INTEGRATING THE VALUE OF ECOSYSTEMS AND BIODIVERSITY IN RICE SYSTEMS IN THAILAND

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

UN environment programme

TEEB
The Economics of Ecosystems & Biodiversity

econ
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TEAM INTRODUCTION

TEAM MEMBERS

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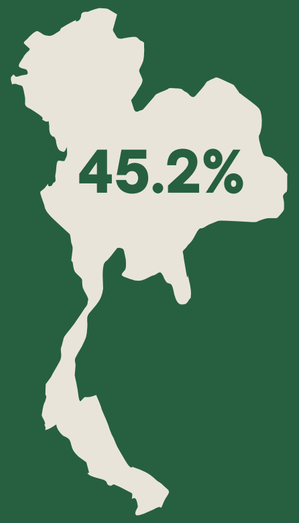
Why is rice sector important for Thailand?

ECONOMICS



- Rice is Thailand's most planted crop, taking **45.2%** of all Thai farmland.[1]
- In 2017, the value of rice traded was **174.5 billion** baht.[2]
  (which is around 12.89% of all agricultural GDP.)

(1) Office of Industrial Economics and National Statistical Office Thailand.
(2) Wipatayotin, Apinya (4 November 2018). "Finding ways to beat farm debt". Bangkok Post.

ENVIRONMENT

PADDY RICE BIODIVERSITY

WATER QUALITY

AIR POLLUTION

Why is rice sector important for Thailand?

PEOPLE

FARMER

Thailand has 8,065,014 farmer households and 3,649,301 are rice growers.[3]

CONSUMER

Rice is one of the main foods and sources of nutrition for most Thai citizens.[4]

HEALTH IMPACT

- Chemical use for farmers
- PM 2.5 and other sources of air pollution

Culture and society

Farmer group or other related with social group

(3) Office of Agricultural Economics.
(4) Faostat.

Rice system in Thailand

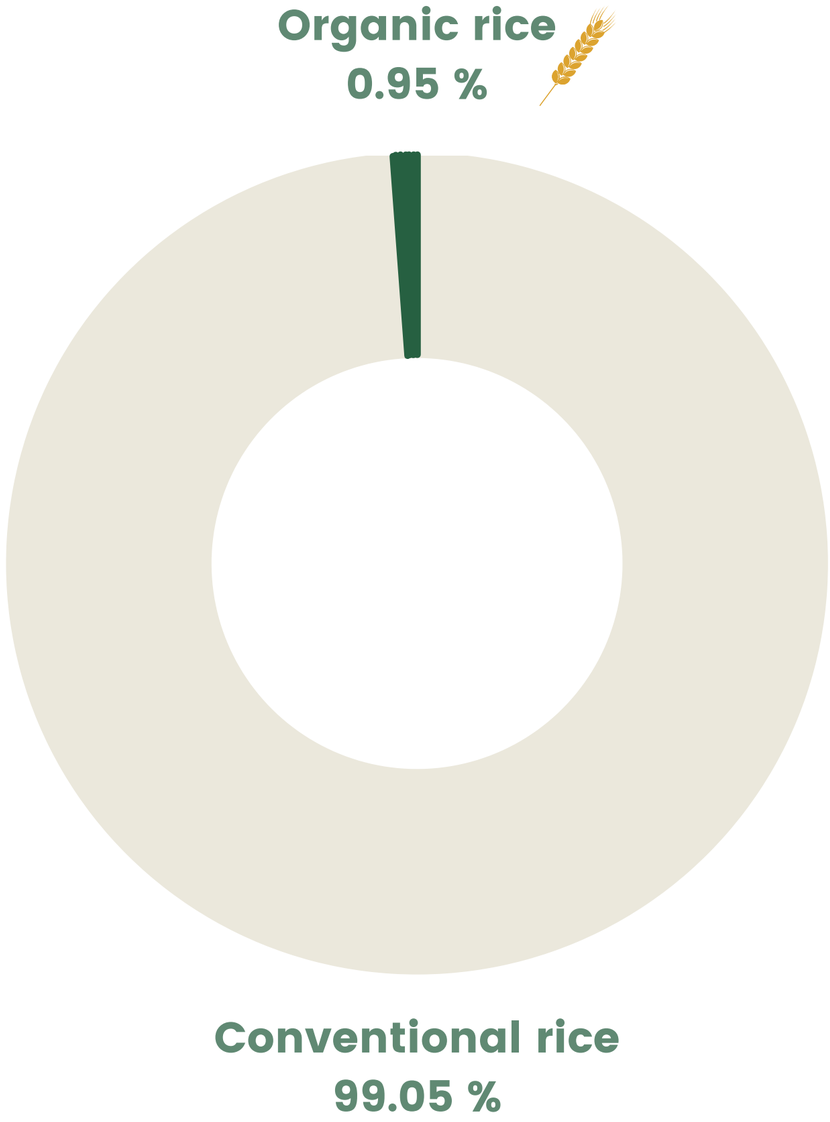
Conventional rice*

9,698,151.75 Ha.

*including GAP, SRP or GAP++

Organic rice

93,368.25 Ha.



Why is organic rice focused?

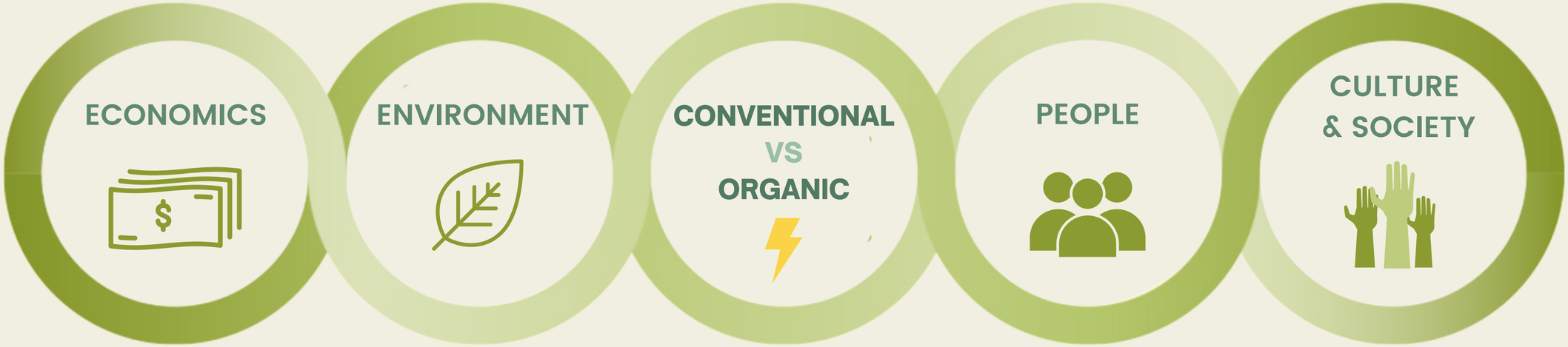
/ PRACTICE	/ CONVENTIONAL	/ ORGANIC
Economics	The value of economic losses from health impacts.	Higher profit in the long run due to lower cost of production.
Biodiversity	Demote biodiversity. : using chemical fertilizers and pesticides.	Promote biodiversity. : excludes synthetic fertilizers and pesticides. : managing pests with ecosystem services.
Air and water pollution	: Air polluted because farmer burned rice straws after harvesting the grain. : Water is polluted due to chemical using.	Create less Air and water pollution.

Why is organic rice focused?

/ PRACTICE	/ CONVENTIONAL	/ ORGANIC
Soi quality	Soil degradation because of the burning.	Building up soil quality through animal and green manures.
Health	Chemical residue in rice, water, and air pollution is harmful to human health.	Less harmful for Farmer's and consumer's health.
Community		• Formal farmers' cooperation and groups. • Improvement of farmers' social network and trust. • create prosocial behavior

Main objective of this study.

To compare **net benefit** between conventional and organic practise.

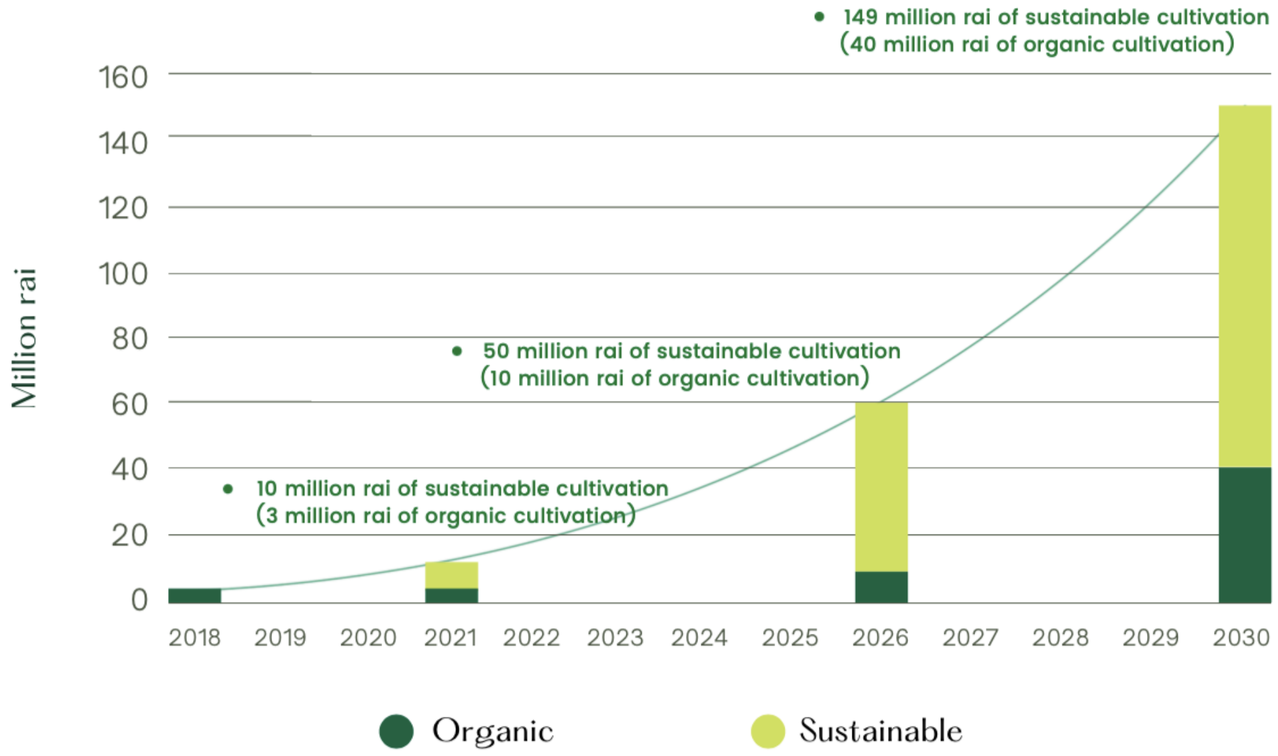


Scenario
Development.

Current policy to encourage organic rice.

- The One Million Rai Organic Rice Farming pilot project.

- Thai parliamentarians.

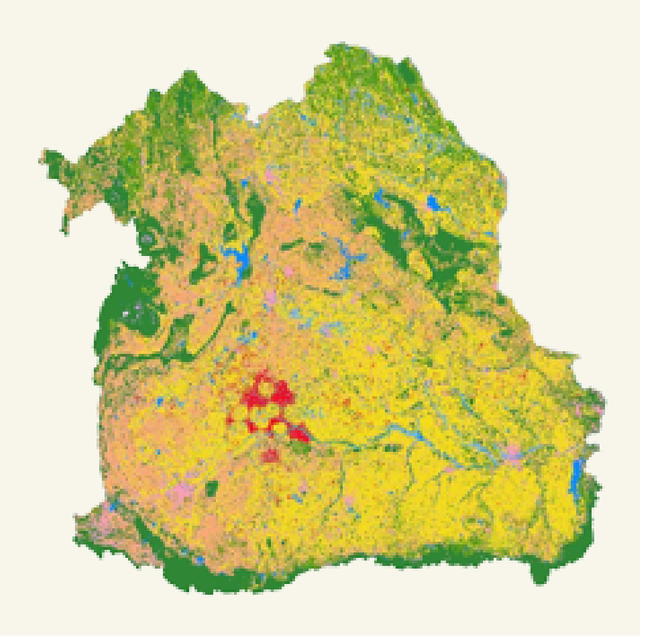


Organic rice expansion in BAU scenario.

Year/ Organic area (Hectare).

2019/ 137,573.31 Hectare.

2025/ 233,181.81 Hectare.



2035/ 233,181.81 Hectare.

Scenario : Accelerated organic rice promotion.

Year/ Organic area (Hectare).

2019/ 137,573.31 Hectare.

2025/ 431,616.51 Hectare.

2035/ 863,163.81 Hectare.

Scenario : Enhanced organic rice promotion

Year/ Organic area (Hectare).

2019/ 137,573.31 Hectare.

2025/ 1,078,937.46 Hectare.

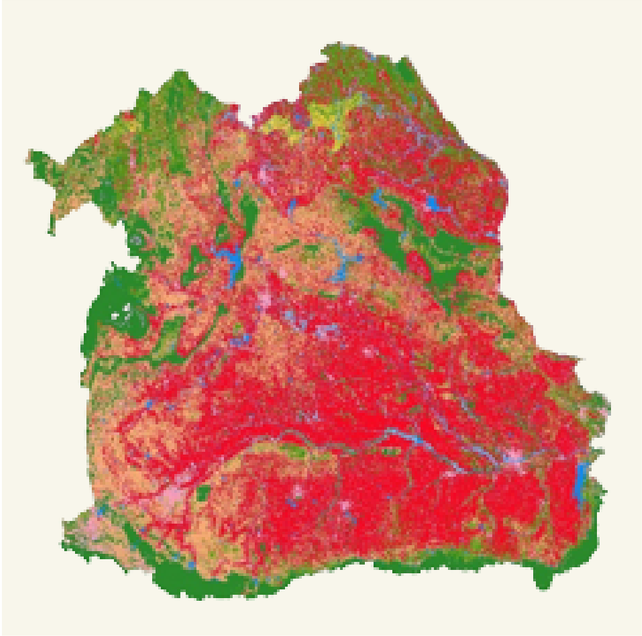
2035/ 3,237,316.20 Hectare.

Scenario : Transformational change towards sustainability

Year/ Organic area (Hectare).

2019/ 137,573.31 Hectare.

2025/ 1,118,752.83 Hectare.



2035/ 6,483,553.92 Hectare.

Scenario Development.

The higher the number of organic area,
the better the benefit for the society.

What will be focused and why?

Biodiversity and environment.

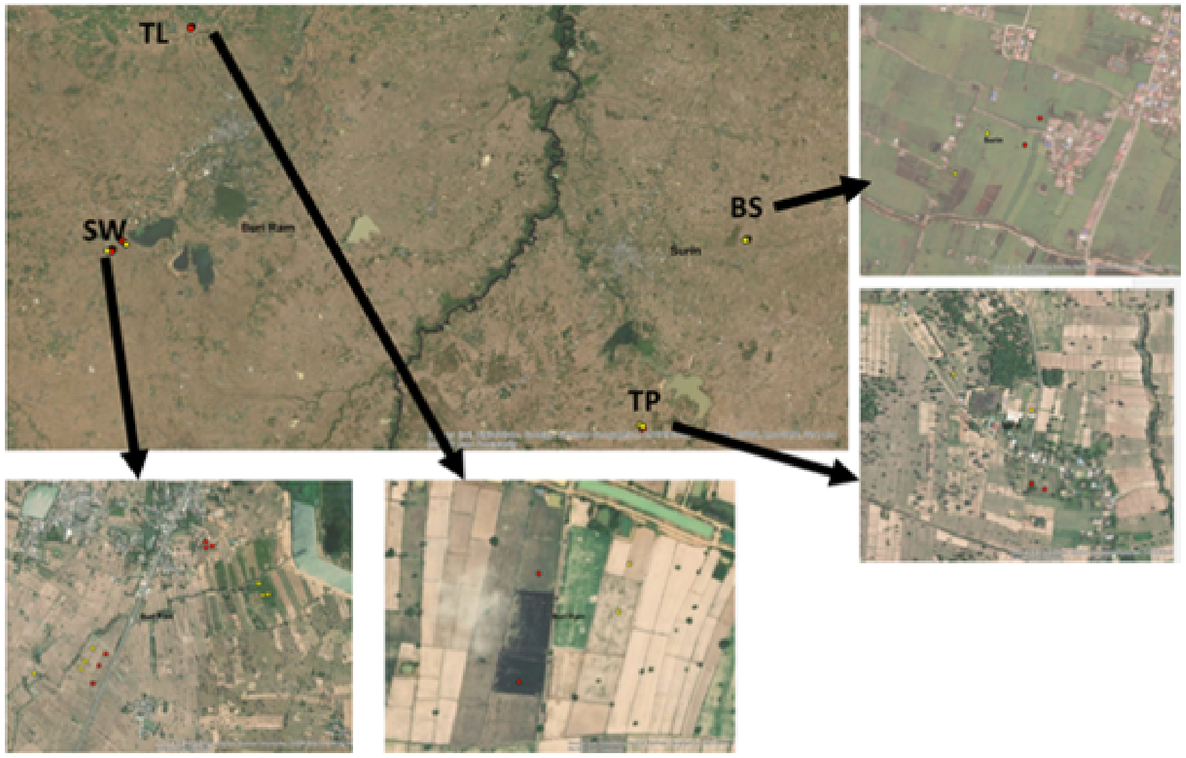
- Biodiversity assessment.

/ Objectives

- Comparative assessment on biodiversity of conventional and organic rice farming practices.
- Quantify the pattern and composition of taxonomic and functional groups in the communities.
- Spatial prediction of biodiversity for the study landscape based on the transformation scenarios of rice farming practices.

Biodiversity and environment.
Study sites.

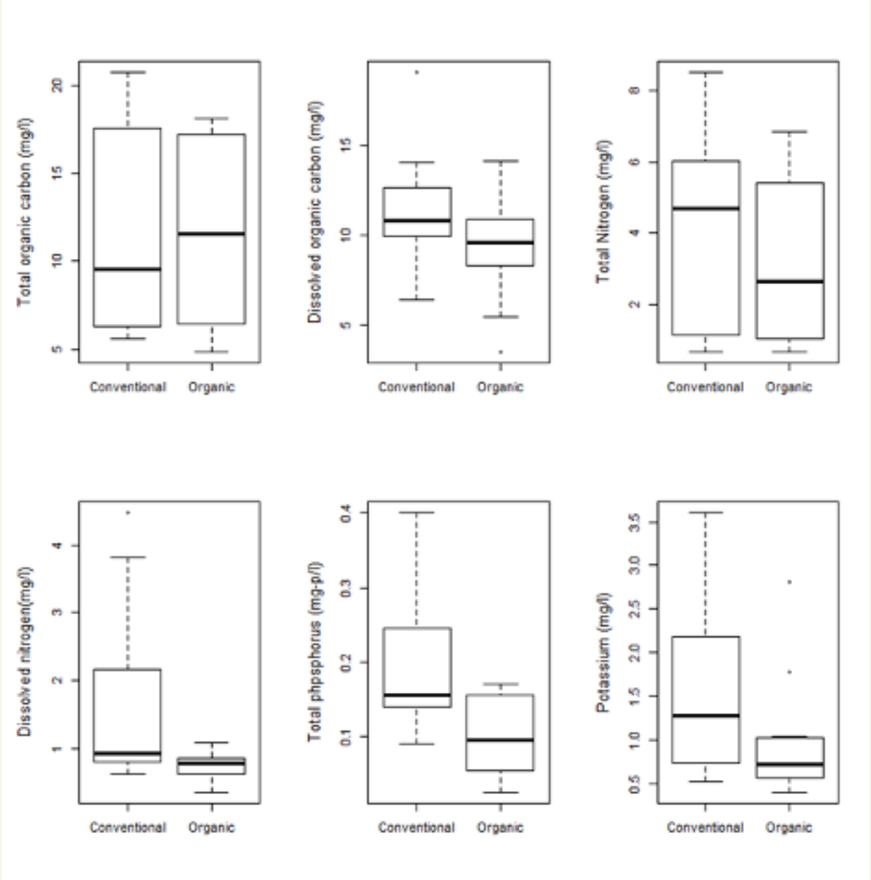
- 4 sites in 2 provinces : Burirum and Surin.
- Total 24 sample plots.
- 12 conventional plots and 12 organic rice farming plots.
- Collecting soil, water.
- Survey of organisms within the plot.
- Additional secondary data based on other 4 study sites in the Northeastern Thailand.



Biodiversity and environment.

Environmental measurements.

- Crop Height.
- Water Depth
- Crop temperature
- pH, EC, Alkalinity



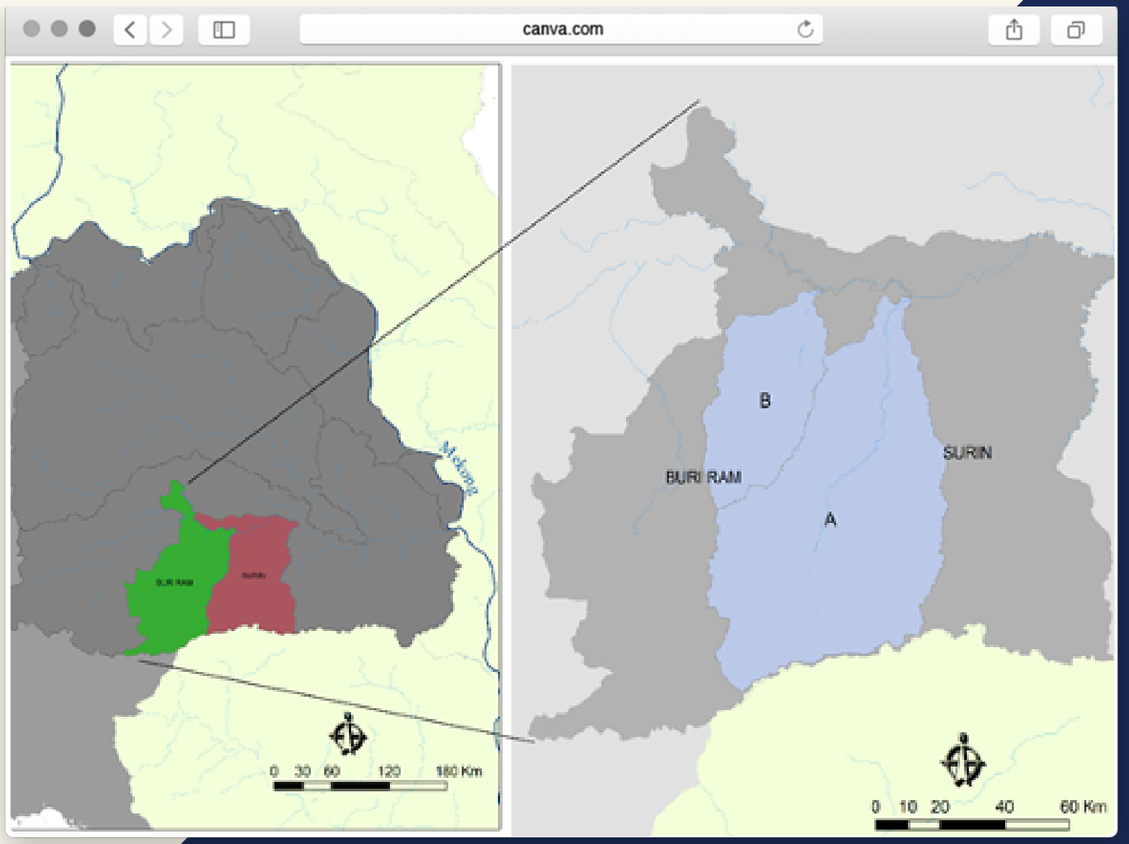
- Soil particle
- TDS
- TOC
- DOC
- Macronutrients

Biodiversity and environment.

Water yield and purification.

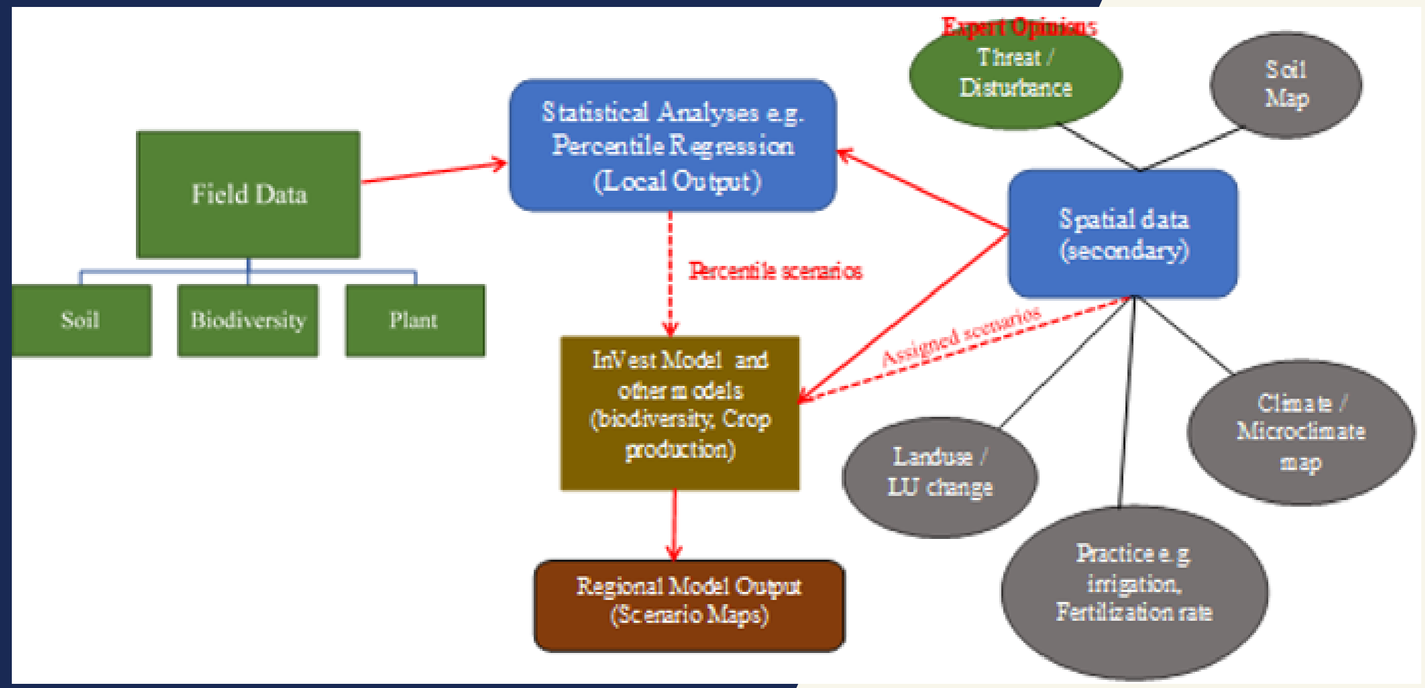
- Sample catchment in Surin and Buriram province

- Land use and meteorological factors were used for water yield model in TERRSET.



Biodiversity and environment.

Developing biophysical analysis



- Predictive model on normalized biodiversity richness
- Exploratory variables: Field covariates, landscape metrics of configuration and composition of landcover based on each landusechange scenarios.

Biodiversity and environment.

Air pollution and biodiversity

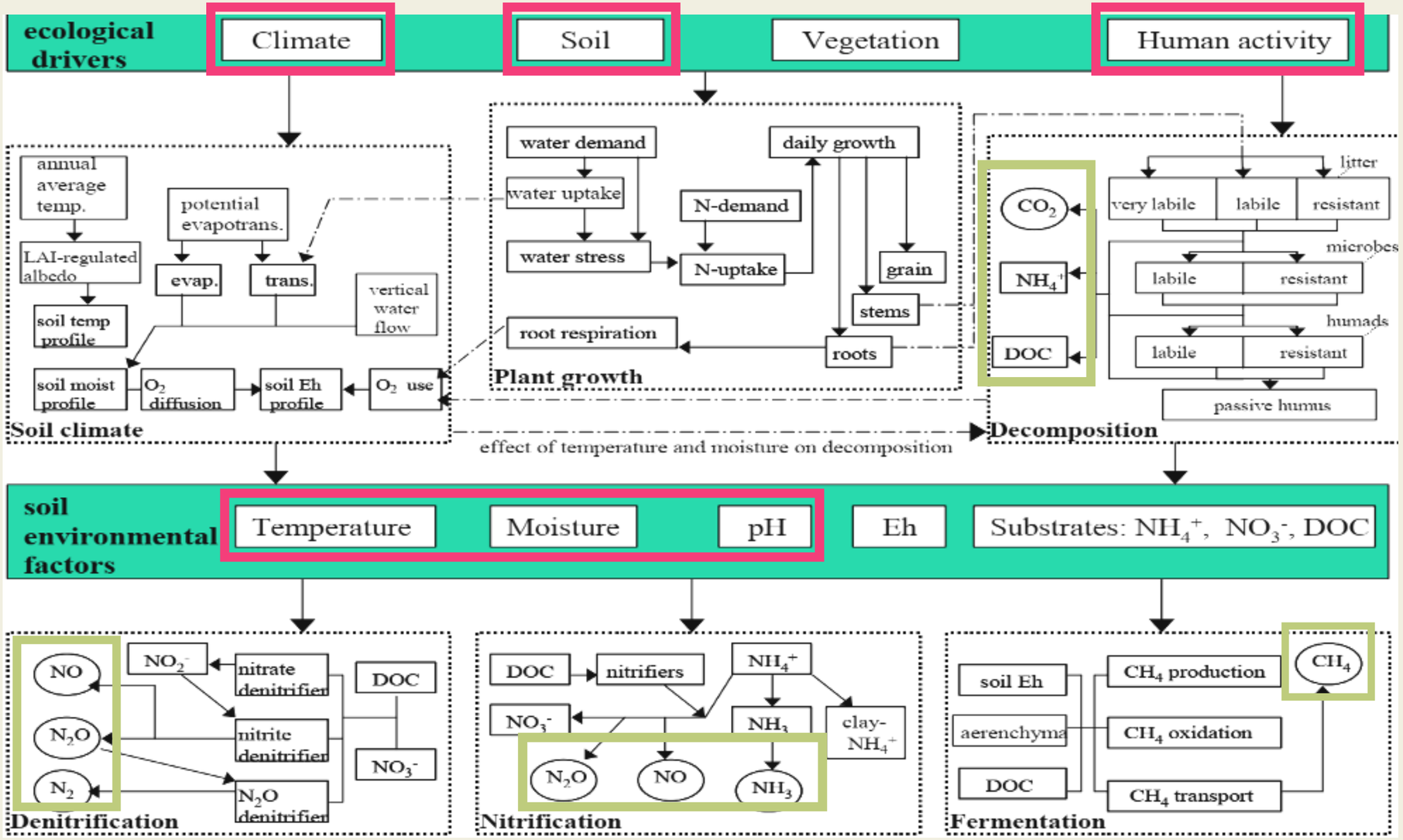
The DNDC Model

DNDC (DeNitrification-DeComposition) is a computer simulation model of carbon and nitrogen biogeochemistry in agro-ecosystems.

For predicting crop growth, crop yield, soil temperature and moisture regimes, soil carbon dynamics, nitrogen leaching, and emissions of trace gases including nitrous oxide (N2O), nitric oxide (NO), dinitrogen (N2), ammonia (NH3), methane (CH4) and carbon dioxide (CO2).

Air pollution and biodiversity

The DNDC Model



Air pollution and biodiversity

GHGs emission and air pollutions

Trace Gases	Emission Factor, EF (G of Trace Gases Per Kg Dry Matter Burned)
CO_2	(1177 [a]), 1105.2 [c1], 1024 [c2], 1393 [d], 1515 [f], 1585 [g], 1185 [h], 1160 [i]
CH_4	9.6 [a], 2.7 [f], 5.2 [f]
CO	(93 [a]), 53.2 [c1], 110.6 [c2], 57.2 [d], 92 [f], 102 [g], 132.2 [h], 34.7 [j]
NO_X	(0.49 [a]), 3.83 [c1], 2.62 [c2], 2.5 [f], 3.11 [g]
SO_2	(0.51 [b])
$PM_{2.5}$	(8.3 [a]), 12.1 [c1], 18.3 [c2], 8.5 [d] 12.95 [e], 3.9 [f], 6.26 [g], 27.63 [h]
PM_{10}	(9.4 [a]), 14.0 [c1], 20.6 [c2], 13.0 [f], 3.7 [j]
BC	(0.53 [a]), 0.69 [f]
OC	(3.1 [a]), 10.53 [c1], 8.77 [c2], 3.3 [d], 8.94 [e]

- Benefit transfer (5)

Amount of residue in the field

Emission factor

Emission of air pollutant

(5) Junpen, A., Pansuk, J., Kamnoet, O., Cheewaphongphan, P., & Garivait, S. (2018). Emission of air pollutants from rice residue open burning in Thailand, 2018. Atmosphere, 9(11), 449.

Air pollution and biodiversity

Emission of air pollution from rice residue open burning in Thailand, 2018[5]

Table A3. The ranking of provinces in Thailand that encountered problems of emission from rice residue open burning in 2018.

Rank	Province	The Amount of Emissions from Rice Residue Open Burning					
		$PM_{2.5}$ (kt)	PM_{10} (kt)	NO_X (t)	CO (kt)	CO_2 (kt)	CH_4 (kt)
1	Nakhon Sawan	3.21	3.63	189	35.93	455	3.71
2	Roi Et	3.17	3.59	187	35.53	450	3.67
3	Khon Kaen	2.82	3.19	166	31.60	400	3.26
4	Nakhon Ratchasima	2.37	2.68	140	26.51	336	2.74
5	Sakon Nakhon	2.13	2.41	126	23.83	302	2.46
6	Suphan Buri	1.91	2.17	113	21.43	271	2.21
7	Phichit	1.65	1.87	97	18.47	234	1.91
8	Mahasarakham	1.64	1.86	97	18.42	233	1.90
9	Auttaradit	1.59	1.80	94	17.84	226	1.84
10	Phitsanu Lok	1.23	1.39	72	13.73	174	1.42

What will be focused and why?

ECONOMICS

1. Household economic status collected from household economics survey.

INCOME AND SPENDING

HOUSEHOLD DEBT INFORMATION

SAVING INFORMATION

2. Production and price
   : using DNDC model.

What will be focused and why?

People : Health

- Chemical: Choice experiment

ATTRIBUTE

1. Present of natural enemies of pest.
2. Incidence rate of farmers dying from pesticide poisoning.
3. Number of days PM2.5 exceeded standard level.
4. Price of rice (per Kilogram).
5. Number of years losing yield by 50 percent within 10 year,

What will be focused and why?

People : Health

- Air pollution

Method:

1.Exposure Risk Function

Conceptual framework.

Conceptual framework.

Calculating PM2.5 based on the change of organic area in each scenario.

End of health, ER coefficient epidemiological literature [6]

Premortality caused by
1. Cardiovascular
2. Respiratory
3. Lung cancer
4. All-cause mortality

Evaluating the effect of PM2.5 to people using the Exposure Risk Function based in the population by province.

Assessing the health cost using the Amended Human Capital (AHC) based in the gross provincial product

Economic loss related to PM2.5 in each scenario (S1-S4)

(6) Yang et al., 2018, Wang et al., 2020

What will be focused and why?

Community

- farmers’ cooperation and groups
- social network, social relations, and trust.

MEDTHOD Household economics survey

What will be focused and why?

ENVIRONMENT
- DNDC MODEL
- INVEST MODEL

ECONOMICS
- HH SURVEY
- DNDC MODEL

monetary value ▶

PEOPLE
- CHOICE EXPERIMENT
- EXPOSURE RISK FUNCTION

COMMUNITY
- HH SURVEY

NET EXERNALITY

★★★

To find factors that could encourage farmers to switch from conventional to organic practice.

Lab in the field experiment.

1. COST / INCOME SUBSIDY
2. SOCIAL LEARNING
3. RISK DIVERSIFICATION