Rice field detection in Thailand through satellite imagery

Jainta Chomtoranin[1], Eric A. Strobl[2], Robert J. R. Elliott[1], and Elodie Blanc[3]

[1] Economics Department, University of Birmingham, Birmingham, United Kingdom

[2] Economics Department ,University of Bern, Bern, Switzerland

[3] Joint Program on the Science and Policy of Global Change, Massachusetts Institute of Technology, Cambridge, USA

Background

- Between 1989 to 2002, reduction in rice yield due to weather events was estimated to be about 1.25 bil. USD (Asian Development Bank, 2009).

- Floods and droughts are the major threats, however, floods have a more severe impact on rice production (Chemin et al., 2012).

- The most costly natural disaster in the last 50 years was the 2011 flood that caused the economy to lose about 45.7 bil. USD of which rice was the largest share (Nara et al., 2014).

- Thailand has 2 major rice seasons: rain-fed season (80 percent) and irrigated season (20 percent) (Office of Agricultural Economics, 2014).

- In addition, the country has 4 rice ecosystems: rain-fed season (rain-fed lowland, deep water, and upland) and irrigated season (irrigated lowland).

Objectives

- To analyse the different rice ecosystems of the country during the 2011 flood.

- To investigate the impact of the 2011 flood on the different rice ecosystems.

Data

- MODIS/Terra Surface Reflectance 8-day L3 Global 500m SIN Grid V005 (MOD09A1) for 2011.

- Rice statistics at the district level for 2011.

- Surveyed deep water rice statistics at the district level for 2011.

Methodology

- We calculated Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), and Land Surface Water Index (LSWI).

- We follow the rice field detection algorithm developed by Xiao et al. (2005;2006).

- However, the algorithm can only detect rain-fed and irrigated rice ecosystems but excludes deep water rice during long-term flooding events.

- Thus, we need to modify the rice field detection algorithm to detect locations of major rice ecosystems of Thailand.

Results

Table 1 The results of accuracy assessment of three rice ecosystems in 2011

Rice ecosystems	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. Deep water rice			
3.1 Deep water rice in 46 Provinces	62,246.32	50,064.66	80.42
3.2 Deep water rice in 8 Provinces	39,952.64	32,282.64	80.80

Figure 1. Spatial distribution of MODIS-derived areas of different rice ecosystems for rain-fed season in 2011
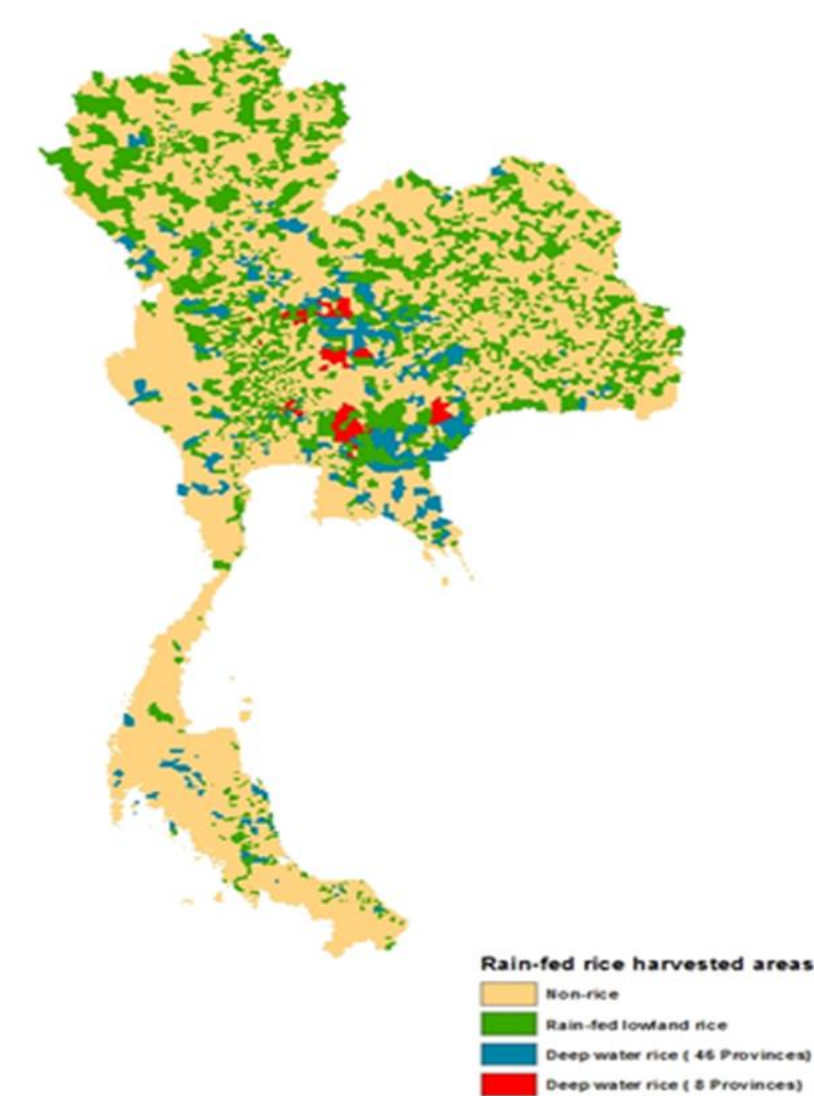
Figure 2 Rice production variation in 2011 of two rice growing season: Rain-fed (left) and irrigated (right)
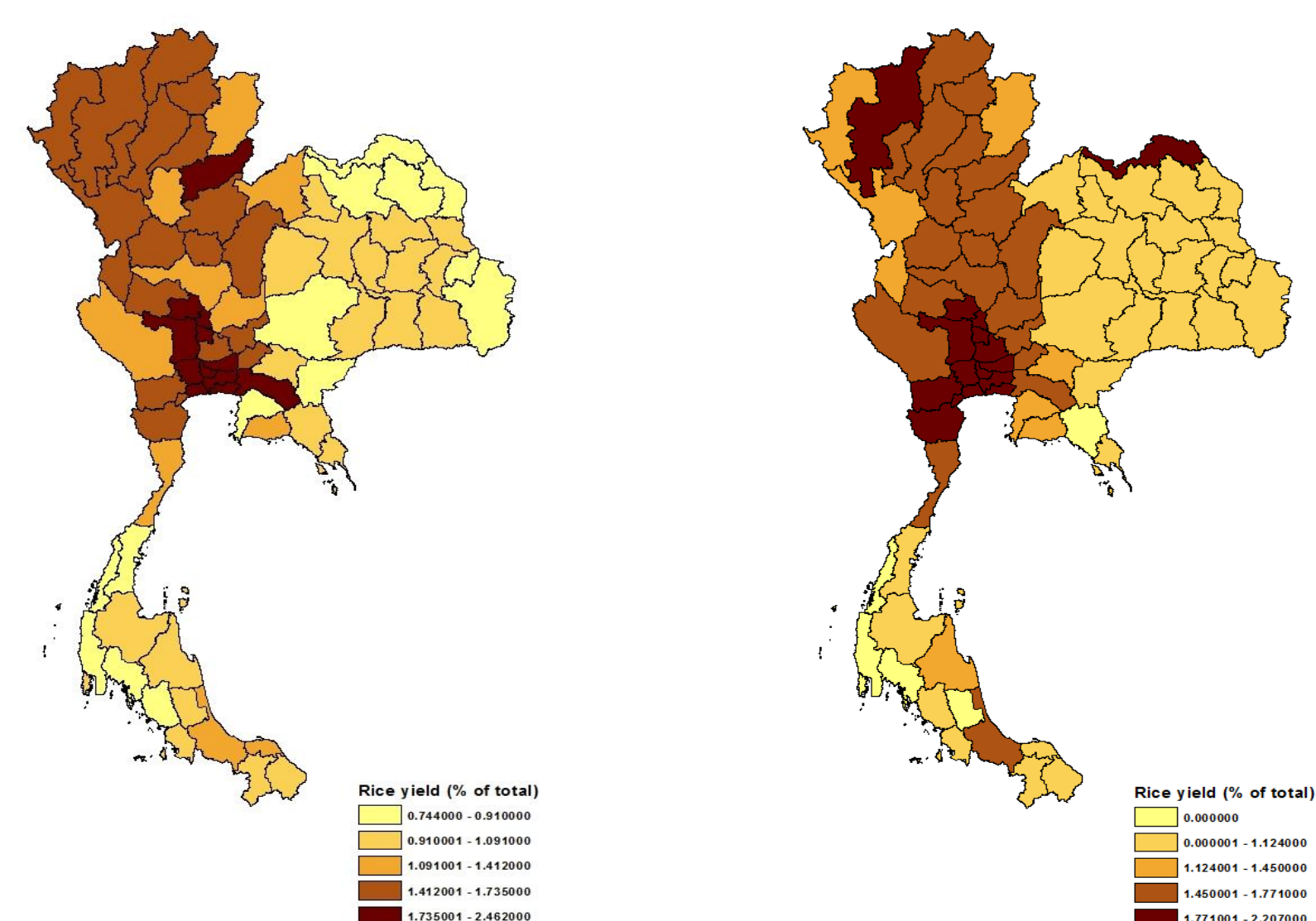
Conclusion

- Our study can be considered as the first attempt to classify different rice ecosystems in Thailand successfully.

- The accuracy are over 80 percent for the rice ecosystems.

- Rice production in Thailand varies considerably across and within provinces for both rice seasons.

- We map the yield of different rice ecosystems for the wet season, consisting of rain-fed lowland and deep water rice ecosystems, which are concentrated in the North.

- Deep water rice survives during long-term submergence which can benefit rice farmers in flood-prone areas.

- For the dry season crop, the rice yield intensification is located in the central part of the country.

References

- Asian Development Bank (2009). *The Economics of Climate change in Southeast Asia: A regional review*. Manila: Asian Development Bank.
- Chemin, Y., Phuphak, S., AJilo, S. and Hijmans, R. J. (2012). Determining Spatial and Temporal Patterns of Submergence in Rice with MODIS Satellite Data. *International Journal of Geoinformatics*. 8, 2, pp. 1-12.
- Nara P., Mao G. and Yena T. (2014). Climate Change Impacts on Agricultural Products in Thailand: A Case Study of Thai Rice at the Chao Phraya. *APCBEE Procedia*. 8, pp. 136 – 140.
- Office of Agricultural Economics (2014). *Agricultural statistics 2013*. Ministry of Agriculture and Cooperatives, Bangkok.
- Xiao X., Stephen T.B., Liu J., Zhuang D., Frolking S., Lia C., Salas W., and Moore B. (2005). Mapping paddy rice agriculture in southern China using multi-temporal MODIS images. *Remote Sensing of Environment*. 95, pp. 480-492.
- Xiao X., Boles S., Frolking S., Li C., Babu J.Y., Salas W. and Moore B. (2006).Mapping paddy rice agriculture in South and Southeast Asia using multi-temporal MODIS images. *Remote Sensing of Environment*. 100, pp. 95-113.