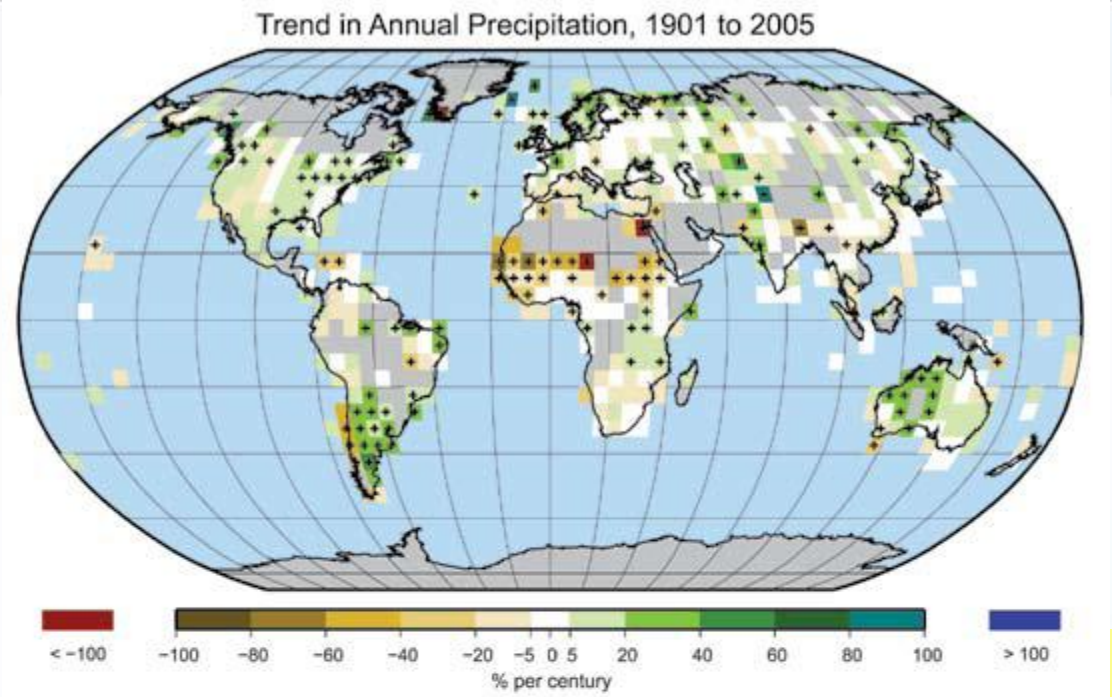
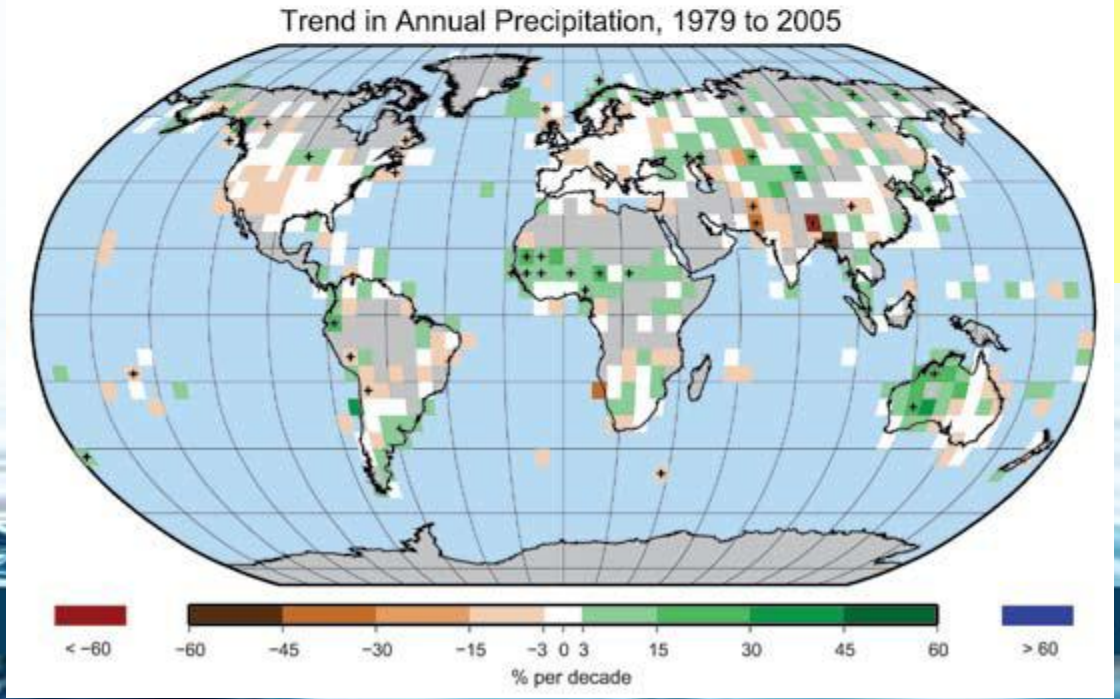

สสนก
HAII
Hydro And Agro
Informatics Institute
Ministry of Science and Technology

# Drought Management in Thailand

- Facts and challenges for Thailand's water resource management
- Prioritizing Framework for Adaptation Technologies
- Community Water Resource Management



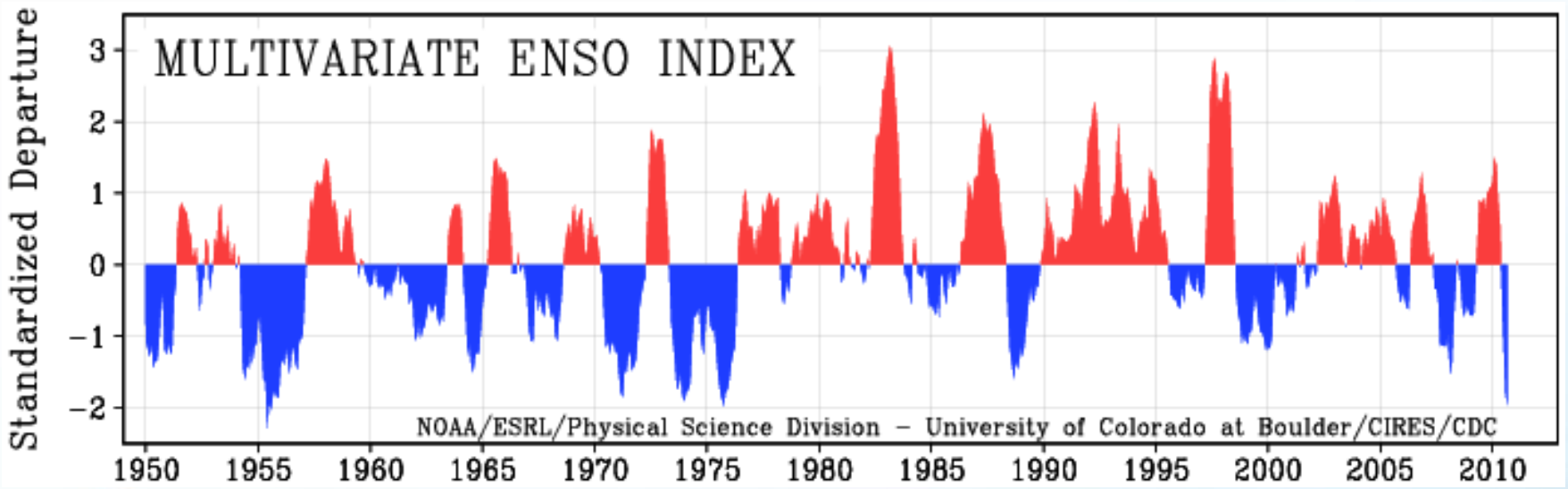

# The trend of the changes in rainfall

**Thailand**

- Low impacts of climate change
- Increasing trend of rainfall

Source: IPCC (2008)

# Extreme events has occurred more frequently – like El Nino Southern Oscillation (ENSO) cycle




**ENSO are becoming more frequent and cause severe disasters for instance severe drought in early 2010 due to strong El Nino and severe flooding in late 2010 due to the abrupt change to strong La Nina in the same year.**

Source: Climate Data Center/NESDIS/NOAA

# Climate Change –the trend of runoff
# Large scale relative change in annual runoff for 2090-2099

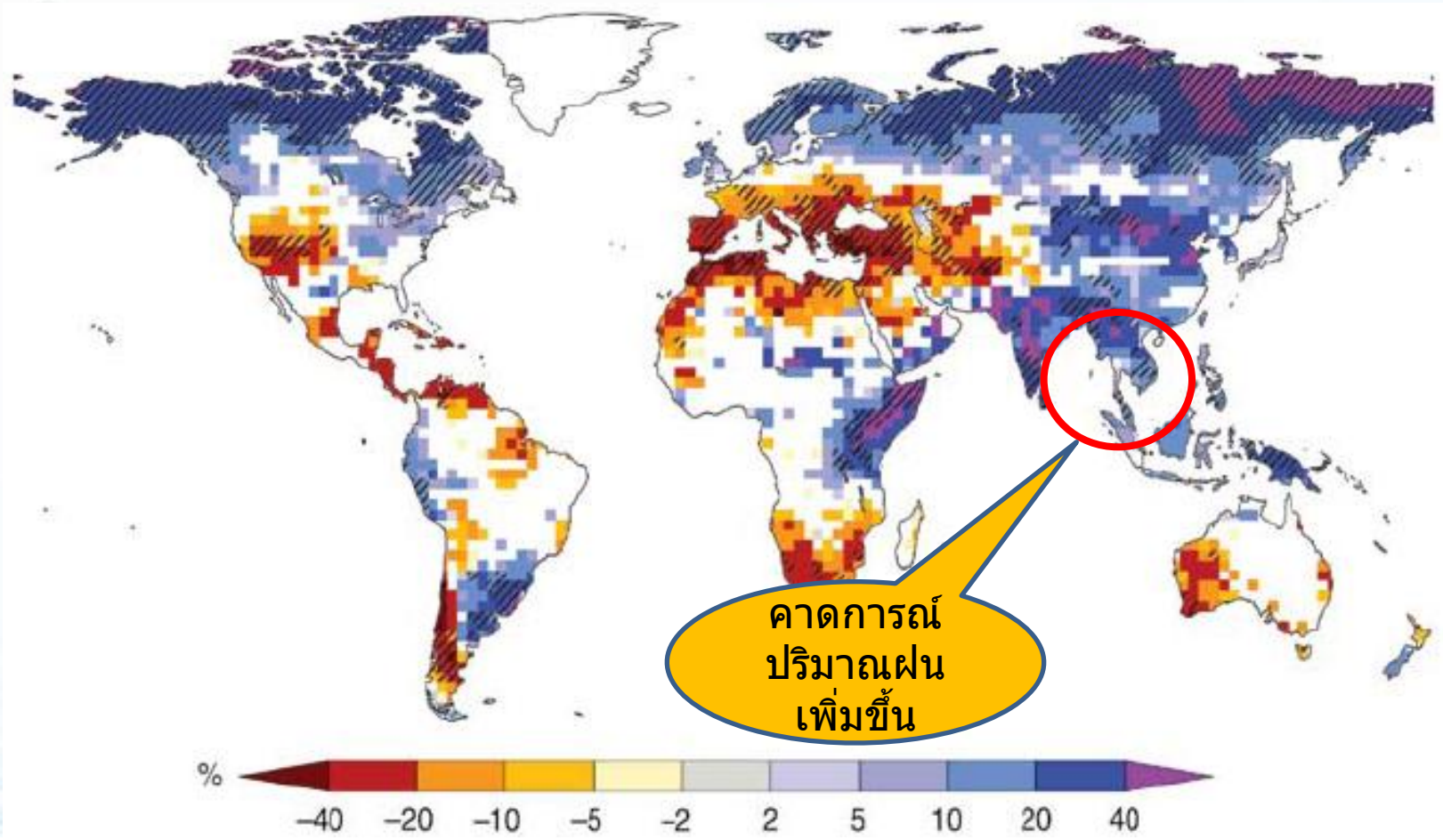
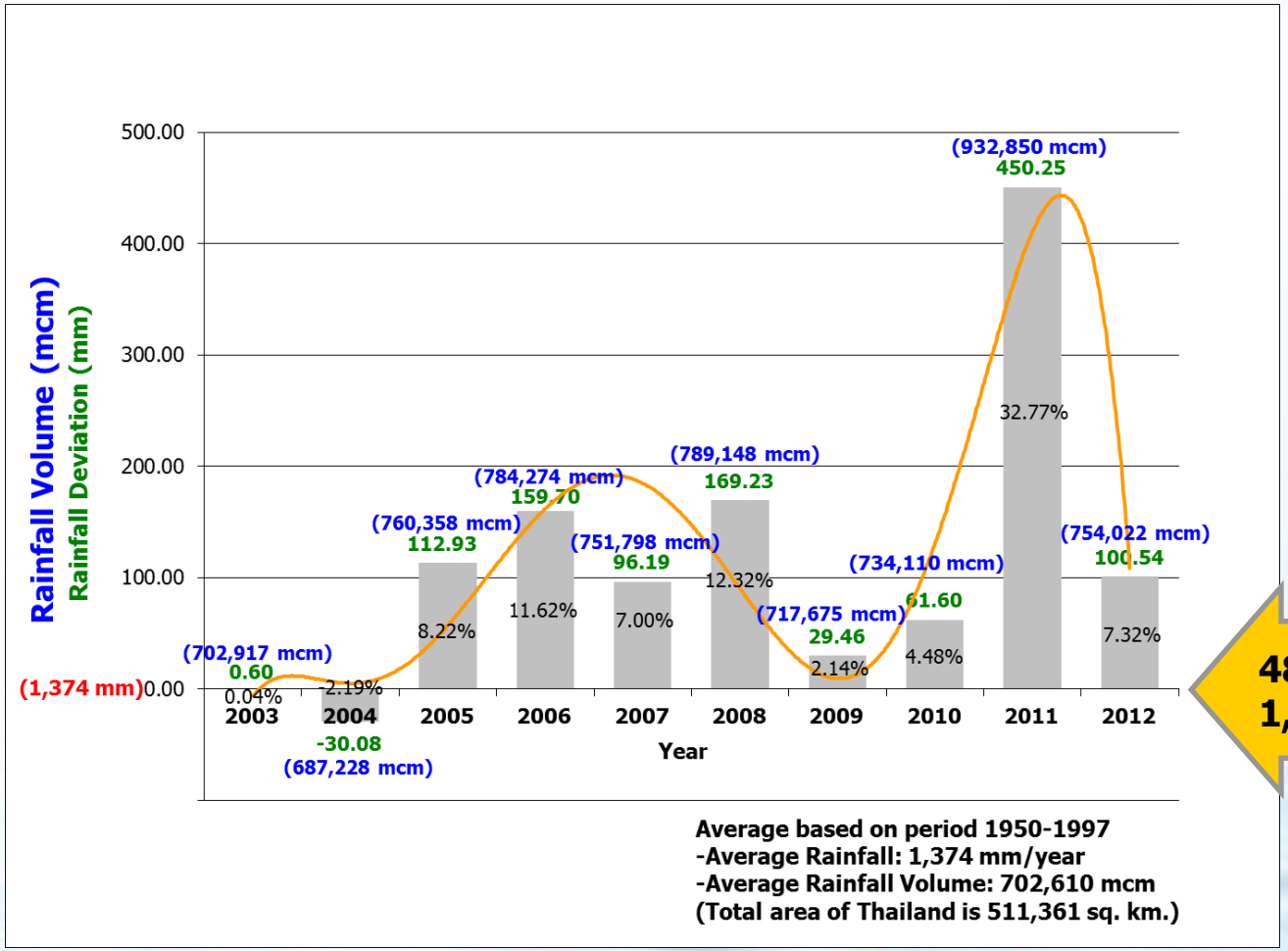



***Figure 2.10**: Large-scale relative changes in annual runoff for the period 2090–2099, relative to 1980–1999. White areas are where less than 66% of the ensemble of 12 models agree on the sign of change, and hatched areas are where more than 90% of models agree on the sign of change (Milly et al., 2005). [Based on SYR Figure 3.5 and WGII Figure 3.4]*

**IPCC (2008)**

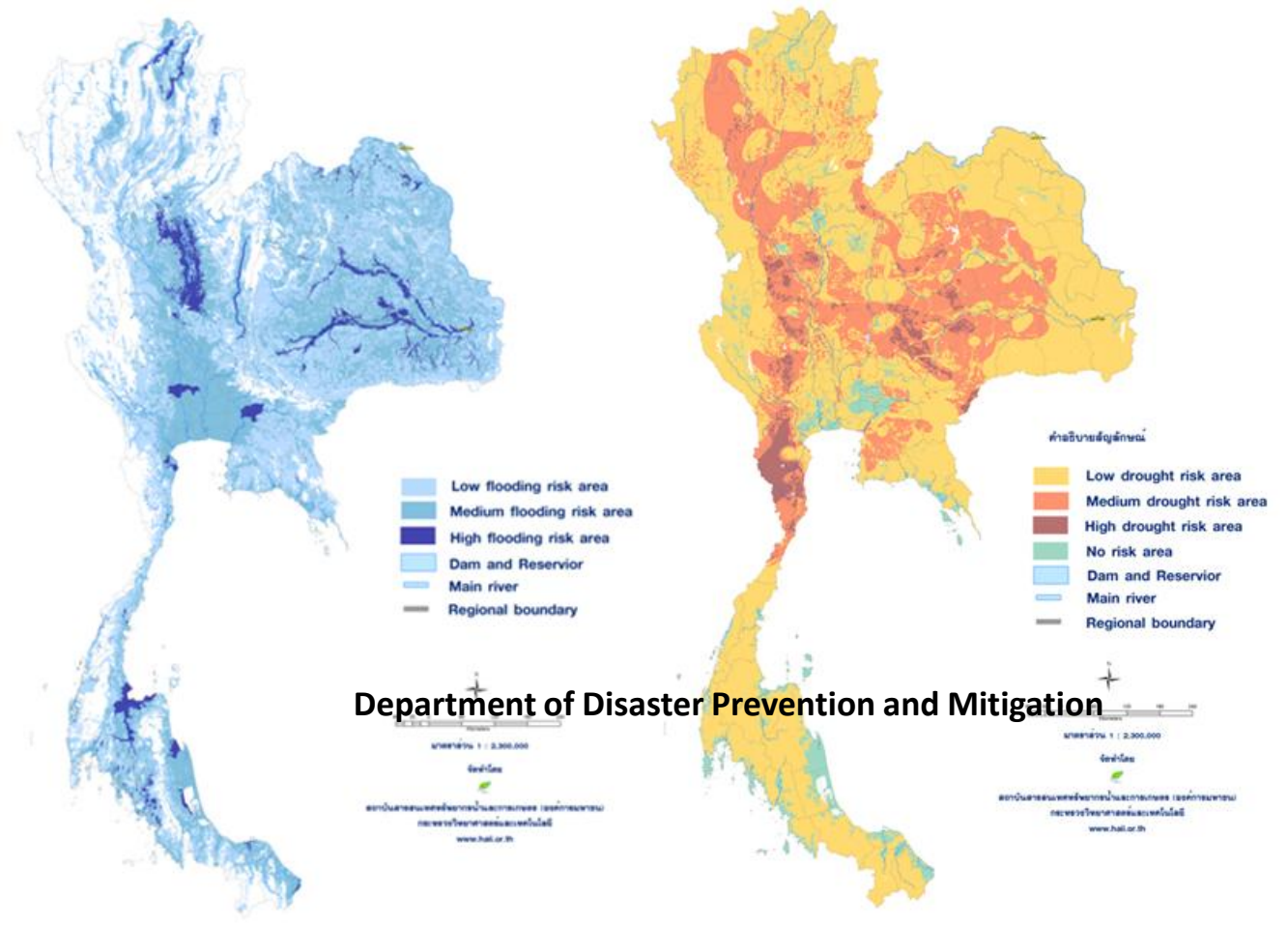
# Recent changes (2003-2012) in annual rainfall of Thailand compared to the baseline 1950-1997 average




**48-year Average 1,374 mm./year**

**The trend of rainfall---INCREASE**

# Flood risk area (left) Drought risk area (right)




Some areas suffer from both drought or floods repeatedly, sometimes in the same year

Department of Disaster Prevention and Mitigation

Table 1.1 Loss from flood in Thailand

# Flood risk

## Loss from flood in Thailand

| Year | Number of events | Number of province | Loss of damage | | |
|---|---|---|---|---|---|
| | | | Injury (person) | dead (person) | value (Million Baht) |
| 2002 | 5 | 72 | 0 | 216 | 13,385.31 |
| 2003 | 17 | 66 | 10 | 44 | 2,050.26 |
| 2004 | 12 | 59 | 3 | 28 | 850.65 |
| 2005 | 12 | 63 | 0 | 75 | 5,982.28 |
| 2006 | 6 | 58 | 1,462 | 446 | 9,627.41 |
| 2007 | 13 | 54 | 17 | 36 | 1,687.86 |
| 2008 | 6 | 65 | 0 | 113 | 7,601.79 |
| 2009 | 5 | 64 | 22 | 53 | 5,252.61 |

# Drought risk

## Loss from drought in Thailand

| Year | Number of province | Loss of damage | | |
|---|---|---|---|---|
| | | Victim (person) | Damaged agriculture area (Rai) | Value (Million Baht) |
| 2002 | 66 | 12,841,110 | 2,071,560 | 508.78 |
| 2003 | 63 | 5,939,282 | 484,189 | 174.32 |
| 2004 | 64 | 8,388,728 | 1,480,209 | 190.66 |
| 2005 | 71 | 11,147,627 | 13,736,660 | 7,565.86 |
| 2006 | 61 | 11,862,358 | 578,753 | 495.27 |
| 2007 | 66 | 16,754,980 | 1,350,118 | 198.30 |
| 2008 | 61 | 3,531,570 | 524,999 | 103.90 |
| 2009 | 62 | 17,353,358 | 594,434 | 108.34 |

# Infrastructure in Thailand

## Reservoirs and Irrigated agricultural areas

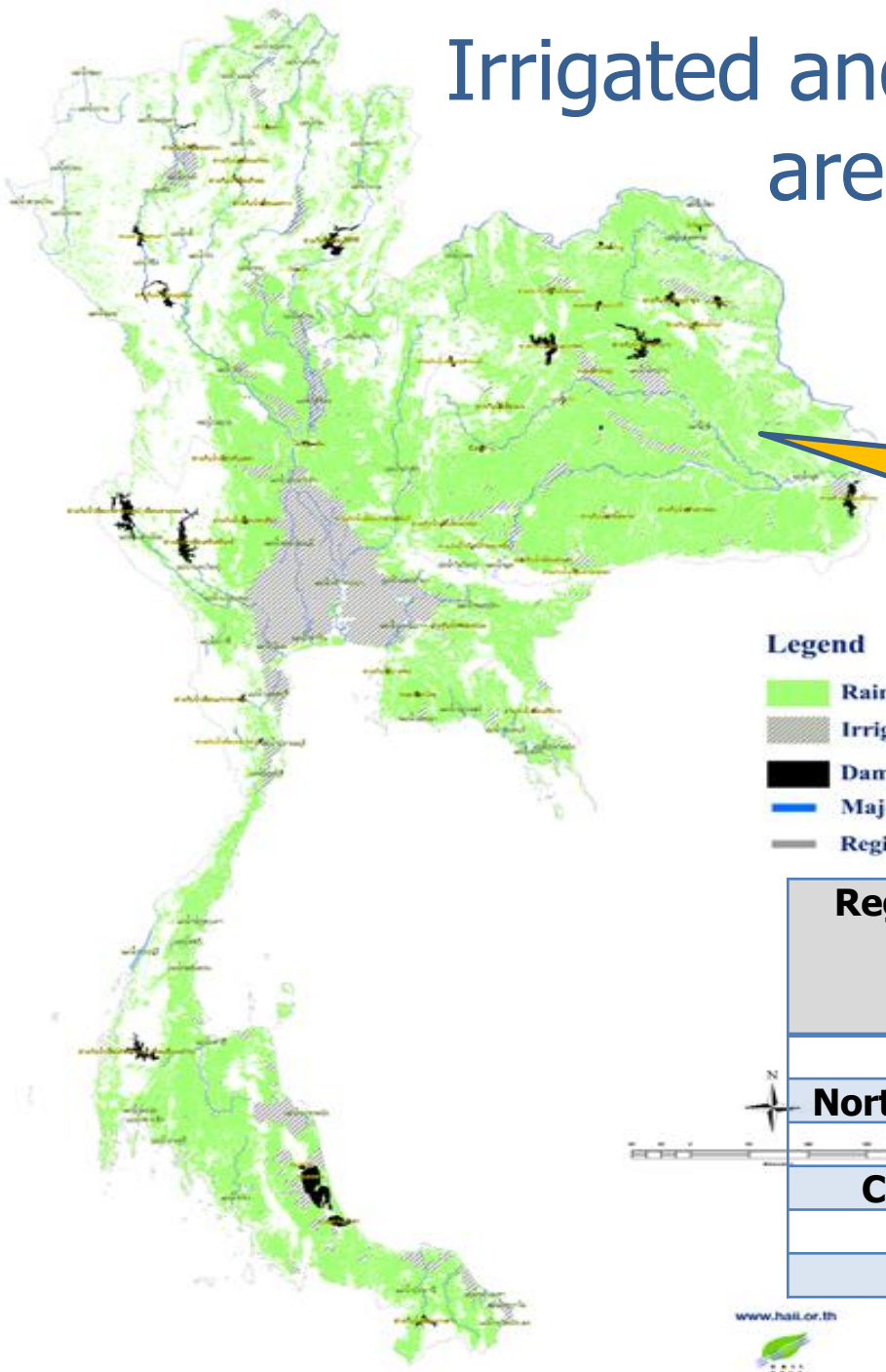
# Recent (2005-2012) rainfall variability and inflow variability of large reservoirs

| Region | Rainfall (Mm3) | Rainfall Variability | Inflow (Mm3) | Inflow (% of Rainfall) | Inflow Variability |
|---|---|---|---|---|---|
| Central & West | **123,950** | **9%** | **14,948** | **12.1** | **35%** |
| North | **174,327** | **28%** | **16,331** | **9.4** | **83%** |
| Northeast | **247,242** | **19%** | **8,848** | **3.6** | **54%** |
| South | **148,059** | **26%** | **5,980** | **4.0** | **27%** |
| East | **66,294** | **12%** | **1,114** | **1.7** | **61%** |
| **National average** | **769,892** | **21%** | **47,221** | **6.1** | **53%** |

**- National average: Rainfall 100 - Inflow 6**

**- Rainfall Variability ~ 20% but Inflow Variability > 50%**

# Irrigated and Rain-fed agricultural areas in Thailand




17% of 247,000 sq.km agricultural areas are irrigated

| Region | Agricultural areas ($km^2$) | | | % Irrigated agricultural areas |
|---|---|---|---|---|
| | Total | Irrigated areas | Rain-fed areas | |
| **North** | 45,936 | 6,080 | 39,856 | 13.2% |
| **Northeast** | 106,704 | 6,384 | 100,320 | 6.0% |
| **East** | 8,832 | 656 | 8,176 | 7.5% |
| **Central** | 46,864 | 24,432 | 22,432 | 52.1% |
| **South** | 38,896 | 4,784 | 34,112 | 12.3% |
| **Total** | 247,232 | 42,336 | 204,896 | 17.1% |

# Challenges for Thailand's water resource management

- Drought and flood matters are handled separately. So, in places where both problems arise, redundant investments are inevitable
- Water security for all user groups on the premise of flood and drought risk reduction is the goal of Thailand's water resource management.
  - Macro level:
    - Irrigated agricultural areas (42,336 km2 or 17.1% of total agricultural areas)
    - Industrial sector
    - Urban/municipal areas
  - Micro level:
  - Rain-fed agricultural areas (204,896 km2 of agricultural areas)

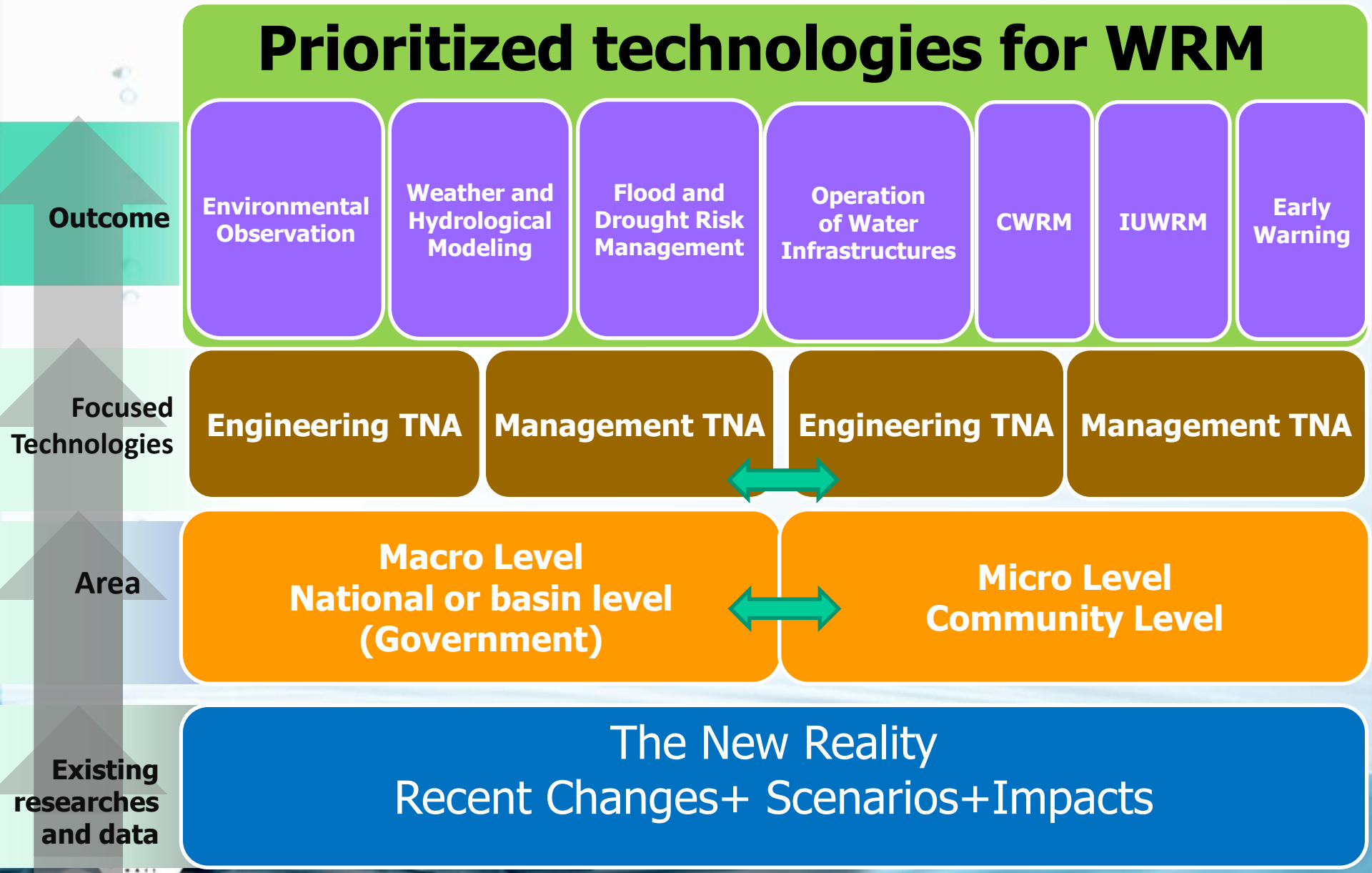
# Prioritizing Framework for Adaptation Technologies

Hydro and Agro Informatics Institute

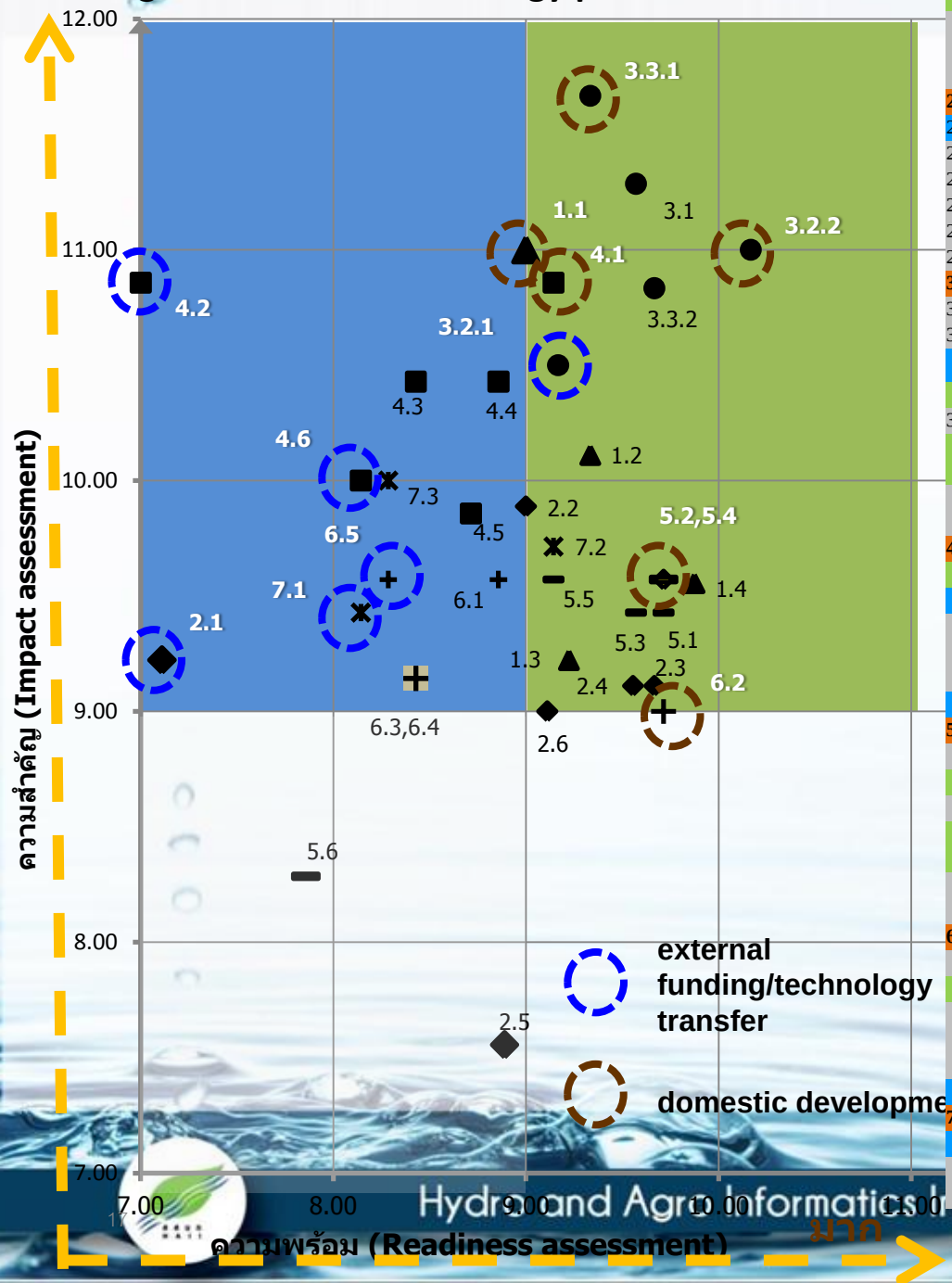
# Strategic targets : water security

| | Objectives | Strategies |
|---|---|---|
| 1 | Increase security in terms of capital water supply | - Increase water supply inventory, storage capacity, and distribution network<br>- Reservoir networking in the area affected by both flood and drought. |
| 2 | Build flexibility for management in all types of supply and demand scenarios | - Reservoir networking in the area affected by both flood and drought.<br>- Build secondary and emergency water resources for risk management |
| 3 | Minimize damage from disasters | - Build capacity for water resource management<br>- Protect and rehabilitate ecosystem |
| 4 | Maximize water usage efficiency | - 3-R techniques (Reduce-Reuse-Recycle) |
| 5 | Include all sectors in the management | - All sectors share and exchange data and experiences<br>- Collaborate/participate in planning and operation<br>- Network |
| 6 | Build knowledge/know-how and data for management | - Collect and manage data systematically |

# Prioritizing Framework for Adaptation Technologies



# Ranking the scores of technology prioritization




**1. Environmental Observation**
- 1.1 Automatic telemetry (e.g. rainfall, stream flow/water level, and water quality)
- 1.2 Water resource surveying
- 1.3 Remote sensing
- 1.4 Mapping and geographic information system (GIS) and other supporting data

**2. Weather & Hydrological Modeling**
- 2.1 Seasonal climate prediction
- 2.2 Short-range forecasting
- 2.3 Hydrological modeling
- 2.4 Hydraulic modeling
- 2.5 Groundwater modeling
- 2.6 Water quality modeling

**3. Flood and Drought Risk Management**
- 3.1 Risk assessment
- 3.2 Risk treatment
  - 3.2.1 Structural technologies/practices for risk reduction (irrigation structure/rubber dam)
  - 3.2.2 Nonstructural technologies/practices for risk reduction
- 3.3 Drought risk treatment
  - 3.3.1 Strategies for developing and managing secondary and emergency water resources (including conjunctive use)
  - 3.3.2 Technology for increasing water-use efficiency (water demand management by 3R technologies)

**4. Operation of Water Infrastructures**
- 4.1 Scenario setting for both supply and demand
- 4.2 Networking (via pipes or canals) and management of infrastructures (including zoning)
- 4.3 Optimization (e.g. dynamic dam/networking rule curve) and decision support system (DSS)
- 4.4 Monitoring and maintenance
- 4.5 Automization and SCADA
- 4.6 Salt water intrusion management

**5 Community Water Resource Management: CWRM**
- 5.1 Data management
- 5.2 Survey and mapping, including developing a community stream water flow concept diagram
- 5.3 Water balance for risk analysis and production planning
- 5.4 Engineering enhancement to increase efficiency in local water management (including rain harvest and wind break)
- 5.5 Knowledge management
- 5.6 Nonpoint source water pollution management

**6. Integrated Urban Water Resource Management (IUWRM)**
- 6.1 Water supply management
- 6.2 Develop an urban water supply and drainage concept diagram
- 6.3 Technology for increasing water-use efficiency (Water demand management with 3R technologies)
- 6.4 Waste & sanitation management
- 6.5 Urban flood management

**7. Early Warning**
- 7.1 Sensor web using observation and/or modeling data
- 7.2 Warning criteria based on season, area, and risk type
- 7.3 Disaster communication

# Result of technology prioritization

| Ranking based on "Impact assessment" (for external funding/technology transfer) | Ranking based on "Capacity assessment" (for domestic development) |
|---|---|
| **Operation of Water Infrastructures** | **Environmental Observation** |
| 1. Networking (via pipes or canals) and management of infrastructures (including zoning)<br>2. Salt water intrusion management | 1. Automatic telemetry |
| **Weather & Hydrological Modeling** | **Community Water Resource Management (CWRM)** |
| 3. Seasonal climate prediction | 2. Survey and mapping, including community stream water flow concept diagram |
| | 3. Engineering enhancement to increase efficiency in local water management (including rain water harvest and wind break) |
| **Flood & Drought Risk Management** | **Flood & Drought Risk Management** |
| 4. Structural technologies/practices for risk reduction (irrigation structure/rubber dam) | 4. Nonstructural technologies/practices for risk reduction<br>5. Strategies for developing and managing secondary and emergency water resources (including conjunctive use) |
| **Early Warning** | **Infrastructure Operations** |
| 5. Sensor web using observation and/or modeling data | 6. Scenario setting for both supply and demand |
| **Integrated Urban Water Management (IUWRM)** | **Integrated Urban Water Management (IUWRM)** |
| 6. Urban flood management | 7. Develop an urban water supply and drainage concept diagram |

# The Community Level

# The Community Level

## S&T for Community Water Resource Management

is used to support the communities in making plans to solve problems in their communities. Local data has been stored for future use in the systematic manner called Local Content Management System.

# The Community Level

## S&T for Community Water Resource Management

-Media Box (The Automated Water Situation Monitoring Equipment): represents the weather information, 3-7 days rainfall forecast, the country's water situation and storm formation including other information, which is very important to follow the weather and water situation.


The official website of Prae Water Resources Management Center: [http://nhc.in.th/web/phrae.html](http://nhc.in.th/web/phrae.html)

# The Community Level

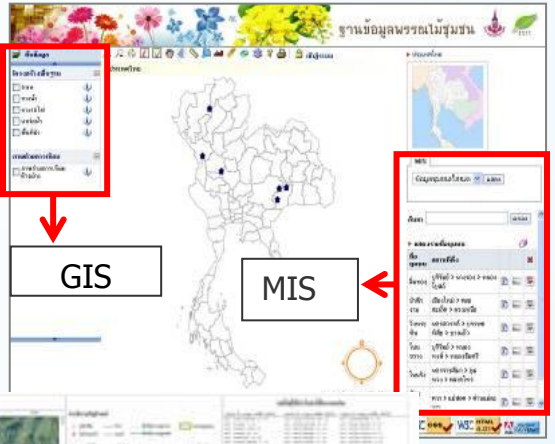
## S&T for Community Water Resource Management

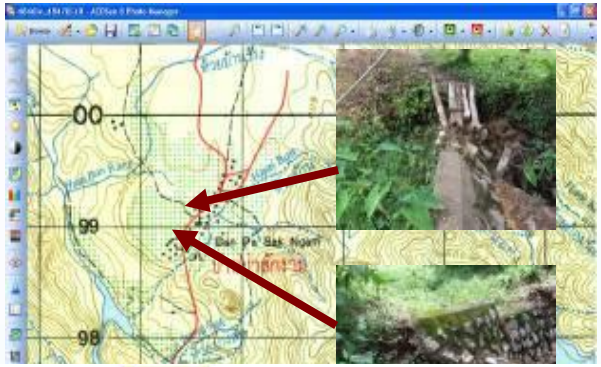
- "NHC Mobile Application" : HAII has developed this application for public to have easy access to water and weather information 24 hours a day. This application is available on iOS and Android, providing information on rainfall, storm tracking, weather, water level in main waterways and dams, and, 7-day weather forecast.

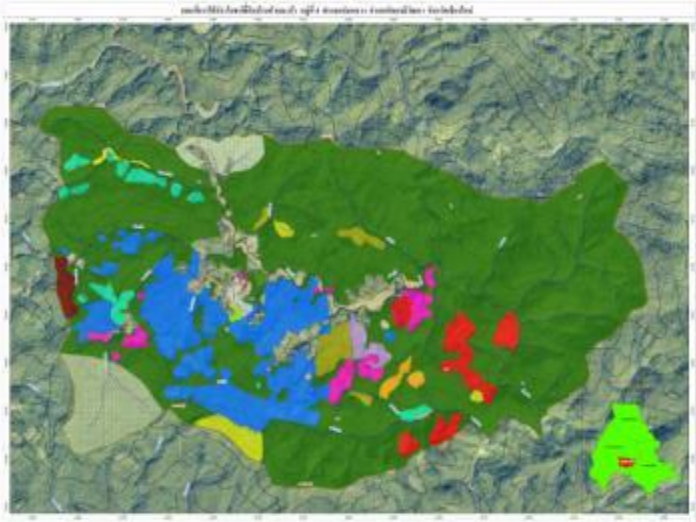

"NHC Thailand" available on iOS and Android.

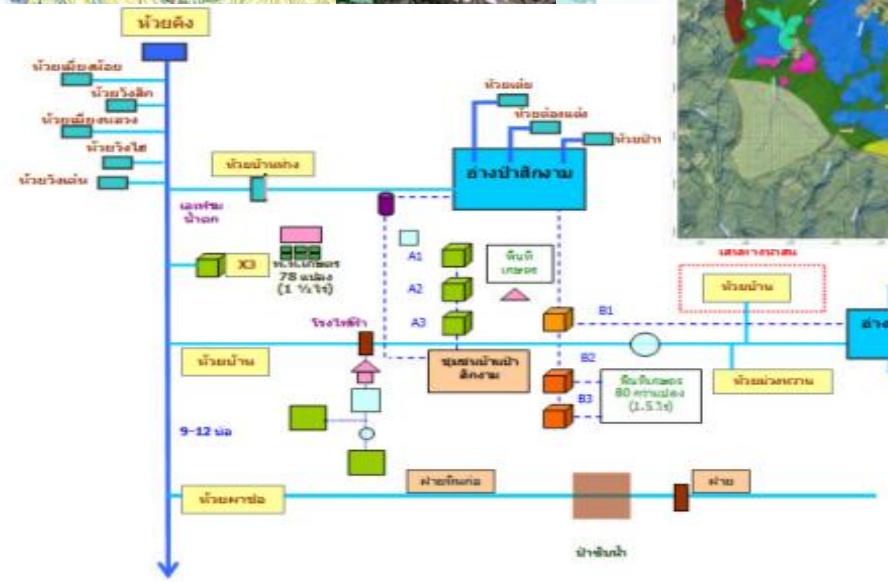
# Community Water Resource Management following the King's Initiative:
# Agroforestry

## Technology Learning



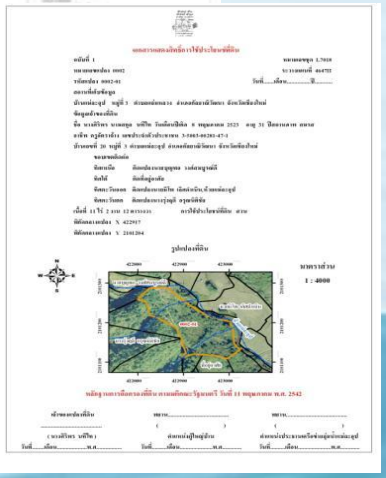






ผังน้ำชุมชนบ้านป่าสักงาม

**Land Used Map and Document**
**Mae-La Oop Sub River Basin**



# Community Water Resource Management following the King's Initiative: New Theory

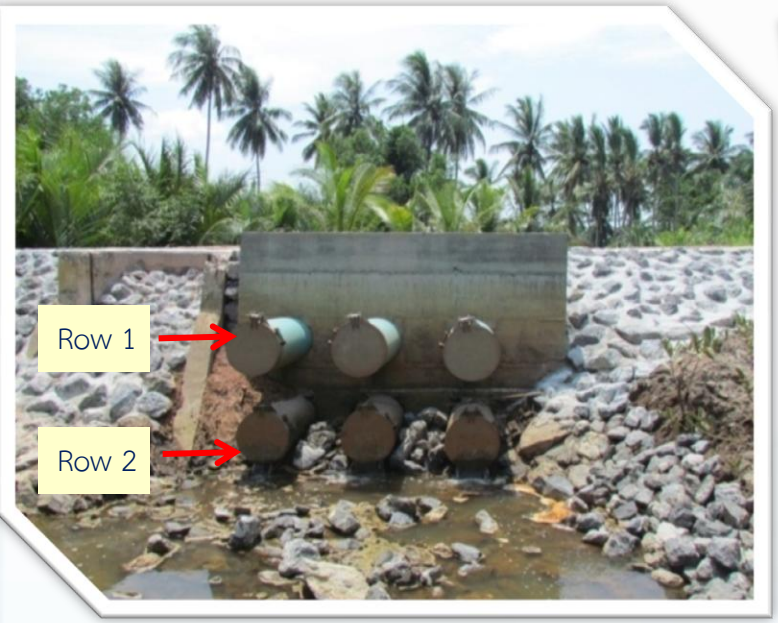
## Past

- Drought and Flood Area
- Lack of Water for Consumption and Agriculture
- Non of Community Water Resource Management Committee
- Debt and High Expenses Problem
- Emigration Problem

## Present

- Flood and Drought problem decreased
- Sufficiency Water for Consumption and Agriculture
- Villagers' Return

# Community Water Resource Management following the King's Initiative: Brackish Water




**Water Gate:**
To divide the sea and canal

**Soft Break:**
**by bamboo or old tyres**
To prevent the scour and
to be the fishery plants

# Thank you