

# **Deepwater rice field detection: Re-evaluating the 2011 flood in Thailand**

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# Overview

- \* Introduction
- \* Data description
- \* Methodology
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Source: Siamrath.co.th



Source: Thaipublica.org

# 1. Introduction

- Rice is a staple food in Thailand and *rice farmers* account for the ***biggest proportion*** of total number of farmers (National Economics and Social Development Council, 2020)
- According to Ministry of Agriculture and Cooperatives of Thailand (2020), during the period 2008-2019, climatic events had affected 9.50 million farmers of which rice farmers had the largest share and floods were major climatic constraint, constituting over ***70 percent of government budget***
- To date, ***the 2011 flood*** was the worst flood in history of Thailand. In addition, the extremely devastating floods caused the country to rise the top of the Climate Risk Index for 2011 (Germanwatch, 2013). Furthermore, the same scale as the 2011 flood is expected to ***happen again*** in the future (Komori et al., 2012)
- Therefore, it is necessary to study rice production in responding to major climatic disaster like severe floods, highlighting the ***different rice ecosystems***' characteristics and nature under the ***long-term submergence*** condition

## 2. Data description

### 2.1 Satellite image

MOD09A1 - - > MODIS, 8-day, 500-m resolution in 2011

### 2.2 Rice data

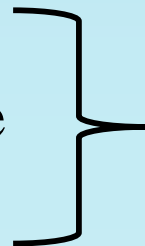
(1) a. *Rice seasons*: Rain-fed rice and Irrigated rice seasons

b. *Rice ecosystems*:

★ Rain-fed lowland

★ Deepwater/ Floating rice

Upland rice



**Rain-fed rice season**

★ Irrigated lowland → **Irrigated rice season**

## 2. Data description (Contd)

### (2) *Special characters of rice*

**Table 1** Elongating ability and water depth tolerance of rice ecosystems in Thailand

Elongating ability	Water-depth tolerance (cm)	Rice ecosystem
Non-elongating	< 80	Rain-fed and irrigated lowland rice
Slow-elongating (2-3 cm/day)	80-150	Deepwater rice
Fast-elongating (15-25 cm/day)	>150	Floating rice

Source: Prachinburi Rice Research Centre, 2018

- (3) *Rice varieties*
- 11 rain-fed lowland rice varieties
  - 9 irrigated lowland rice varieties
  - 14 deepwater rice varieties

### (4) *Rice statistics of 2011 at **district level***

- rice production areas, rice harvested areas and rice varieties for both rice seasons
- deepwater rice - - > surveyed by Prachinburi Rice Research Centre

# Rice growth development



Source: mdpi.com



Source: oecd-illibrary.org

# 3.Methodology

- The rice cultivation area is generally a combination of water surface and green canopy from the rice leaves. We then use the surface reflectance value to calculate the vegetation indices (*NDVI and EVI*) and the water index (*LSWI*), representing the green canopy and water thickness in the rice field
- The combination of the *three indices* together with the three rice growth development phases and the rice field's characterisation can help to identify the rice pixel
- Basically, we follow the thresholds developed by Xiao et al. (2005; 2006). However, the original algorithm is generally used for *lowland rice field detection*, particularly rain-fed and irrigated rice ecosystems, excluding other rice ecosystems
- More specifically, the thresholds are *unlikely to allow detection of deepwater rice* during long-term floods, thereby drastically *reducing the accuracy of satellite detection* on rice fields in flood-prone areas

### 3.Methodology (Contd)

- Therefore, in this study, we *need to modify* the rice field detection algorithm and *propose new threshold* to detect locations of major rice ecosystems in Thailand at a 500-m resolution
- The threshold of Xiao et al. (2005; 2006) *excludes a persistent water body pixel* from the analysis if the pixel has  $NDVI < 0.10$  and  $NDVI < LSWI$  for ten or more 8-day composite periods (at least 80 days) in the year
- To this end, a true deepwater rice pixel during a long period of submergence is identified if that pixel has either  *$NDVI > 0.1$  or  $EVI > 0.1$  and  $LSWI > 0.1$  for at least ten or more 8-day composite periods (at least 80 days)* in that crop cycle



# 4. Results

## 4.1 Rice field detection using the threshold of Xiao et al. (2005; 2006)

- The algorithm of Xiao et al. (2005; 2006) excludes the rice field detection of deepwater rice
- As a consequence, the accuracy of the two categories of deepwater rice is considerably lower than the harvested areas from the statistics

**Table 2** The results of accuracy of deepwater rice in 2011 using the threshold of Xiao et al (2005; 2006)

Rice	Harvested areas from statistics (Ha)	Harvested areas from MODIS (Ha)	Accuracy (%)
1. Deepwater rice in 46 Provinces	62,246.32	21,691.36	34.85
2. Deepwater rice in 8 Provinces	39,952.64	4,458.22	11.16

## 4. Results (Contd)

### 4.2 Rice field detection using *proposed threshold*

- The accuracy of the three rice ecosystems: rain-fed lowland, irrigated lowland and deepwater rice ecosystems
- Overall, the accuracy for the three rice ecosystems exceeds 80 percent

**Table 3** The results of accuracy assessment of three rice ecosystems in 2011

Rice	Harvested areas from statistics (Ha)	Harvested areas from MODIS (Ha)	Accuracy (%)
1. Rain-fed lowland rice	8,935,573.60	7,339,940.57	82.14
2. Irrigated lowland rice	2,901,340.00	2,440,564.00	84.12
3. Deepwater rice			
3.1 Deepwater rice in 46 Provinces	62,246.32	50,064.66	80.42
3.2 Deepwater rice in 8 Provinces	39,952.64	32,282.64	80.80

# 4. Results (Contd)

Fig. 1 Spatial distribution of MODIS-derived areas of different rice ecosystems in 2011

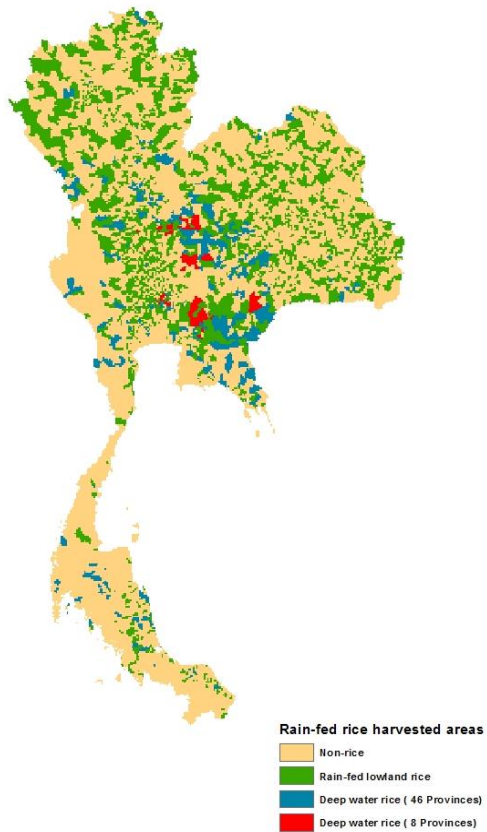


Fig. 2 Spatial distribution of MODIS-derived areas for rain-fed rice season in 2011

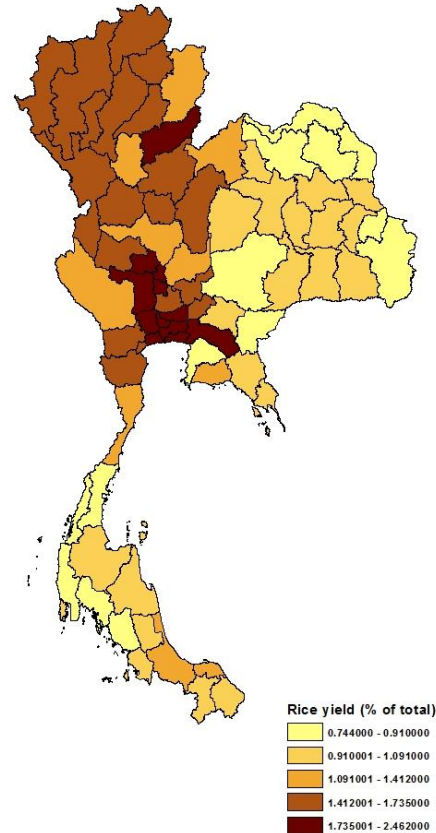
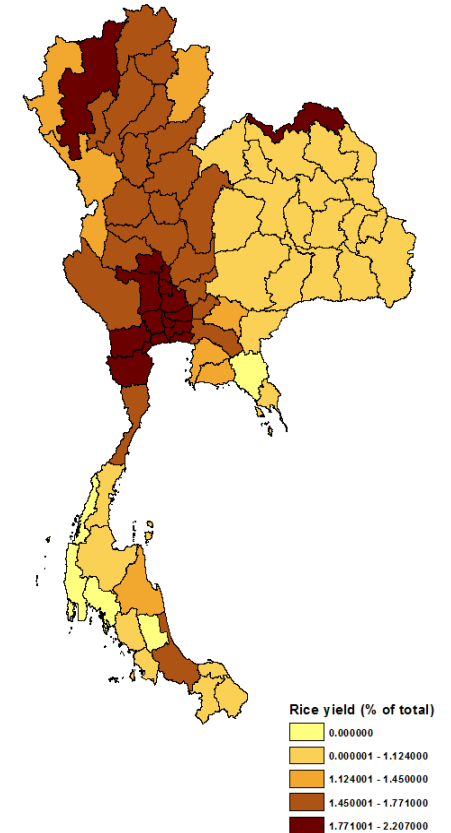


Fig. 3 Spatial distribution of MODIS-derived areas for irrigated rice season in 2011



# 5. Conclusion

## 5.1 Ways forwards

- Deepwater rice *should be grown* in flood-prone areas
- The government should support rice farmers, particularly in flood-prone areas, to cope with *frequent and intense floods* in the future

## 5.2 Future prospects

- We would like to explore *deepwater rice in Cambodia* facing floods in 2011
- We would also like to explore *deepwater rice in Bangladesh*

# **Thank you**

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