



Reducing Irrigation water requirements of the Chao Chet - Bang Yihon Operation and Maintenance Project by Defining New Cropping Calendar based on Time Series NDVI.

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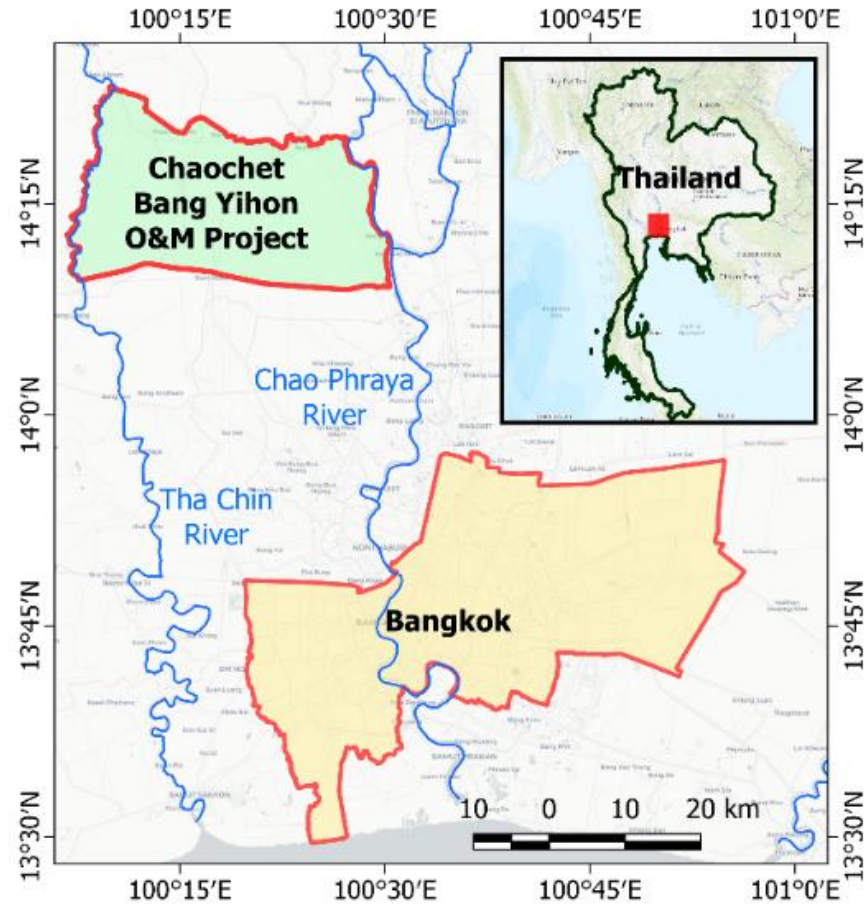


Study Area

Chao Chet – Bang Yihon operation and maintenance project (CCBY)
is controlled by Regional Irrigation Office 11 (RIO.11)

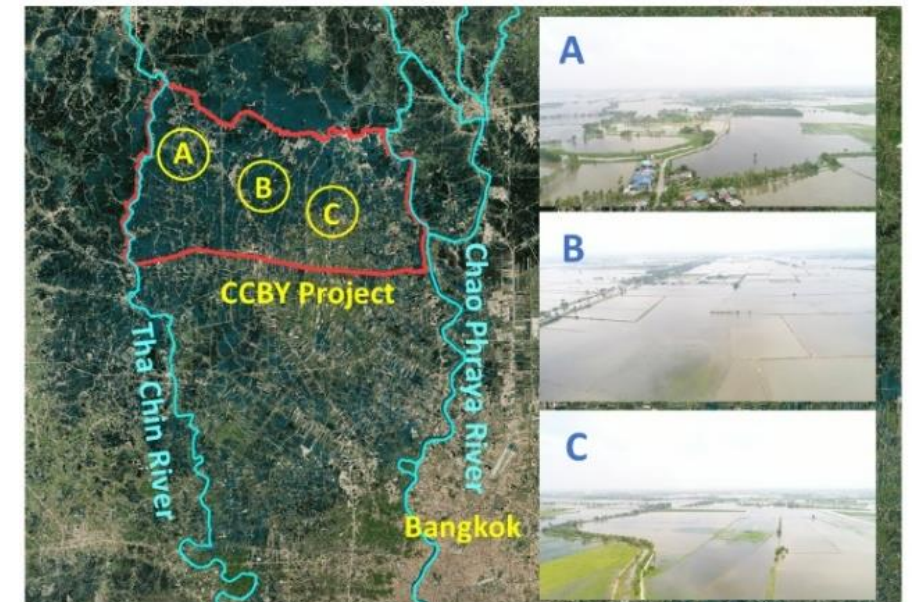
The total irrigated area
of the CCBY project is
65,000 ha.

80%
of the area is **rice
paddy fields**



Location map of
the study area

Flooding on 8th
October 2017.



- (A) Bang Pla Ma District, Suphan Buri Province
- (B) Sena District, Ayutthaya Province
- (C) Bang Sai District, Ayutthaya Province

Research Background

Royal Irrigation Department (RID) has an irrigation water allocation plan according to the cropping calendar

Wet Season: May – October
Dry Season: November - April

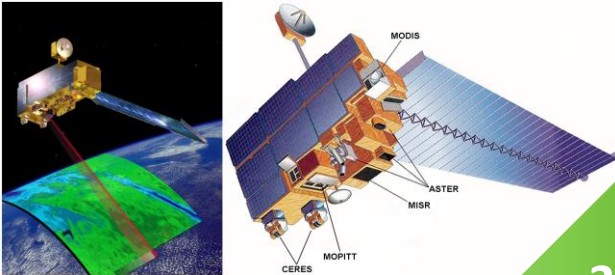
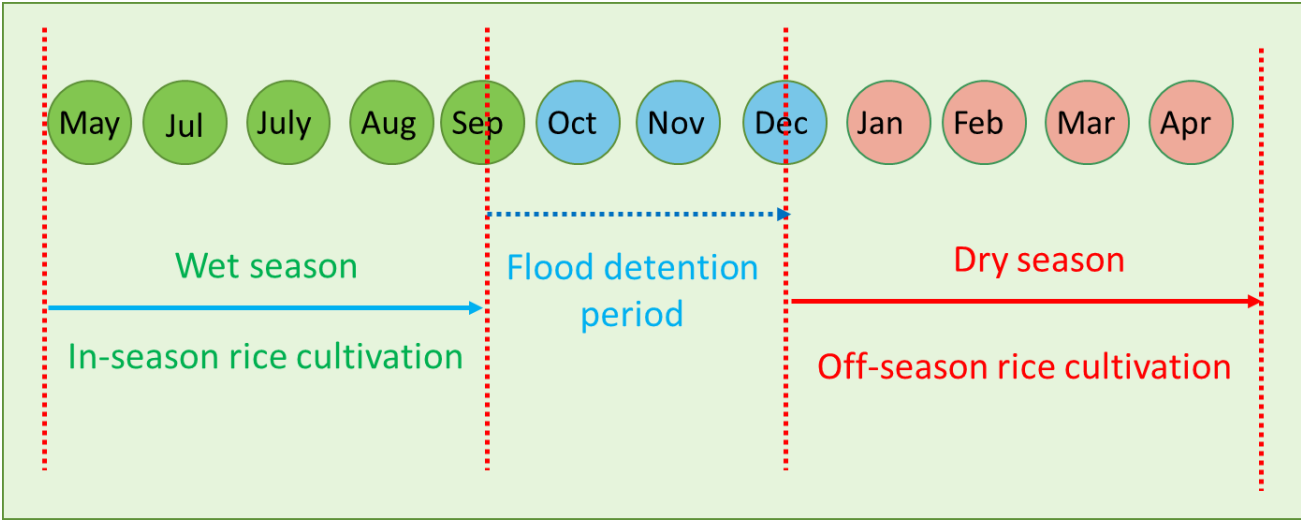
Chao Chet - Bang Yihon operation and maintenance project (CCBY)

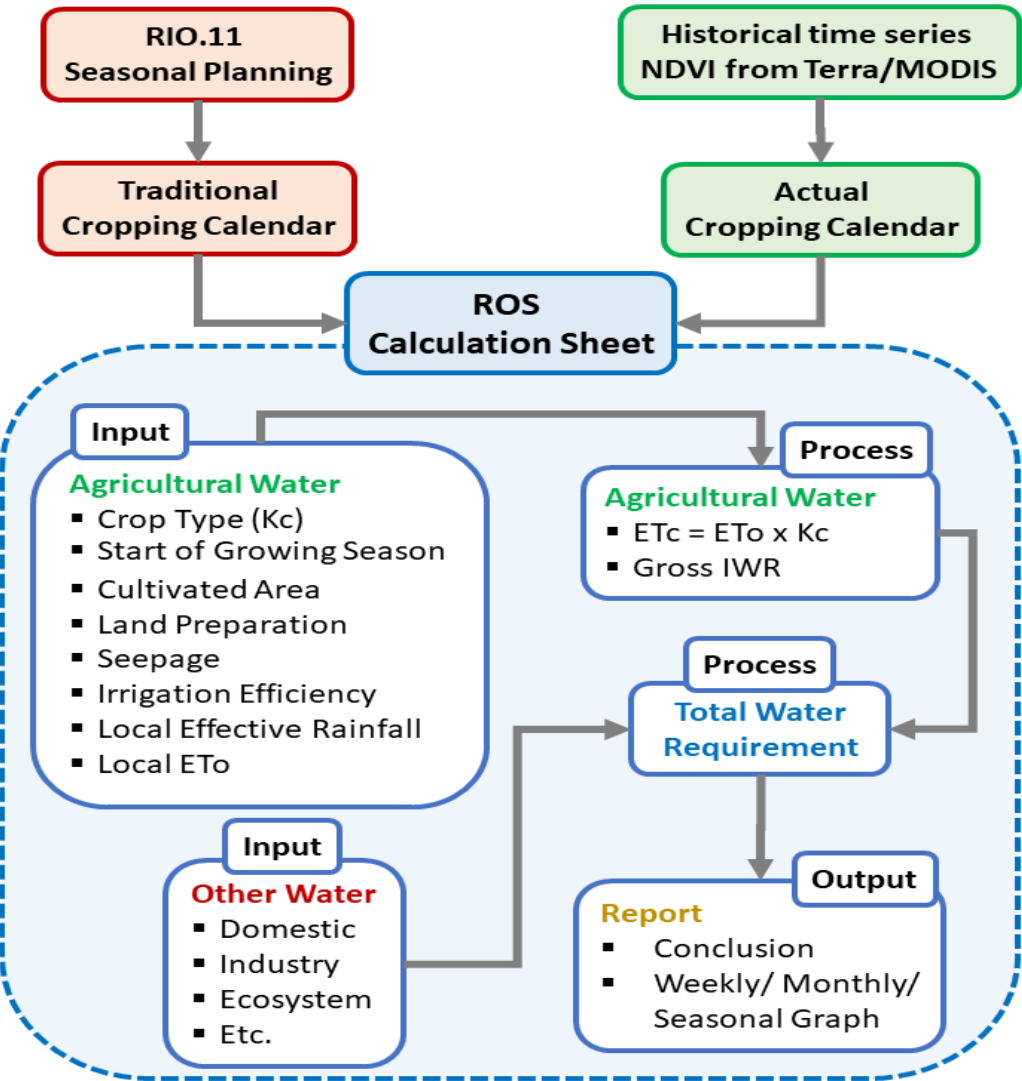
The cropping calendar was required to shift the in-season rice cultivation ahead of schedule in May and complete harvesting before mid-September

OBJECTIVE:

To compare water demand in the CCBY using the traditional RID's cropping calendar and the actual rice cropping pattern derived from the time series NDVI of the Terra/MODIS satellite.

Cropping calendar in Flood season





Research framework

❖ Normalized Difference Vegetation Index (NDVI) data

Terra/MODIS 8-day composite products (MOD09Q1) at 500m resolution

Band 1 (red band, 620-670 nm)

Band 2 (near-infrared band, 841-876 nm)

$$NDVI = \frac{\rho_{NIR} - \rho_{RED}}{\rho_{NIR} + \rho_{RED}}$$

ρ_{NIR} = surface reflectance of near-infrared (NIR)

ρ_{RED} = surface reflectance of visible red (RED)

The range of NDVI values between -1 to1

NDVI Values	Identify
High (0.6-0.8)	a dense green vegetation canopy
Low (near Zero)	bare area or urban area
Negative	water and cloud

❖ Reservoir Operation Study (ROS)

is a Microsoft Excel sheet to calculate irrigation water requirements.

$$W_g = \frac{W_n}{E_i}$$

$$W_n = ET_c - R_e$$

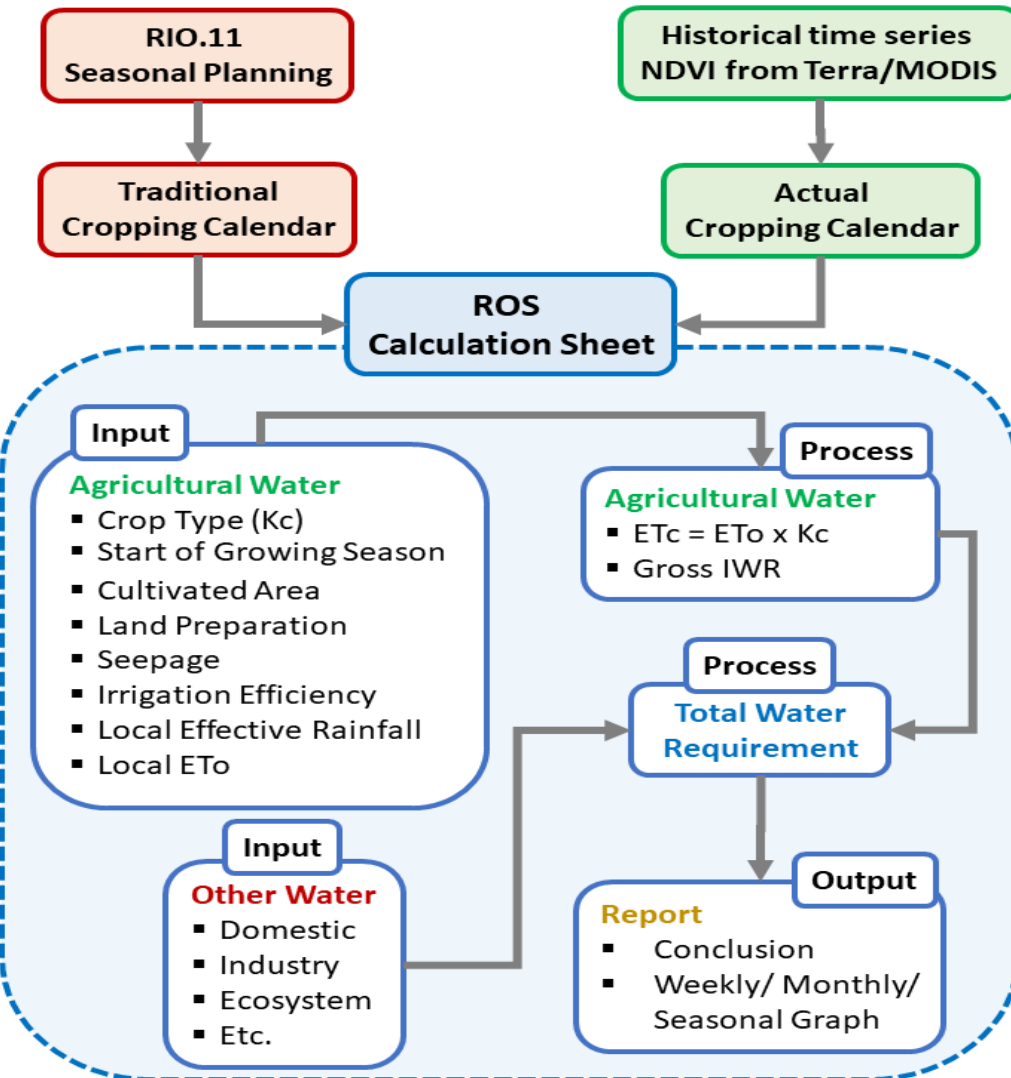
$$ET_c = K_c \times ET_o$$

Year	In-season rice (ha)	Off-season rice (ha)
2017	56,000	53,083
2018	53,216	39,859

W_g = Gross irrigation water requirements

W_n = Net water application

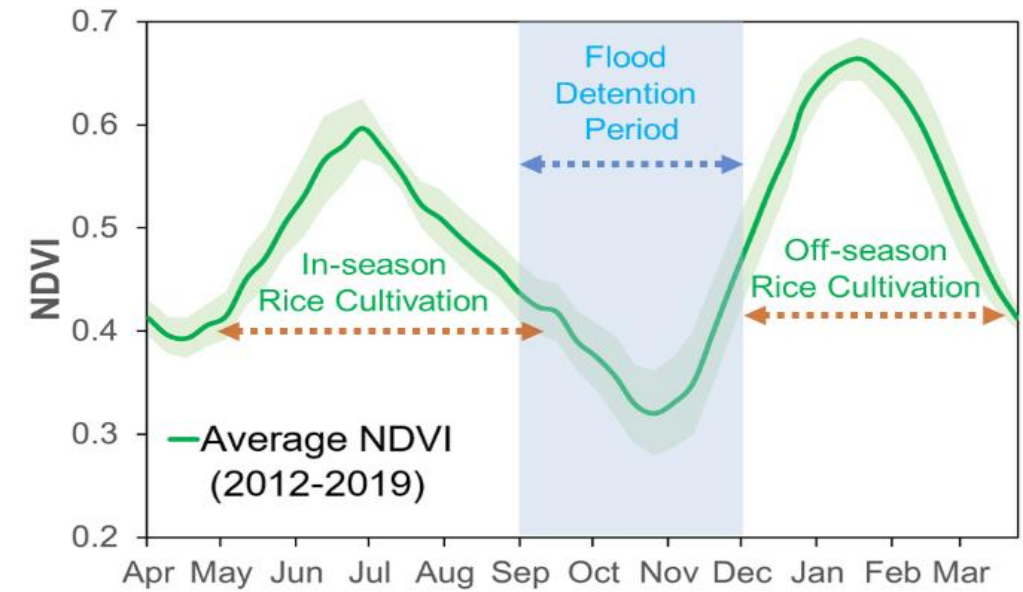
- E_i = irrigation efficiency of 45%
- Seepage of 7 mm week⁻¹
- Land preparation of 240 mm week⁻¹
- ET_o using the Penman-Monteith method
- K_c values were obtained from RID's crop coefficient database
- R_e , effective rainfall using the weighted rainfall method from RID



Research framework

Results

Average NDVI obtained from Terra/MODIS satellite during 2012-2019.



Cultivation start

In-season rice : April – September
Off-season rice : December - April



Flood detention period

September - December

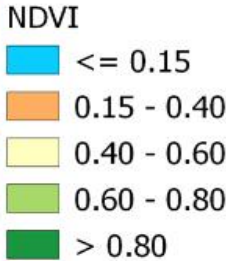
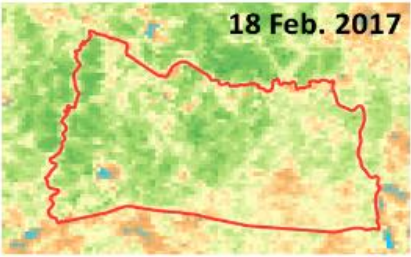
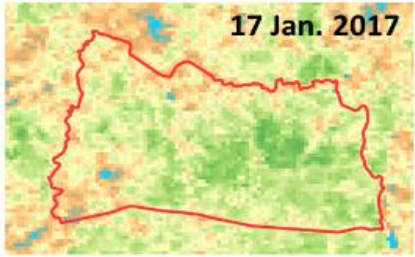
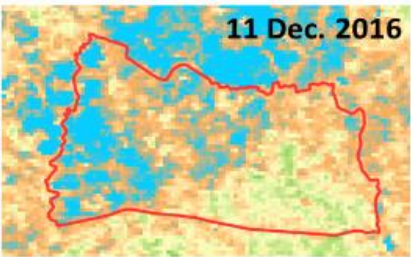
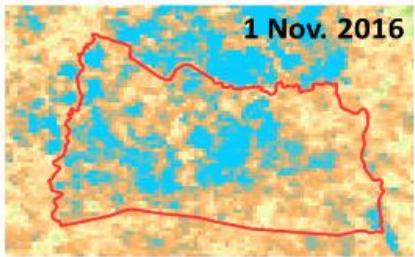
➤ **NDVI Map**

1st November and 11th December 2016 : **Flood**
17th January and 18th February 2017: **Cultivation**

➤ **NDVI Value**

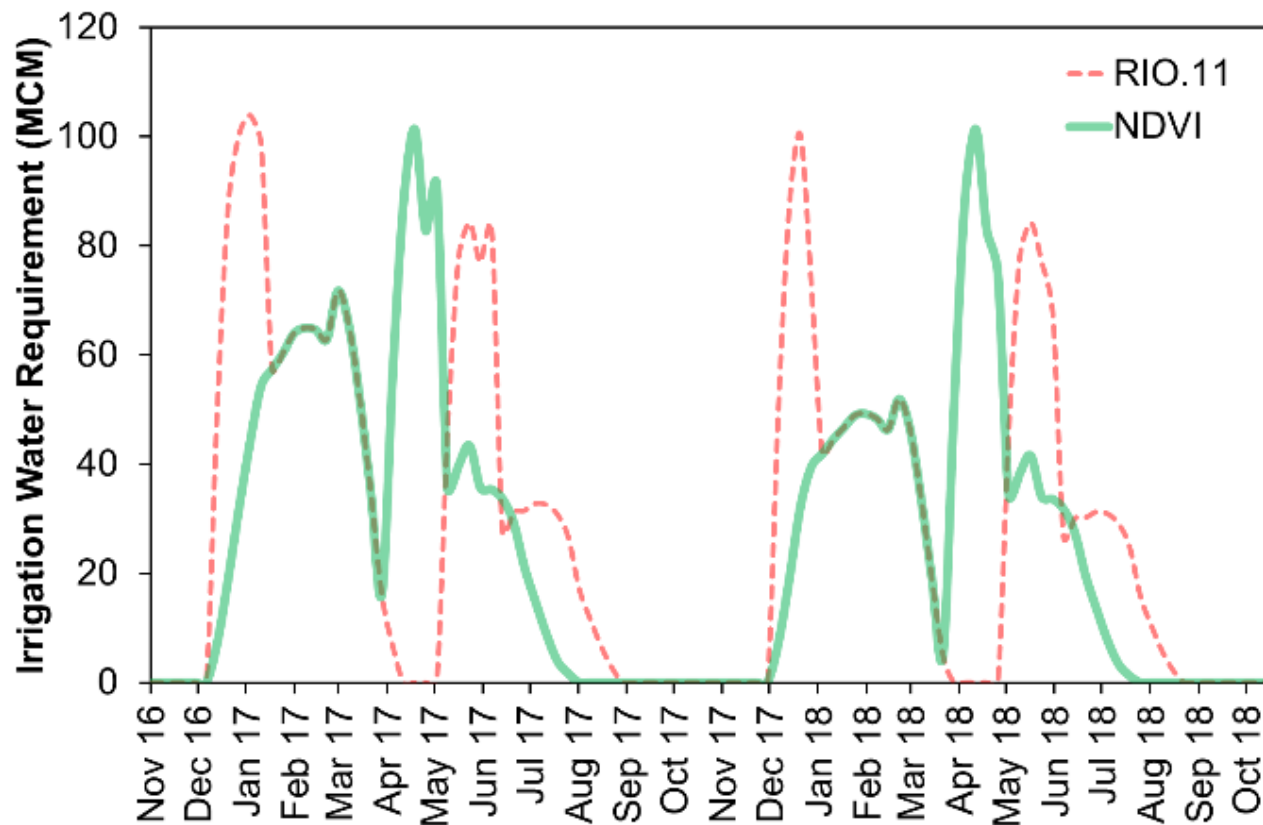
Eastern area > Western area

the flooding on the eastern area could be drained before the western area.



NDVI maps of the CCBY during the dry season of 2016/17.

Results



Weekly irrigation water requirements of the CCBY during 2017- 2018.

➤ **Flood detention period:**

$NDVI > RIO.11$

➤ **Off- season rice:**

$NDVI < RIO.11$

➤ **In- season rice cultivation on:**

RIO.11: **9 - 15 May**

Historical NDVI: **4 – 10 April**

Therefore, the policy of shifting the cropping calendar in 2017-18 **is not well-matched** with an identical pattern according to the historical NDVI.

Results

Year	Season	Gross IWR (MCM)	
		RIO.11	NDVI
2017	Off-season rice	1,060.56	777.45
	In-season rice	619.18	717.19
	Total	1,679.69	1,494.64
	Difference	185.05 (11.01%)	
2018	Off-season rice	792.50	579.92
	In-season rice	589.66	684.26
	Total	1,382.16	1,264.18
	Difference	117.98 (8.54%)	



Rainy season in central Thailand starts around **mid-May**

Therefore, starting **rice cultivation in April** may **require more irrigation water** due to **less effective rainfall.**

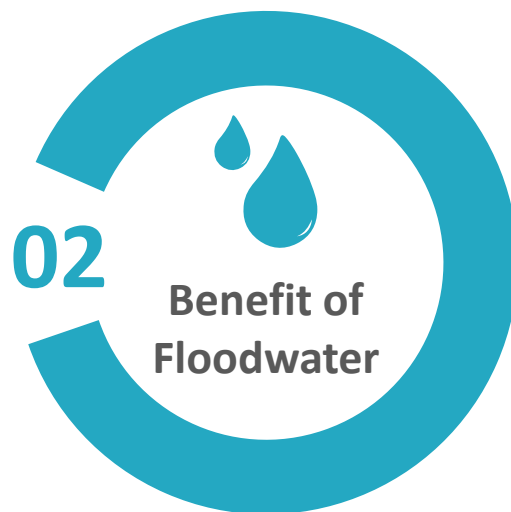


The gross IWR for off-season rice cultivation **decreased** because farmers could take **advantage** of the remaining floodwater for land preparation water

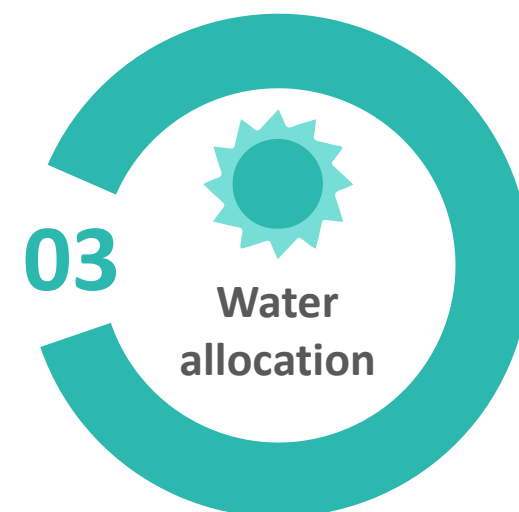
Discussion



The shifted rice cropping pattern derived from the time series NDVI indicated that **farmers had an autonomous adaptation to flooding before the Ministry of Agriculture and Cooperative policy was promulgated.**



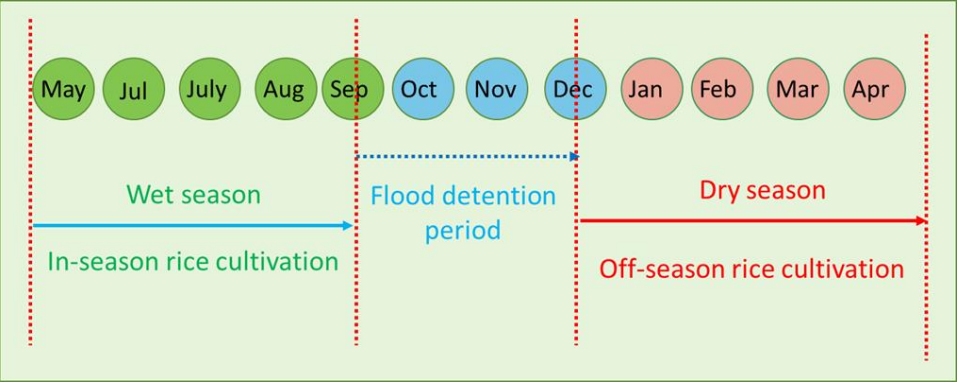
Floodwater during the benefit period is valuable for preparing the land to cultivate rice .
Thus, **land preparation water should not be taken into account in the gross IWR calculation** after the flood detention period



Changing the cropping calendar is suggested to **photo-insensitive rice varieties only** due to the constant crop duration and not affecting irrigation water requirements.

Conclusion

Old cropping calendar

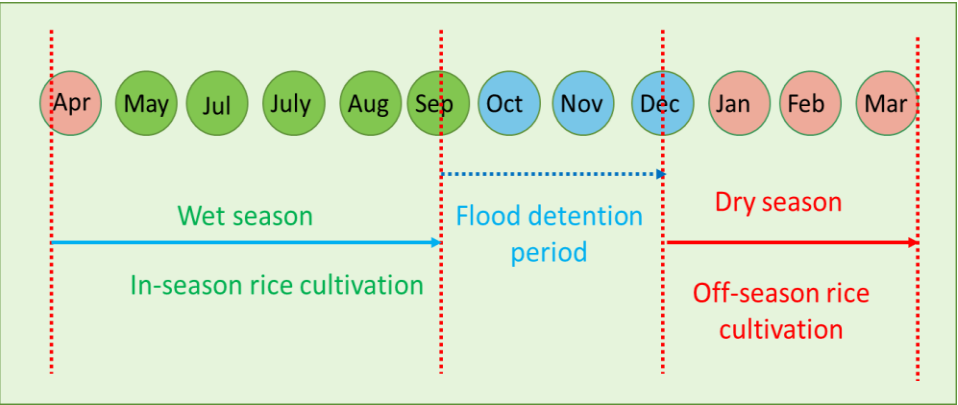


Cropping calendar: Start date of growing rice

Wet season: 4 -10 April

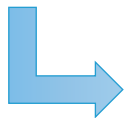
Dry season: 13 – 19 December

New cropping calendar



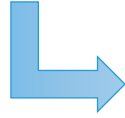
Irrigation Water : **SAVE**

In 2017

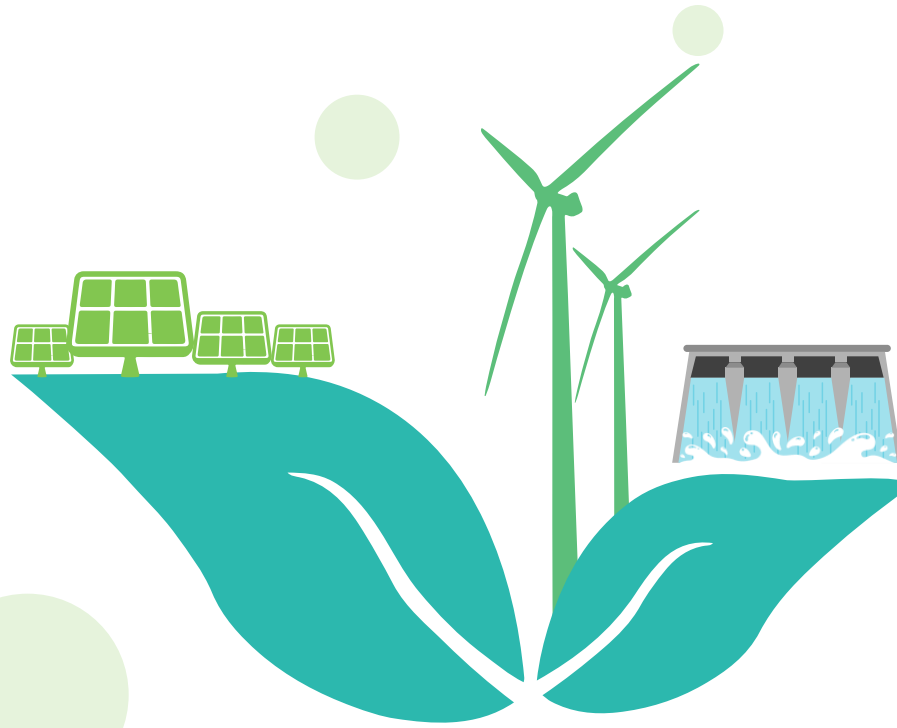


11.01%
185.05 MCM

In 2018



8.54%
117.89 MCM



Thank You