

Rethinking the Agrarian Transition in Rice Farming in Southeast Asia

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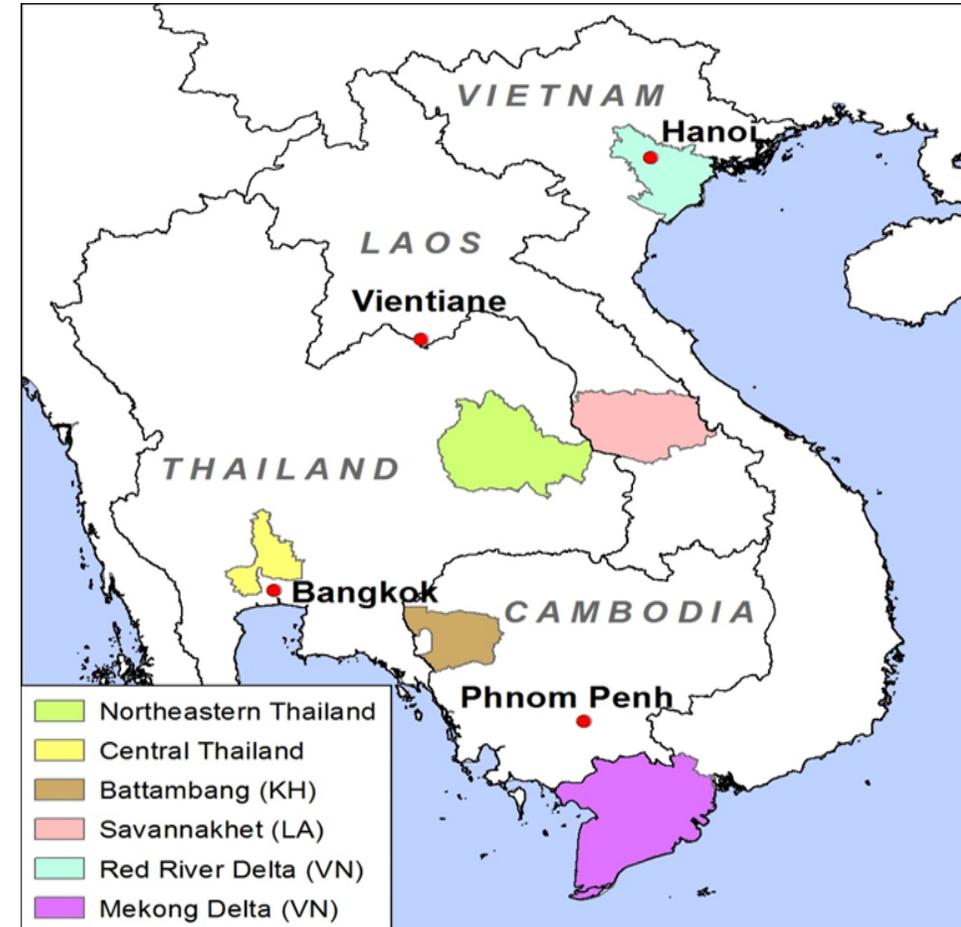
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The agrarian transition in Mainland Southeast Asia: Changes in rice farming—2000 to 2018

- Funded by NASA's Land-Cover and Land-Use Change Program
- Identified six major rice basins that have shown substantial changes in their rice production for more intensive study.



Project Objectives

The project is a multi-disciplinary effort that conducts work at two nested scales:

Regional

- Analyzed remotely sensed images to monitor long-term changes (2000 to 2018)

Local:

- Conducted focus group discussions and household interviews for a place-based understanding of changes between 2000 and 2018
 - Completed 240 interviews in each of the six rice growing basins for a total of 1,440 interviews
 - Analyzed interview data to identify variables associated with change.

Theory of the Agrarian Transition

As per capita income rises:

- **Economies diversify, workers leave agriculture**
- **Rural wages go up**
- **Capital becomes cheaper relative to land and labor**
- **Large farms become more efficient**
- **Mechanized farming accelerates this trend**
- **The result is a transition towards larger farms such as occurred in the west and elsewhere (Hazell and Rahman 2014:3) .**

Background

FAO and World Bank statistics for MSEA show:

In concurrence with theory of agrarian transition

- **Rural population (as a % of total population and the % of agricultural employment) decreased**
- **Average age of farmers increased**
- **Value of agricultural production as a percent of GDP decreased at rates varying from 10% to 28%**

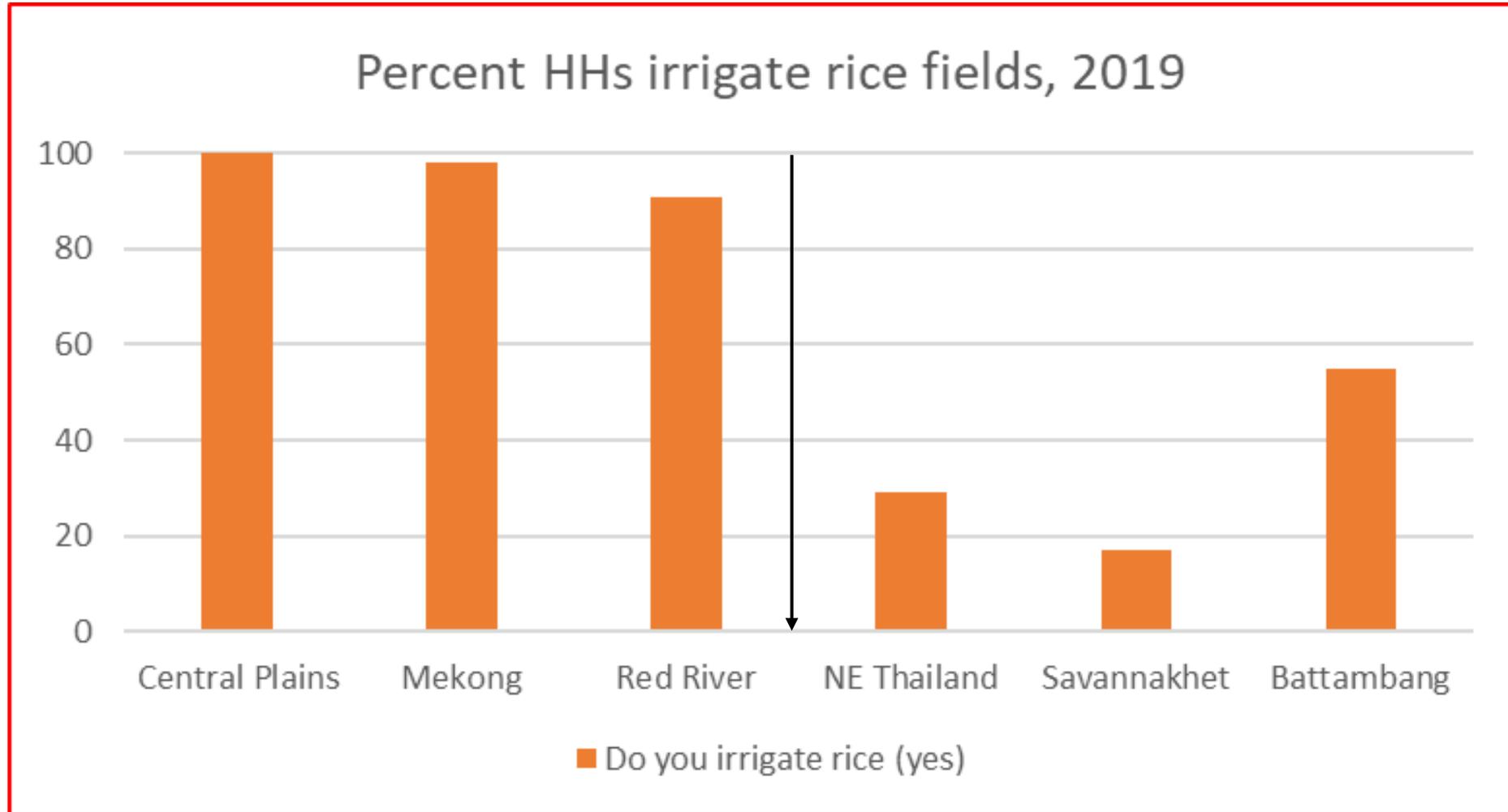
Problem Statement

Contrary to the agrarian transition theory World Bank data shows:

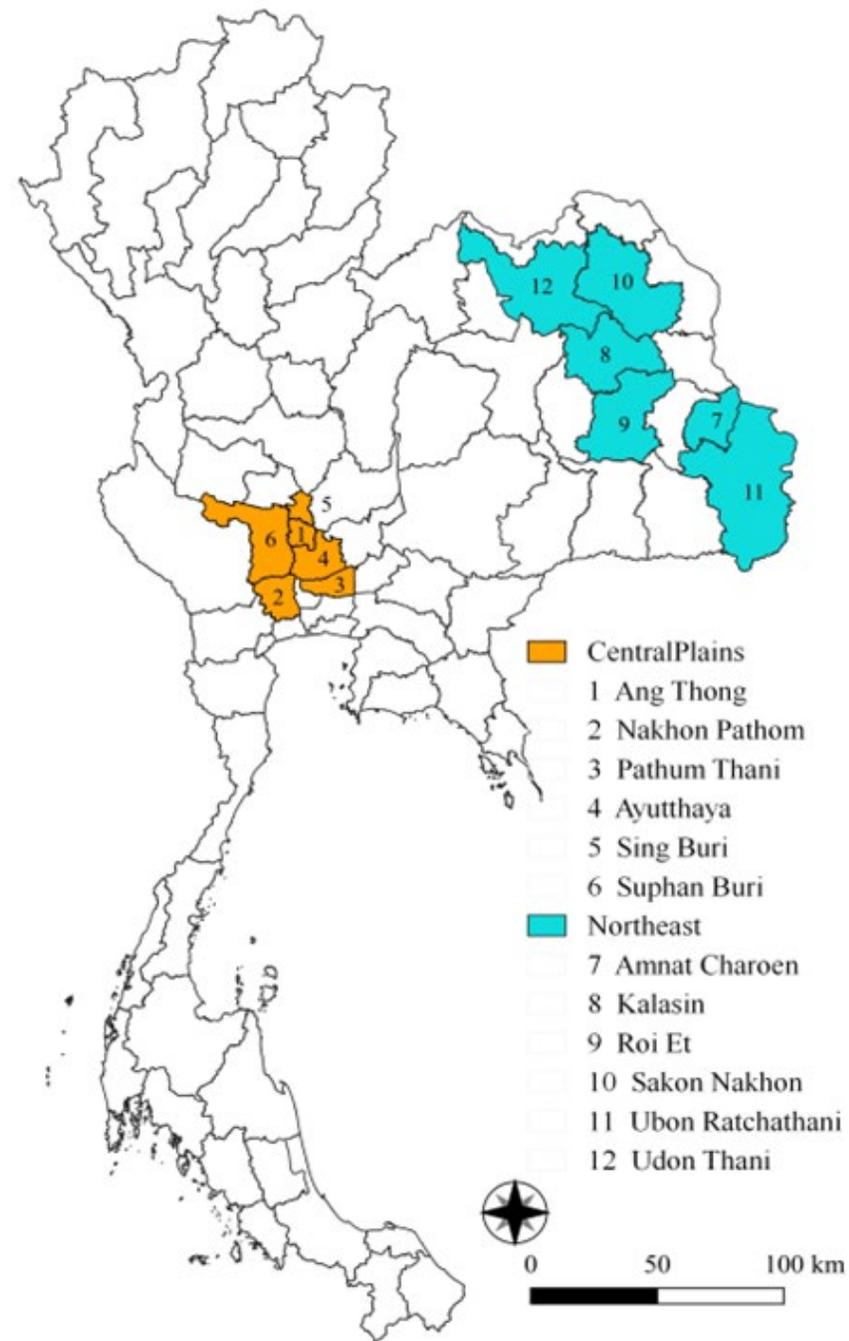
- **Average size of farms decreased to 2 ha.**
- **Rice production increased by an average of 205% between 2000 and 2018**

These statistics raise the question: How did fewer, older farmers with smaller farms increase total rice production?

Geographical Context: Irrigated vs Rainfed



Selected province study sites in Central and Northeast Thailand



Demographics (2018)

HH characteristics	Central Plains	Northeast
Age of farmers interviewed	58	58
No of people living in HH	4.24	3.85*
Total Migrants	0.64	1.55***
Skipped HH (%)	5.42	15.42***
# of family farm workers	1.78	2.07***
# of female family farm workers	0.71	1.05***
Hired laborers 2000 (%)	34.5	57.92***
Hired laborers 2018 (%)	12.40	56.67***
Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% level		

Findings: Access to Land (2018)

Access to Land	Central Plains	Northeast
HHs that own rice land (%)	60.85	96.67%***
HHs that do not own rice land (%)	39.15	3.33***
Average amount of rice land owned (ha)	3.29	2.42**
Average # rice plots	1.18	1.83***
Average amount of rice land farmed	5.58	2.64***
Average amount of non-rice land owned (ha)	1.08	1.70*

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% level

Findings: Access to Water (2000 and 2018)

Access to Water	Central Plains	Northeast
Access to irrigation in 2000	99.22	16.66***
Irrigated area (ha)	5.26	0.70***
Access to irrigation in 2018	99.61	29.17***
Irrigated area (ha)	5.76	0.99***
Built a water storage pond since 2000	8.14	67.50***
Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% level		

Findings: Yields and sources of income (2018)

Access to Water	Central Plains	Northeast
Wet Season (kg/ha)	5,966	2,298***
Dry season yields (kg/ha)	5,821	823***
Rice main income source (%)	93.41	53.00***
Receive remittance income	25.29	58.00***

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% level

Findings: Mechanization—Planting (% of HHs)



Mechanization Planting	Central Plains	Northeast
Transplant 2000	7	87***
Transplant 2018	0	32***
Hand broadcast 2000	69	13***
Hand broadcast 2018	12	56***
Machine broadcast 2000	24	0***
Machine broadcast 2018	88	3***

Findings: Mechanization—Plowing (% of HHs)



Mechanization Plowing	Central Plains	Northeast Thailand
Buffalo/cattle 2000	3	45***
Buffalo/cattle 2018	0	1
Hand tractor 2000	57	55
Hand tractor 2018	7	20***
Large tractor 2000	40	0***
Large tractor 2018	92	79***

Findings: Mechanization—Harvesting (% of HHs)



Mechanization Plowing	Central Plains	Northeast Thailand
Hand harvest 2000	29	97***
Hand harvest 2018	0	29***
Combine 2000	64	2***
Combine 2018	98	68***

Findings: Government support and agricultural policies



% HH receiving government support	Central Plains	Northeast Thailand
Member of ag coop in 2018	78.29	77.08
Received ag training in 2000	34.11	45.42**
Received ag training in 2018	56.98	73.33***
Received Subsidies in 2000	22.89	23.33
Received Subsidies in 2018	77.52	92.08***

Summary

- **Our results suggests that Asian rice farmers are ‘transitioning’ (changing the way they farm) in ways not theorized by the World Bank and others, i.e, economists.**
- **We document a set of variables including demographics (age, # of farmers, migration), access to land and water (amount of land owned, size of plots, irrigation), sources of income (farm and non-farm), mechanization, and government policies that better capture the dynamics of smallholder rice production in Thailand and elsewhere than the agrarian transition that posits a trend towards larger farms.**

Conclusion

- Farms have remained small—but not stagnant
- Rice farms will remain small throughout the foreseeable future
- Changing occurring differently in Thailand than in other parts of the world and it is occurring differently between irrigated and rainfed areas of Thailand.
- The small size of fields, the smaller size of rice plots, and the significant differences between the Central Plains and the Northeast make remote sensing analysis extremely difficult, and perhaps not currently possible in rainfed systems.

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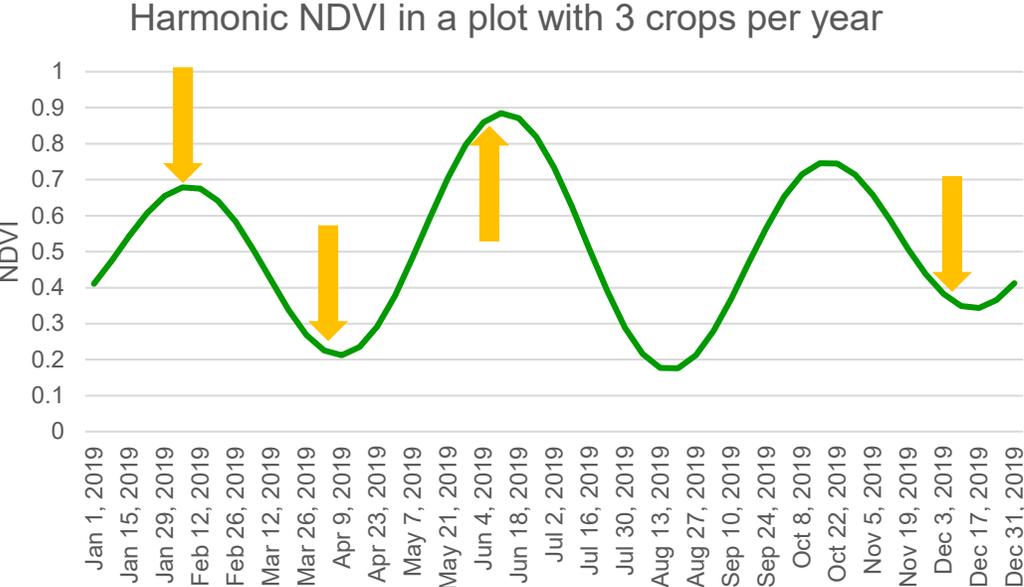
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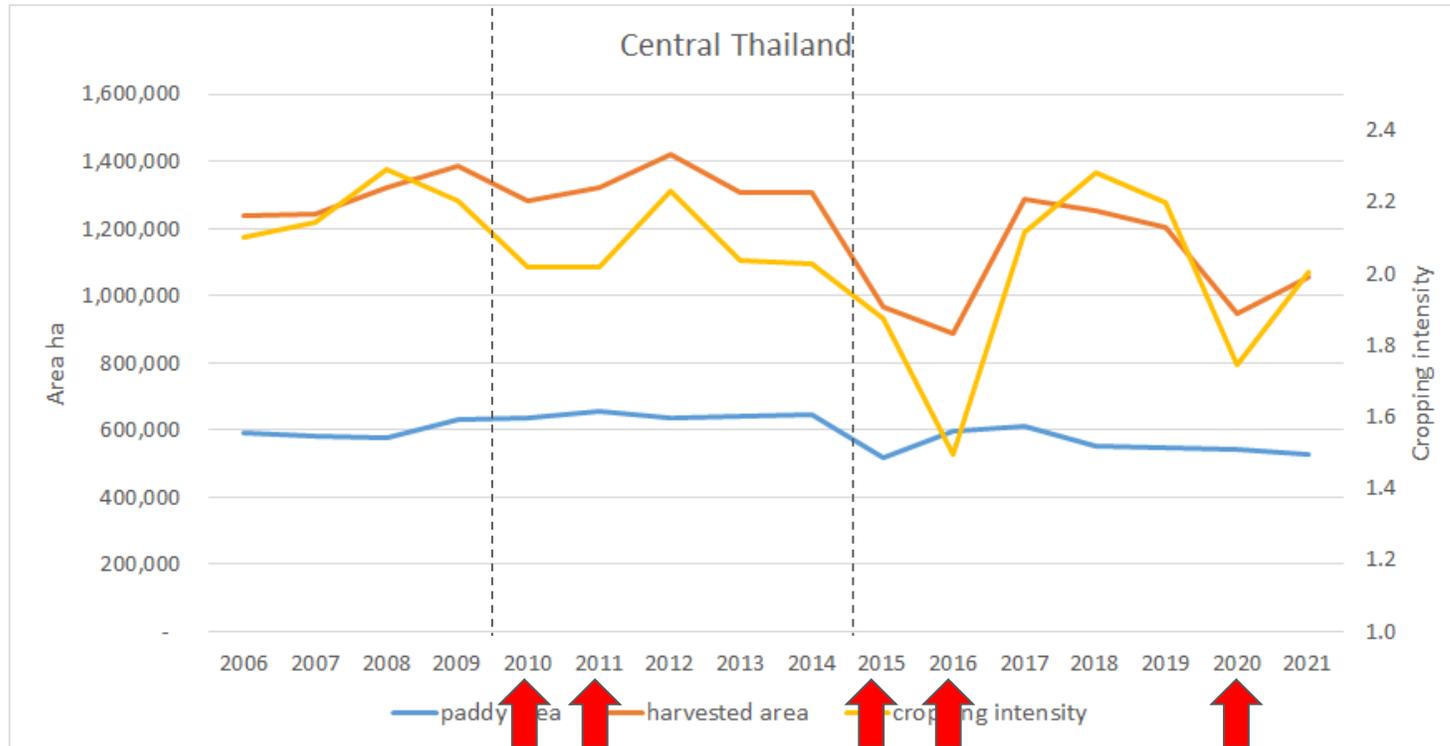
RS of cropping intensities: Example from a plot near Chai Nat, Central Thailand



Using a Fourier transformed time-series of NDVI observations we can map the number of rice crops in a given year. The four high resolution images show a plot with 3 crops per year in 2019 when close to peak greenness (Jan, Jun) and bare (Apr, Dec).

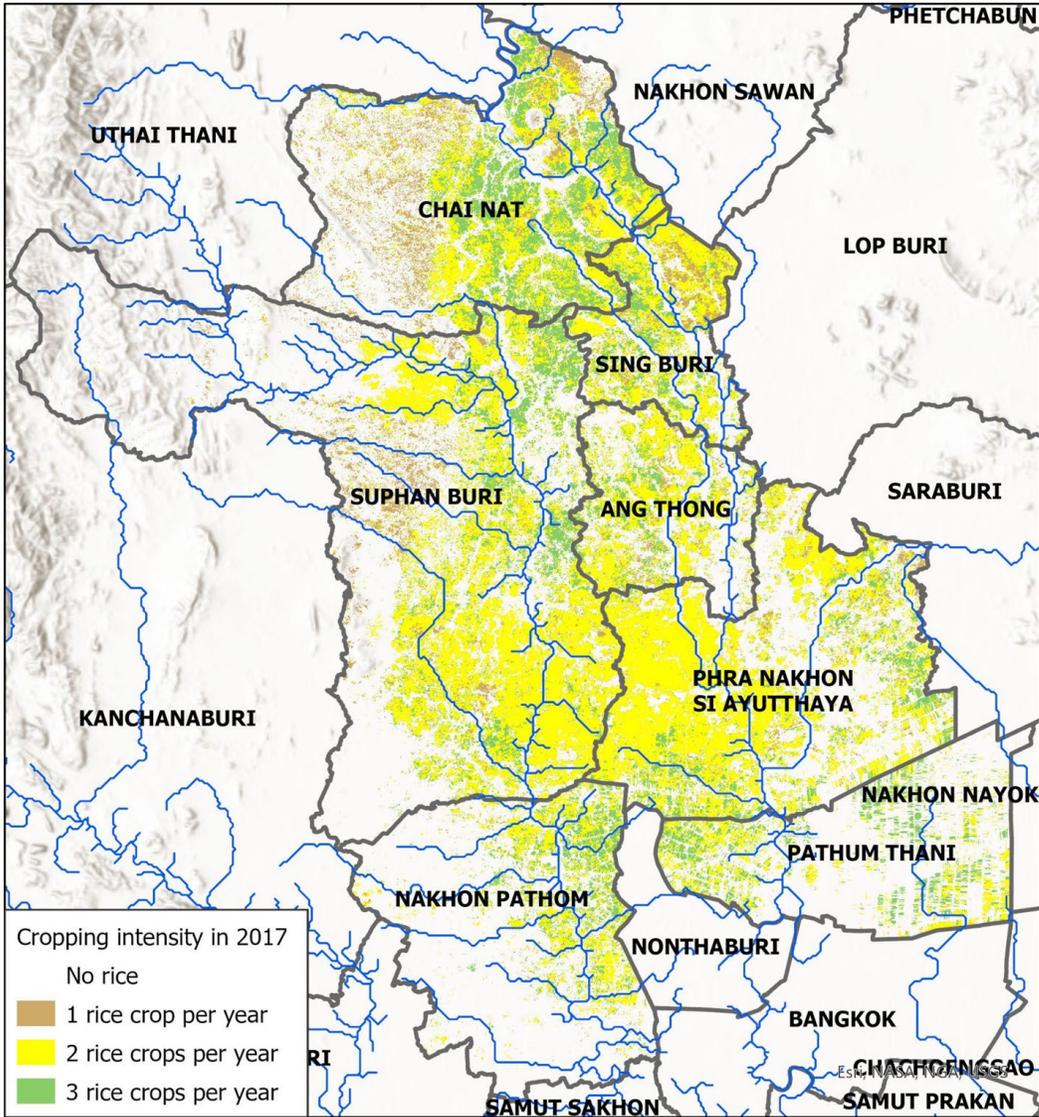
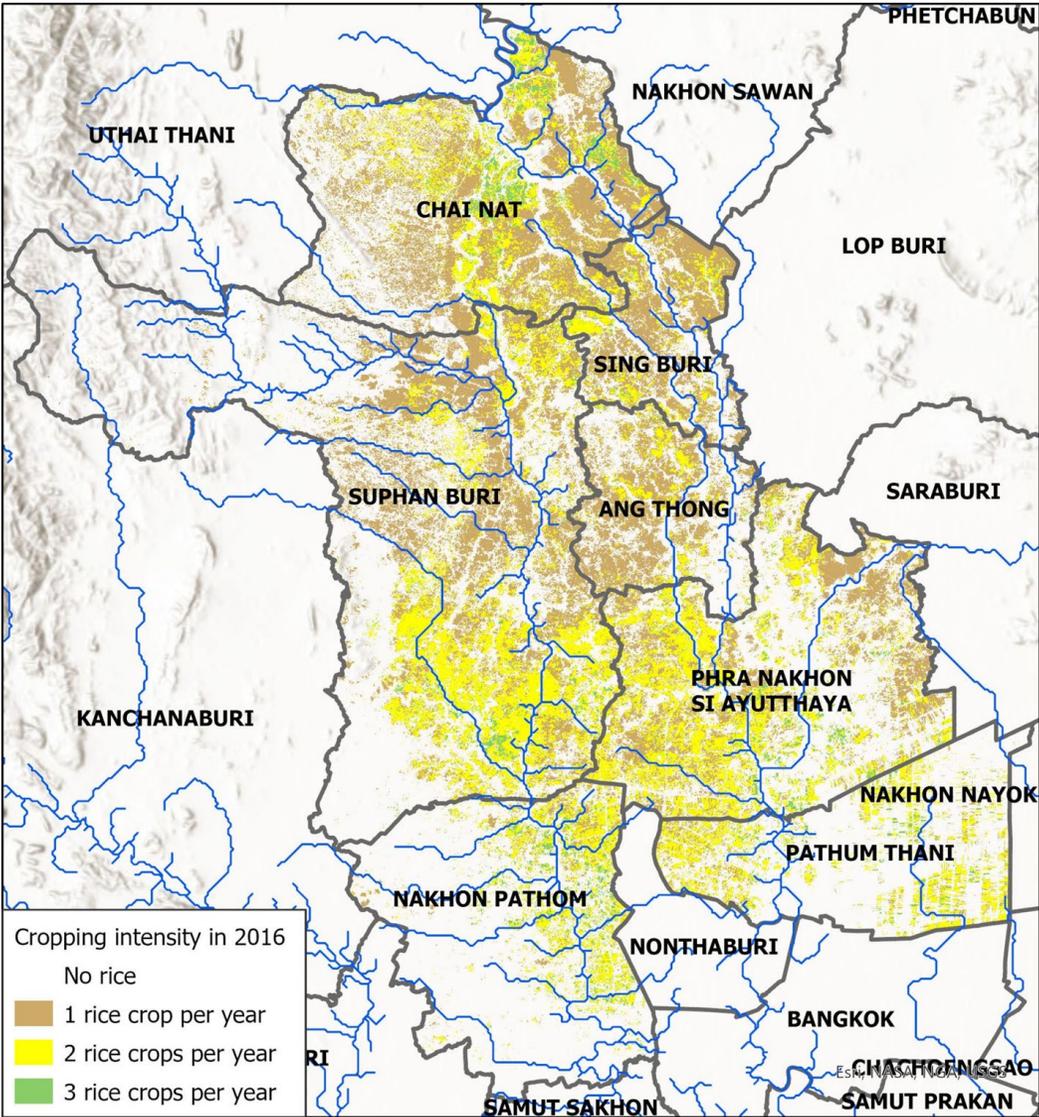


RS results: Changes in paddy area and cropping intensity in Central Thailand 2006-2021

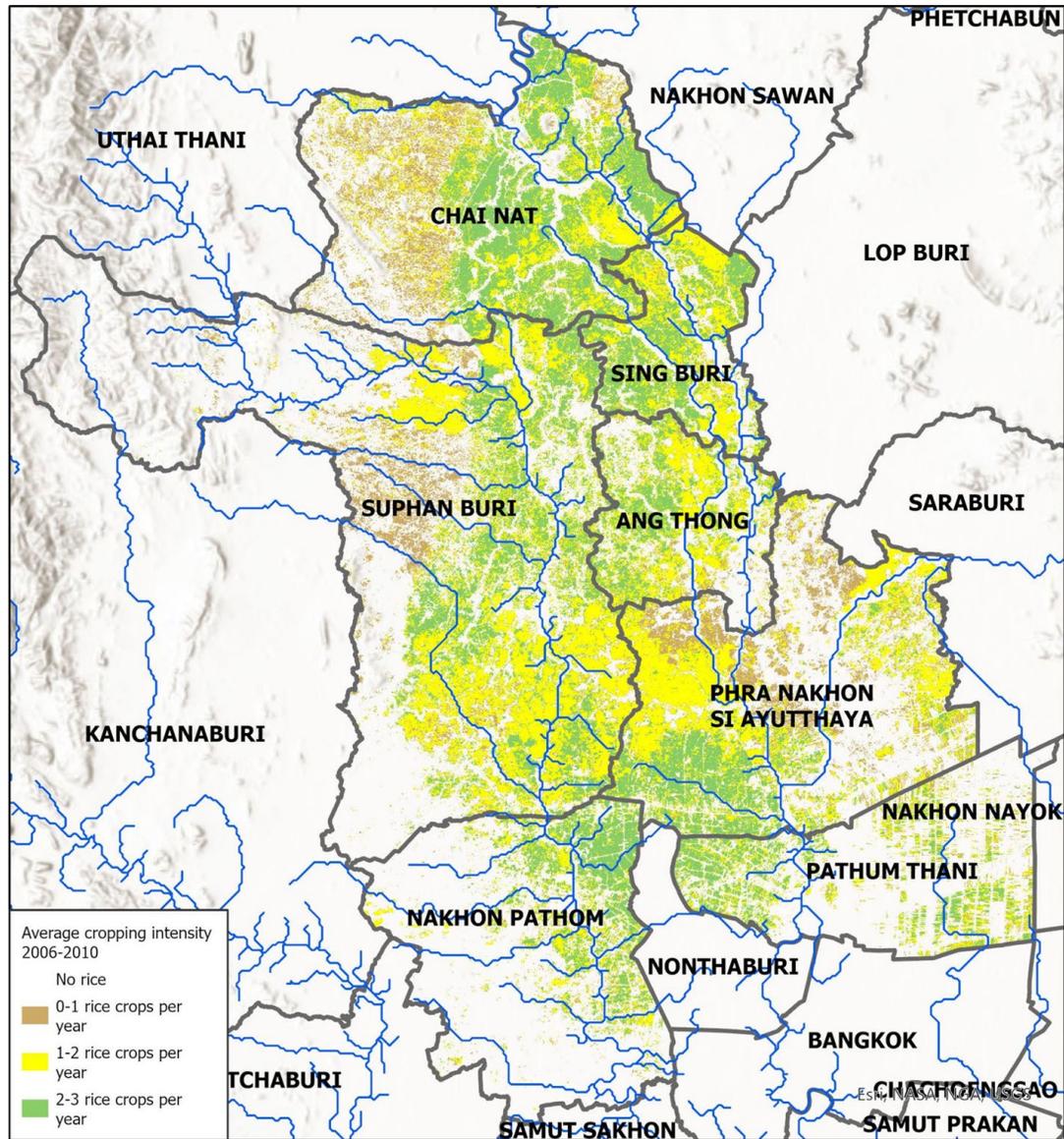


- 2010, 2011: Floods in Central Thailand
- 2010-2015: High subsidies for rice - 'paddy pledging scheme', about 50% above market price
- 2015-2016: Droughts with late rains in 2016
- 2017: Launch of 'large scale schemes' (production of rice in collectives)
- 2020: Drought

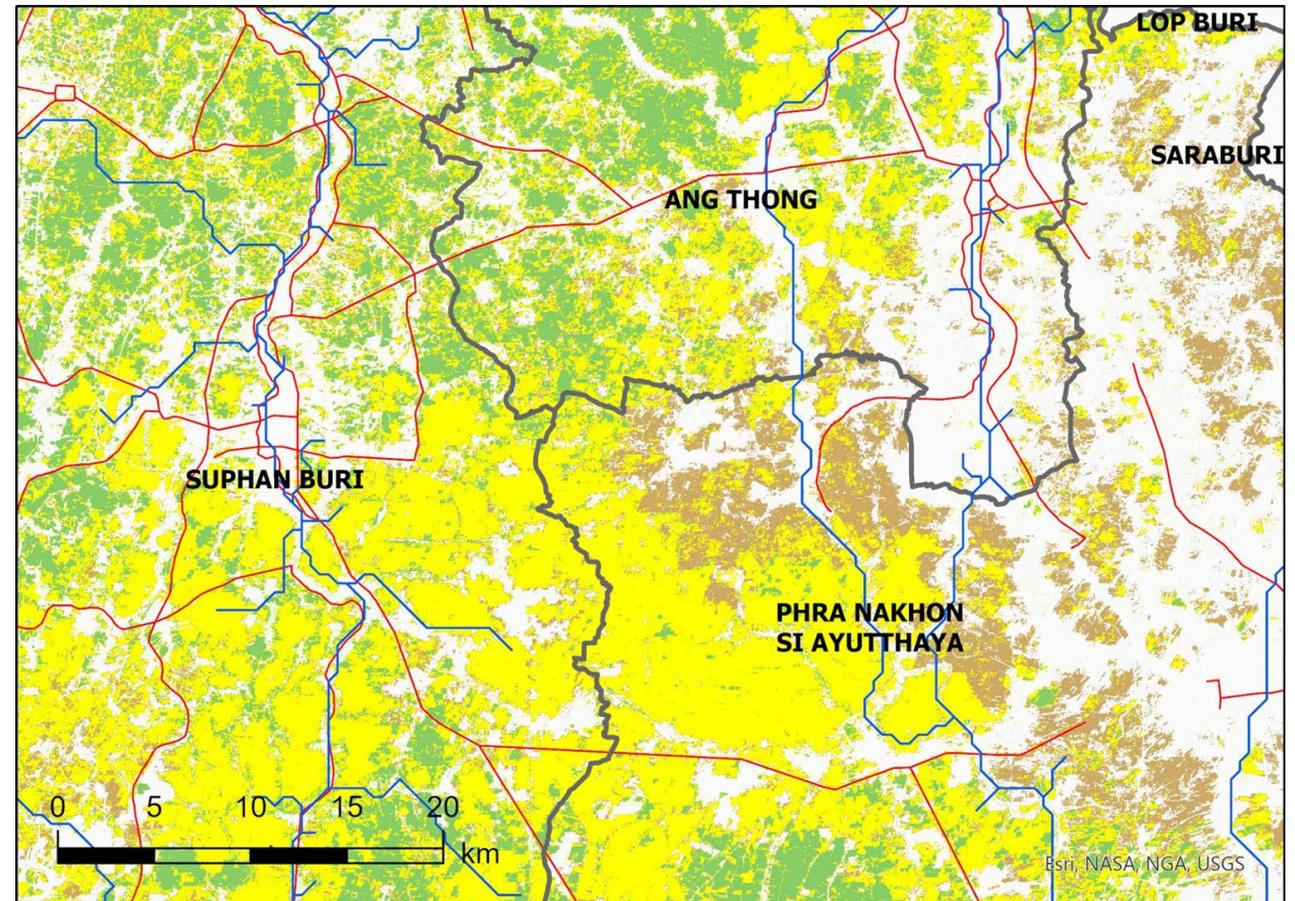
Spatial patterns 2016 (drought / late rains) and 2017 (regular)



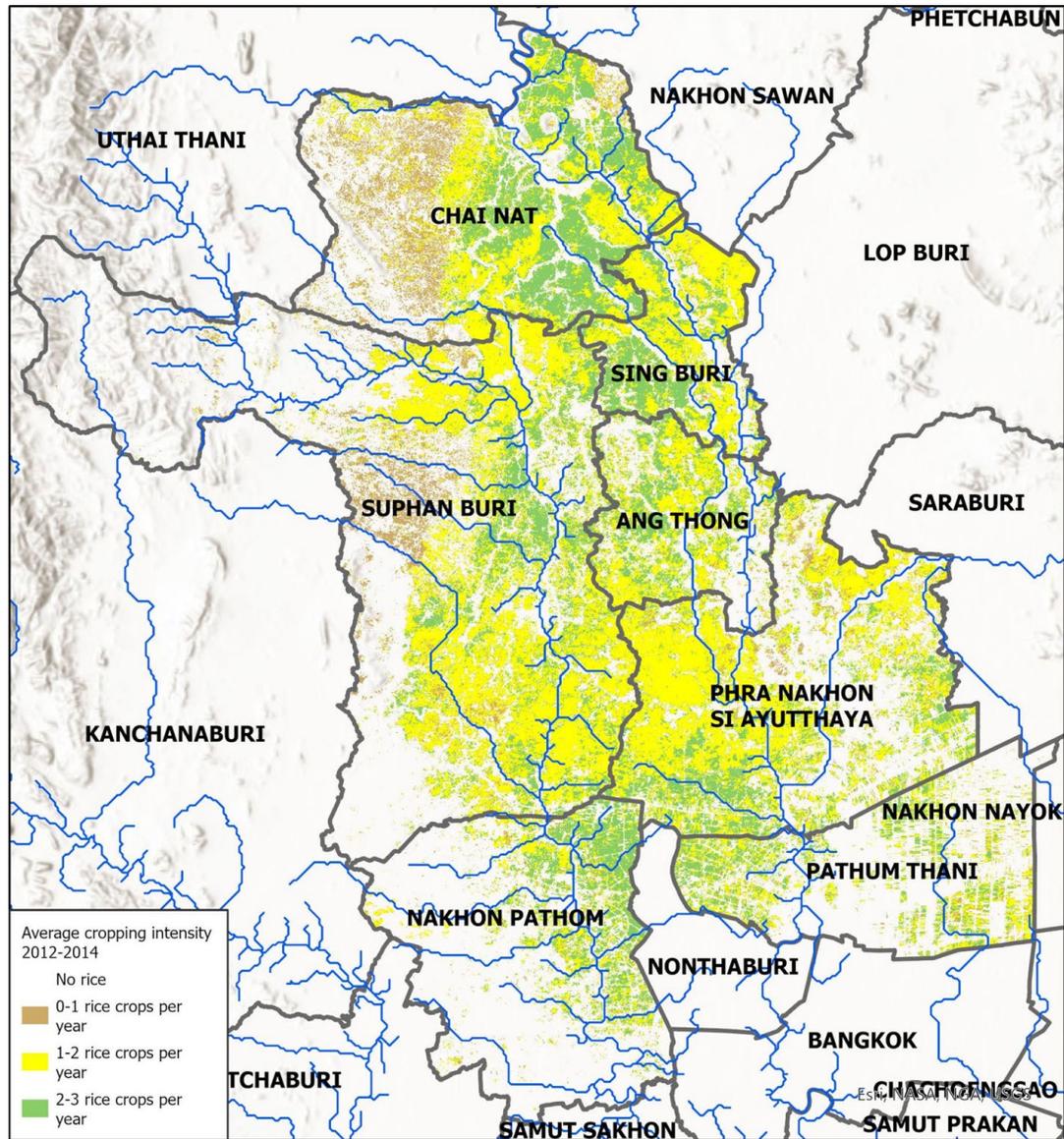
Average cropping intensities 2006-2009



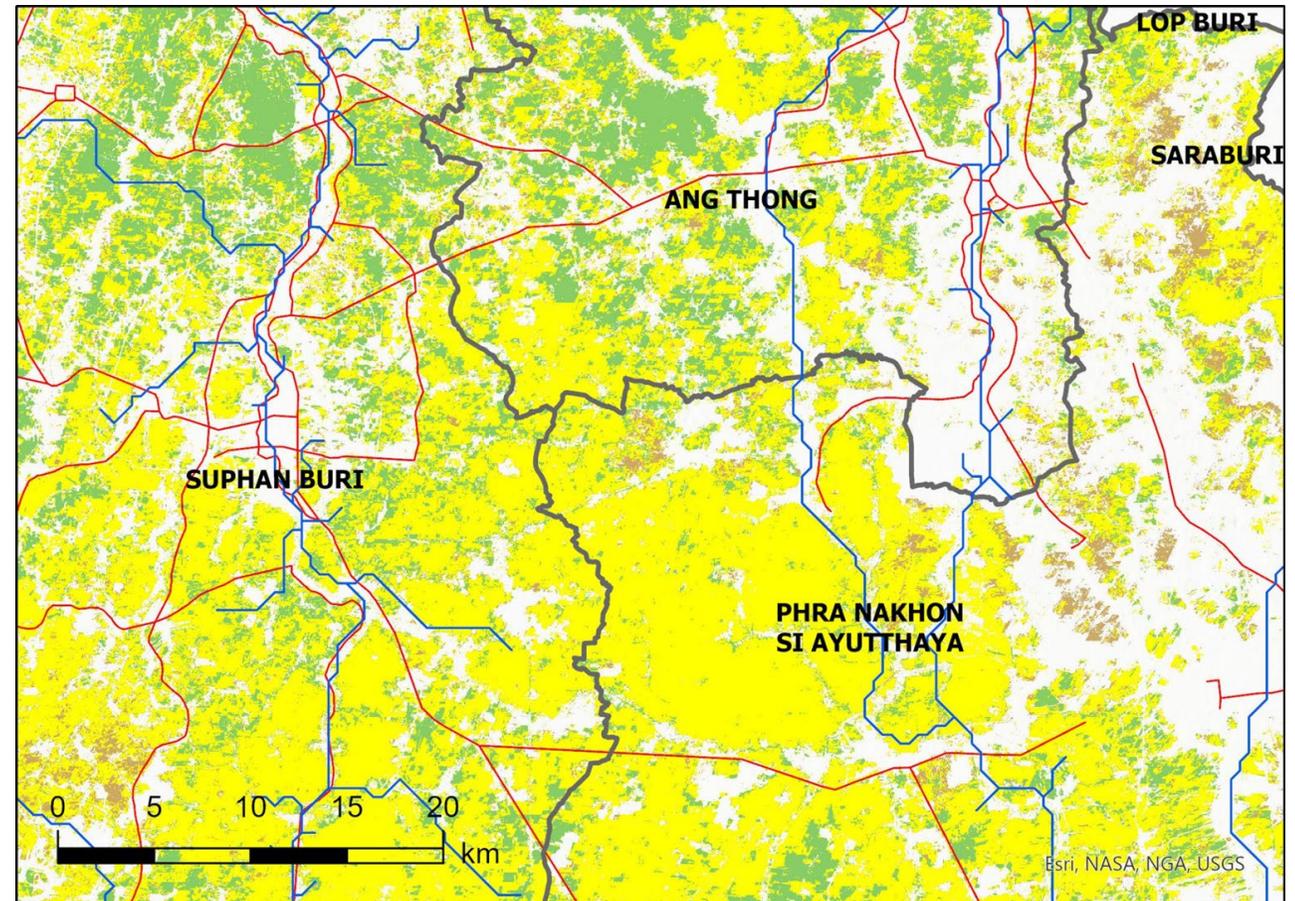
Clear patterns, distinguished areas with rather 1, 2, or 3 crops per year



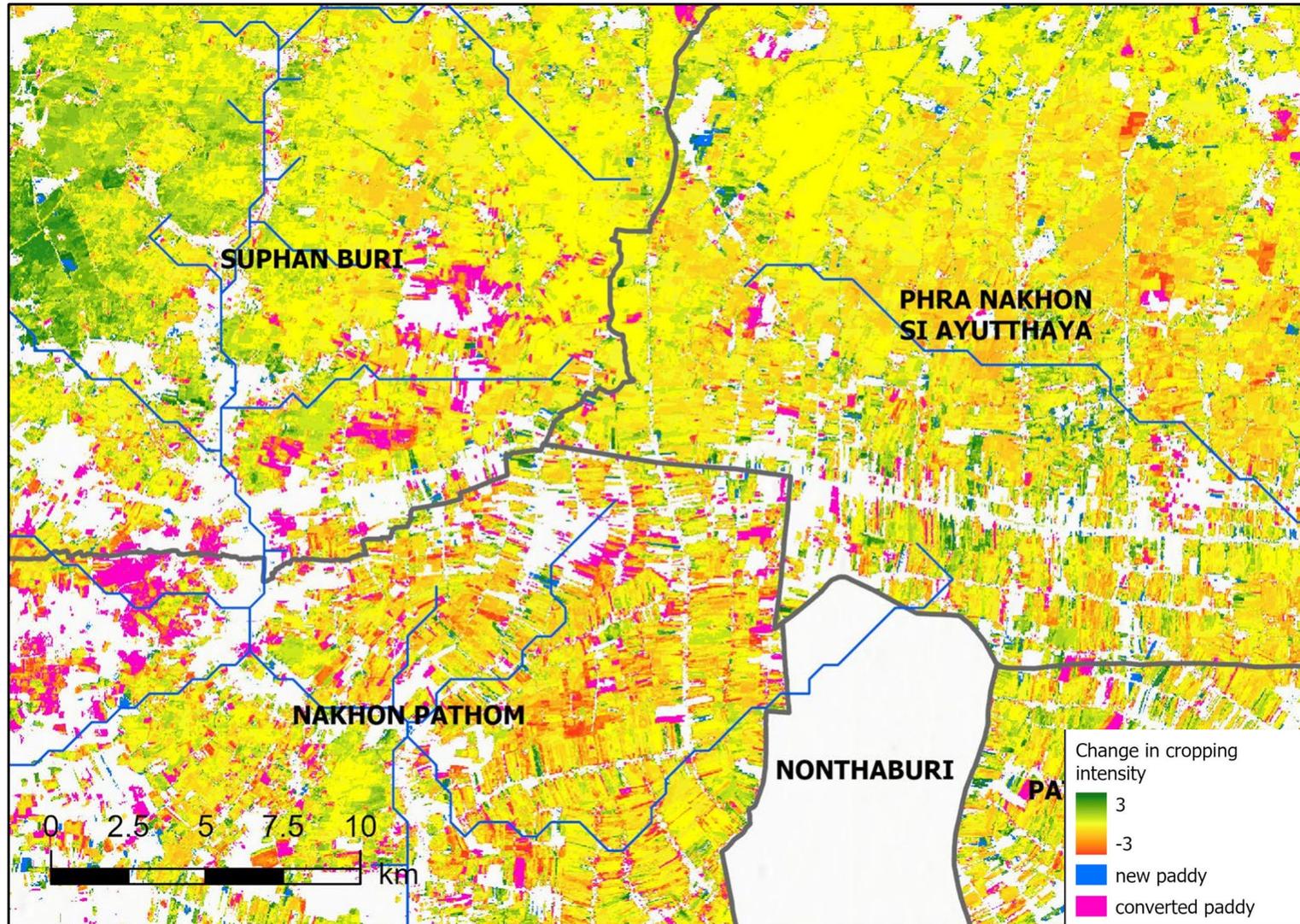
Average cropping intensities 2012-2014



Consolidation - more areas with 2 crops, smaller areas with 1 or 3 crops (high subsidies)

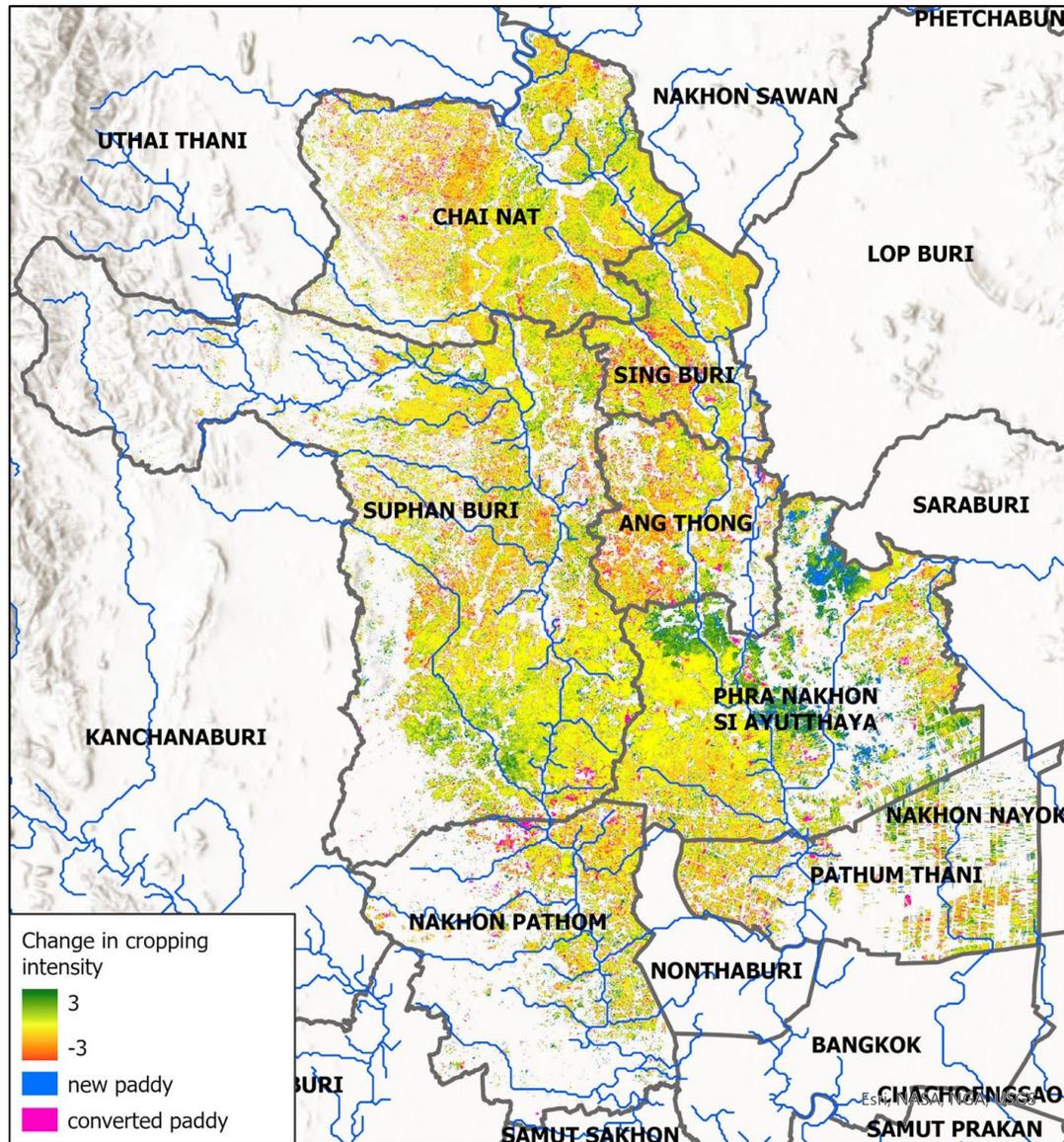


Details around Bangkok



- Individual plots and clusters of plots have been converted from paddy to other land use
- Ponds and greenhouses are often associated with the conversion of clusters of multiple plots (west of the map)
- Many plot level changes persist, particularly close to Bangkok
- Cropping intensities and changes seems more homogenous across multiple plots in the north of this map (collectives?)

Average cropping intensities 2017-2019 & 2021



Decrease - Around Bangkok, Ang Thong, Sing Buri, and in the northwest

Increase in east Chai Nat, Ayutthaya, and south Suphan Buri

- Paddy area declined, but also new fields emerged
- Cropping intensities shifted substantially. Intensification mainly around Chai Nat, Ayutthaya, and south Suphan Buri; diversification in other parts of the study area.
- Change patterns remain mainly small-scale and diverse, land consolidation does not seem to occur

Remote sensing progress

- The remote sensing approach worked well in areas with intensive rice cultivation (e.g. Central Thailand, the Mekong Delta, Vietnam) and intensifying regions (e.g. Battambang, Cambodia)
- The approach showed lower accuracies in areas where **rainfed paddy cultivation** prevails (Northeast Thailand and Savannakhet, Laos), **cloud cover is persistent** during the growing season (Red River Delta Vietnam, Northeast Thailand, and Savannakhet), **small plots** (Red River Delta, Northeast Thailand and Savannakhet), and **trees** occur in the paddy plots (Northeast Thailand and Savannakhet)

Remote sensing progress

- Small plots: We work with a fusion of Landsat and MODIS data, replacing missing Landsat observations with data from MODIS composites. Longer gaps in the Landsat time-series (persistent cloud cover) reduce spatial mapping accuracies
- Rainfed means more variability during plant growth – a less consistent ‘rice paddy signal’ reduces mapping accuracies
- Trees in the rice fields ‘weaken’ the characteristic signal of rice paddy plots, which also reduces mapping accuracies

Conclusion

- **Farms will remain small <5 ha throughout the region.**
- **Despite differences between irrigated and rainfed areas, and access to land, farmers have developed livelihoods that are comparable across the region and are sustainable.**
- **Large irrigated basins are easier to map than small fields both rainfed and irrigated.**
- **But without high resolution imagery, i.e., 1 meter as McCarthy found in the Mekong Delta, we cannot map the size of rice fields in the mainland Southeast Asia.**

Thank you

