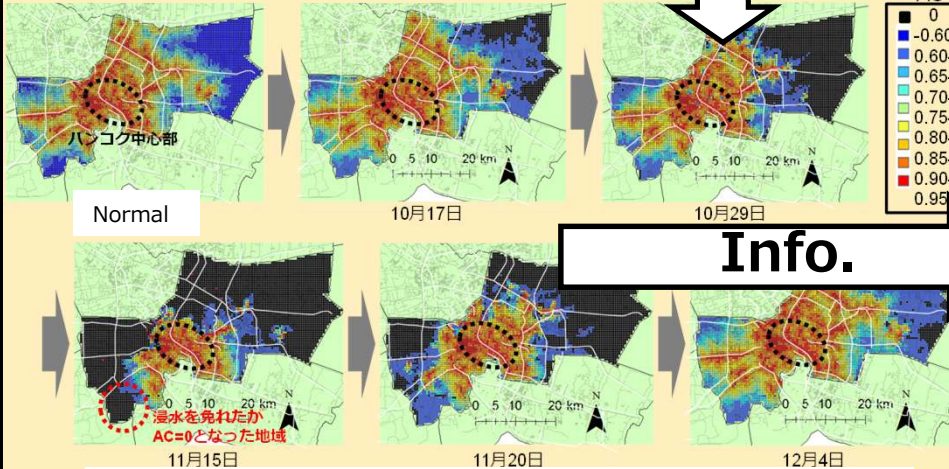
# Scientific knowledge

Urban flood

Watershed Model H08



Accessibility



Time series of accessibility map(2011)

# Urban water

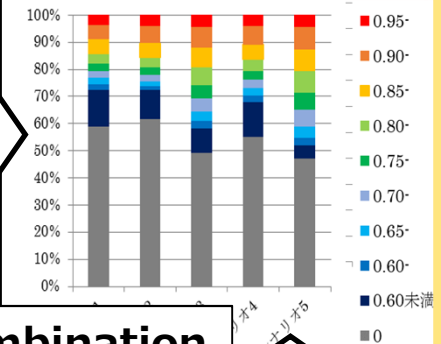
Government

ONEP

Good practice: **Producing hazard maps & Installing pumps for drainage & Strengthening retaining wall**

Implementation Agencies: BMA, DOH, DLT

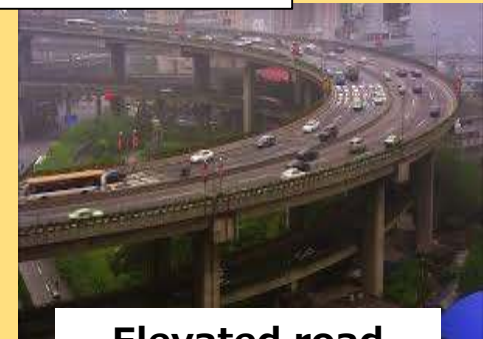
Benefits by counter measures



Ex. Scenarios; combination of counter measures

# Considerable measures

| Adaptation    | Cost function |   | requirement |   | Cost   |
|---------------|---------------|---|-------------|---|--------|
| Elevated Road | ○ US\$/km     | × | ○ km        | = | ○ US\$ |
| Pump install  | ○ US\$/Unit   | × | ○ Units     | = | ○ US\$ |
| Polder Dike   | ○ US\$/km     | × | ○ km        | = | ○ US\$ |



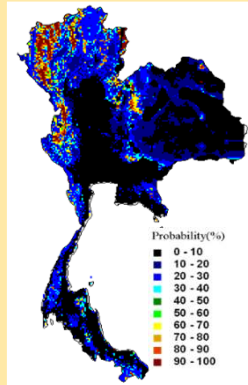
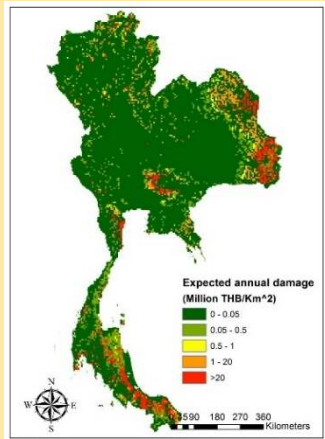
Elevated road

# Scientific knowledge

Risk of landslide

Probability of Return Period 100yrs (%)

Expected damage (10<sup>6</sup>THB/km<sup>2</sup>/yr)



Where are high risk regions?  
How much damage?

Info.

# Sediment

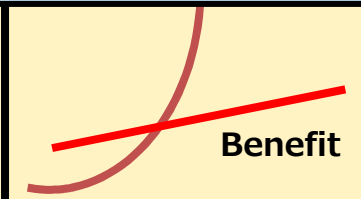
Government

ONEP

Good practice: **Landslide surveillance network, Rehearsal disaster, & Right areas for habitation**

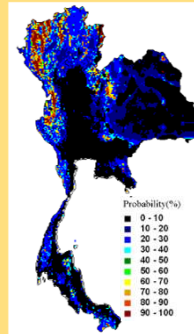
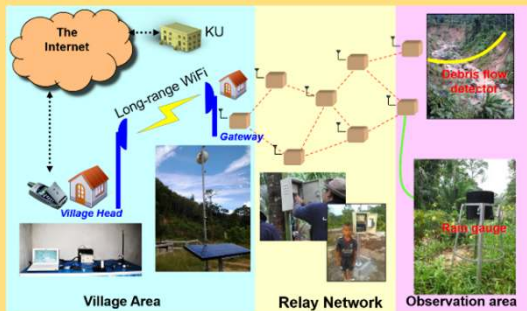
Implementation Agencies: RID, RFD, LDD, DDPM, DLA, Local gov.

Benefits by counter measures



# Considerable measures

## Early warning



Hazard map

## Rehearsal disaster

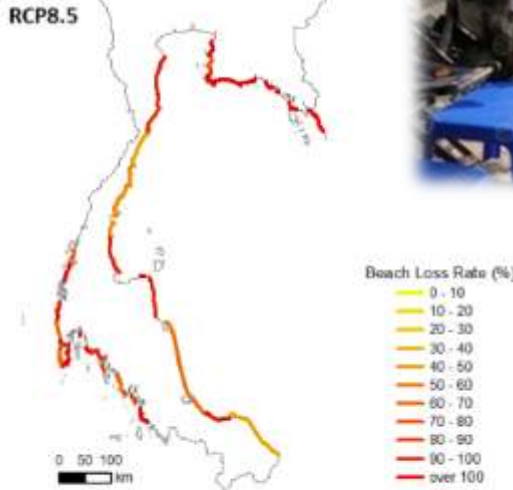


# Scientific knowledge

Beach erosion!!



RCP8.5



Info.

Beach loss rate 67.74 %

Area loss 37.48 km<sup>2</sup>

# Considerable measures

| Adaptation measures     | Cost function |   | requirement |   | Cost   |
|-------------------------|---------------|---|-------------|---|--------|
| Beach nourishment       | ○ US\$/ton    | × | ○ ton       | = | ○ US\$ |
| Seawall construction    | ○ US\$/km     | × | ○ km        | = | ○ US\$ |
| Mangrove rehabilitation | ○ US\$/ha     | × | ○ ha        | = | ○ US\$ |
| Retreat ?!              |               | × |             | = |        |

# Coastal

Government

ONEP

Good practice: Coastal vulnerability assessment, beach loss analyses, beach value valuation, beach nourishment

Implementation Agencies: DMCR, DDPM, DLA, Local gov., Harbor Dept., Royal Thai Navy, TAT

Where is dangerous?

To decide priority

cost/benefit

Info.

US\$ benefit

cost

km

US\$

cost

benefit

ton

## Scientific knowledge

Sallow groundwater exploration tool and Cost cutting of drilling

When the extreme drought occur, groundwater use is only the solution in agricultural sector.

Farmer pay money for dug well. (by hand made)  
5,000 Baht / 10m well



## Groundwater

Government

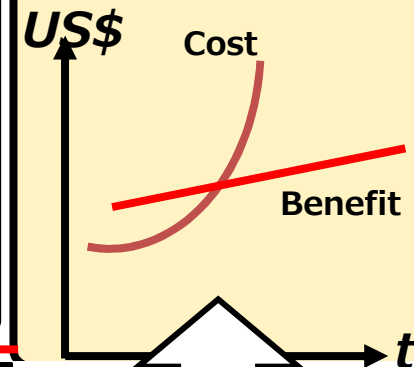
ONEP

Good practice: **shallow groundwater use**

Implementation Agencies:  
DGR, OAE, RID, LDD

Info

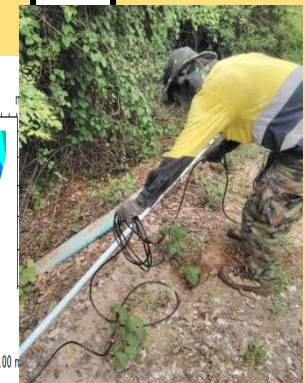
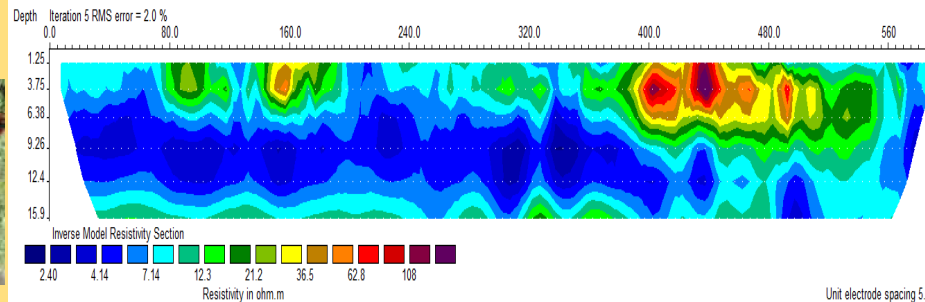
Benefits by counter measures



## Considerable measures

## Groundwater Assessment

2D-Imaging Resistivity Survey



# ST1-GW

## Adaptation measure : Sallow Groundwater Use

When the extreme drought occur, groundwater use is only the solution in agricultural sector.

### EXAMPLE

Sallow well < 20m was focused in ST1-GW.

(because deep well >50m needs license from

DGR: Department of Groundwater Resources)



### Cost

Farmer pay money for dug well.

(by hand made)

5,000 Baht / 10m well

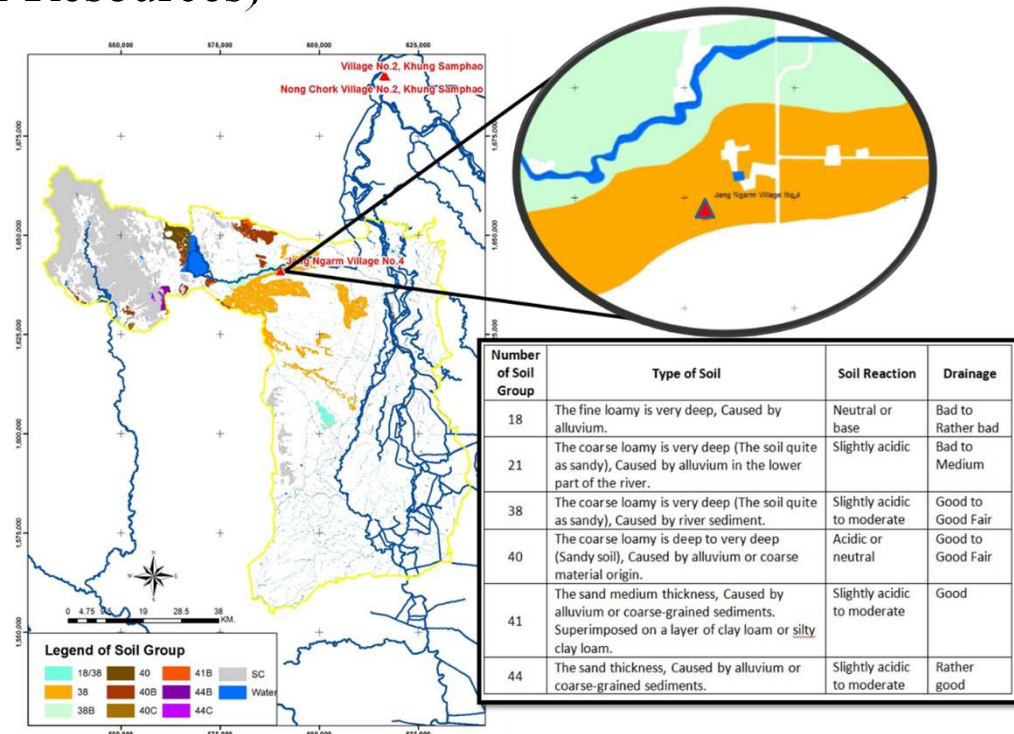
(by machine)

1,000 Baht / 1m depth

### Problem

Farmer can get enough water only from 20% well.

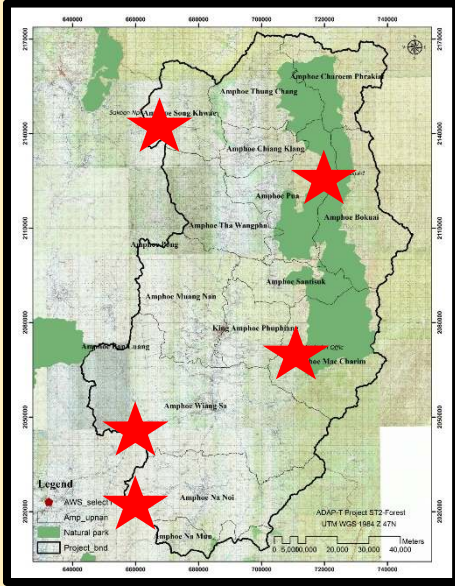
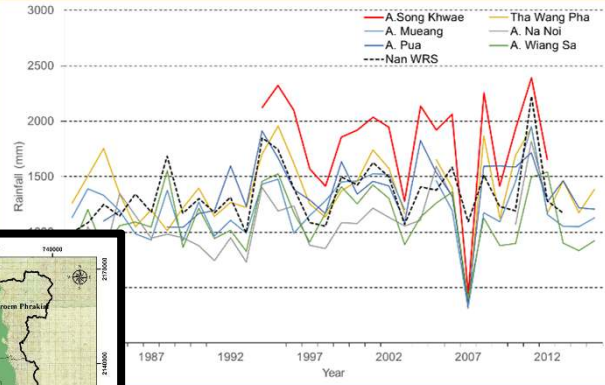
**Economic loss**



Target area : Suphanburi Province

# Scientific knowledge

## Historical data collection



## Field Experiment By AWS

Info.

# Forest

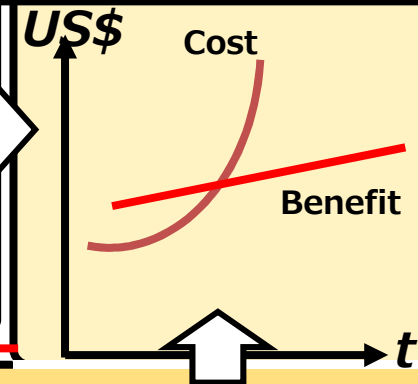
## Government

ONEP

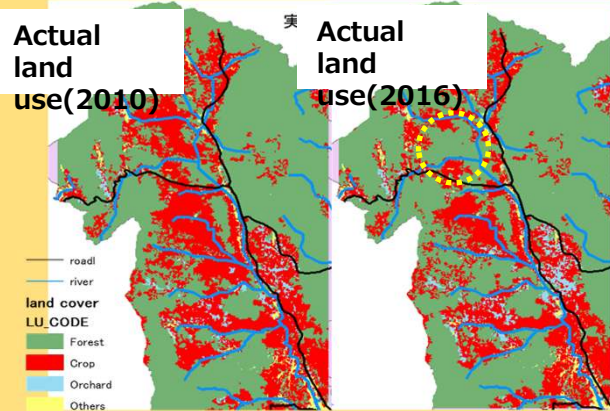
Good practice: Land use control incentive (e.g. streamflow reduction credits, transpiration credits, PES)

Implementation Agencies: Depend on the land location

Benefits by counter measures



## Considerable measures



Transformation from crop to forest

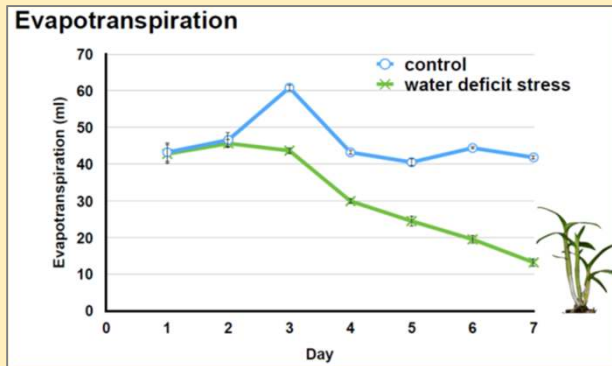
## Modelling

CLUEs model (land use change prediction)  
SWAT model (Rainfall-runoff)

## Scientific knowledge

Plant response to drought and salinity

Water and salinity stress experiment



Info.

Info.

## Considerable measures

Adaptation and improvement of cultivation methods

Water optimization, Seeding adjustment, Modification of planting time...



## Rural: Agriculture

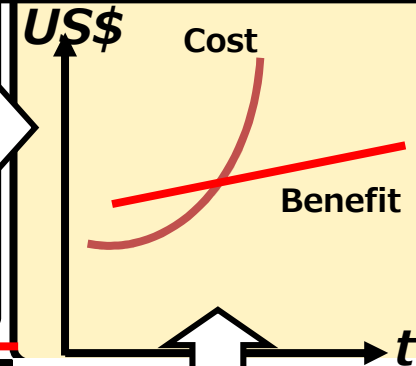
Government

ONEP

Good practice: **Water management, Modification of planting time & Local weather forecast**

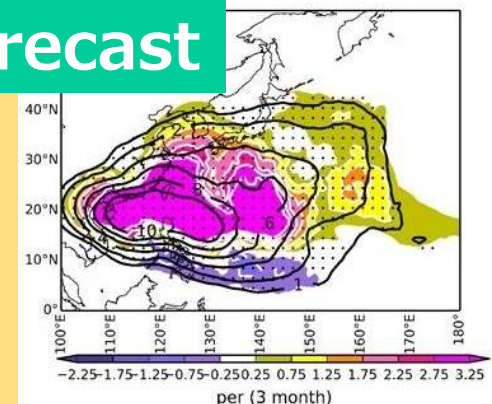
Implementation Agencies: DOAE, DOA, RID, LDD, TMD

Benefits by counter measures



## Seasonal forecast

Singular Value Decomposition analysis; SVD



# **Output & Outcome**

## **Adaptation Measures**

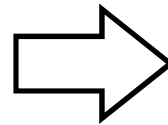
- \* Modification of planting time, Local weather forecast**
- \* Scenarios; combination of counter measures (e.g. elevated road), Producing hazard maps, Installing pumps for drainage**
- \* Early warning, Hazard map, Rehearsing how to respond to a disaster event.**
- \* Beach nourishment**
- \* Sallow Groundwater Use**
- \* Cultivation methods, Modification of planting time, Water optimization, Seeding adjustment**
- \* Land use control incentive (e.g. stream flow reduction credits, transpiration credits, PES), Transformation from crop to forest**
- \* Hazard map of drought, precipitation map, scenario**



# ADAP-T's ST3

## Knowledge Sharing for Planning Comprehensive Strategies to Climate Change

- **ST3-1 Tool integration**
- **ST3-2 Knowledge sharing**



- Support and review National Adaptation Plans (NAPs) of Thailand
- Output/Outcome → Portfolio of co-design of integrated strategies based upon adaptation to CC

## Highlight of Activities for this year

| <b>ST1 - Data</b>  | <b>ST2 - Adaptation</b>   | <b>ST3 – Knowledge sharing</b>  |
|--|---|---|
| <ul style="list-style-type: none"> <li>- Organized seminar, workshop, meeting</li> <li>- Weather forecast in basin/ provincial/ national level</li> <li>- Land use change and scenario</li> <li>- Application Programming Interface for data exchange</li> </ul> | <ul style="list-style-type: none"> <li>- Organized seminar, workshop, meeting</li> <li>- Crop selection and crop calendar</li> <li>- Rainfall pattern, innovation, traffic impact in Bangkok</li> <li>- Knowledge transfer (manual, guideline)</li> <li>- Flood or drought hazard map</li> <li>- Framework of adapting to sea level rise</li> <li>- Rice and orchid experiment for salinity and drought tolerance</li> <li>- Research papers</li> </ul> | <ul style="list-style-type: none"> <li>- Organized seminar, workshop, meeting</li> <li>- Web application</li> <li>- Submission of adaptation measure report to ONEP for supporting NAP of Thailand</li> </ul> |



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Advancing Co-Design of Integrated Strategies with AdaPtation to Climate Change in Thailand  
2016-2021

***THANK YOU!***

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