2016 July 1 Symposium
Graduate School of
Global Environmental Studies
Sophia University, Tokyo .

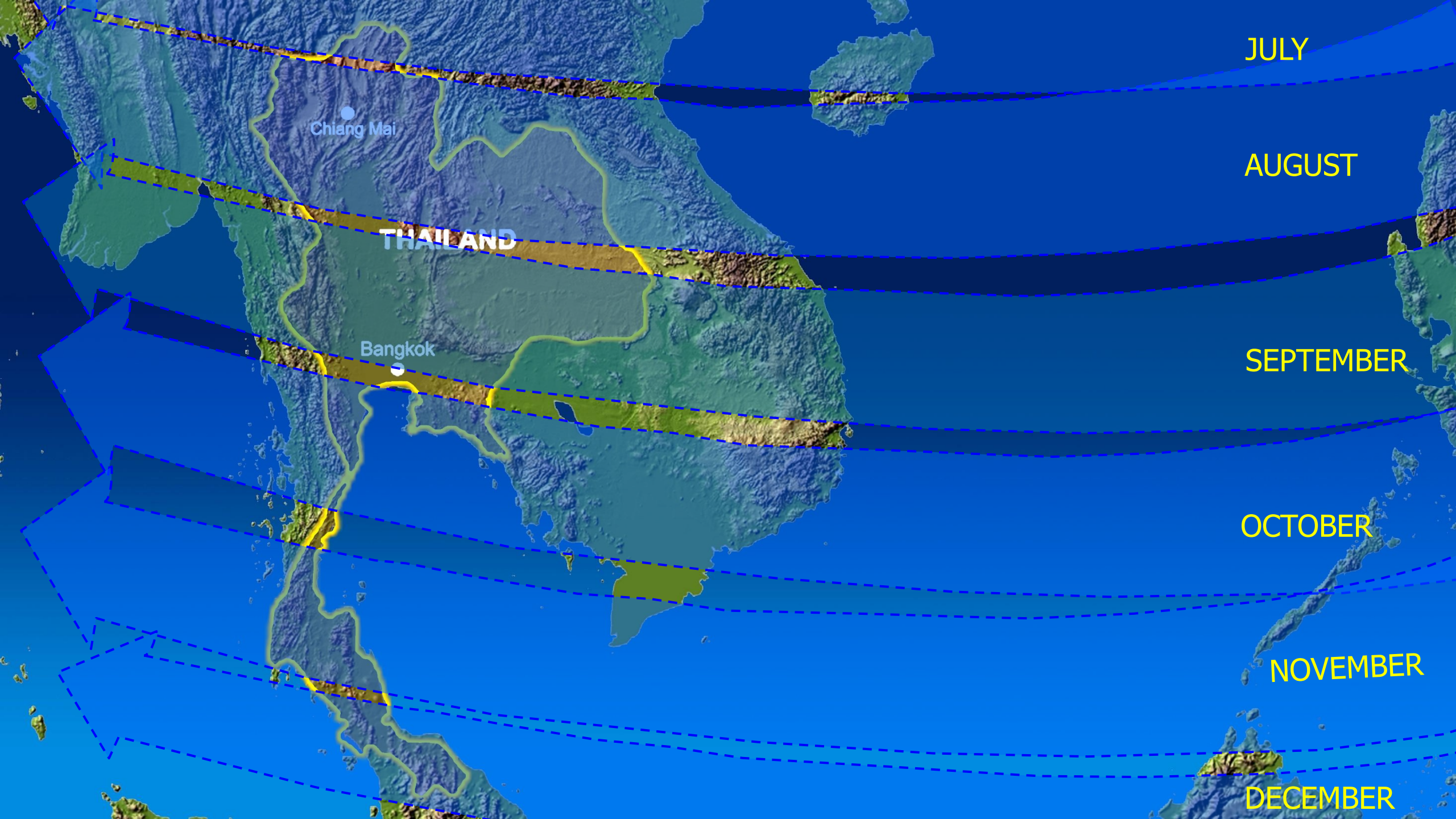
CLIMATE CHANGE IMPACT ON WATER RESOURCES

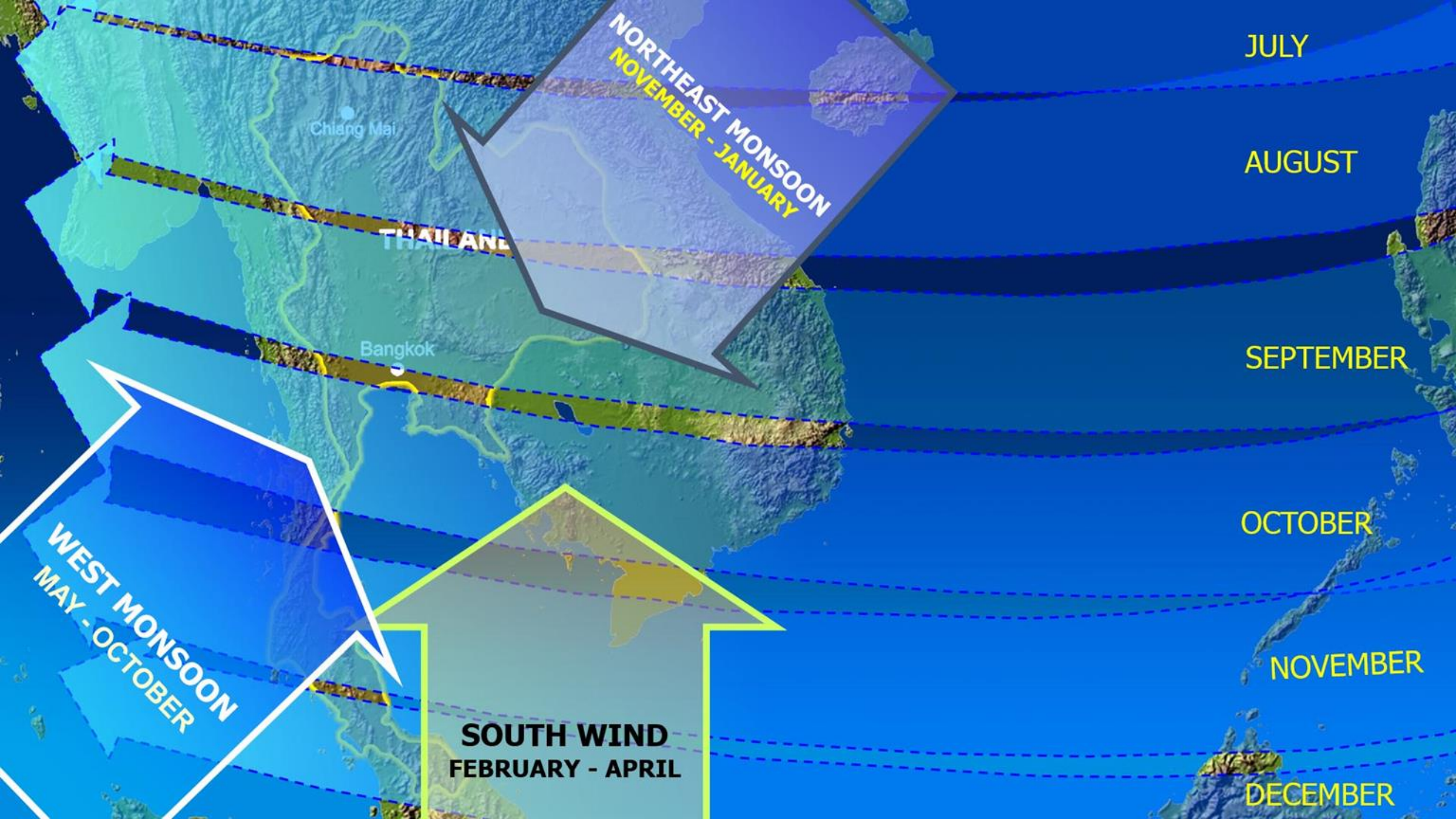
THADA SUKHAPUNNAPHAN
ROYAL IRRIGATION DEPARTMENT
THAILAND

MONSOON TROUGHS AND STORM PATHS

THROUGH THAILAND IN EACH MONTH

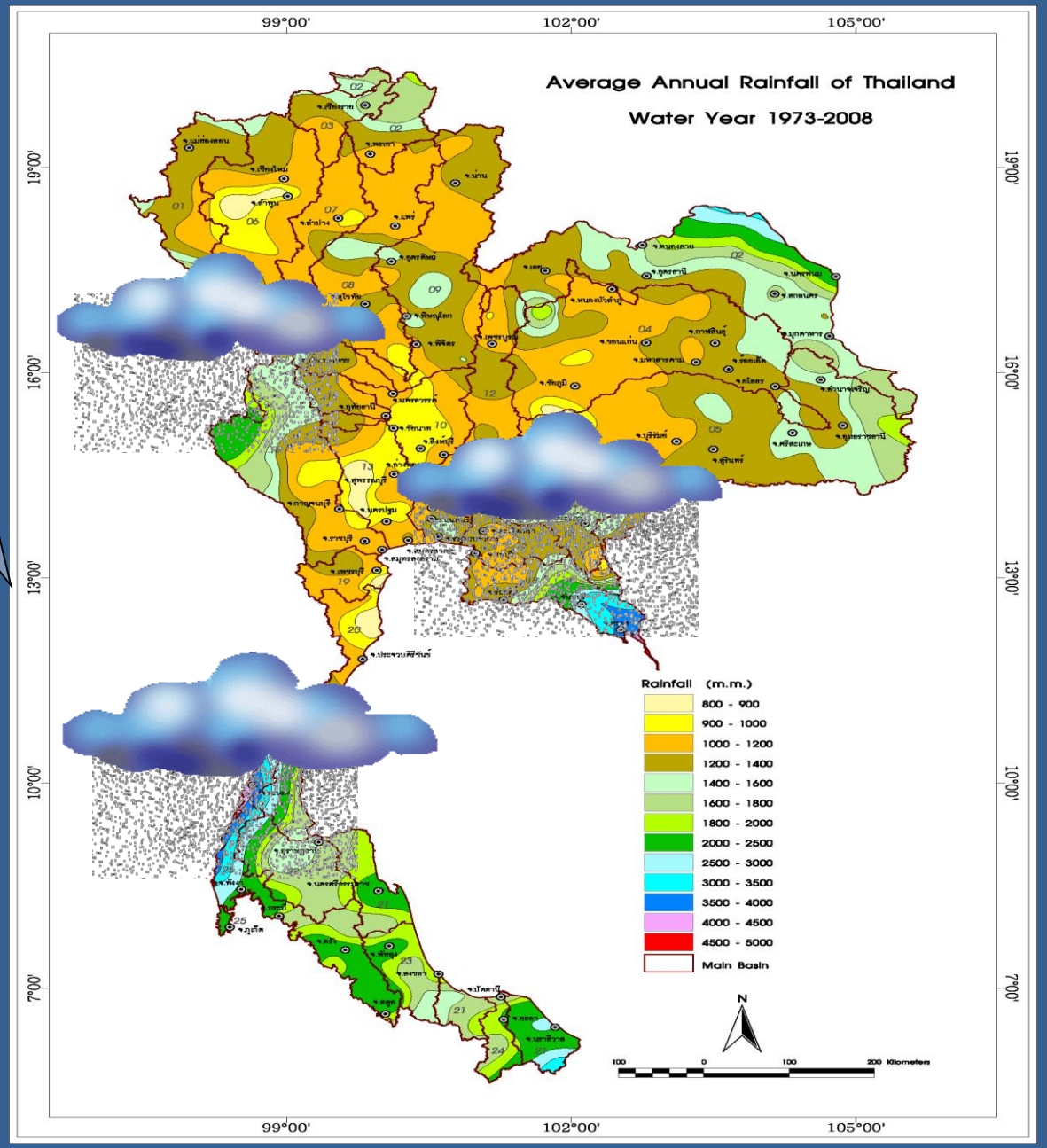

THAILAND
LOW PRESSURE TROUGH
and TROPICAL STORM PATHS

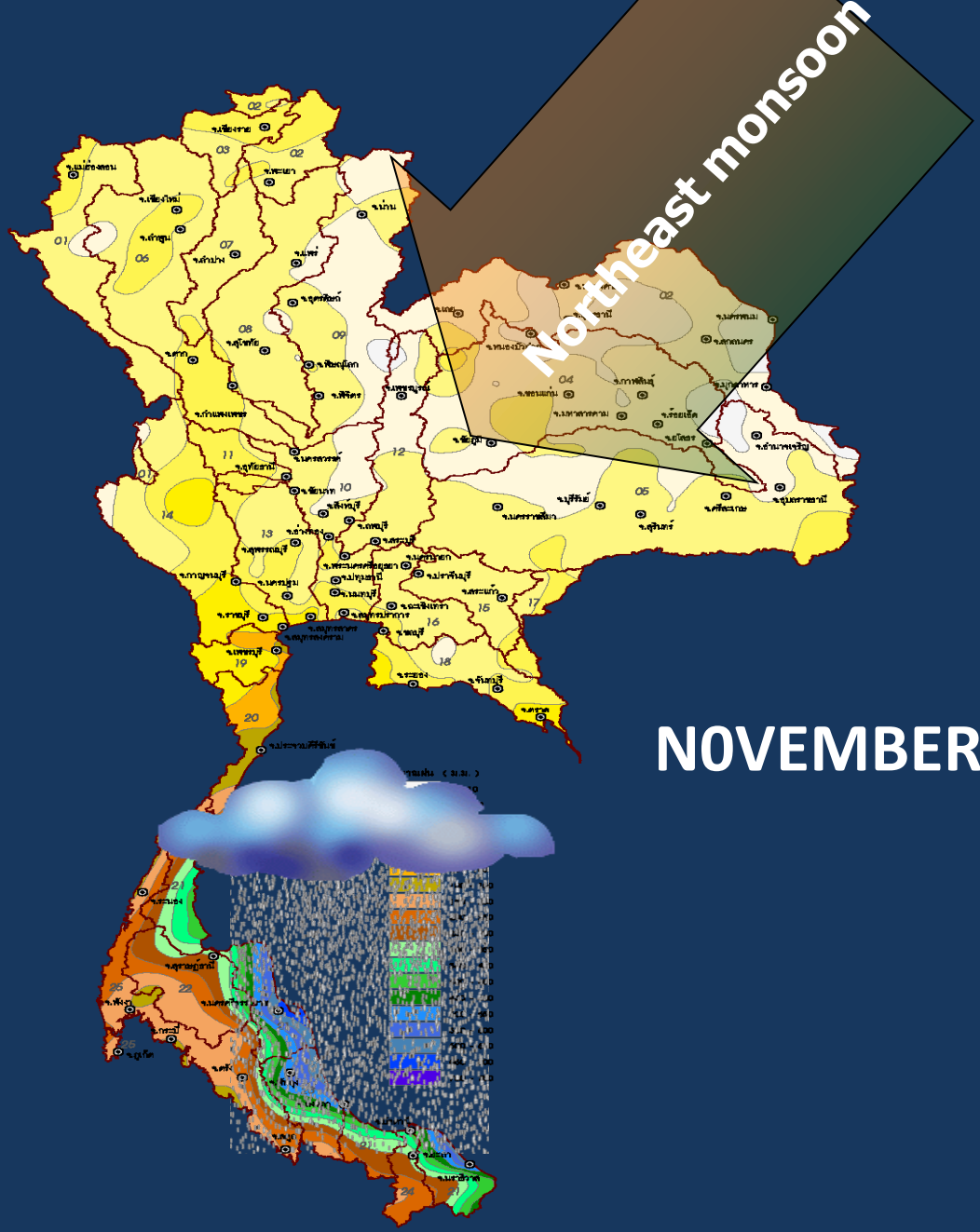

JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
Chiang Mai
THAILAND
Bangkok


NORTHEAST MONSOON
NOVEMBER - JANUARY
Chiang Mai
Bangkok
WEST MONSOON
MAY - OCTOBER
SOUTH WIND
FEBRUARY - APRIL
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

MAY – OCTOBER

Southwest monsoon





N0VEMBER – JANUARY

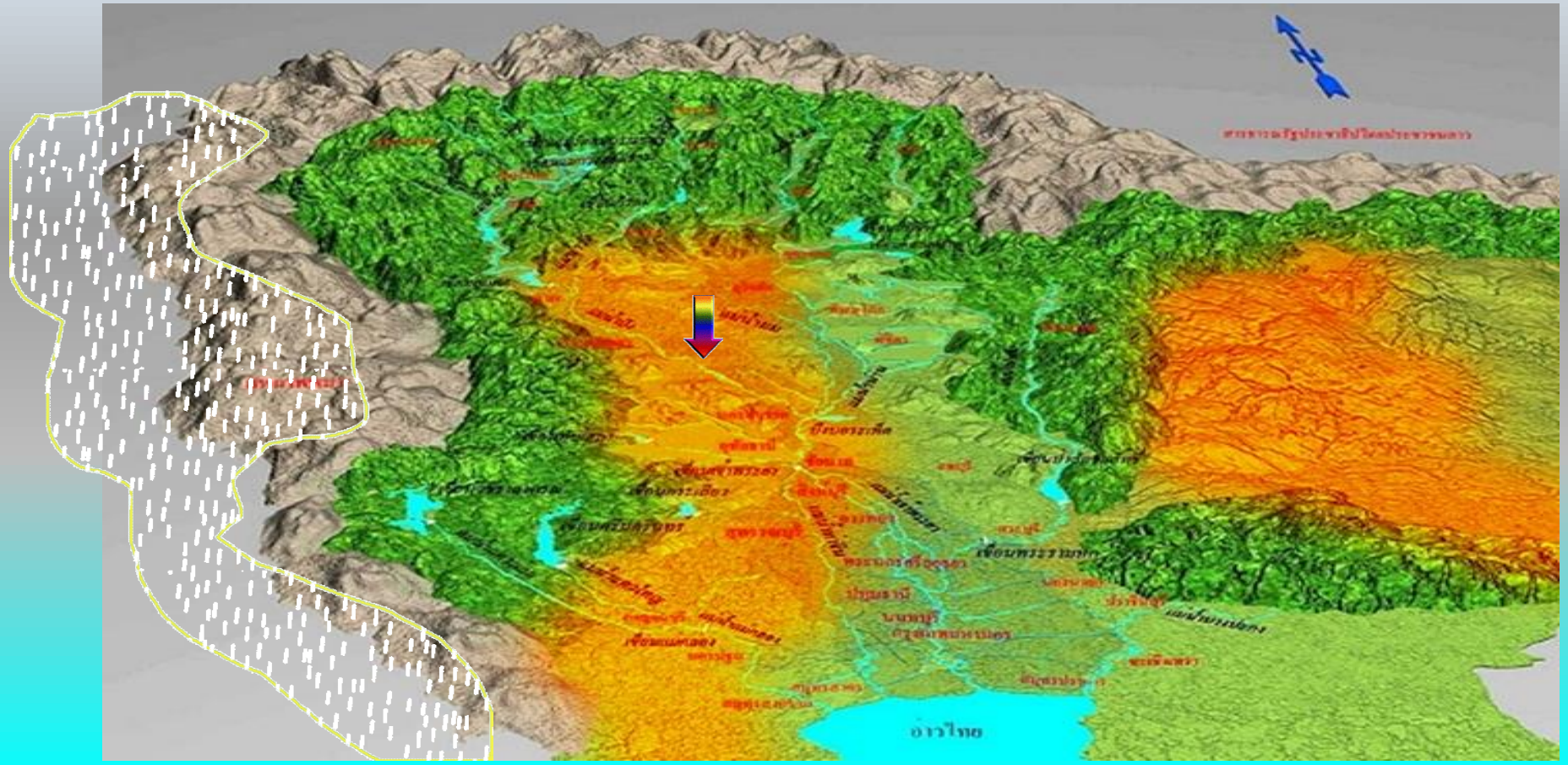
MONSOON RAINFALL

MAY - OCTOBER

JUNE - DECEMBER

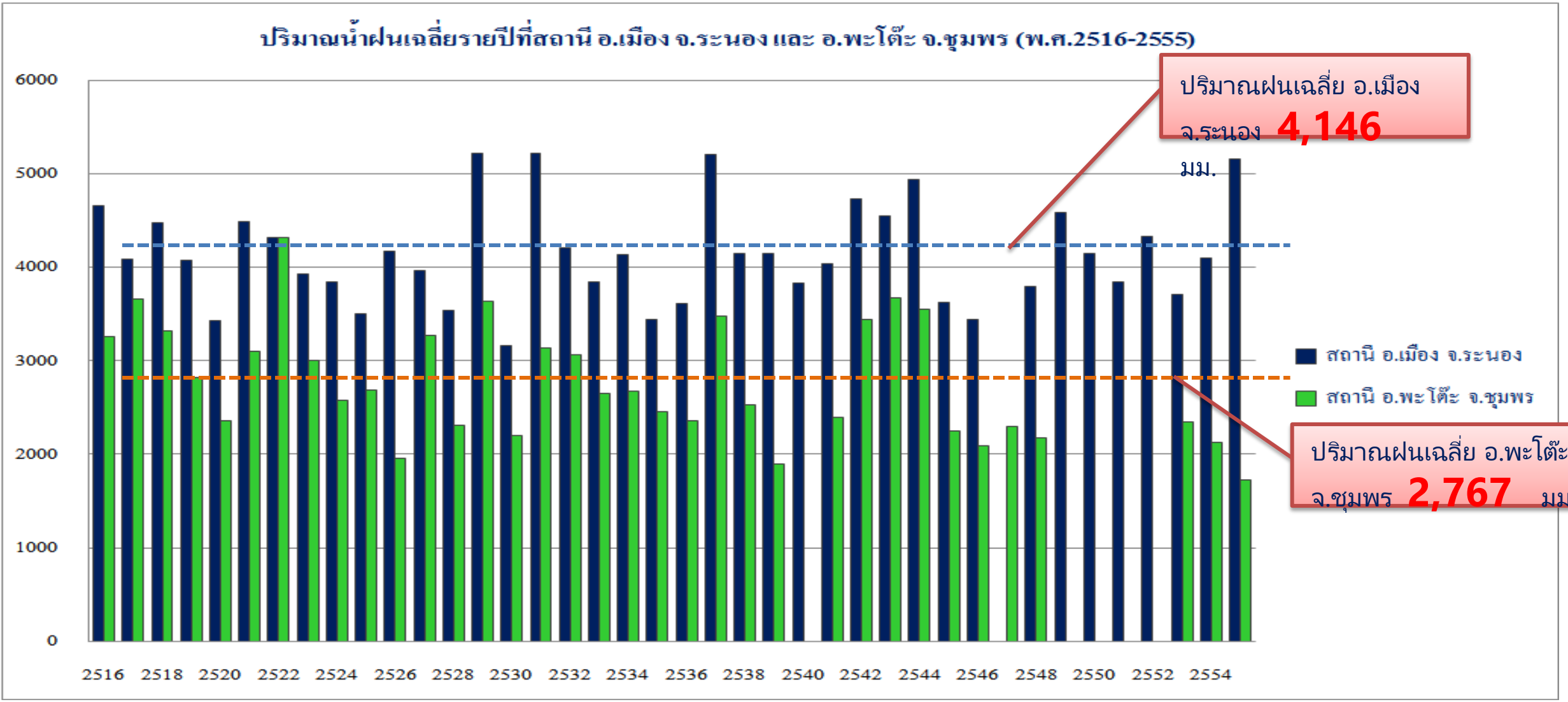
MONSOON RAINFALL

May->Oct




สถานี อ.เมือง จ.ระนอง
สถานี อ.พะโต๊ะ จ.ชุมพ

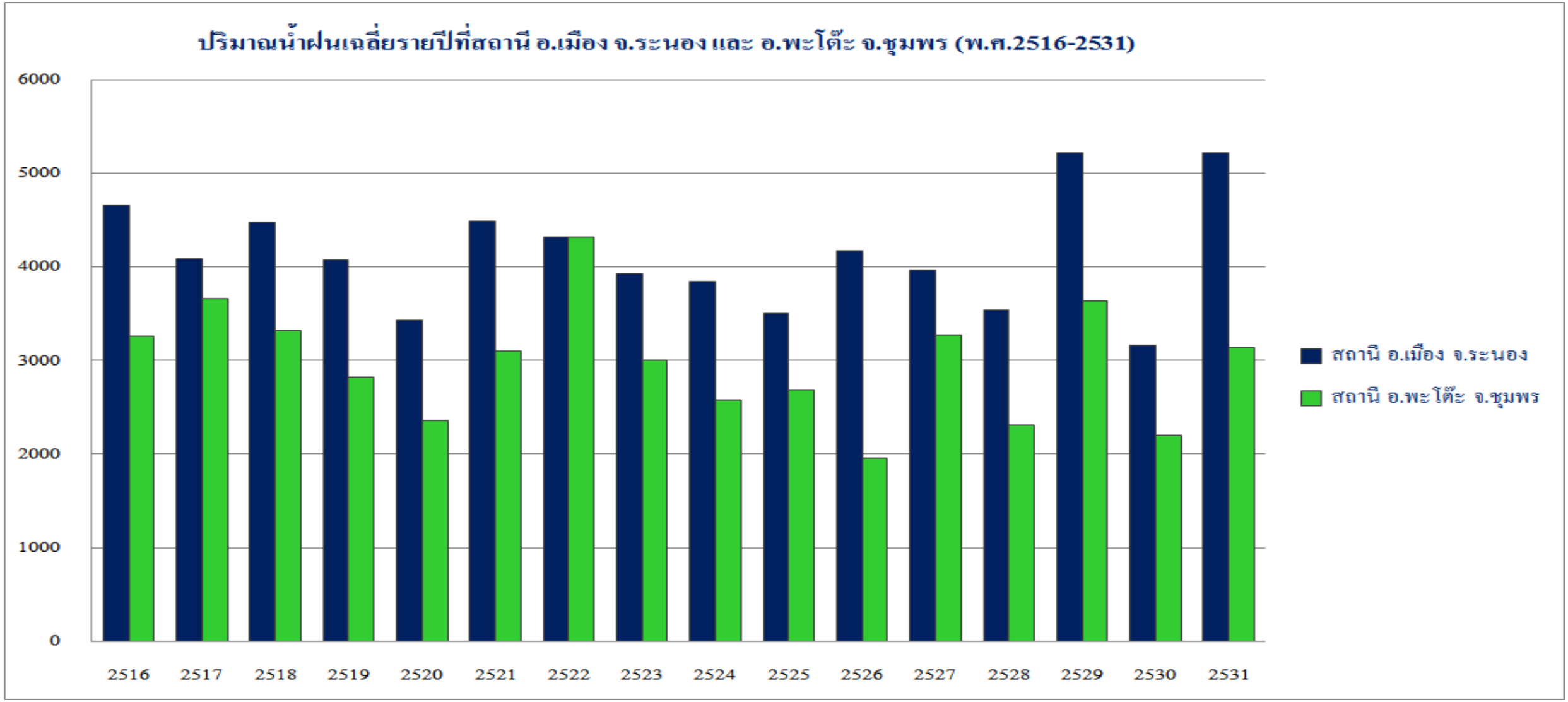
Annual Rainfall



Windward

Leeward

Annual Rainfall

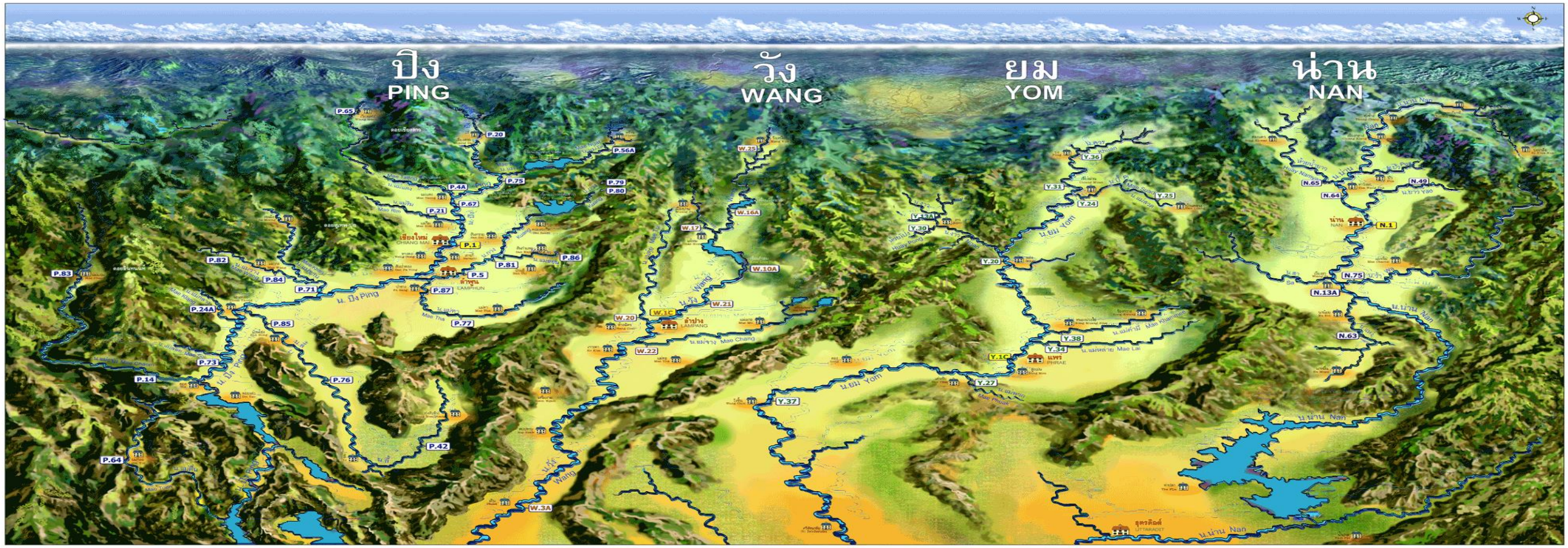


CHAO PHRAYA BASIN

Source Rivers :

Ping, Wang, Yom and Nan
in Northern Thailand

Source Rivers : Ping, Wang, Yom and Nan in the Northern Thailand



CHAO PHRAYA BASIN

DOWNSTREAM BASIN :

Chao Phraya, Sakae Krang and Pa Sak rivers in Central Plain.

CHAO PHRAYA BASIN
CENTRAL PLAIN

สาละวิน
SALWEEN

สะแกกรัง
SAKAE KRANG

ป่าสัก
PASAK

พิษณุโลก
PHISANULOK

พิจิตร
PHICHIT

เพชรบูรณ์
PHETCHABURI

นครสวรรค์
NAKHON SAWAN

อุทัยธานี
UTHAI THANI

ชัยนาท
CHAI NAT

สิงห์บุรี
SING BURI

ลพบุรี
LOP BURI

สระบุรี
SARABURI

อ่างทอง
ANG THONG

สุพรรณบุรี
SUPHAN BURI

อยุธยา
AYUTTHAYA

นครนายก
NAKHON NAYOK

ปราจีนบุรี
PRACHIN BURI

กาญจนบุรี
KANCHANABURI

ปทุมธานี
PATHUM THANI

นครปฐม
NAKHON PATHOM

นนทบุรี
NONTHABURI

กรุงเทพฯ
BANGKOK

ฉะเชิงเทรา
CHACHOENGSAO

สมุทรสาคร
SAMUT SAKHON

สมุทรปราการ
SAMUT PRAKAN

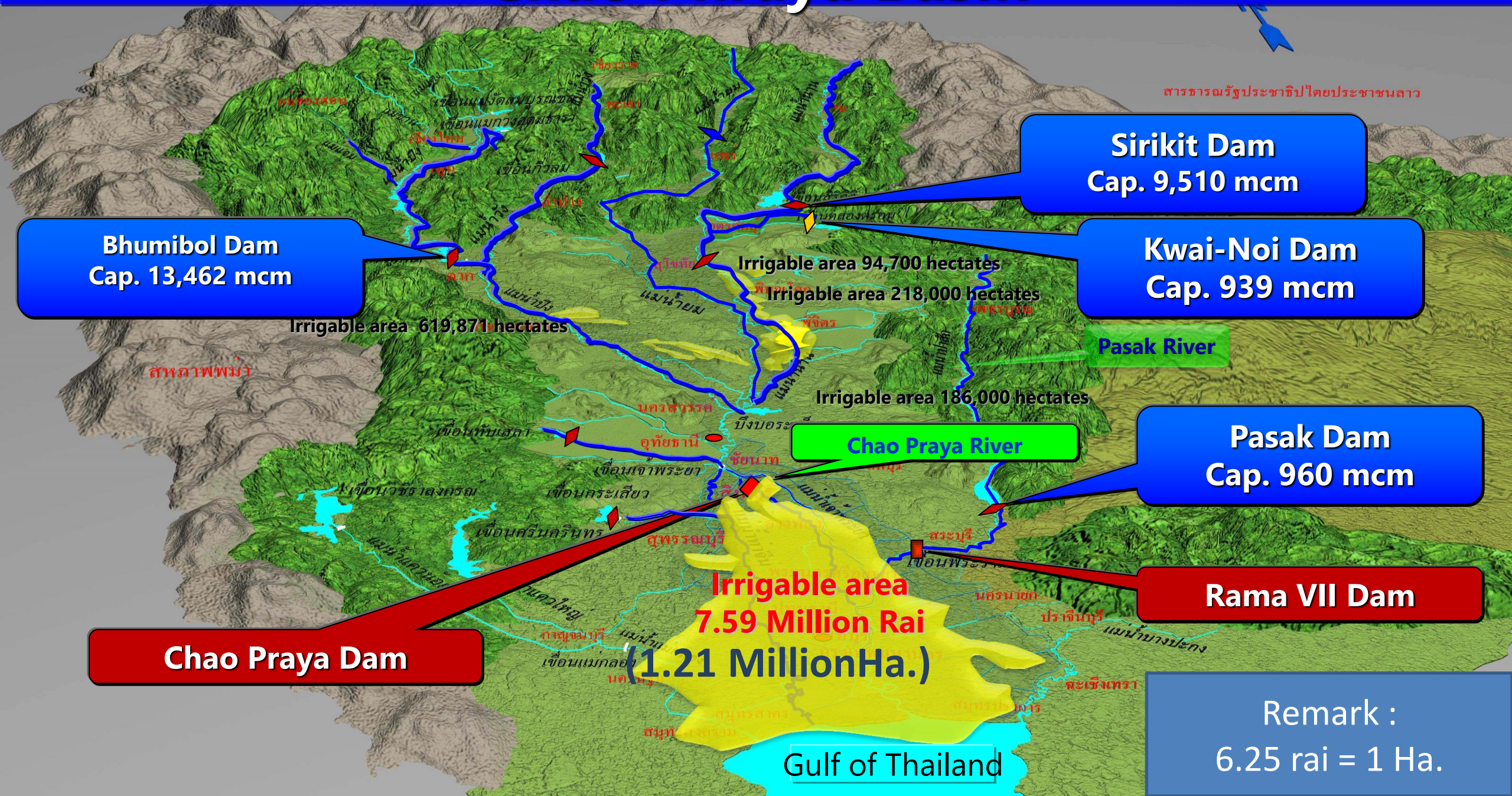
ราชบุรี
RATCHABURI

สมุทรสงคราม
SAMUT SONGKHRAM

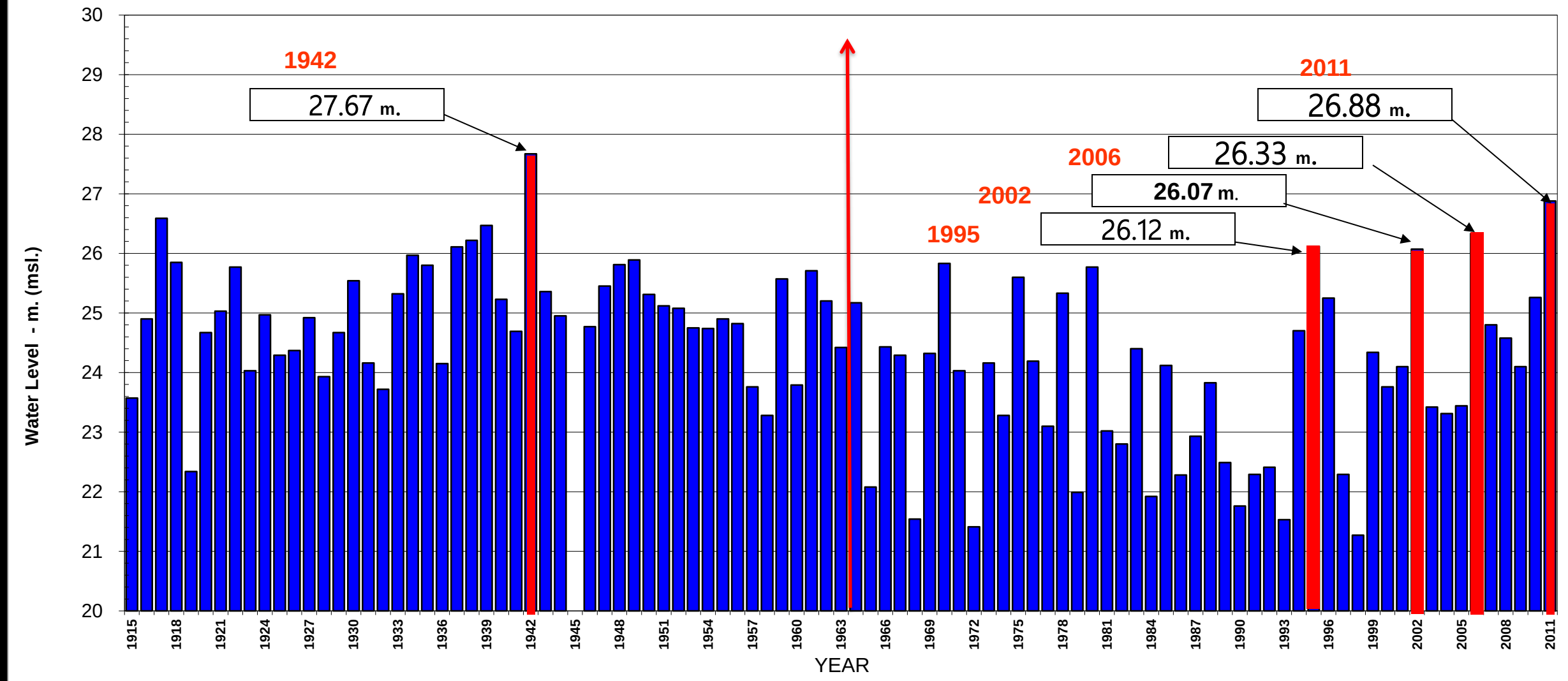
อ่าวไทย
(Bight of Bangkok)
GULF OF THAILAND


Ping River
Wang River
Yom River
Nan River
Mae-Ngat Dam
Kewkhoma Dam
Kewlom Dam
Maeguang Dam
Sirikit Dam
Kwaenoi Dam
Pasak River
Bhumipol Dam
Sakaekrang River
Tabsalao Dam
Chao Phraya Dam
Pasak Dam
Kraseao Dam
Rama VI Dam
Gulf of Thailand

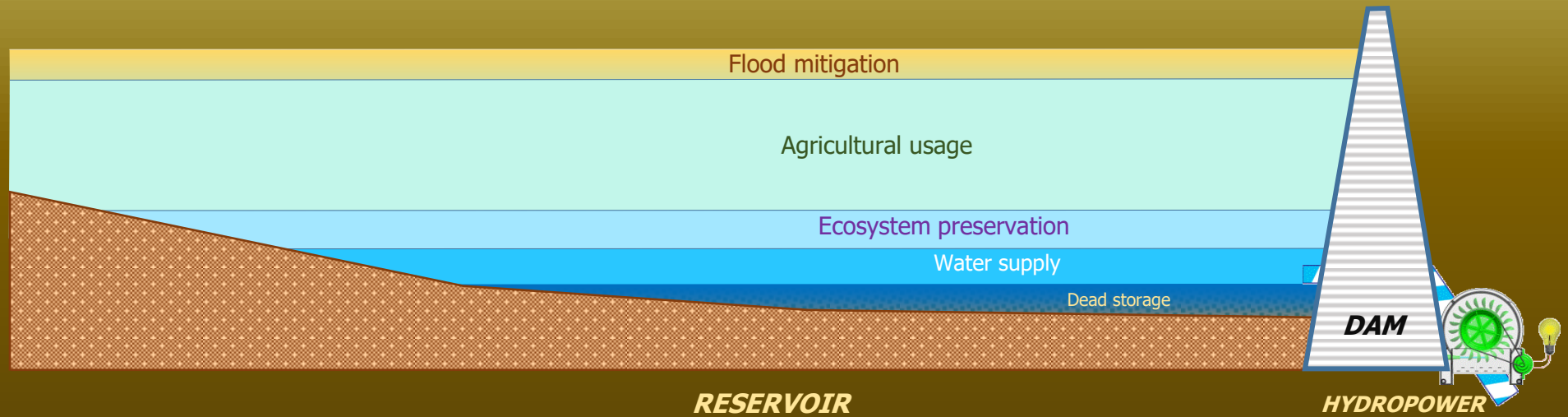
Chao Phraya Basin



Annual Maximam Water Level
Station C2. Chaopraya River A.muang M.Nakhon Sawan



STORAGE ALLOCATION PRIORITY



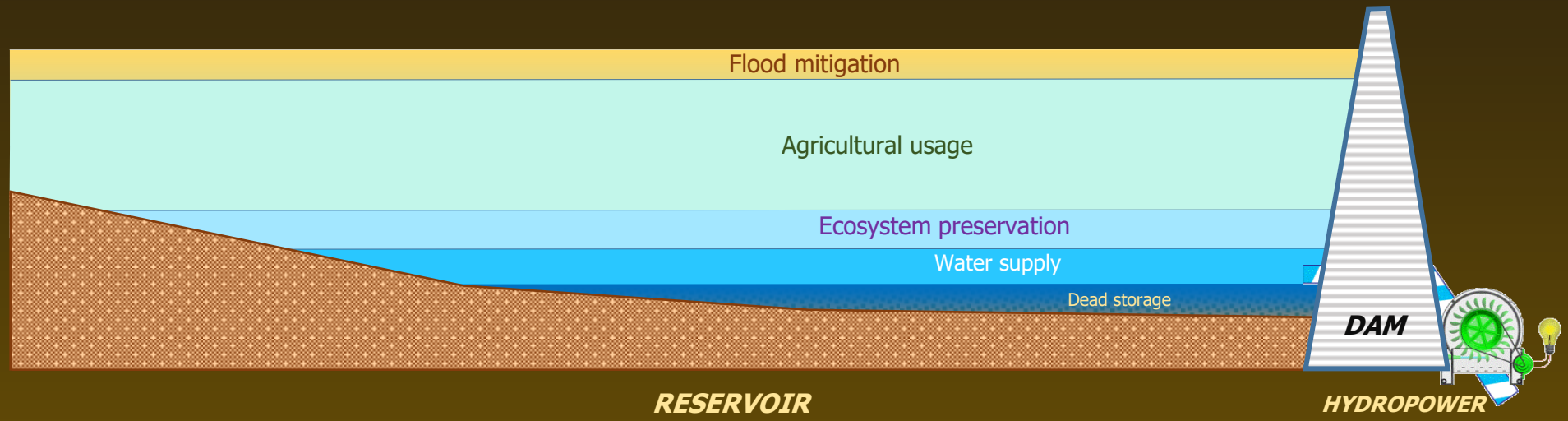
Flood mitigation

Agricultural usage

Ecosystem preservation

Water supply

STORAGE ALLOCATION PRIORITY



Flood mitigation

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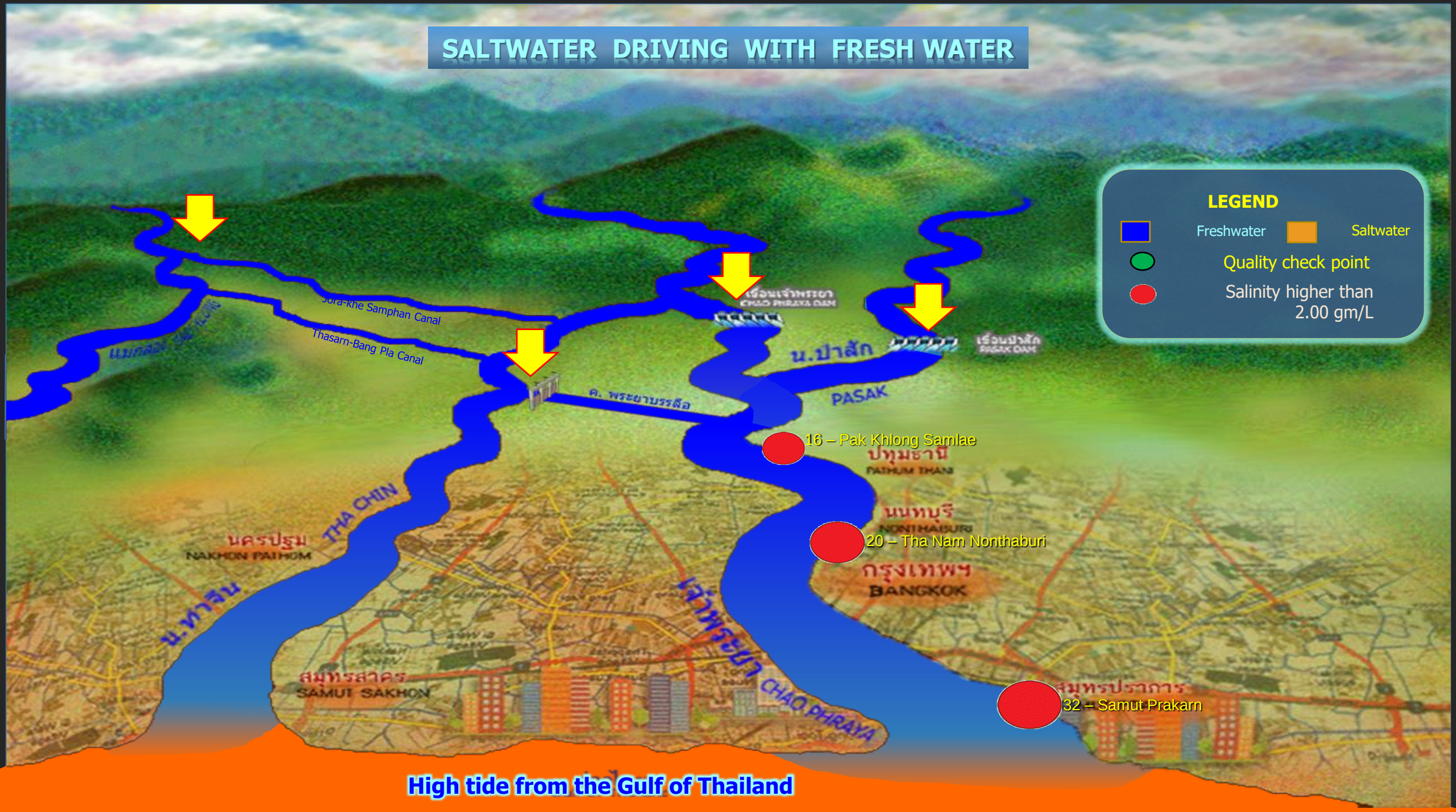

SALTWATER DRIVING WITH FRESH WATER
LEGEND
Freshwater
Saltwater
Quality check point
Salinity higher than 2.00 gm/L
Tha-khe Samphan Canal
Thasarn-Bang Pla Canal
เขื่อนเจ้าพระยา
CHAO PHRAYA DAM
เขื่อนปากลัด
PASAK DAM
น.ปากลัด
PASAK
ค. พระยาบรรลือ
16 – Pak Khlong Samlae
ปทุมธานี
PATHUM THANI
นนทบุรี
NONTHABURI
20 – Tha Nam Nonthaburi
กรุงเทพฯ
BANGKOK
นครปฐม
NAKHON PATHOM
THA CHIN
น.ท่าจีน
สมุทรสาคร
SAMUI SAKHON
เจ้าพระยา CHAO PHRAYA
สมุทรปราการ
32 – Samut Prakarn
High tide from the Gulf of Thailand

Water Management in Dry Season
Estimate the water demand for agriculture

1. HOW CLIMATE CHANGE HAS BEEN AFFECTING WATER RESOURCES IN THE CHAO PHRAYA RIVER BASIN, AND THE CONSEQUENCES.

Temperature

- **The temperature increase** affects on the loss of water resource by accelerated evaporation rate :
  - Large reservoir storage
  - Open irrigation canals

- **Rising mean sea level** results the saltwater in trusion into the land. to protect the agricultural area from damage, the more water supply must be used to push it back.

Rain

- **Rainfall Variability.**
  - Above-average rainfall increases flood risk and losses so the higher budget must be spent on flood prevention both structural and non-structural measures.
  - Below-average rainfall may cause drought and less dead storage of the reservoirs. The water allocation management must be considered for long term situation instead of year by year management.

2. HOW CLIMATE CHANGE MIGHT AFFECT THE PUBLIC PARTICIPATION IN WATER MANAGEMENT.

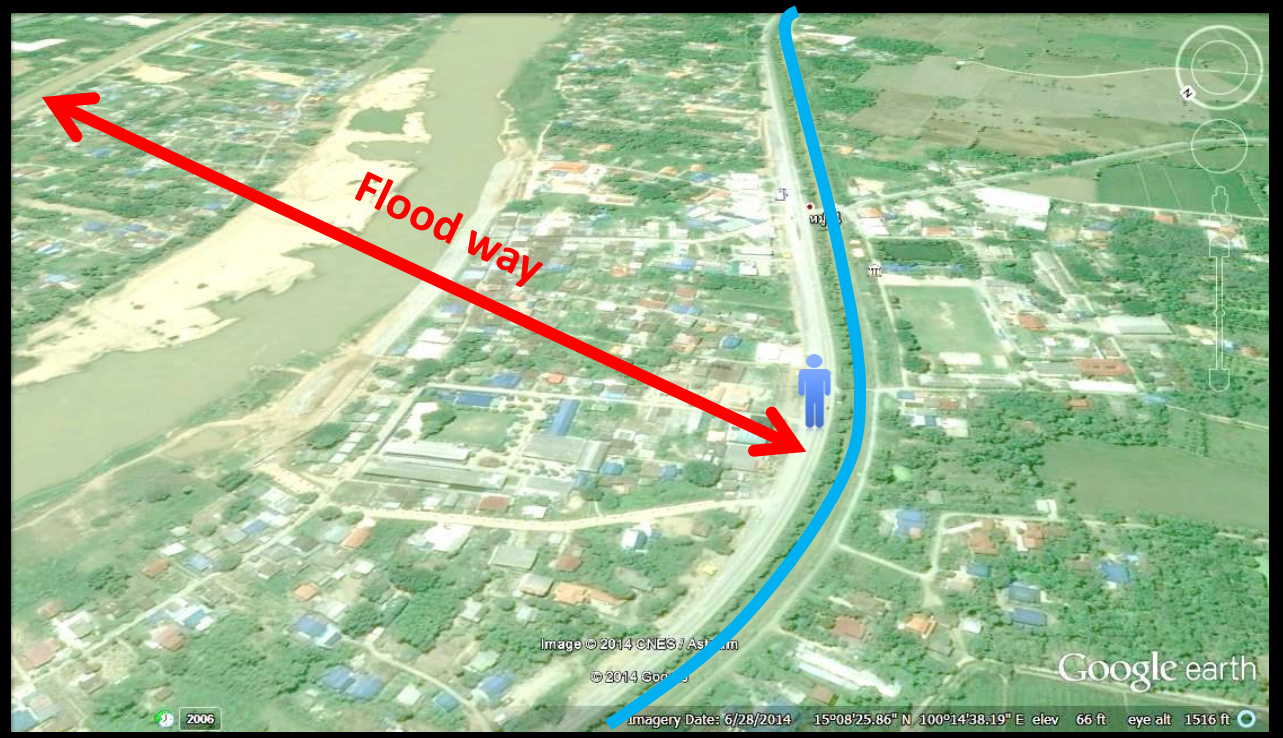
WATER SCARCITY caused by climate change leads to the critical situation for planting and water management. Intensive measures and strict rules of water allocation must be conducted to avoid conflict among all stakeholders. Cropping area limitation or crop types might be changed to another varieties appropriate to dry weather. Irrigated water must be used carefully and efficiently with self-awareness.




Flood Disaster

JAPAN

Chao Phraya River
THAILAND



APPLICATION : The Knowledge could be applied in appropriately ways for regional level flood management Thailand both in structural implementation and public awareness. Many lessons from this man-made river construction should to be learned in various aspects. In advance we need to redesign the diversion channels for dealing with the future effects of climate change as well.

....to redesign the diversion channels for dealing with the future effects of climate change.

THE CHAO PHRAYA RIVER

3. VIEW ON THE CONNECTION BETWEEN AGRICULTURE AND CLIMATE CHANGE, A "THREAT" OR "OPPORTUNITY" FOR AGRICULTURE ?

"Threat" and "Opportunity" both it is !

"Threat"

as it normally bring along with natural disasters such as flood, drought, heat waves or storms that cause agricultural damages and losses.

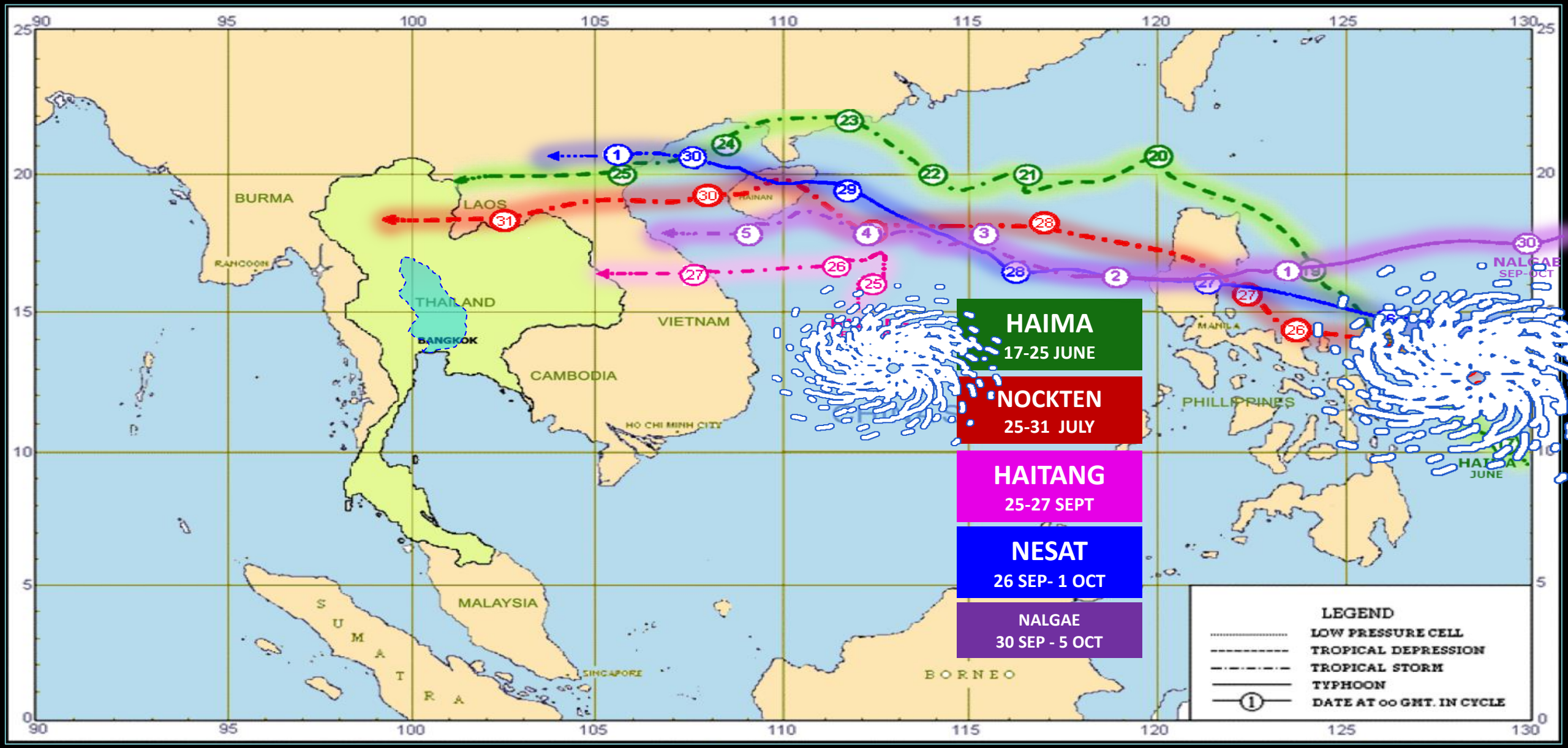
But at the same time it is

"Opportunity" in the other aspect,

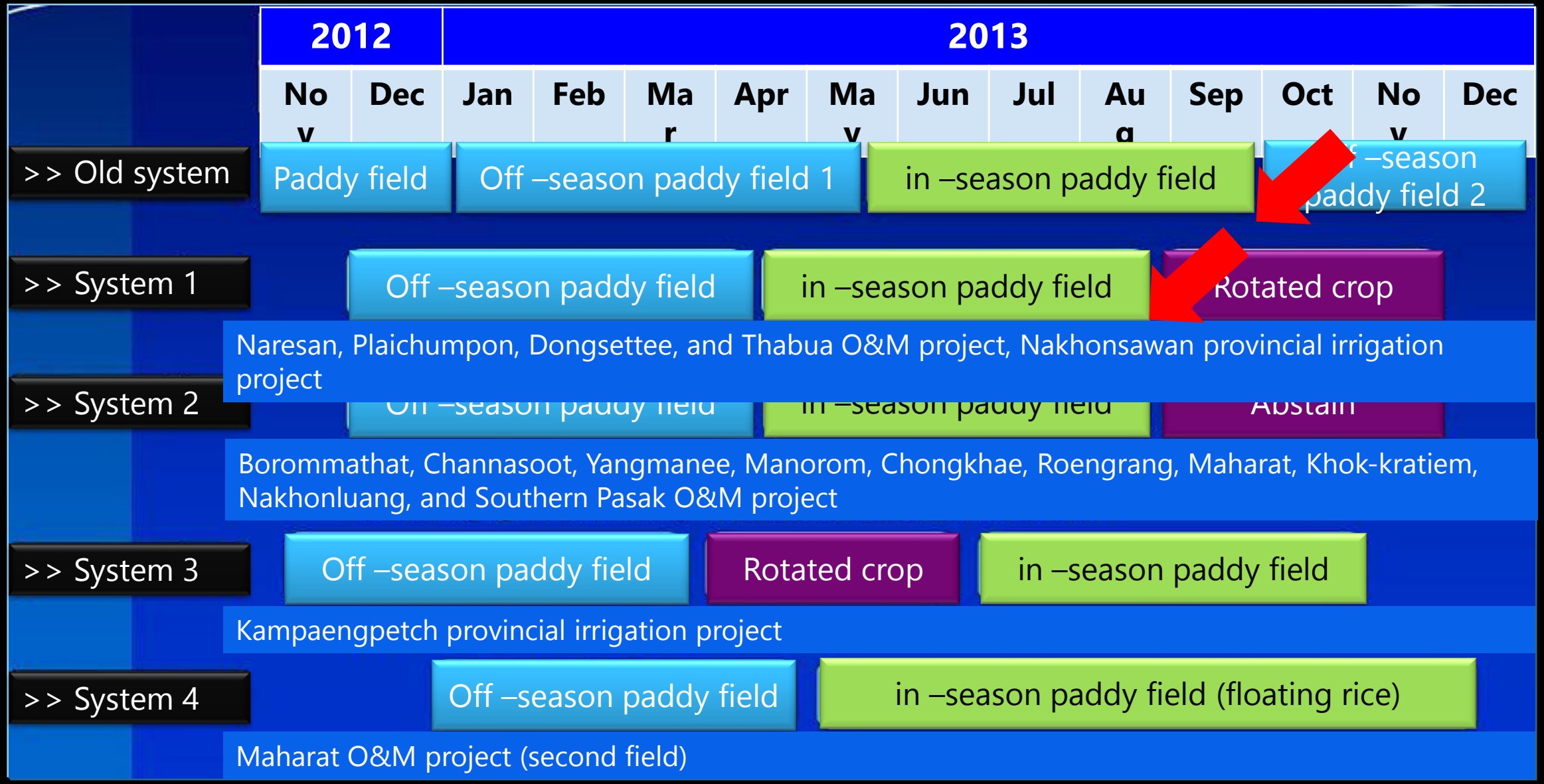
because it forces us to seek for the new ways to cope with the 'Threat' we encounter. The experiences of '2011 - Extrem Flood' and '2015 - Extrem Drought' gave us valuable lessons about the hazardous effects of climate change and how to prevent its impact in the future.

So it is the opportunity to develop new technique of planting, improve the climate-resistant varieties and improve agricultural producing and marketing. By the threat of climate change, agriculturists have to be alert and keep on updating the information and participate in suitable action against the climate change.

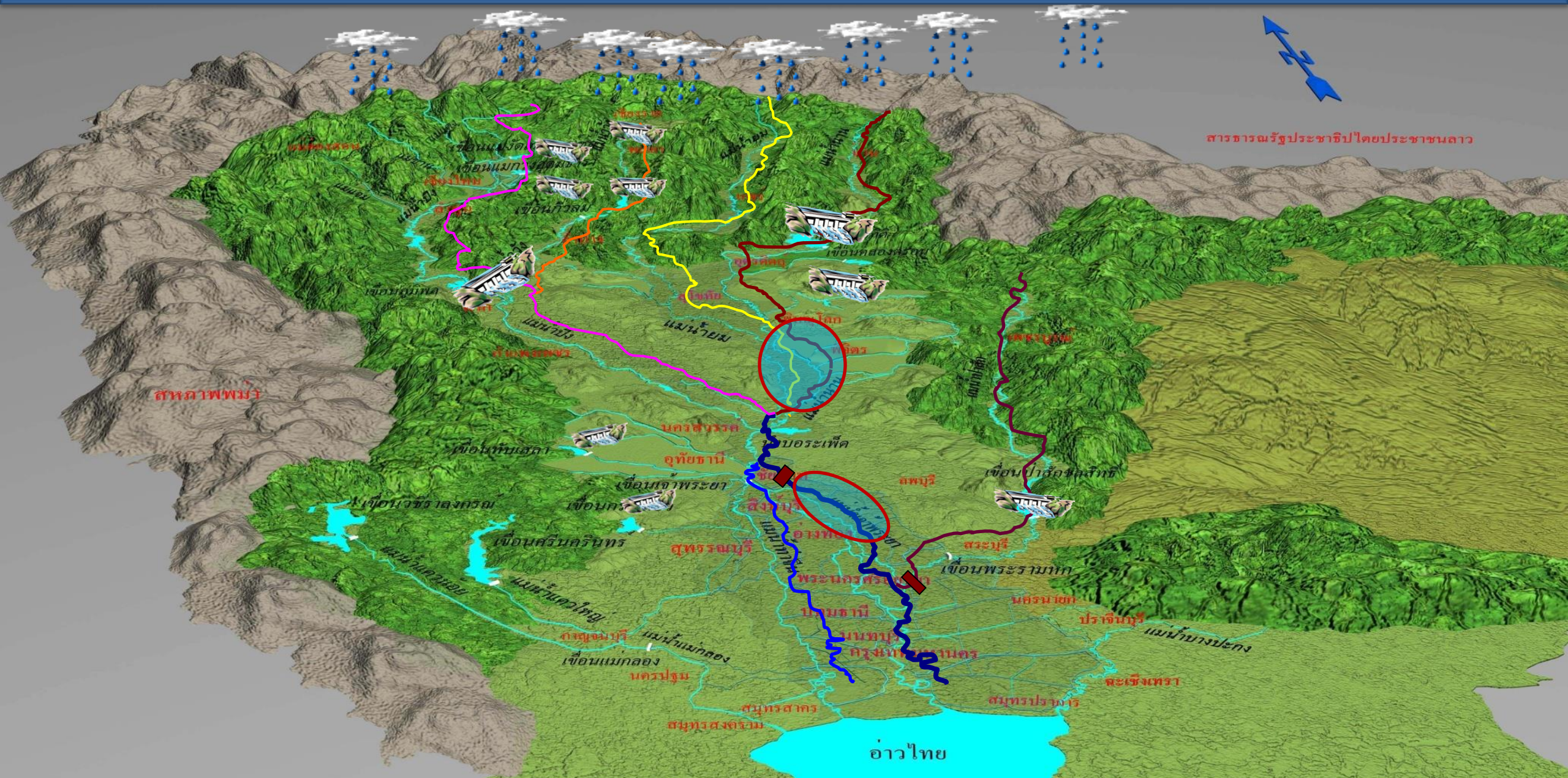
TROPICAL STORMS AFFECTED THAILAND 2011



Adjust cropping pattern and water allocation



Retention Area



Paddy field in Chao Phraya Basin

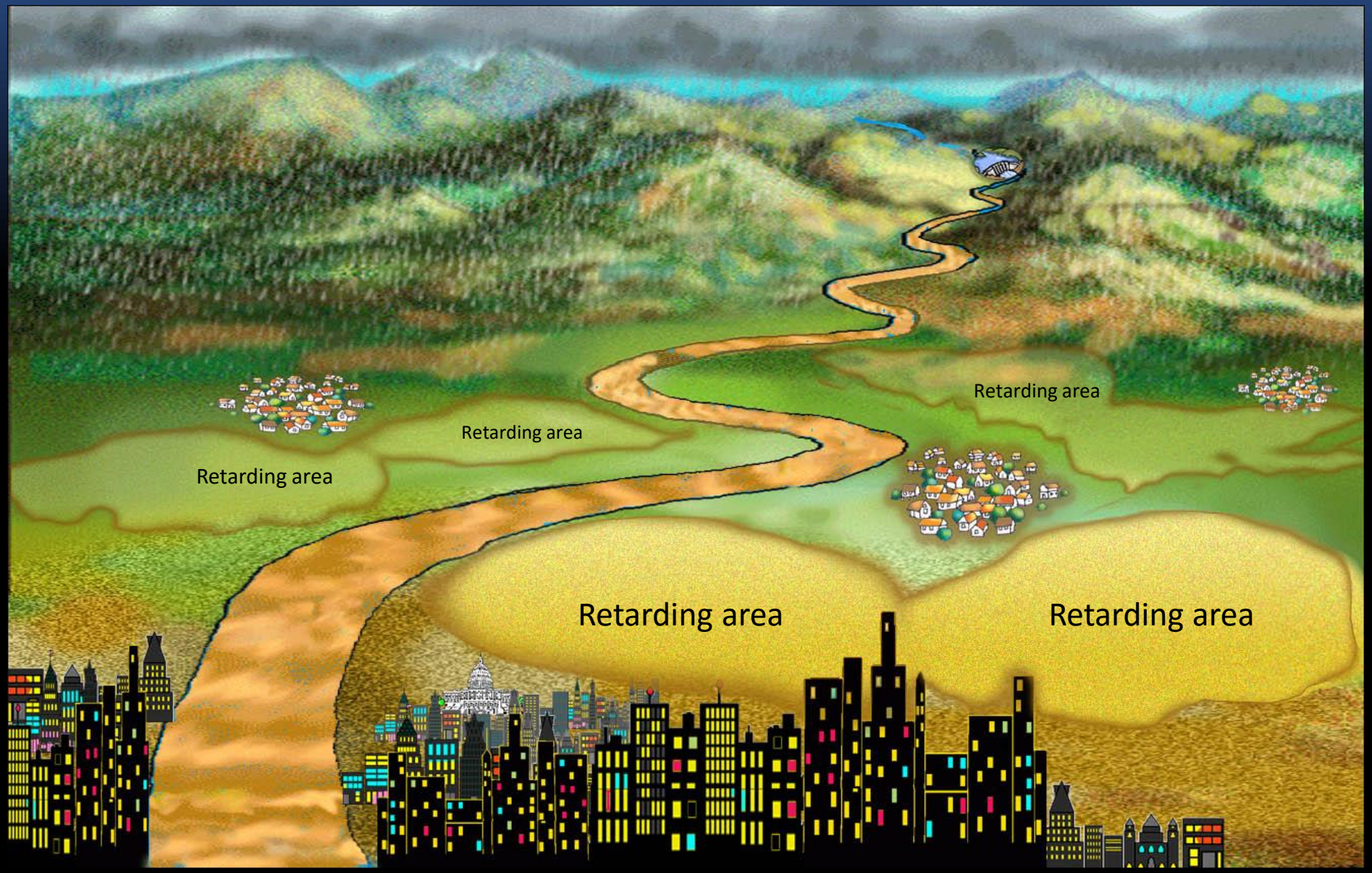
PREPARING RETARDING AREAS BEFORE FLOODING SEASON

Rice planting 1 month earlier than regular time.

PREPARING RETARDING AREAS BEFORE FLOODING SEASON

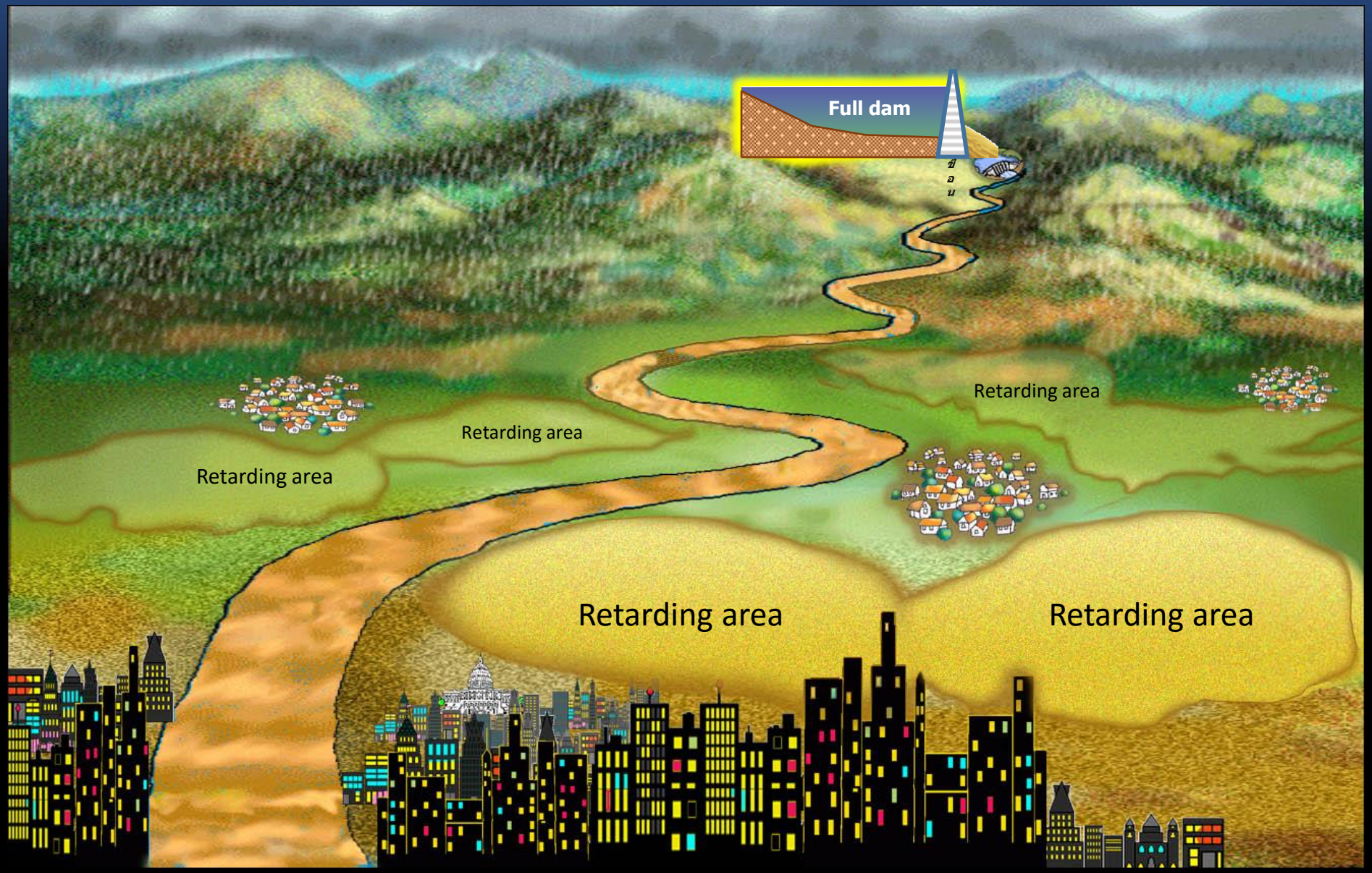
1 month earlier harvesting

PREPARING RETARDING AREAS BEFORE FLOODING SEASON



Retarding areas are ready to store the excess discharge

PREPARING RETARD INGAREAS BEFORE FLOODING SEASON



Saving downstream economic areas from severe flooding.

TARGET

- Increase Irrigation Efficiency

- Increase Rice Yield

WATER SUPPLY : CROP YIELD

CURRENT PROPORTION

WATER SUPPLY
(CU.M/Rai)

AREA
(Rai)

YIELD
(Kg./Rai)

650

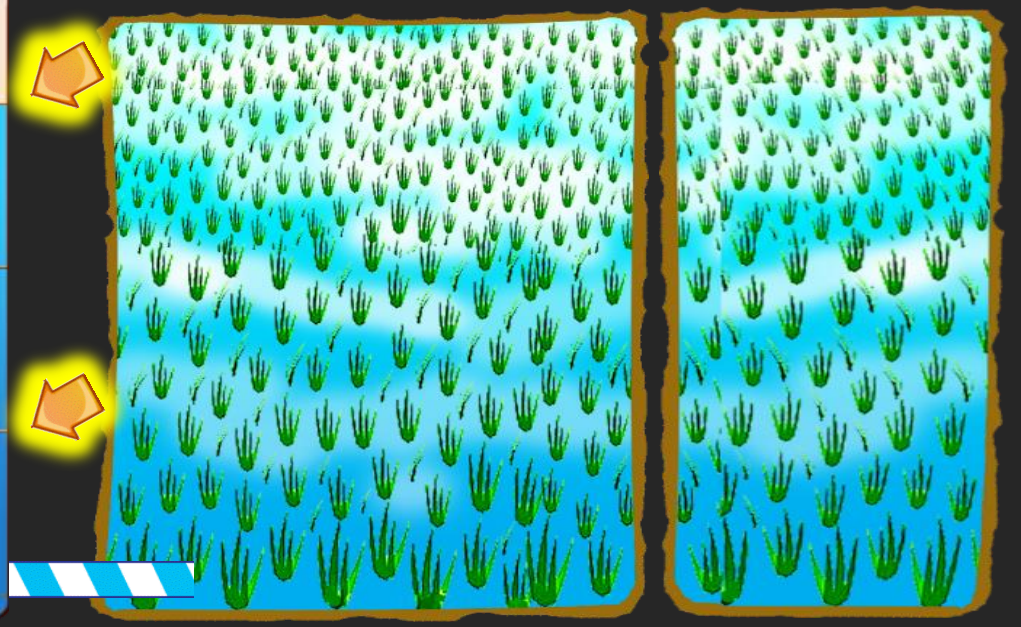
1,500 Cu.M WATER -> 1 RAI (X 650 Kg.) => CROP YIELD = 650 Kg.

WATER SUPPLY : CROP YIELD

AIM 1 : REDUCE WATER – INCREASE AREA

WATER SUPPLY
(CU.M/Rai)

AREA
(Rai)



YIELD
(Kg./Rai)

975

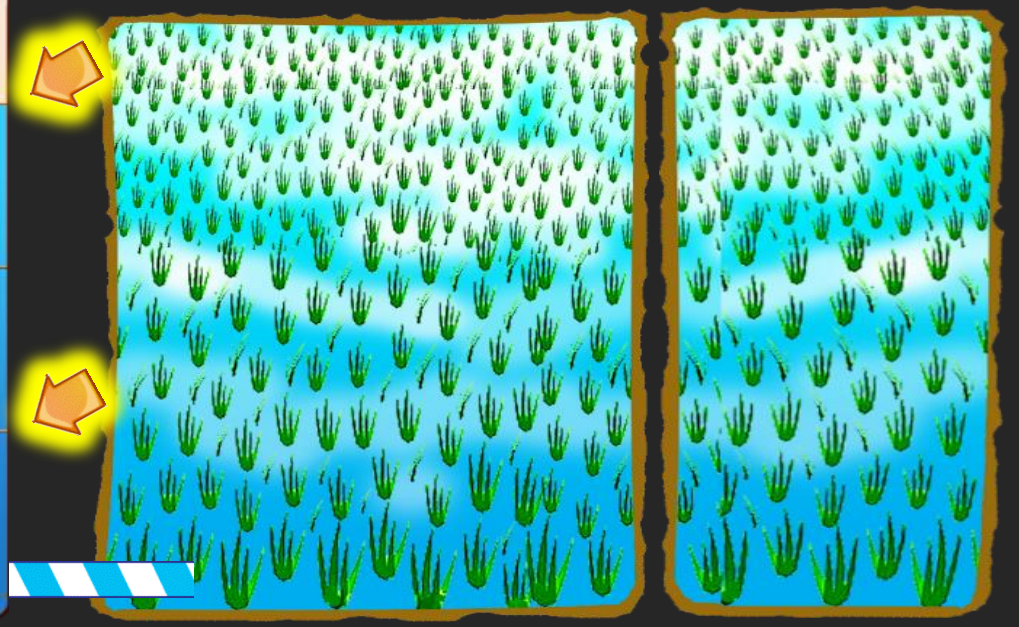
1,500 Cu.M WATER -> 1.5 RAI (X 650 Kg.) => CROP YIELD = 975 Kg.

WATER SUPPLY : CROP YIELD

AIM 2 : REDUCE WATER - INCREASE AREA + YIELD

WATER SUPPLY
(Cu.M/Rai)

AREA
(Rai)

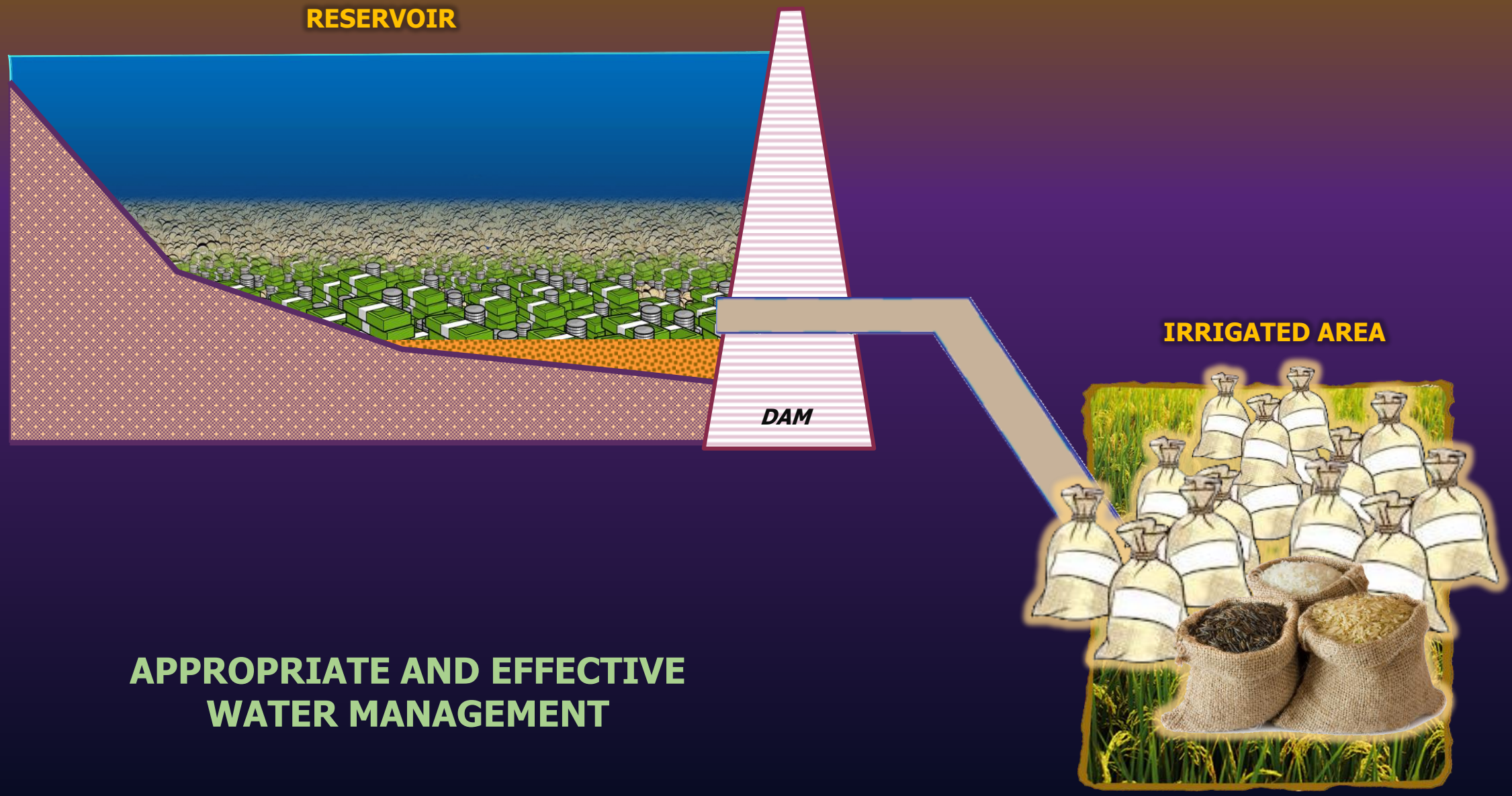


YIELD
(Kg./Rai)

1,200

1500 Cu.M WATER - > 1.5 RAI (X 800 Kg.) => CROP YIELD = 1200 Kg.

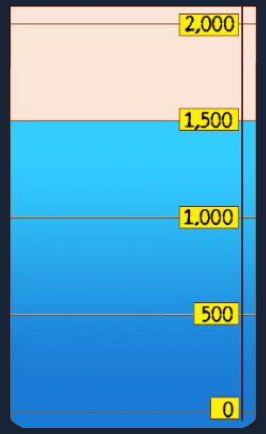
WATER : AS VALUABLE RESOURCE



APPROPRIATE AND EFFECTIVE WATER MANAGEMENT

WATER VALUE : BY CROP YIELD

Water used
(1,500 Cu.M/RAI)



CROP YIELD
(Kg./Rai)

650

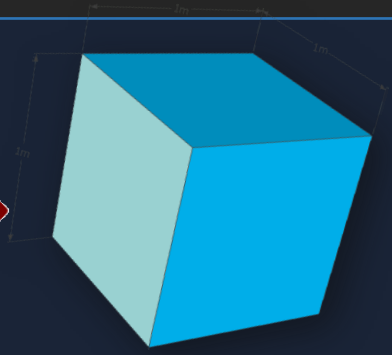
Rice price 12 baht / kg.
650 kg.=

7,800 baht

(per 1 Rai)

Water 1,500 Cu.M
=

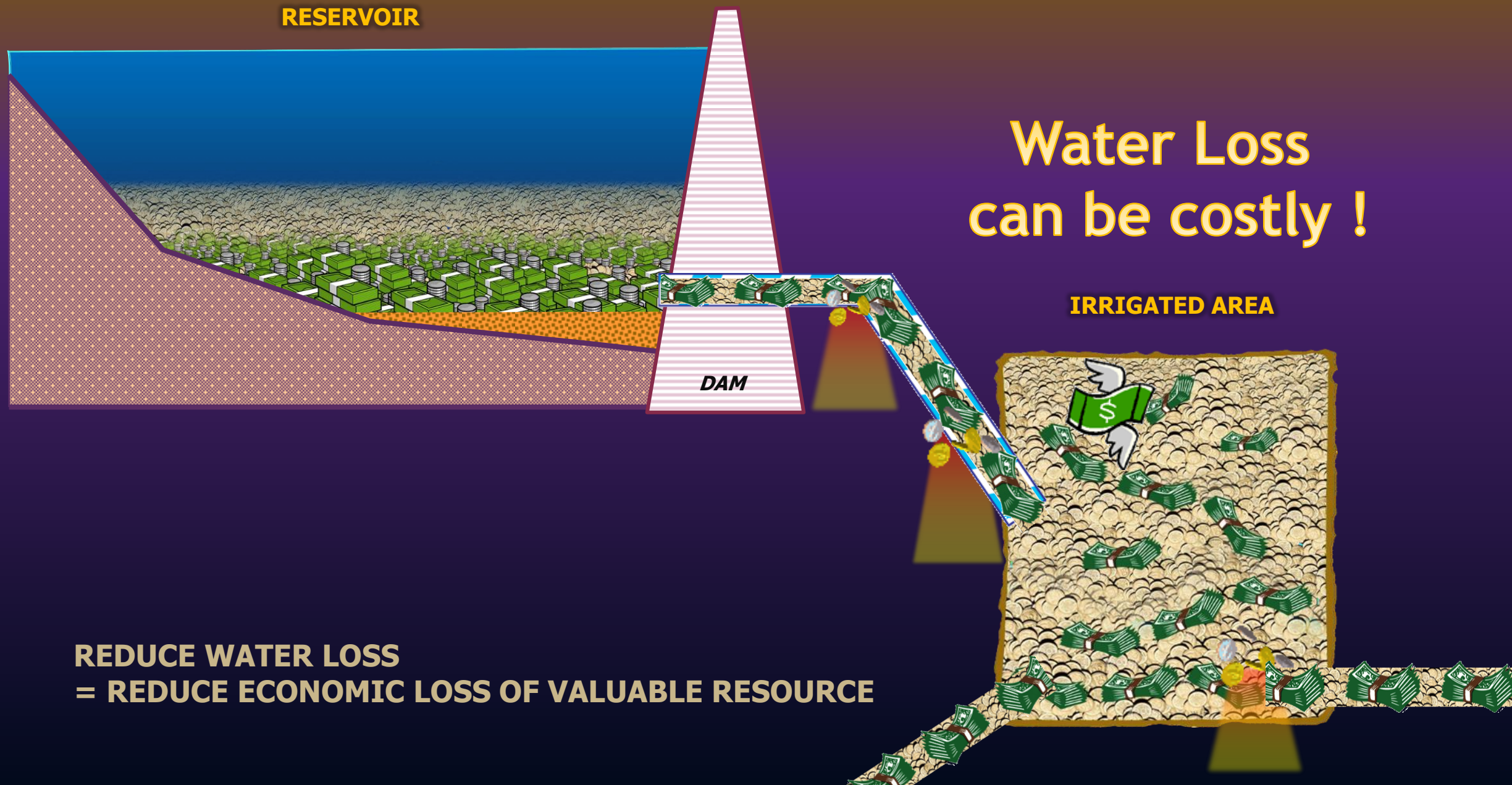
7,800 baht



Water 1 Cu.M

= 5.2 baht

WATER : AS VALUABLE RESOURCE



Water Loss can be costly !

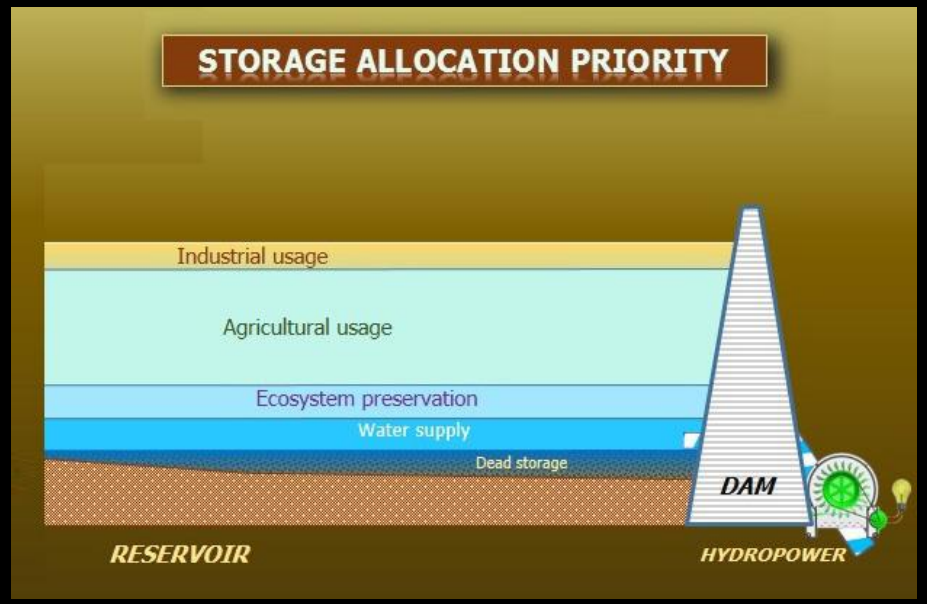
REDUCE WATER LOSS
= REDUCE ECONOMIC LOSS OF VALUABLE RESOURCE

4. THE WAYS FORWARD TOWARD SUSTAINABILITY IN THE CHAO PHRAYA RIVER BASIN IN TIMES OF CLIMATE CHANGE.

Upstream - forest encroachment prevention, reforestation promoting, reservoirs and trans-boundary water management.

Midstream - network of flood-retarding areas coverage, irrigation efficiency.

Downstream - salt water prevention measures.



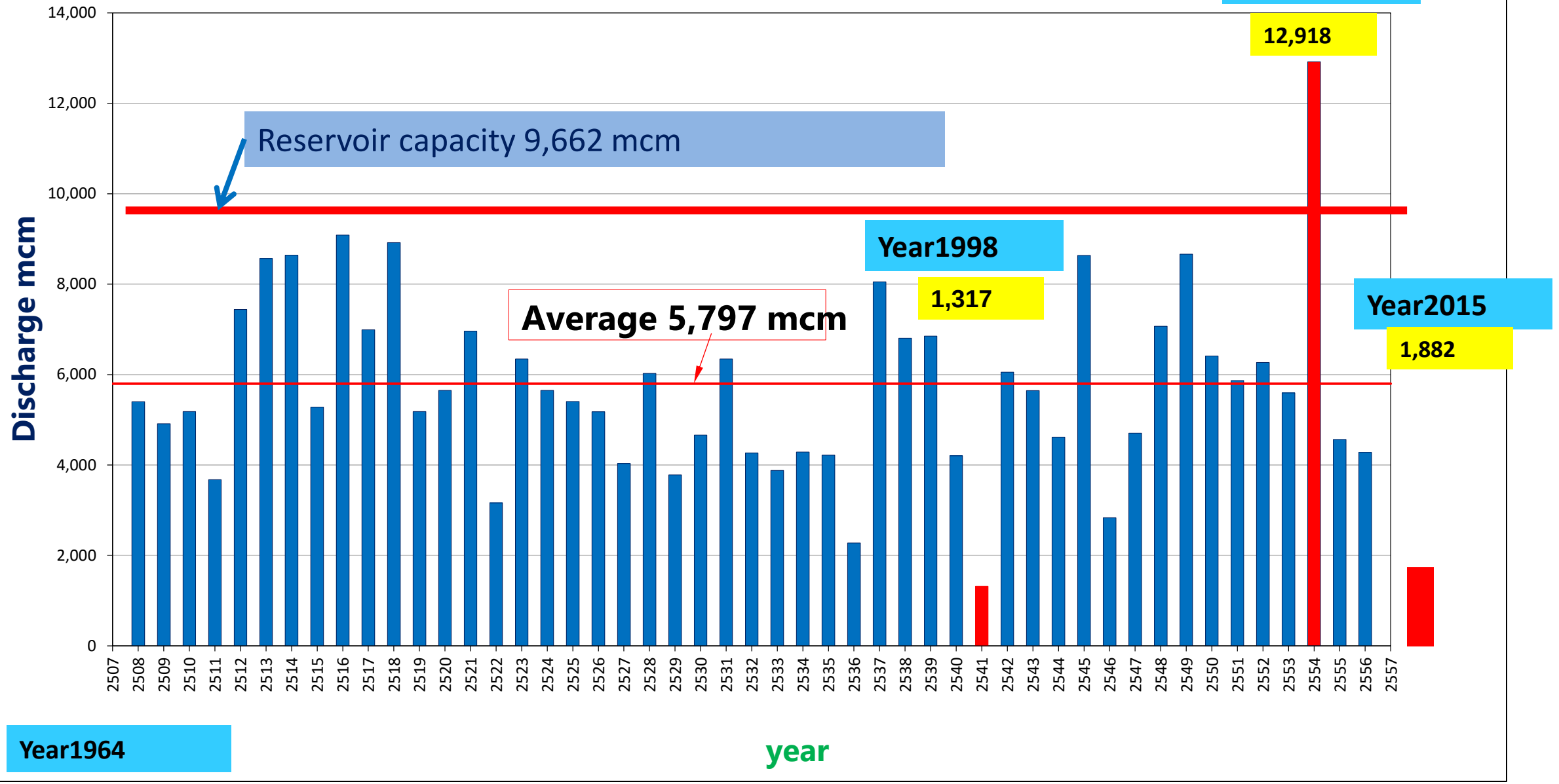
Large reservoir storage will function as the water banks (water shortage risk insurance) each level of the storage allocated by priority (Industrial usage / agricultural usage/ ecosystem preservation/water supply/dead storage).

CASE : RESERVOIR CAPACITY GREATER THAN EVERAGE ANNUAL INFLOW

- Reserve water for in season crop (wet season)

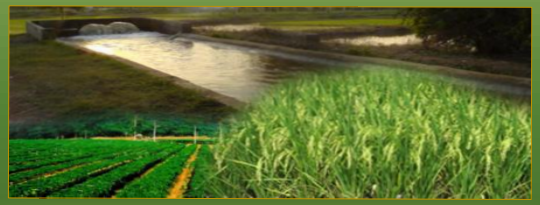
- Reserve water for water shortage situation due to climate variability

Annual inflow of Phumiphon Dam



STORAGE ALLOCATION PRIORITY (DROUGHT SITUATION)

Flood mitigation

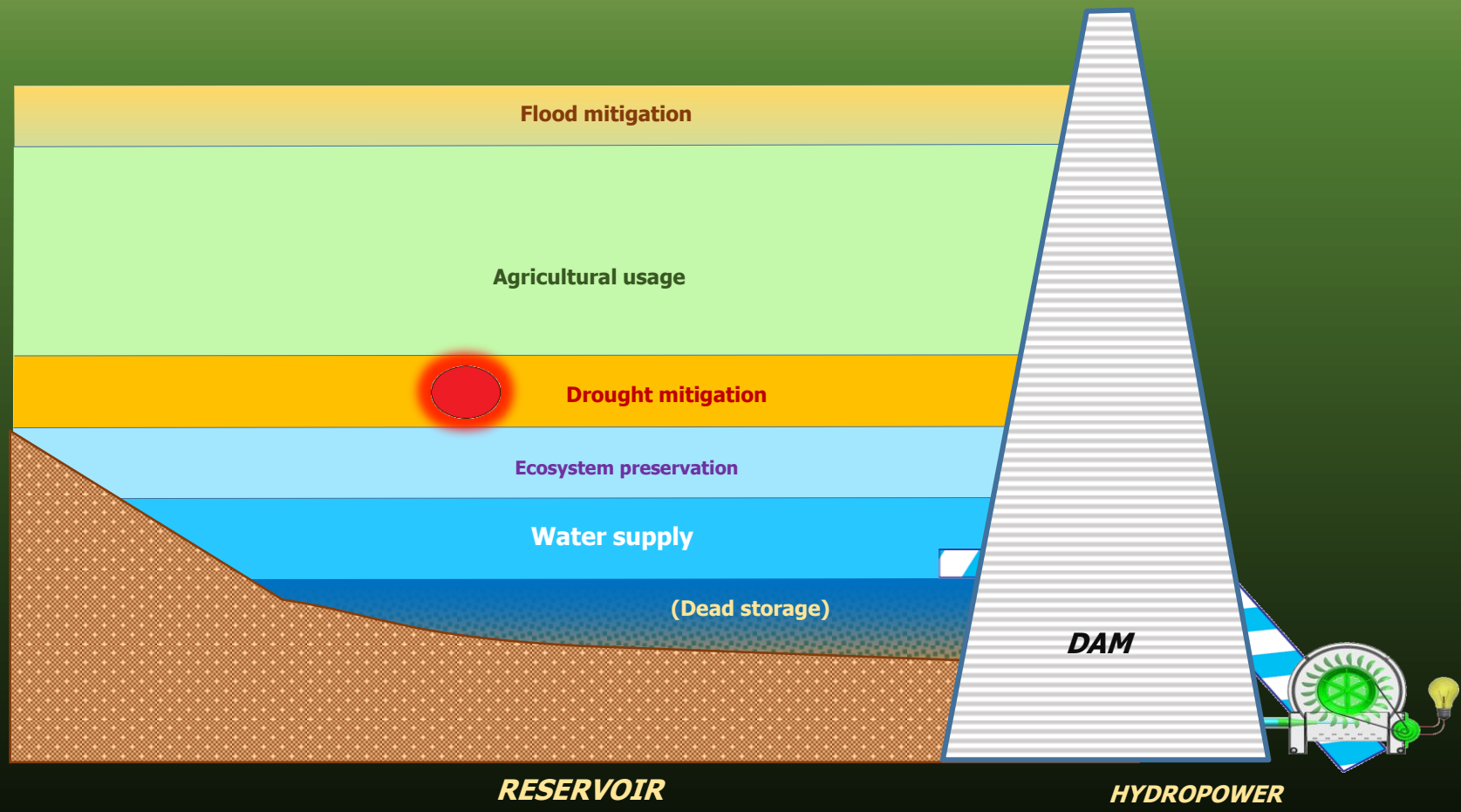


Agricultural usage

Drought mitigation

Ecosystem preservation

Water supply

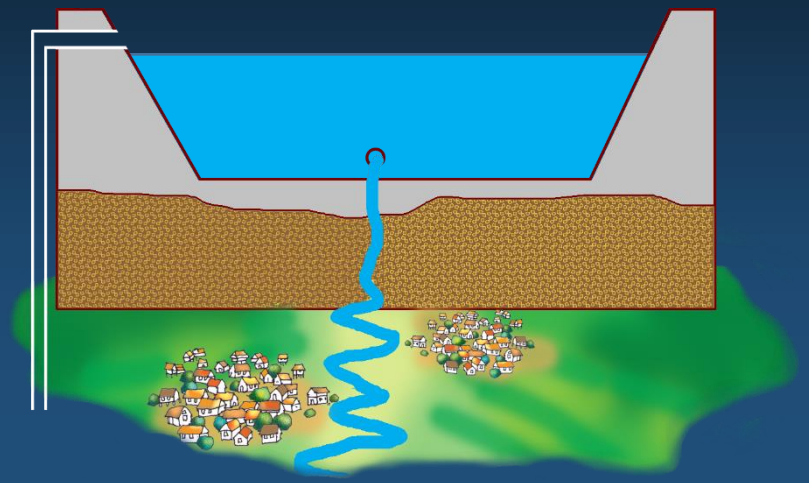


CASE : RESERVOIR CAPACITY LESS THAN EVERAGE ANNUAL INFLOW

- Flood monitoring
- Seasonal forecasting

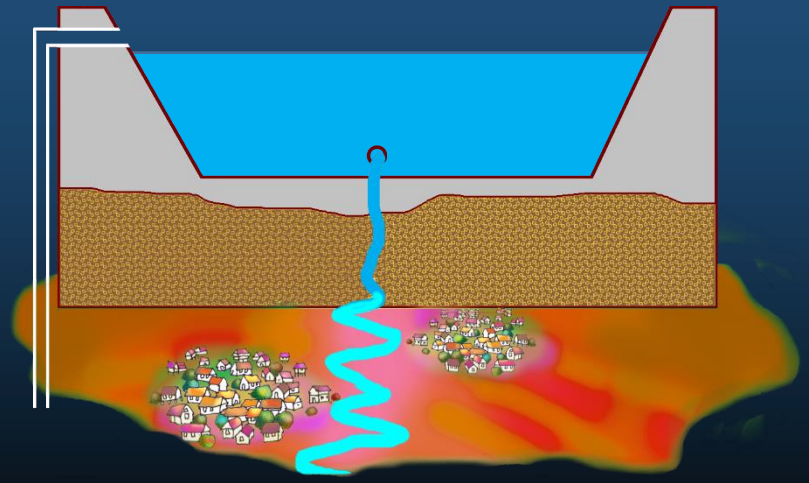
FLOOD-DROUGHT CONTROL BY DAM OPERATION

(Principle)



1. FLOOD PREVENTION

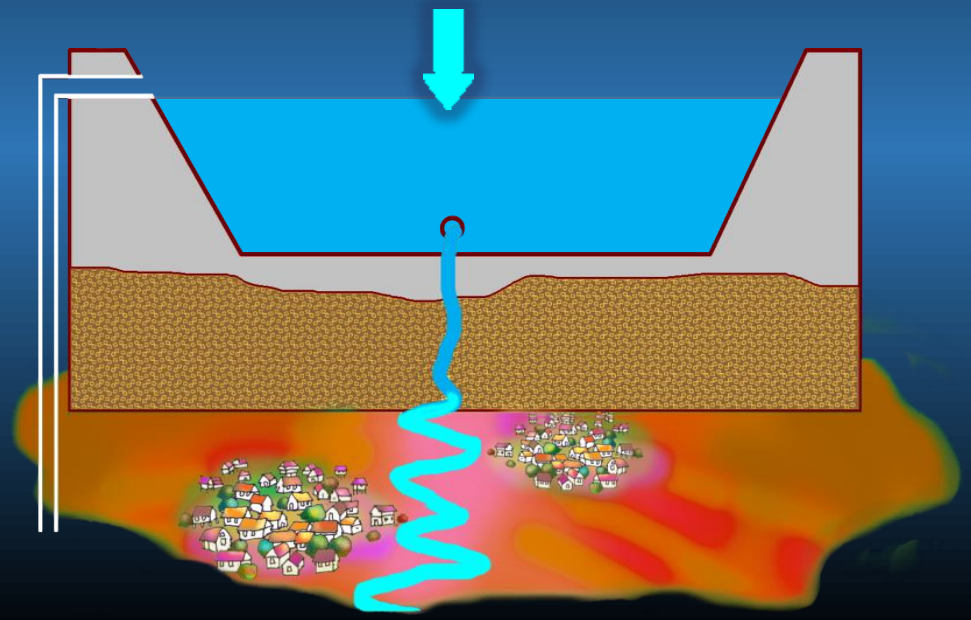
Storage drained to increase reservoir capacity before the coming storms.



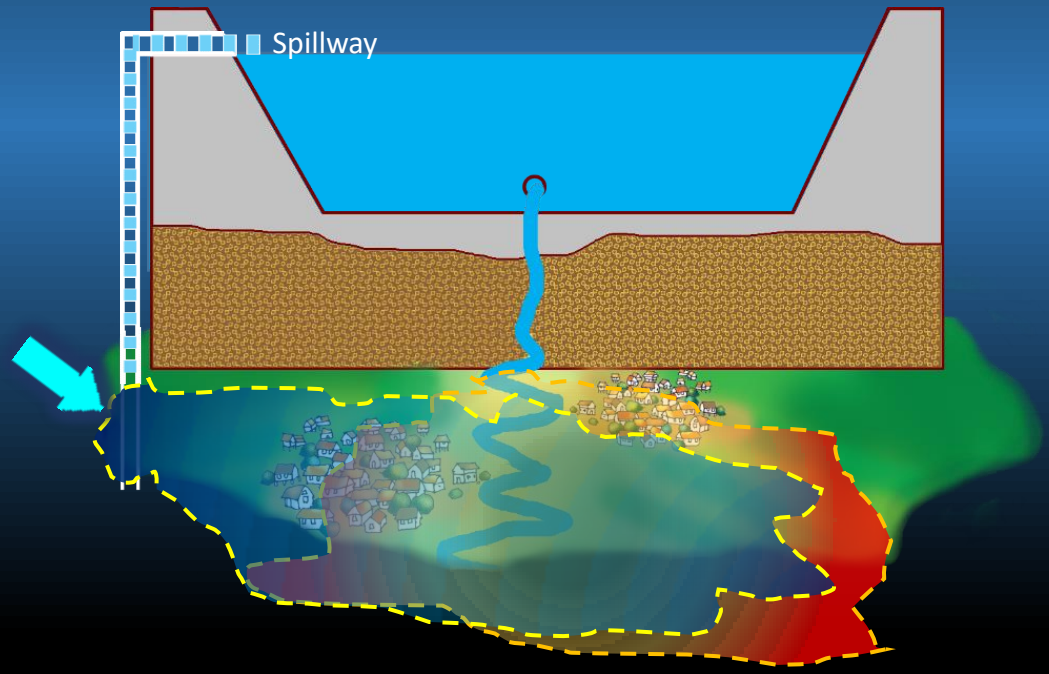
2. DROUGHT MITIGATION

Maximum storage reserved for dry season.

PROBLEM OF THE RIGHT TIME DECISION MAKING BETWEEN STORAGE SAVING AND DRAINAGE



DECREASE STORAGE
TO PREPARE ROOM FOR COMING STORMS - BUT……
No rain……and no water for drought mitigation

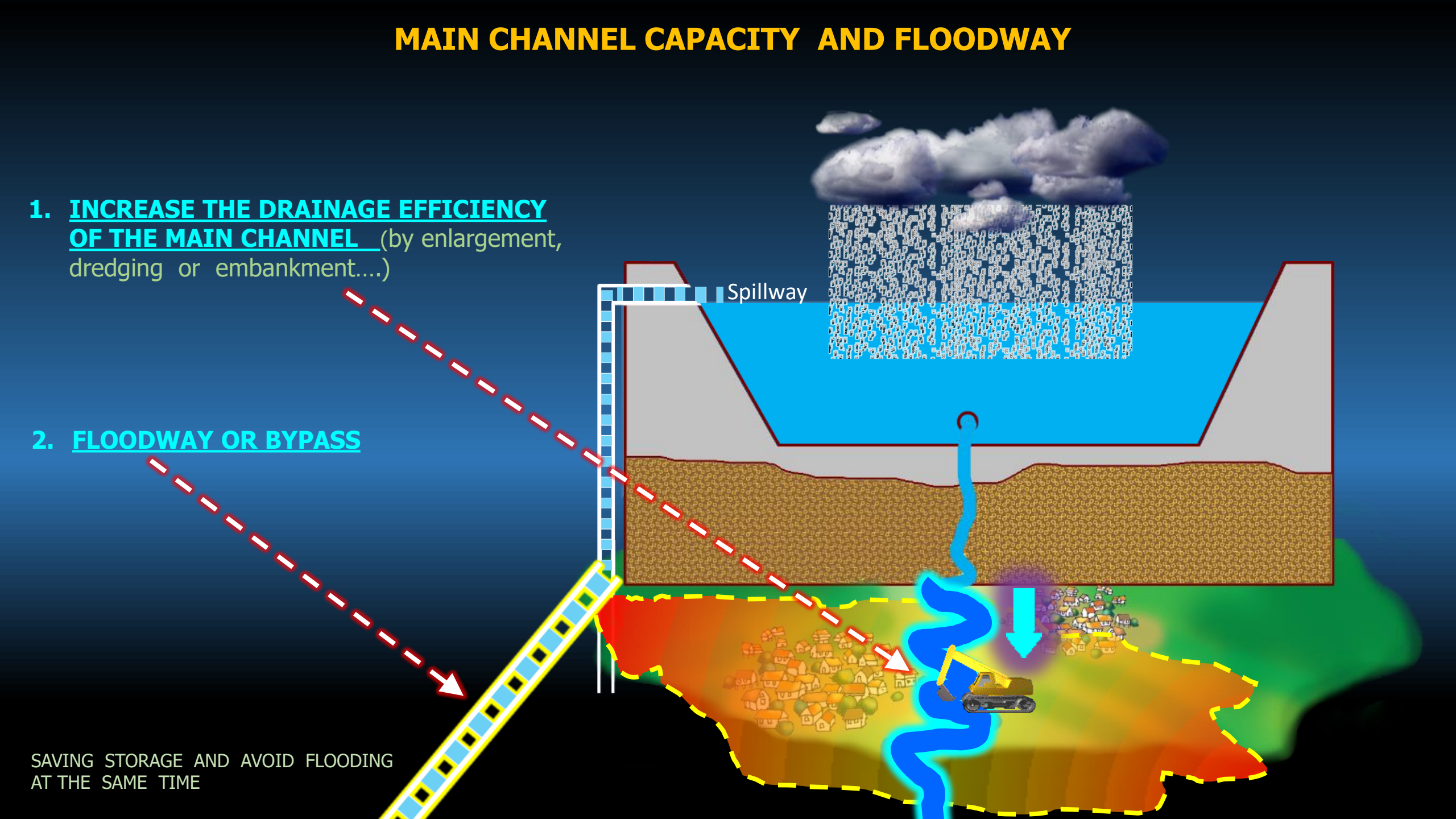


PREPARE FOR THE DROUGHT
SAVING MAXIMUM STORAGE – BUT…..
Continuous heavy rainfall – exceeded storage -> flooding

MAIN CHANNEL CAPACITY AND FLOODWAY

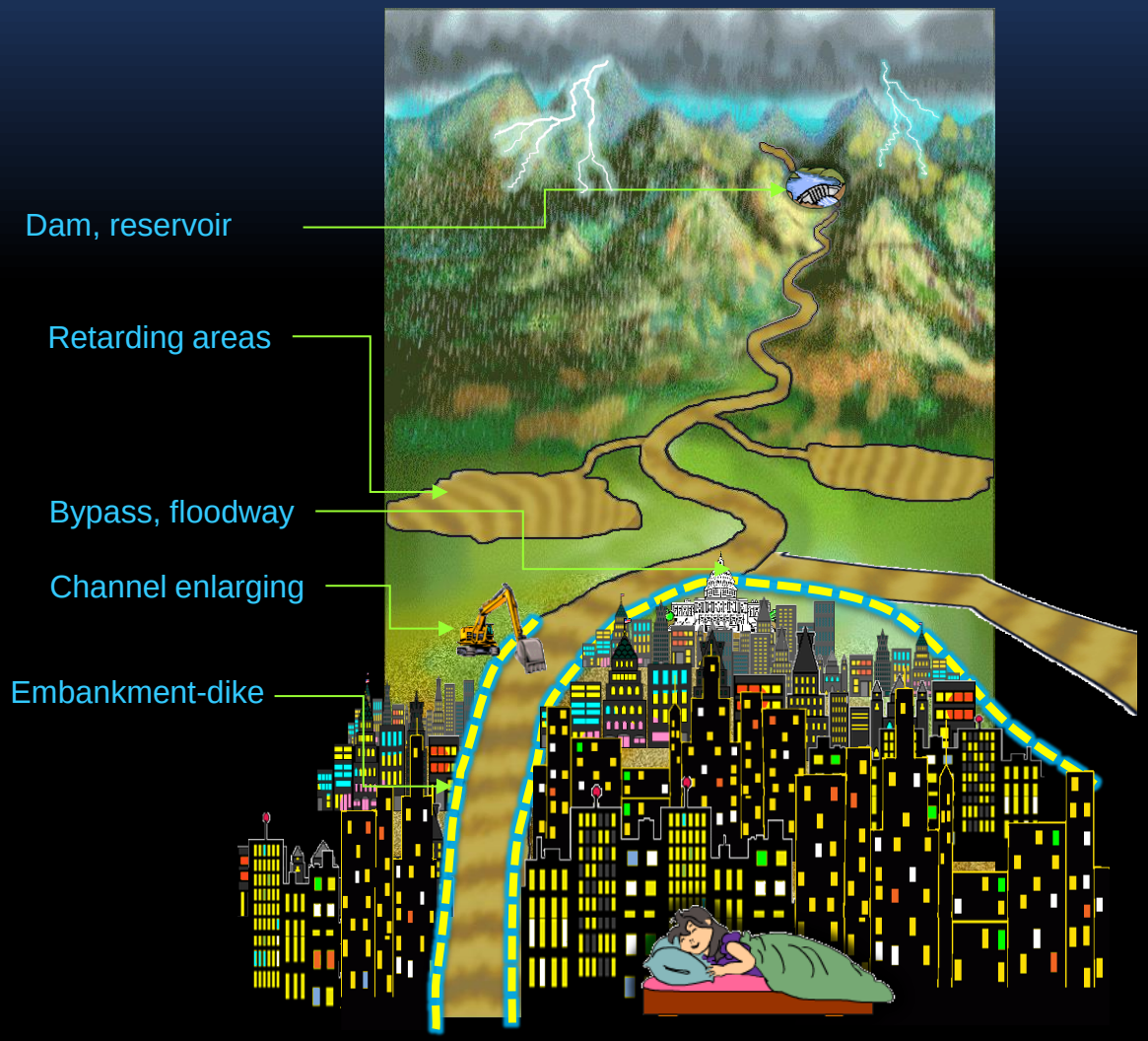
1. **INCREASE THE DRAINAGE EFFICIENCY OF THE MAIN CHANNEL** (by enlargement, dredging or embankment….)

2. **FLOODWAY OR BYPASS**



SAVING STORAGE AND AVOID FLOODING AT THE SAME TIME

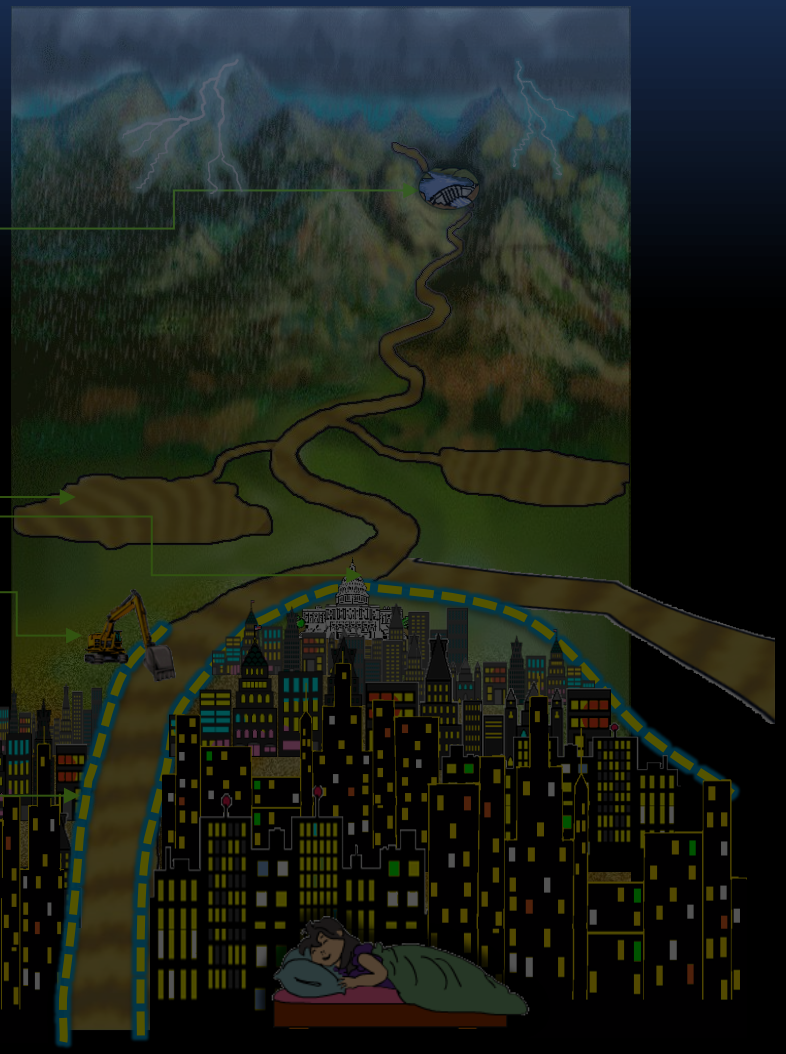
STRUCTURAL MEASURES



MOVE WATER…!! NOT MOVE PEOPLE

WATER-RELATED DISASTER PREVENTION MEASURES IN THAILAND

STRUCTURAL MEASURES



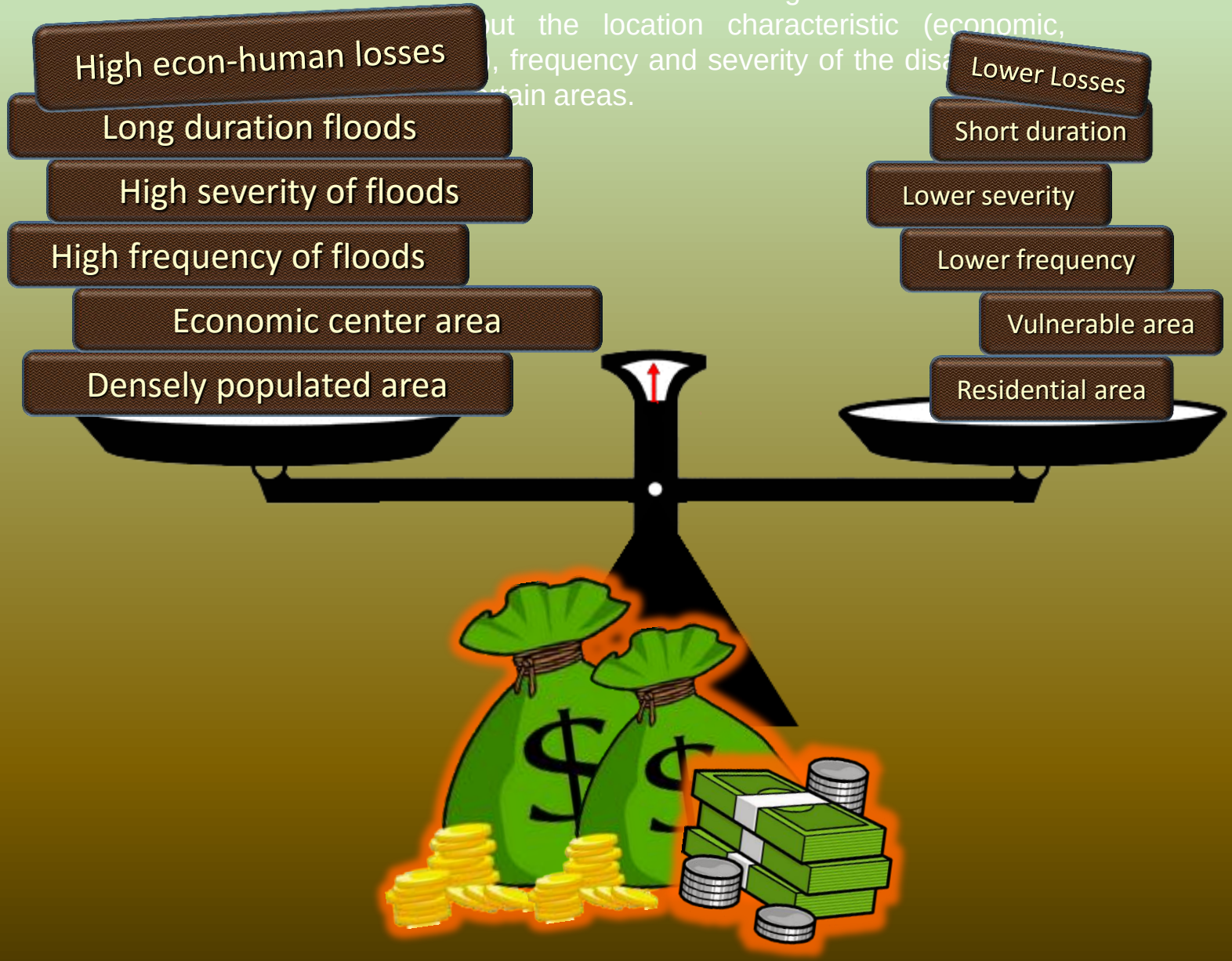
MOVE WATER…!! NOT MOVE PEOPLE

NON-STRUCTURAL MEASURES

MOVE PEOPLE…. NOT MOVE WATER

WATER-RELATED DISASTER PREVENTION MEASUREMENTS IN THAILAND

Investment toward implementing hard and soft measures of water-related disaster management based on the ut the location characteristic (economic, , frequency and severity of the dis ain areas.



WATER-RELATED DISASTER PREVENTION MEASUREMENTS IN THAILAND

Investment toward implementing hard
measu er management ha
consid on characteristi
popula severity of the
used to occur in certain areas.

Investment for permanent solution

- High econ-human losses
- Long duration floods
- High severity of floods
- High frequency of floods
- Economic center area
- Densely populated area

Emergency measurement

- Lower Losses
- Short duration
- Lower severity
- Lower frequency
- Vulnerable area
- Residential area

- **STRUCTURAL MEASUREMENTS :**

To divert or keep away water volume by constructing :

- Dams, reservoirs and retarding areas.
- Bypass, floodway.
- Dredging or enlarging water channels.
- River embankment, levee .

MOVE WATER
(not move people)

- **NON-STRUCTURAL MEASUREMENTS :**

Evacuate the residents to the safety place in time before flooding is the way to save human lives and properties. But the effective early warning system must be prompt, accurate and reliable, so it still needs more improvement with:-

- Flood model developing and training.
- Basin coverage of meteo-hydrological station network.
- Water-related disaster information disseminated to public and involved authorities to deal with the critical situation in any stage appropriately.

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Thank you
for your attention