Land-use change impacts weed communities' assembly in mountainous Northern Thailand

M. Neyret, H. Robain, A. de Rouw, B. Soulileuth, K. Trisophon, C. Valentin

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Context

Weed communities provide various ecosystemic services :

- Support biodiversity at higher trophic levels
- Control pests
- Soil conservation

Jordan *et al.* (2004) and Durán Zuazo *et al.* (2008)

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These functions depend on plant communities composition, abundance, and richness but are compromised by agricultural intensification.

Jordan *et al.* (2004) and Durán Zuazo *et al.* (2008)

Context

Intensification of management + Temporal and spatial homogenisation

- Variation of species richness (+ or -)
- Homogenisation of communities
- Switch towards more resistant, competitive species

Jordan *et al.* (2004), Storkey *et al.* (2012), and Fried *et al.* (2008)

Context

Northern Thailand traditionally dominated by slash and burn agriculture

1970's Switch to more intensive, market-oriented agriculture

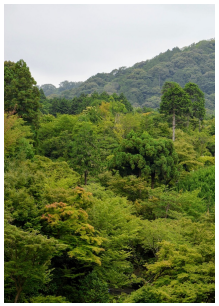
$\rightarrow$ Deforestation + environmental degradations

1990's Governments incentives to expand **rubber trees (RT)** plantations

Fox *et al.* (2013) and Wangpakapattanawong *et al.* (2016)

Context

Forest



RT plantations

Biodiversity loss, soil degradation

Beukema *et al.* (2007) and Valentin *et al.* (2008)

Context

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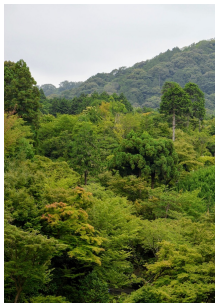
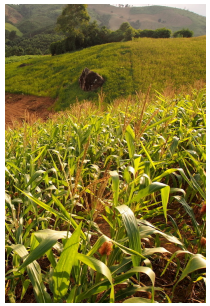


RT plantations

Annual crops



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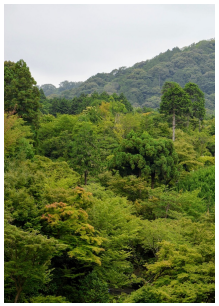

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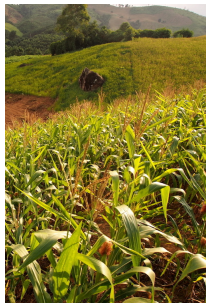

RT plantations

Biodiversity loss, soil degradation

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1. What are the impacts of afforestation by rubber trees on plant communities?

Beukema *et al.* (2007) and Valentin *et al.* (2008)

Context

Various factors can affect weed communities in addition to crop:

- Soil
- Landscape
- Management
- Crop rotations

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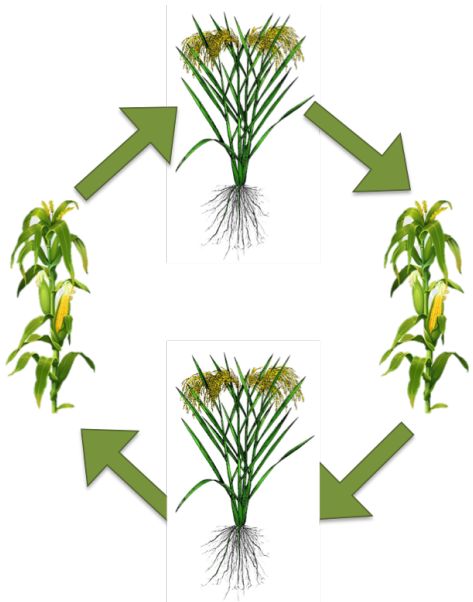
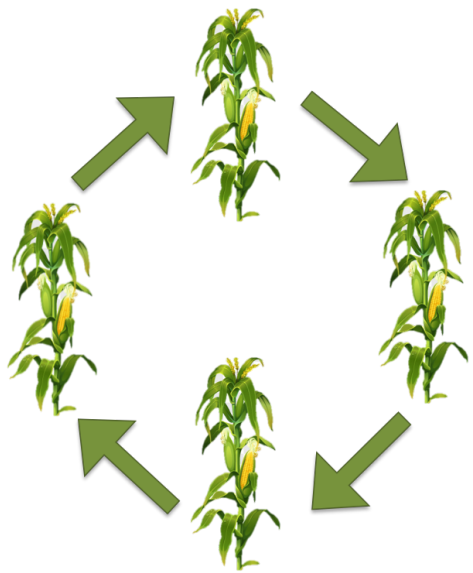
2. What is the relative importance of soil, landscape and land use on weed communities in a fragmented landscape of Mountainous SE Asia?

Context

Agricultural intensification in SE Asia $\rightarrow$ disruption of traditional crop rotations





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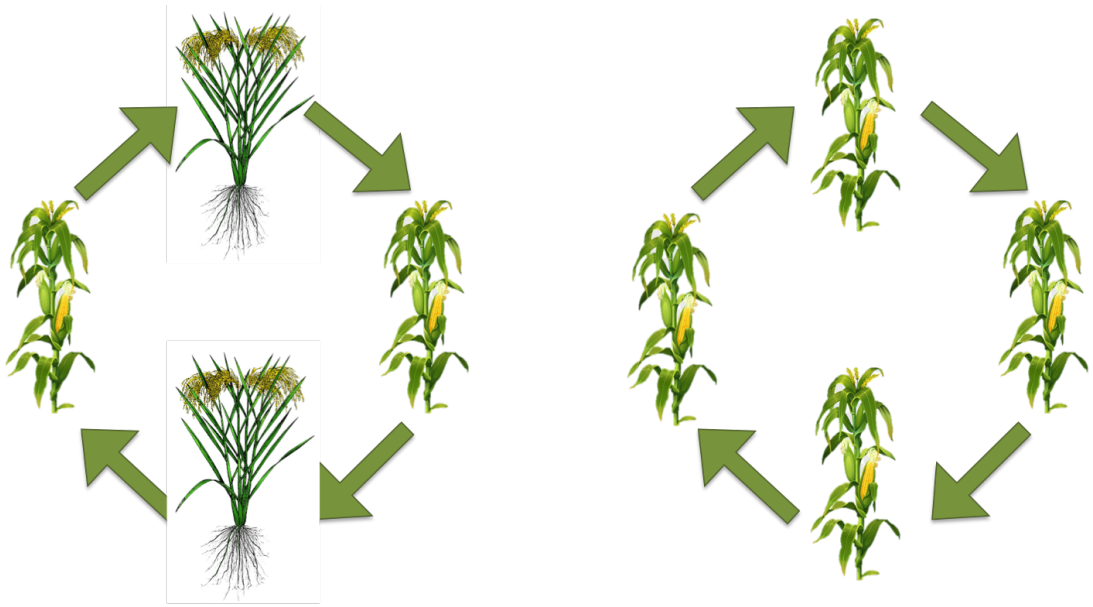
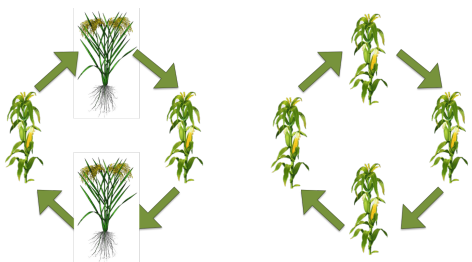


3. What are the effects of crop temporal variability on weed communities?

Research questions

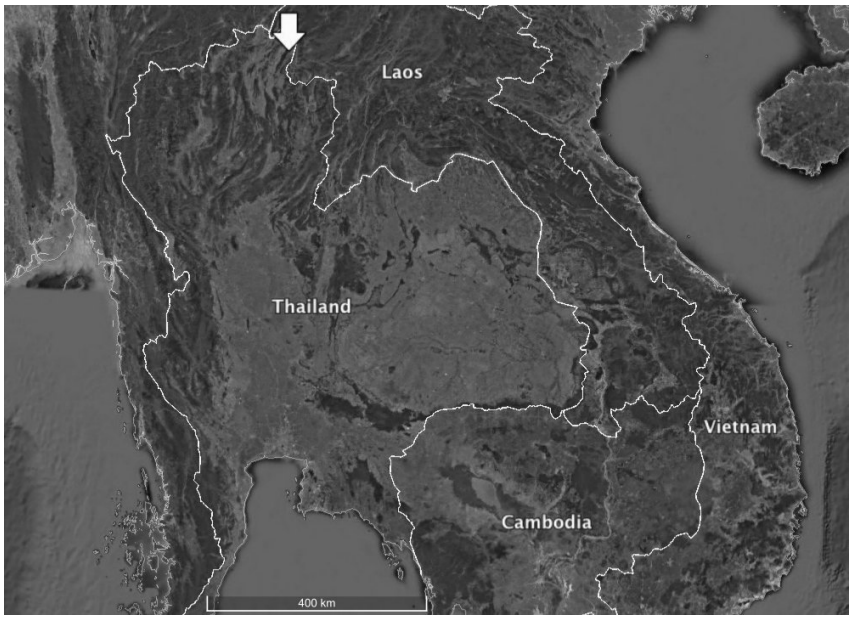
1. What are the impacts of afforestation by rubber trees on plant communities?

2. What is the relative importance of soil, landscape and land use on weed communities?



3. What are the effects of crop temporal variability on weed communities?

Study site: Huai Lang, Northern Thailand



Study site: Huai Lang, Northern Thailand

- 20 fields followed since March 2016
- Botanical inventories
- Soil characterisation
- Dry and rainy season

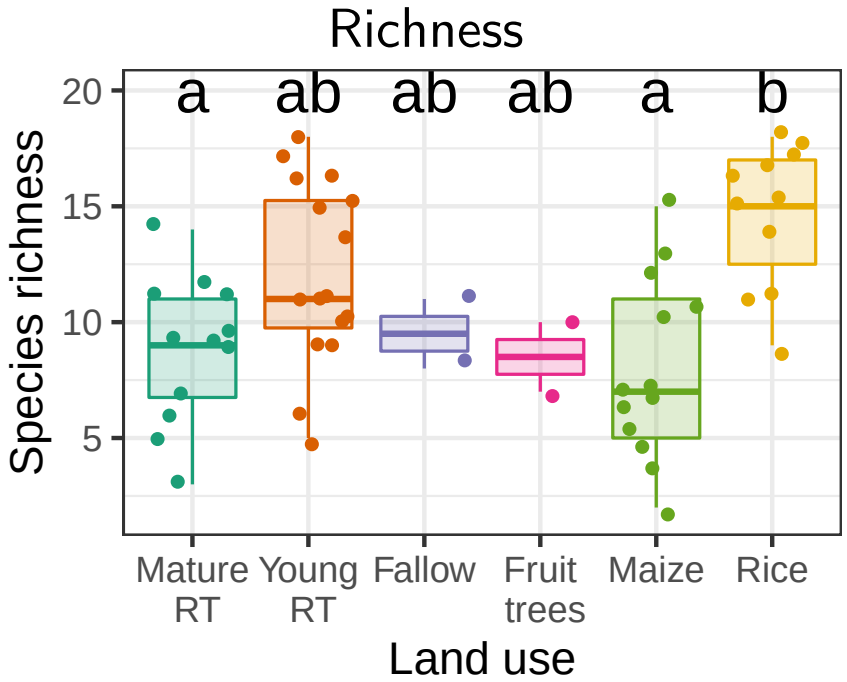
Agricultural fields: maize, upland rice, young RT with maize intercrop, mature RT (2016), then following crop rotations in the same fields.

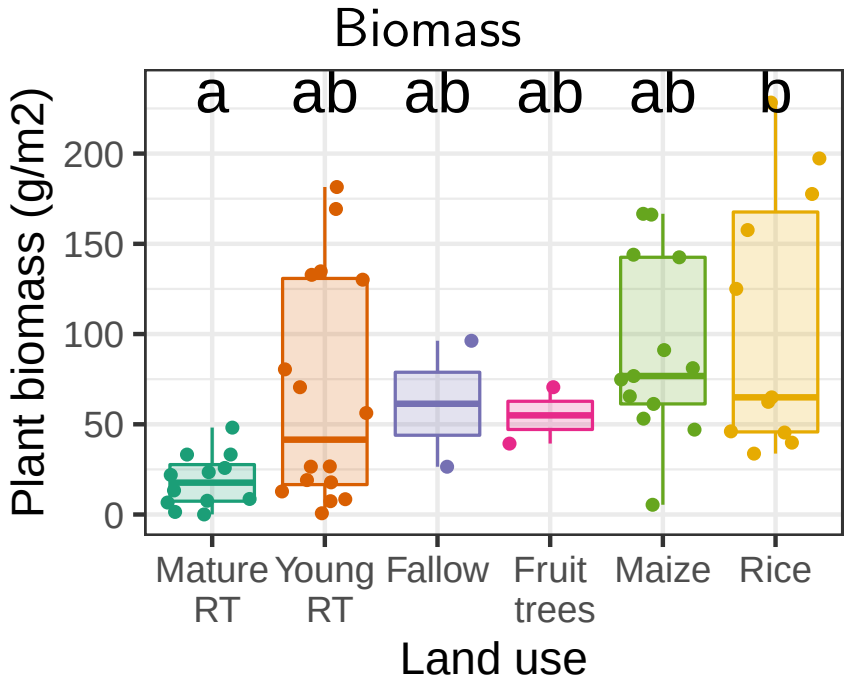
Results

73 herbaceous species and 93 shrub/tree species.

2 main species: *Ageratum conyzoides* (63% of all individuals) and *Conyza sumatrensis* (16%).

1. RT effect on communities





Afforestation by RT plantations lowers plant biomass

Mixed linear models

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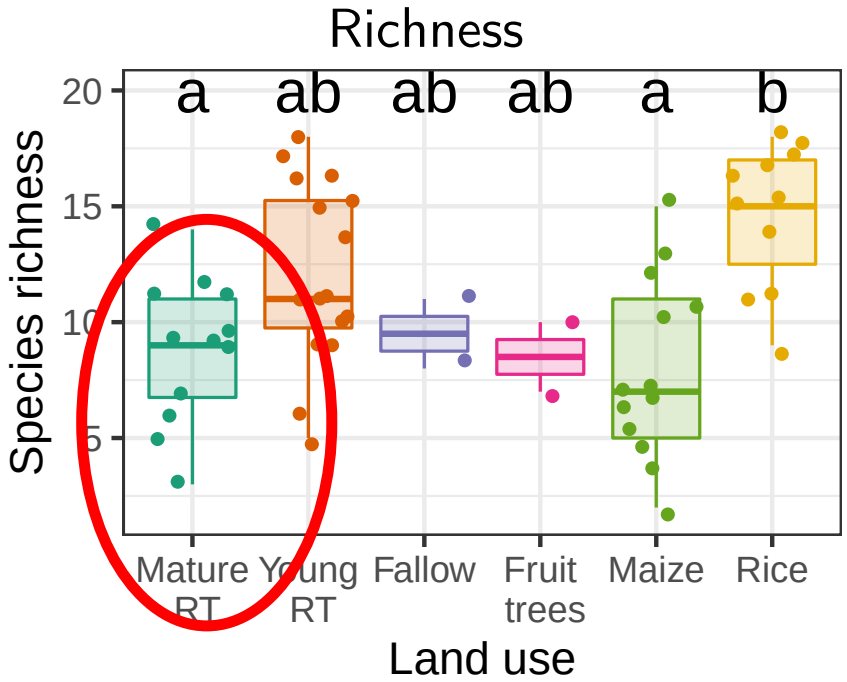

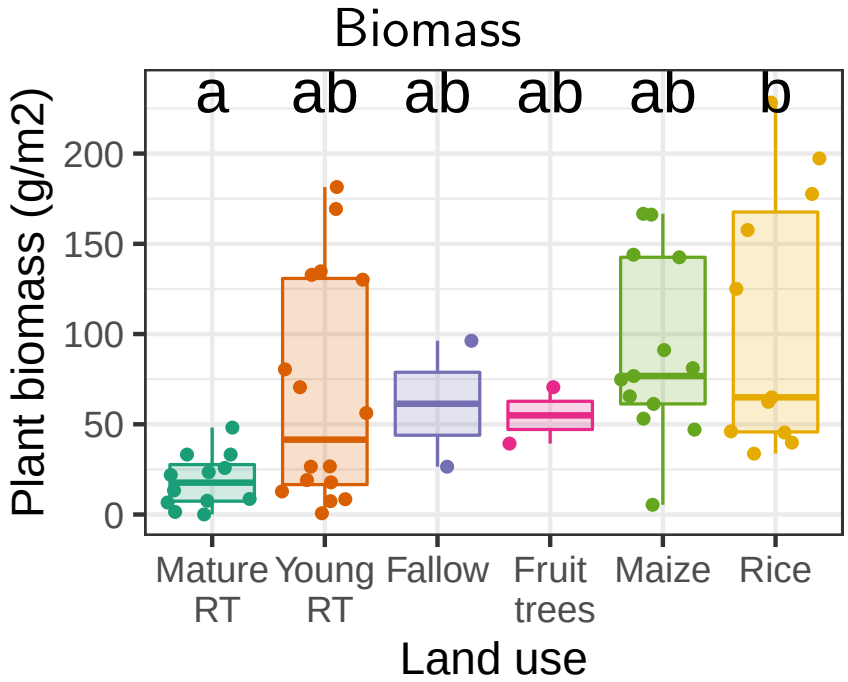

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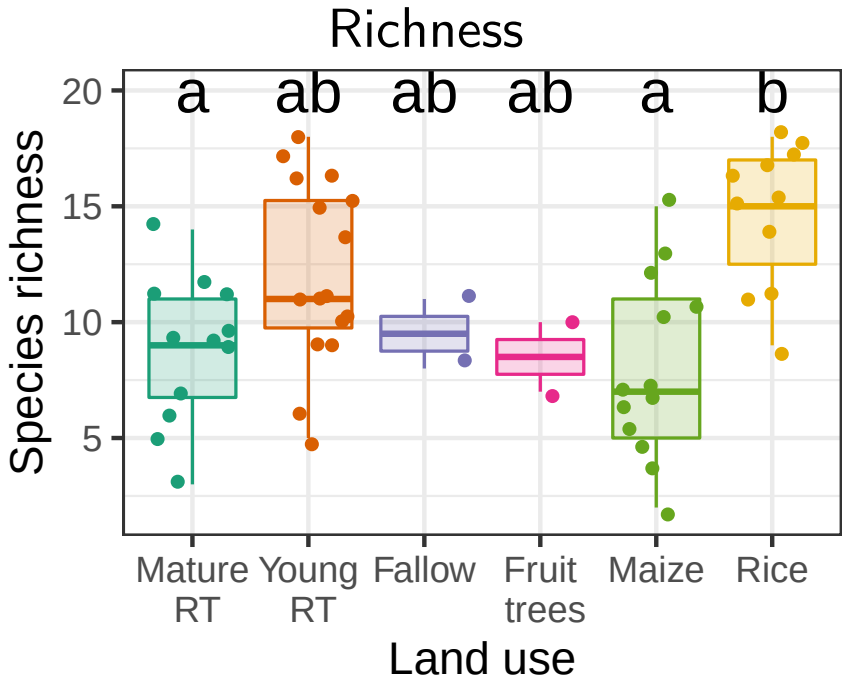

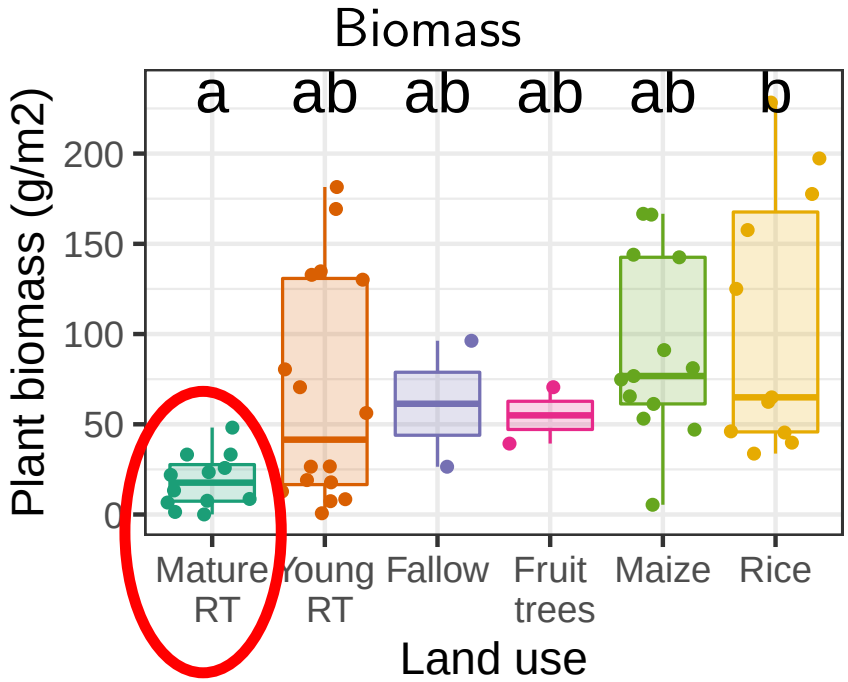

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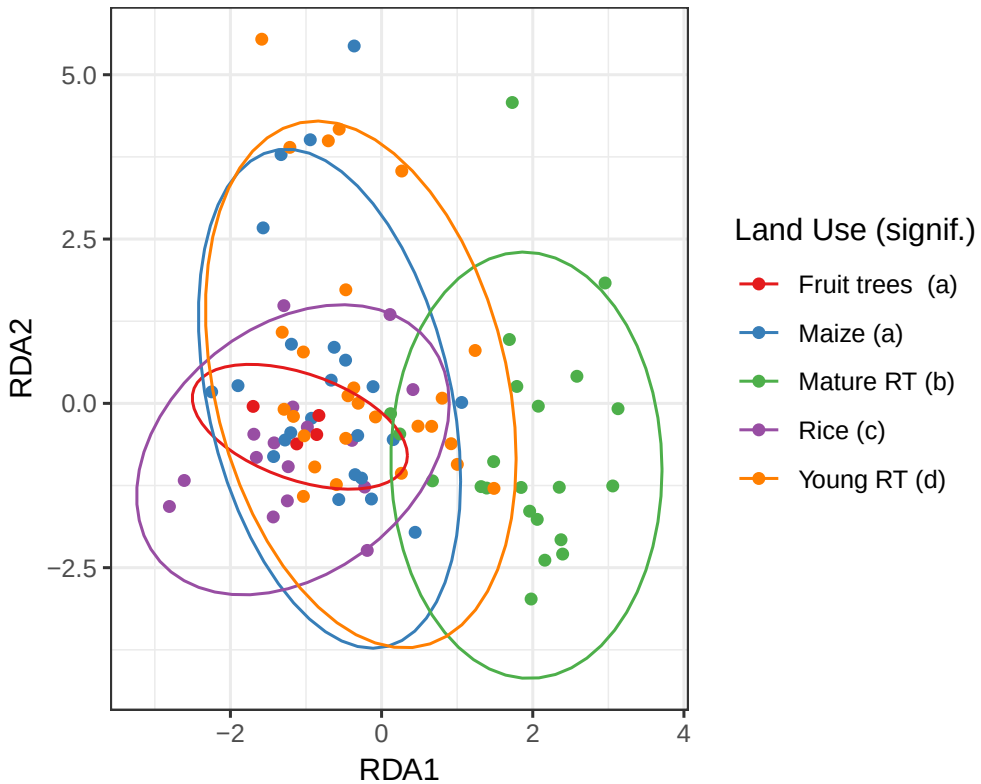


Afforestation by RT plantations lowers plant biomass and change communities composition

RDA on hellinger-transformed species abundances matrix

2. Effects of land use, landscape and soil

Choice of factors in each group based on preliminary model selection

Land use

Crop

Spatial

Northing/Easting

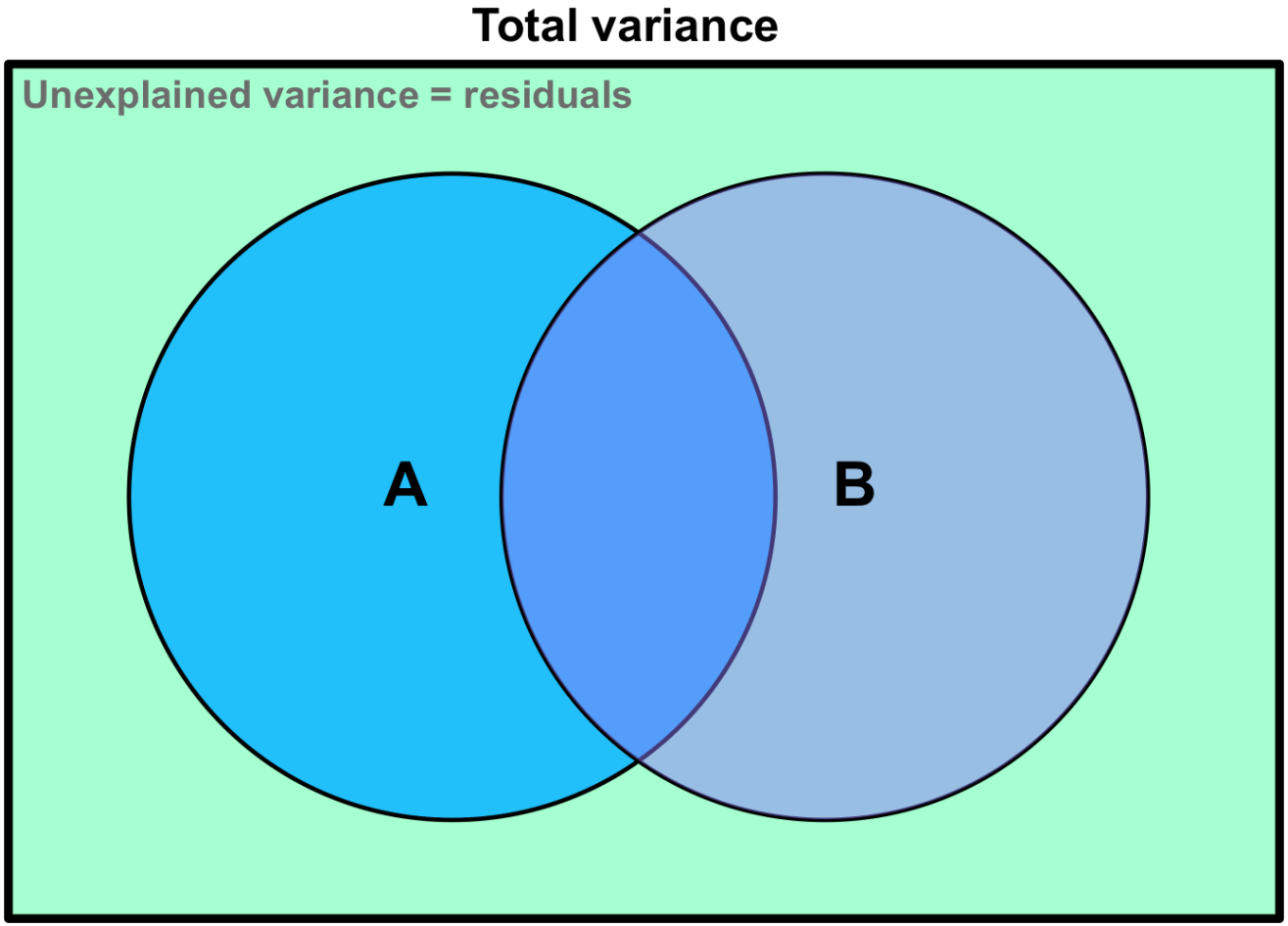
Landscape

% annual crops, % marginal areas,
% riparian vegetation,
natural areas connectedness

Soil

texture, humidity,
C/N, soil profile class

2. Effects of land use, landscape and soil



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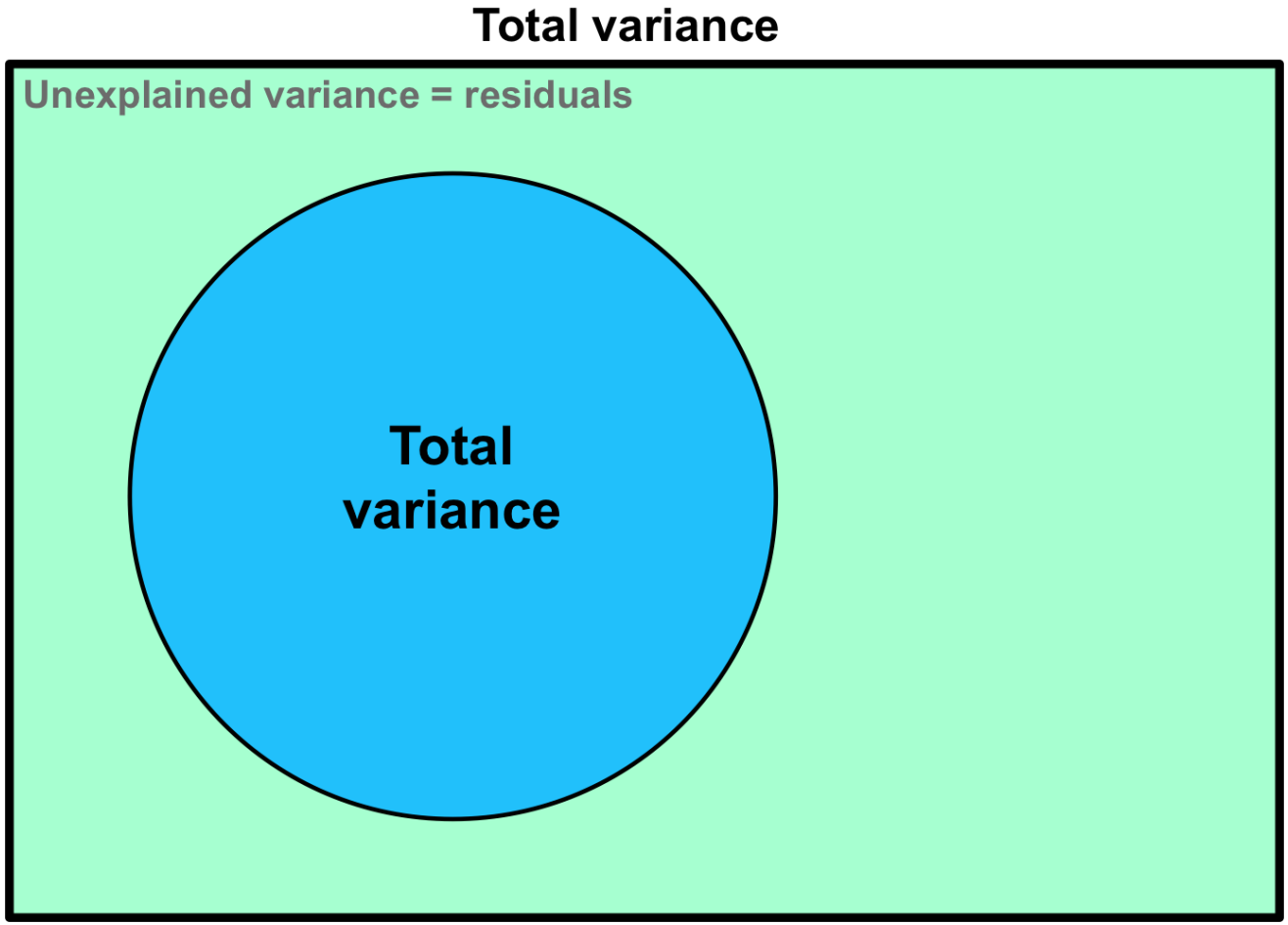

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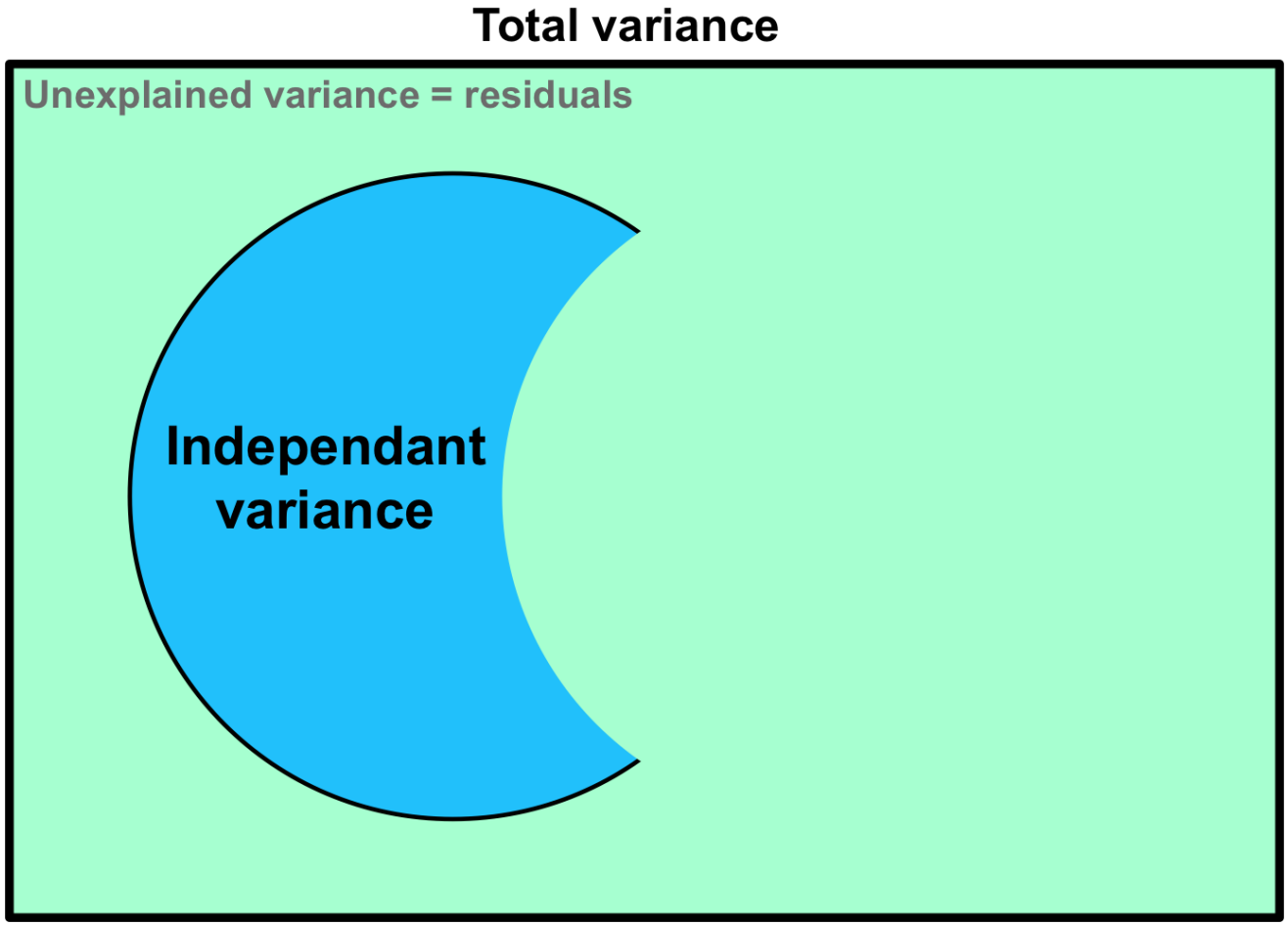
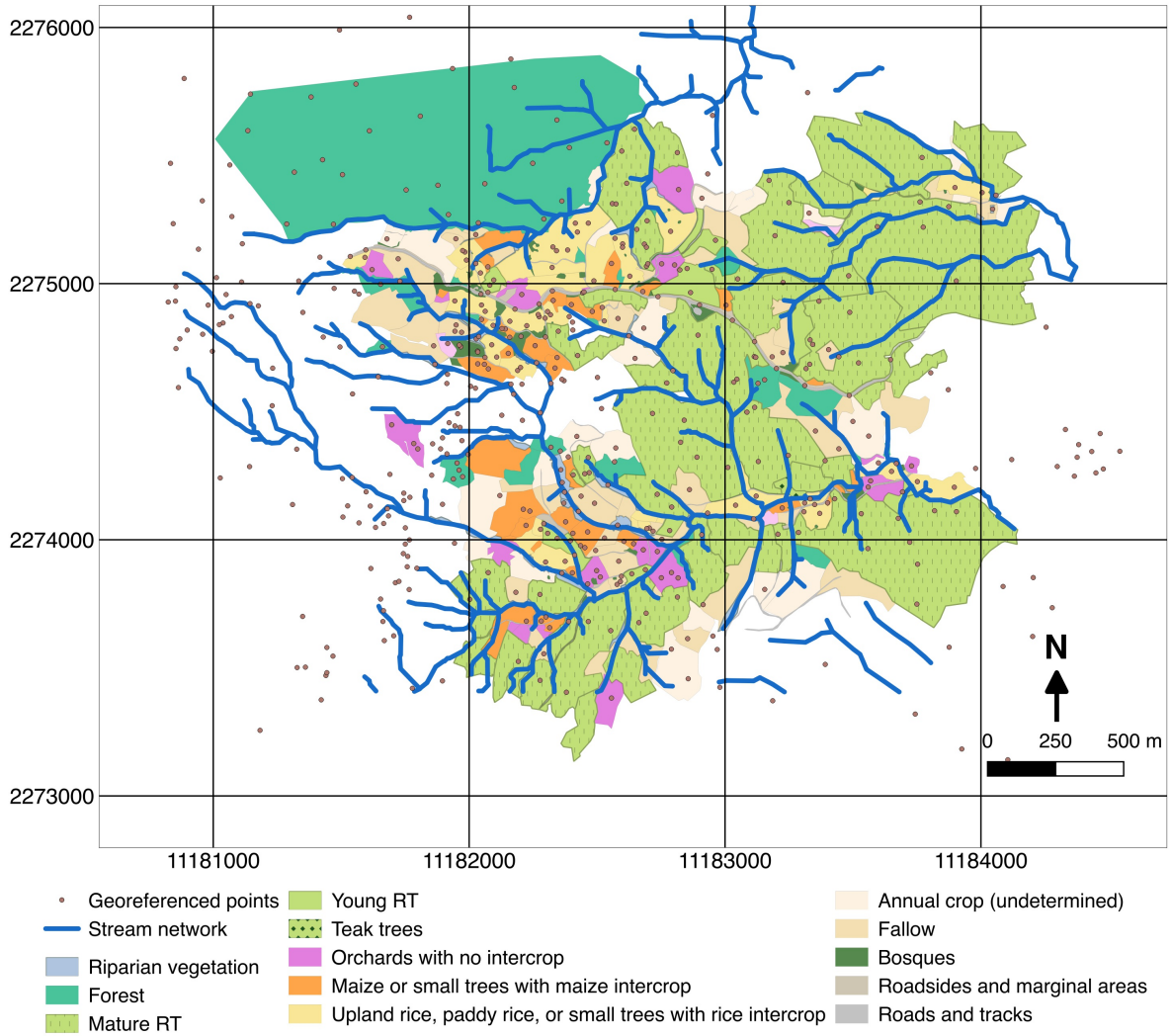


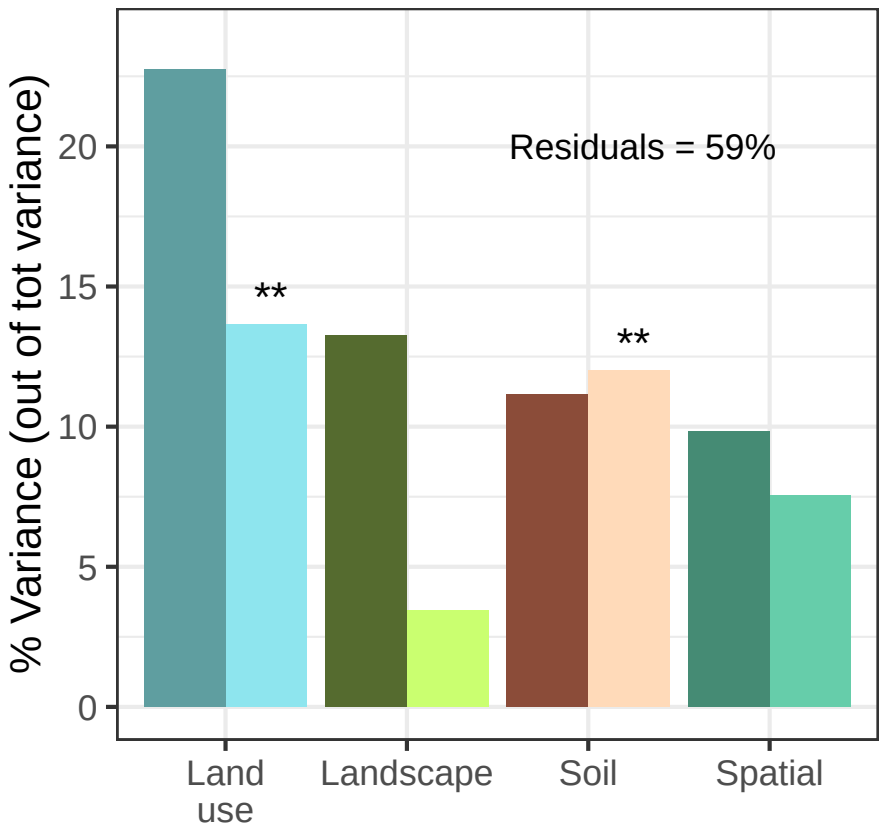
2. Effects of land use, landscape and soil

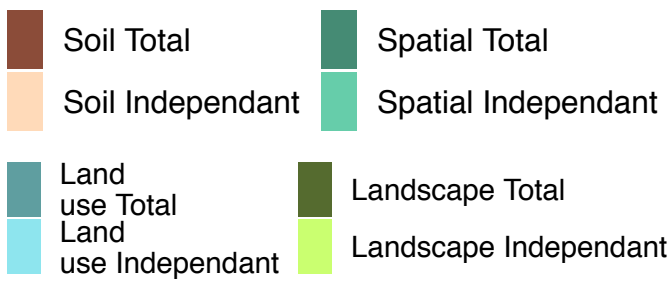
Determination of landscape structure and composition



2. Effects of land use, landscape and soil

Relative effect of factors on community composition





Hierarchical variance partitioning + mixed regressions. $*$ = P $<$ 5%; $**$ P $<$ 0.01

2. Effects of land use, landscape and soil

	Land use	Landscape	Soil
Community composition	**	n.s.	**

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2. Effects of land use, landscape and soil

	Land use	Landscape	Soil
Community composition	**	n.s.	**
Species richness	*	*	n.s.
Plant density	*	*	n.s.
Plant biomass	*	**	n.s.

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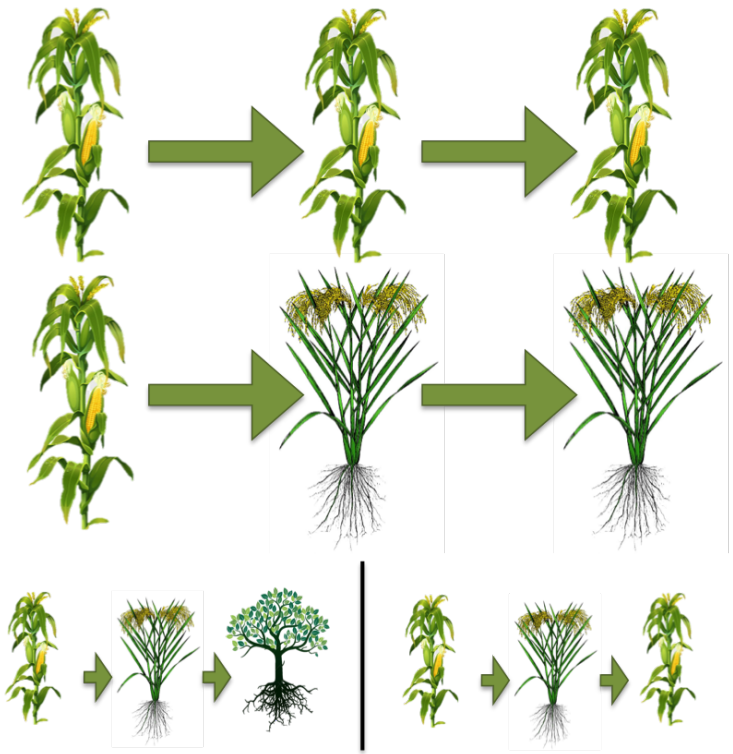
Community composition	**	n.s.	**
Species richness	*	*	n.s.
Plant density	*	*	n.s.
Plant biomass	*	**	n.s.

Landscape is the second main factor, after land use, affecting communities

Hierarchical variance partitioning + mixed regressions. $*$ = P $<$ 5%; $**$ P $<$ 0.01

3. Crop temporal variability

Temporal variability is measured as the number of shifts changes in the 3 previous years.



0 shift

1 shift

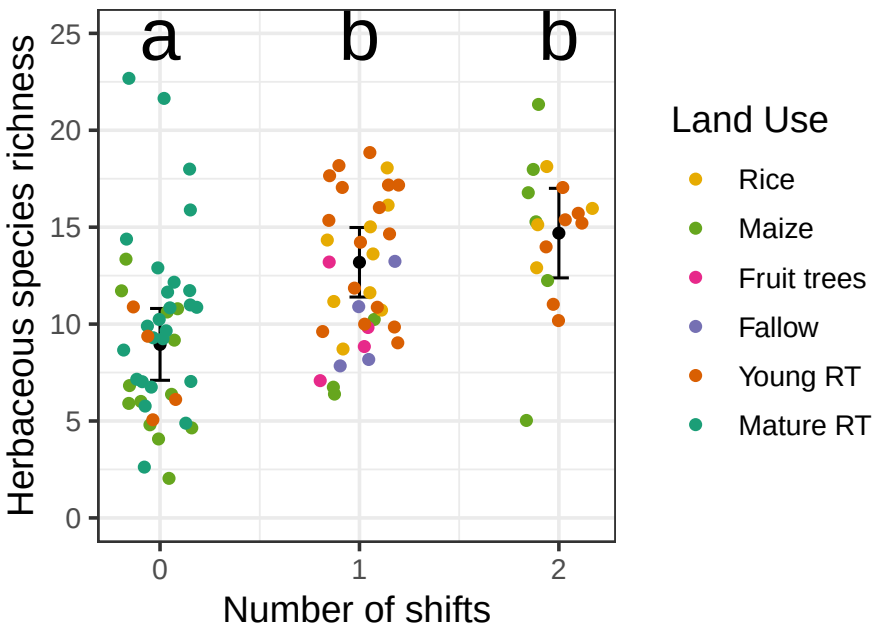
2 shifts

Mixed models after removal of land use effect

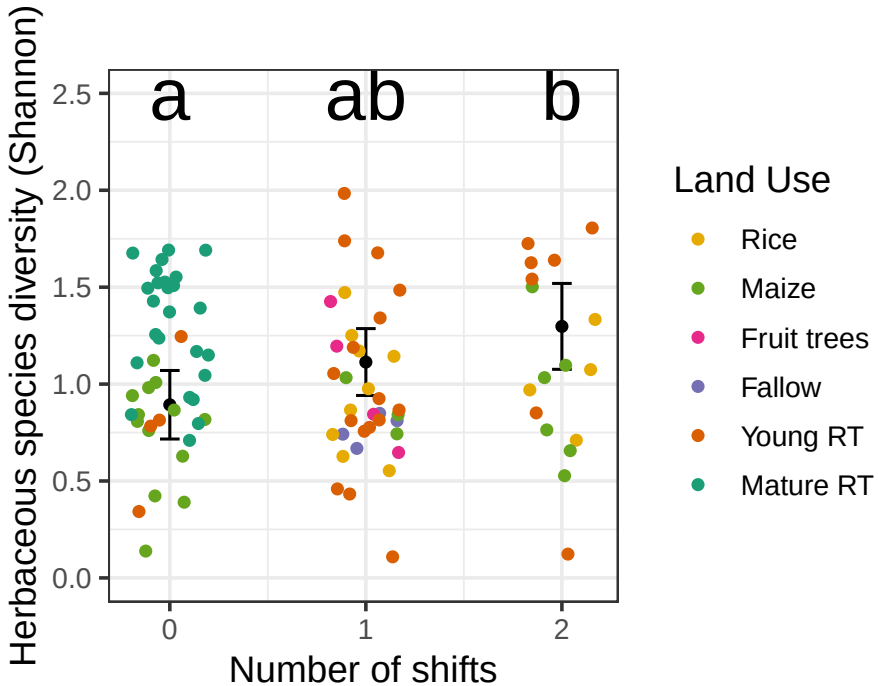
3. Crop temporal variability

Herbaceous species richness and diversity increase with crop temporal variability.

Herbaceous species richness



Herbaceous species diversity



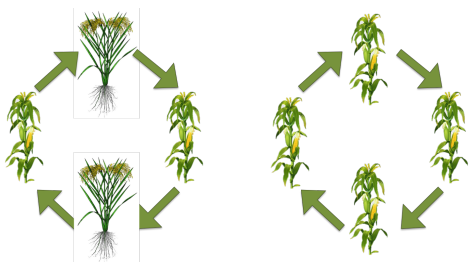
Land Use
Rice
Maize
Fruit trees
Fallow
Young RT
Mature RT

Mixed models after removal of land use effect

Conclusion

1. Afforestation by RT changes community composition, decrease plant species richness and abundance

2. Landscape is the second main factor, after land use, affecting communities



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Take home message

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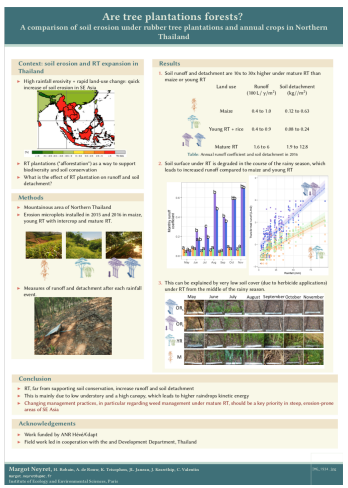
- Necessity to integrate field and landscape levels to effectively manage weed communities.
- Especially important under RT plantations for soil conservation.



Poster n. 14

Acknowledgements

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Thank you for your attention! questions?

References

Neyret, Robain, de Rouw, Soulileuth, Trisophon and Valentin (2018). The transition from arable lands to rubber tree plantations in northern Thailand impacts weed assemblages and soil physical properties. *Soil Use and Management*.
Neyret, Robain, de Rouw, Janeau, Keawthip, Trisophon and Valentin. Rubber tree plantations increase runoff and soil detachment compared to annual crops in mountainous Northern Thailand. Submitted to *Catena*.

PhD defense in July 2019 → Looking for a postdoc starting Sept-Oct 2019!

http://www.neyret.me/ margot.neyret@upmc.fr