Landscape and land use history, main drivers of weed communities in mountainous SE Asia

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Unifying Tropical Ecology

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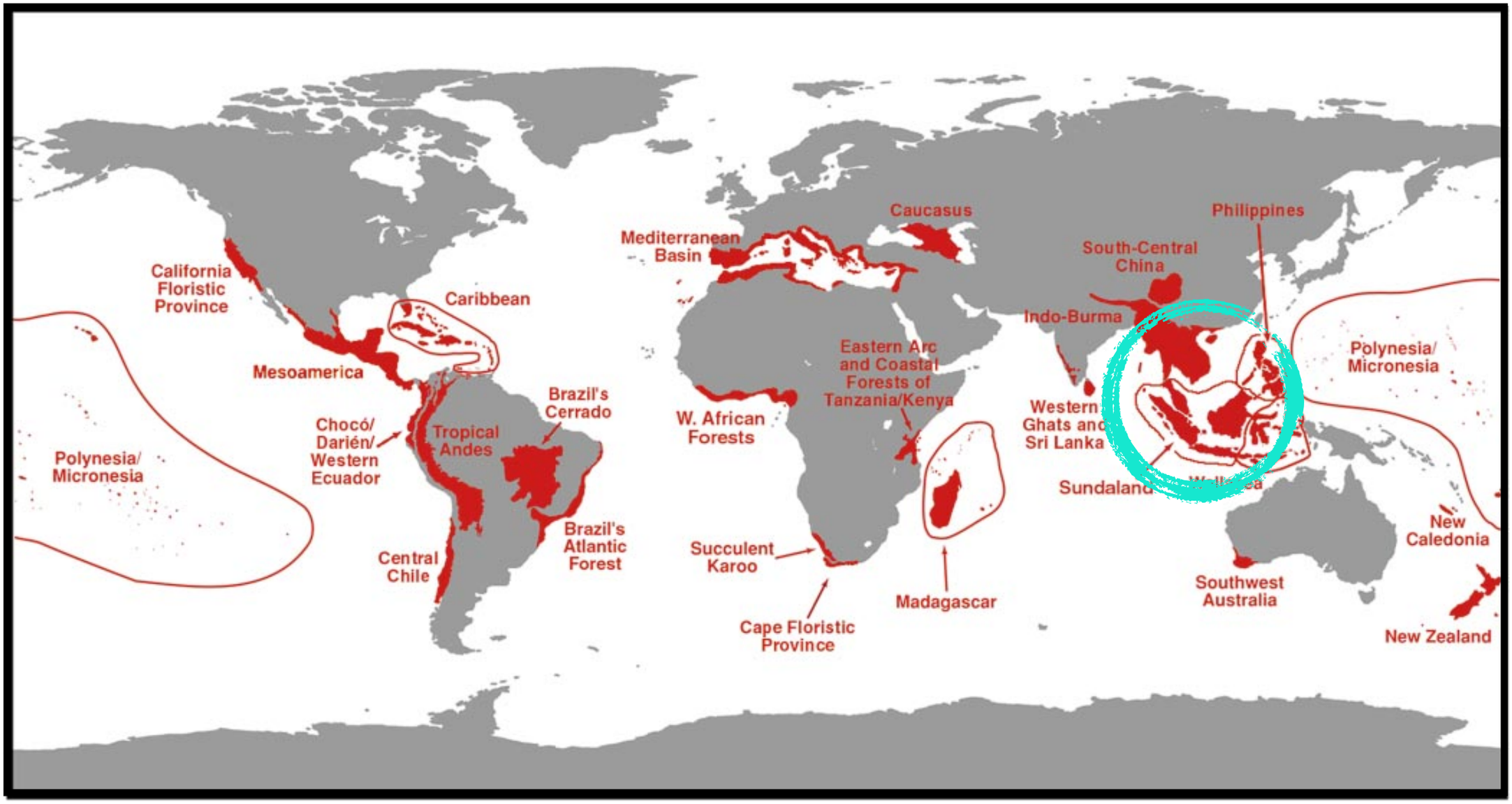
Mountainous SE Asia

A hotspot of biodiversity



From Myers *et al*. (2000)

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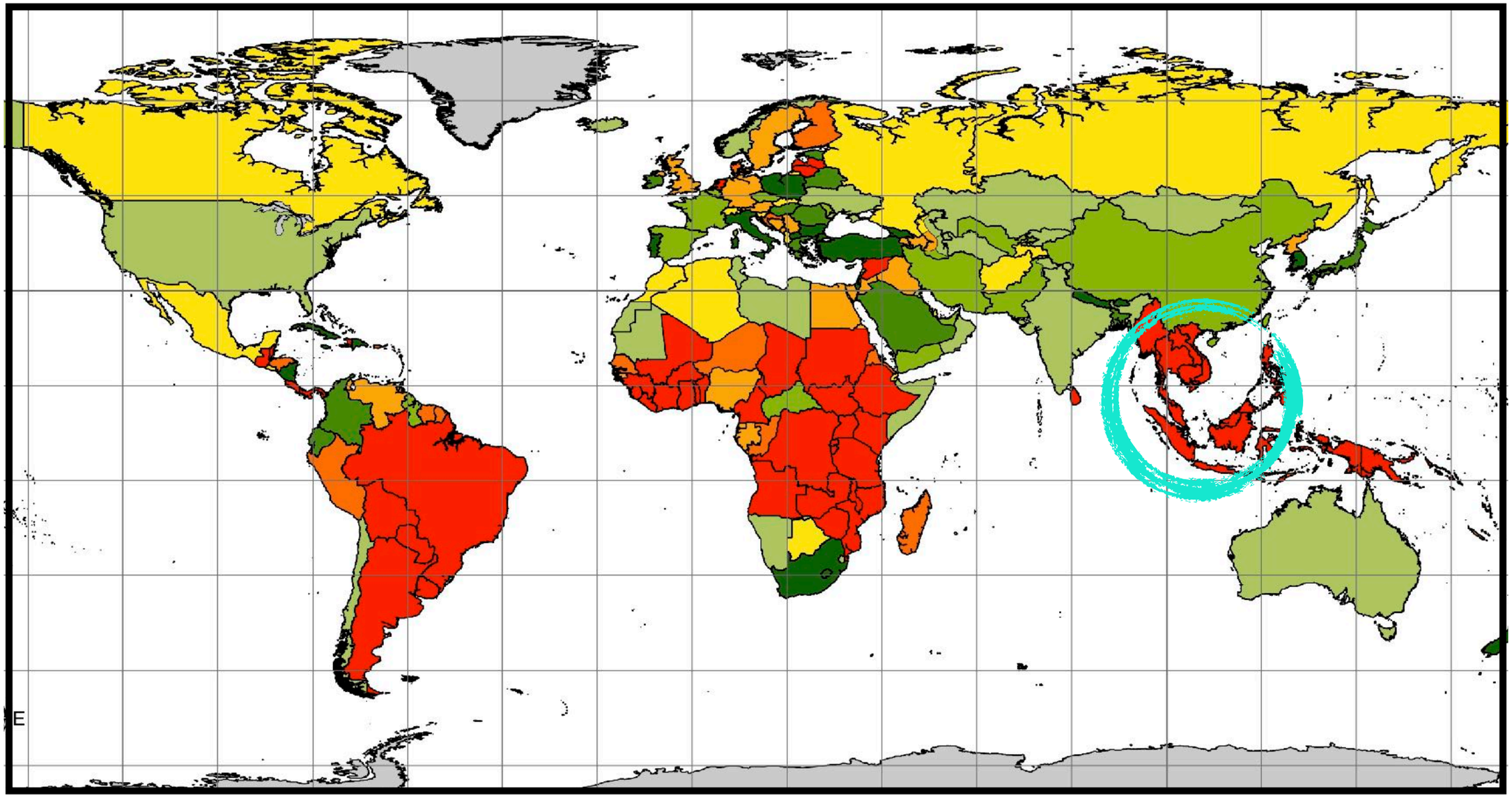
Mountainous SE Asia

A hotspot of environmental degradation



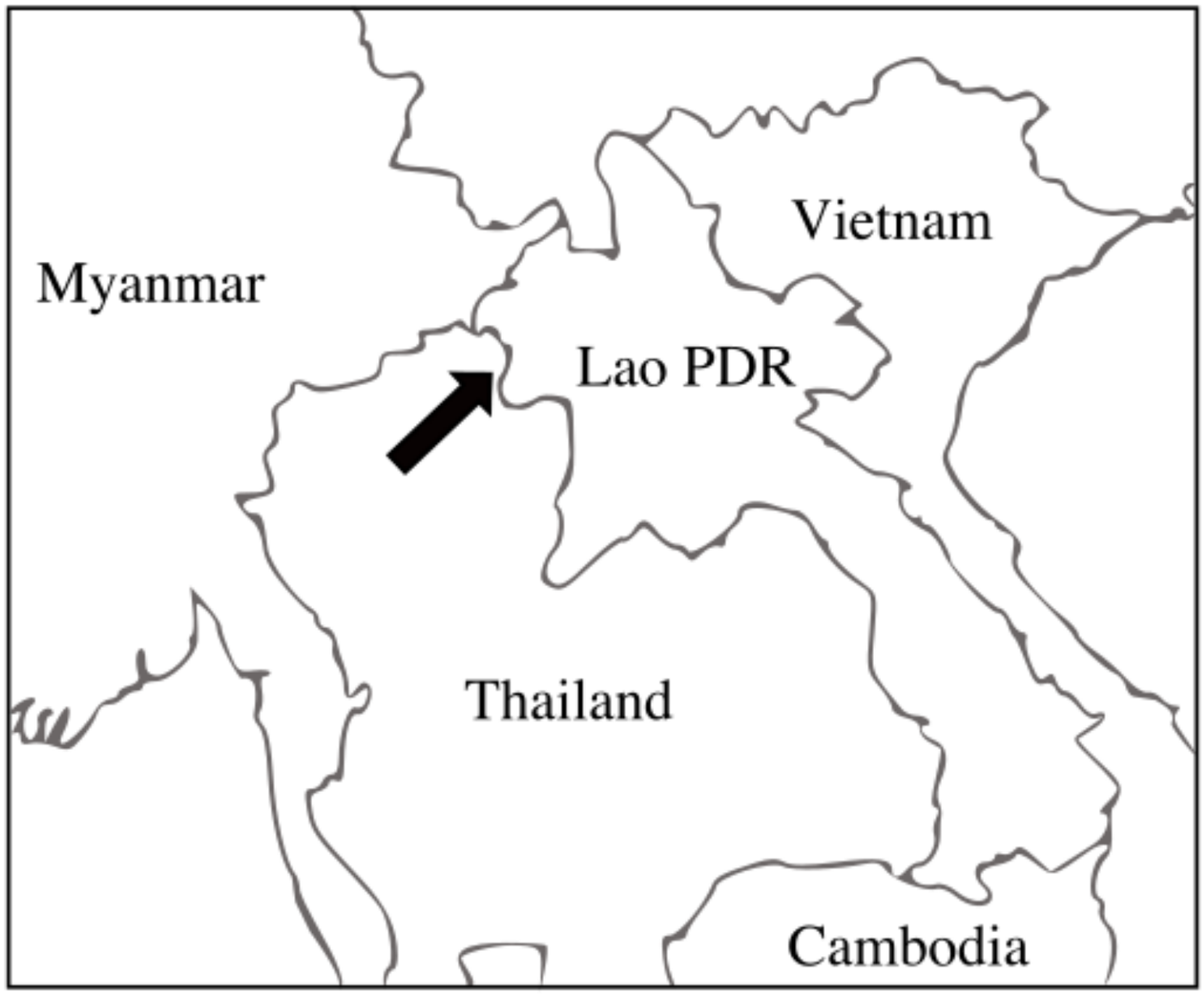
Predicted annual soil erosion change (baseline scenario)

[%]

< –5 | –5 – –2.5 | –2.5 – –0.5 | –0.5 – 0 | 0 – 0.5 | 0.5 – 2.5 | 2.5 – 5 | > 5 | No data

From Borrelli *et al*. (2017)

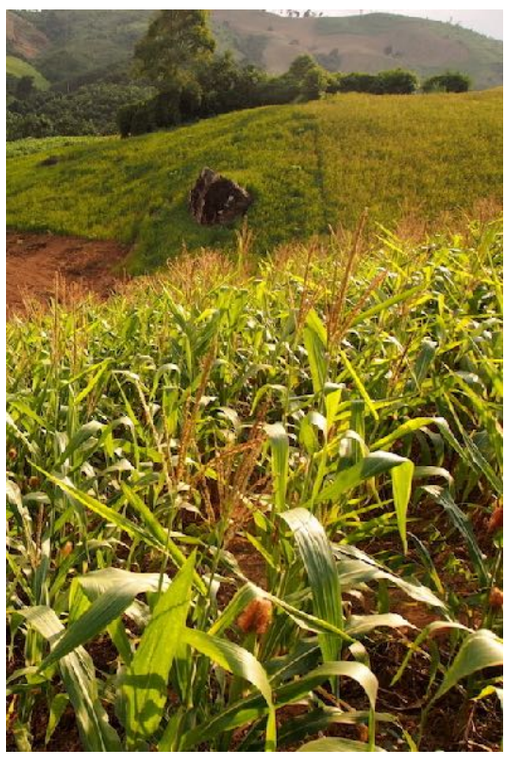
Mountainous SE Asia



From Borrelli *et al*. (2017)

Intensification of management

Transition from annual to cash perennial crops



- Soil erosion **x 10**

- Biodiversity **?**

Weeds in the agroecosystem

Agricultural intensification…

- ↑ herbicides
- ↑ monocultures
- ↑ landscape homogenisation

… strongly affects weed communities

- ↓ Diversity
- ↓ Abundance
- ↑ Competitivity

and their ecosystem services

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

Study site

- 20 fields followed 2x/year between March 2016 and March 2018

- Botanical inventories

- Soil characterisation

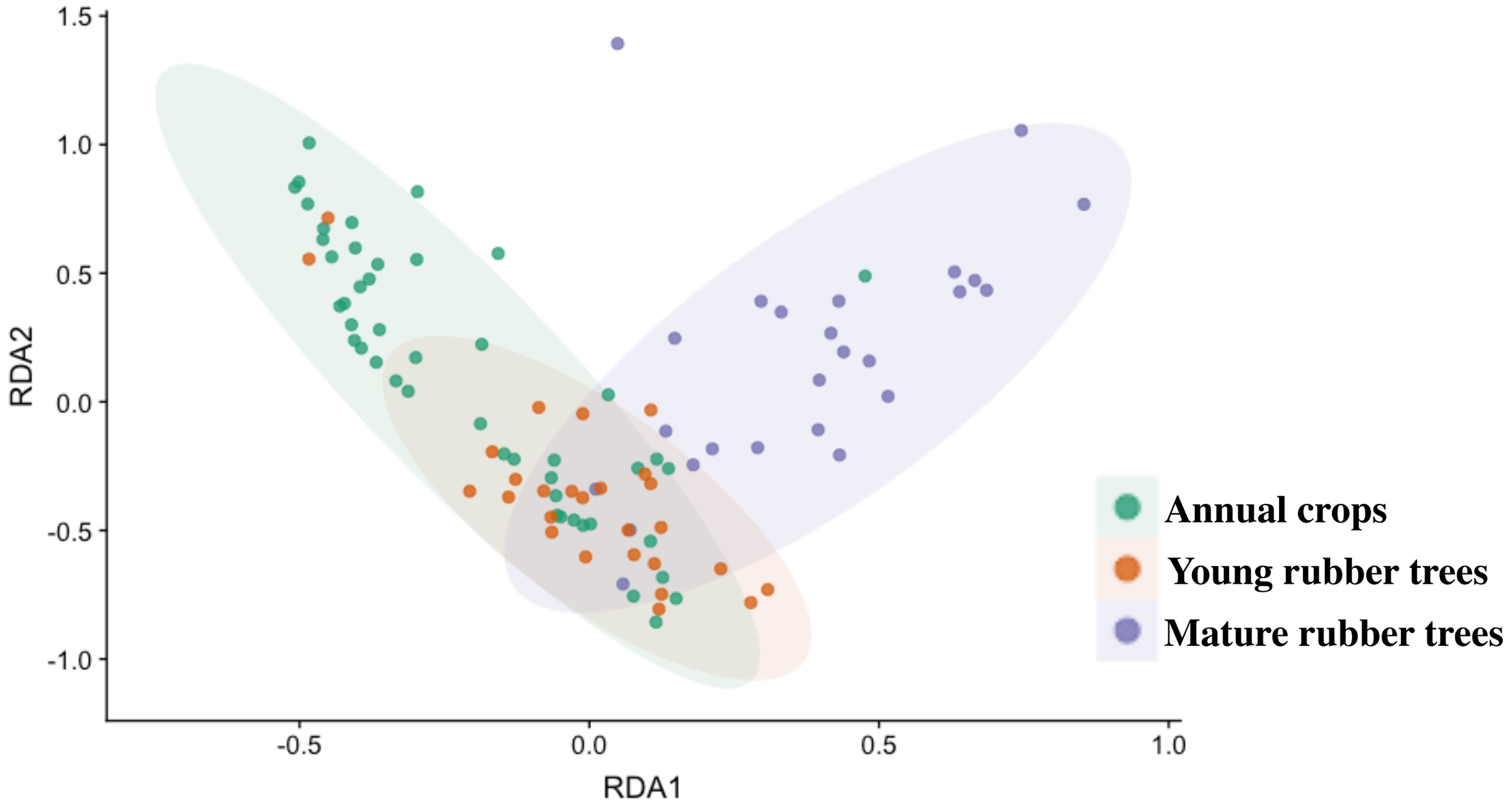
Rice

Maize

Young rubber trees

Mature rubber trees

Land use effect on weeds



Redundancy model analysis, all pairwise comparisons $P < 0.01$

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Agricultural intensification

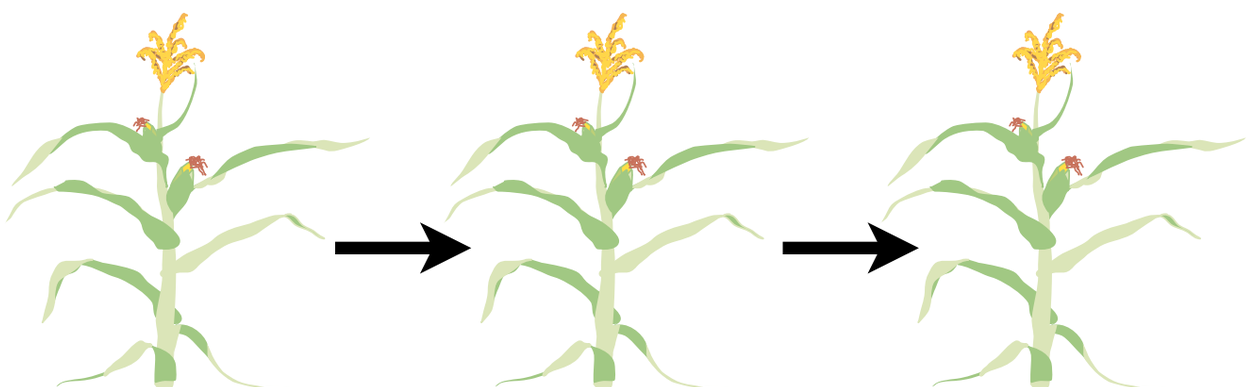
1. Agricultural intensification → simplified rotations.

➢ **What is the effect of land use temporal variability on plant diversity?**

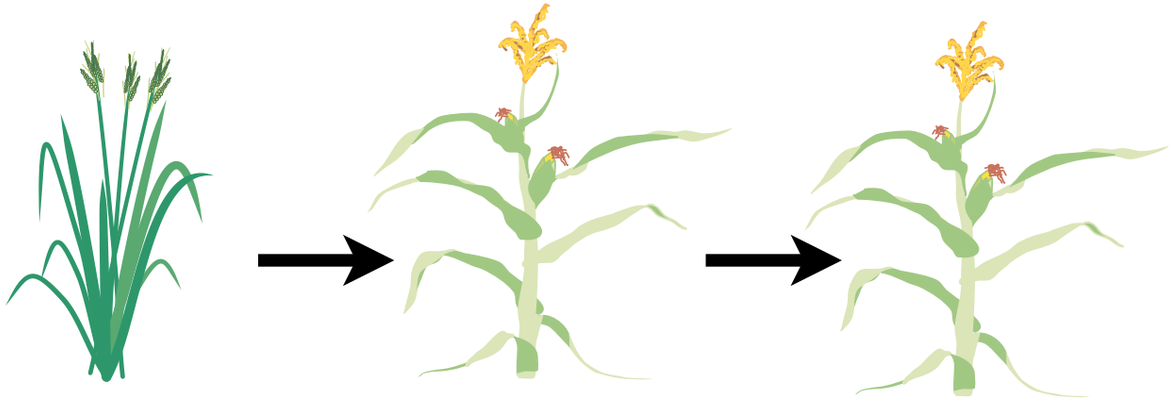
2. Plant diversity affected by land use, soil… and landscape.

➢ **What is the relative impact of land use, landscape, soil and space on plant communities?**

Land use temporal diversity



0 shift



1 shift

2 shifts

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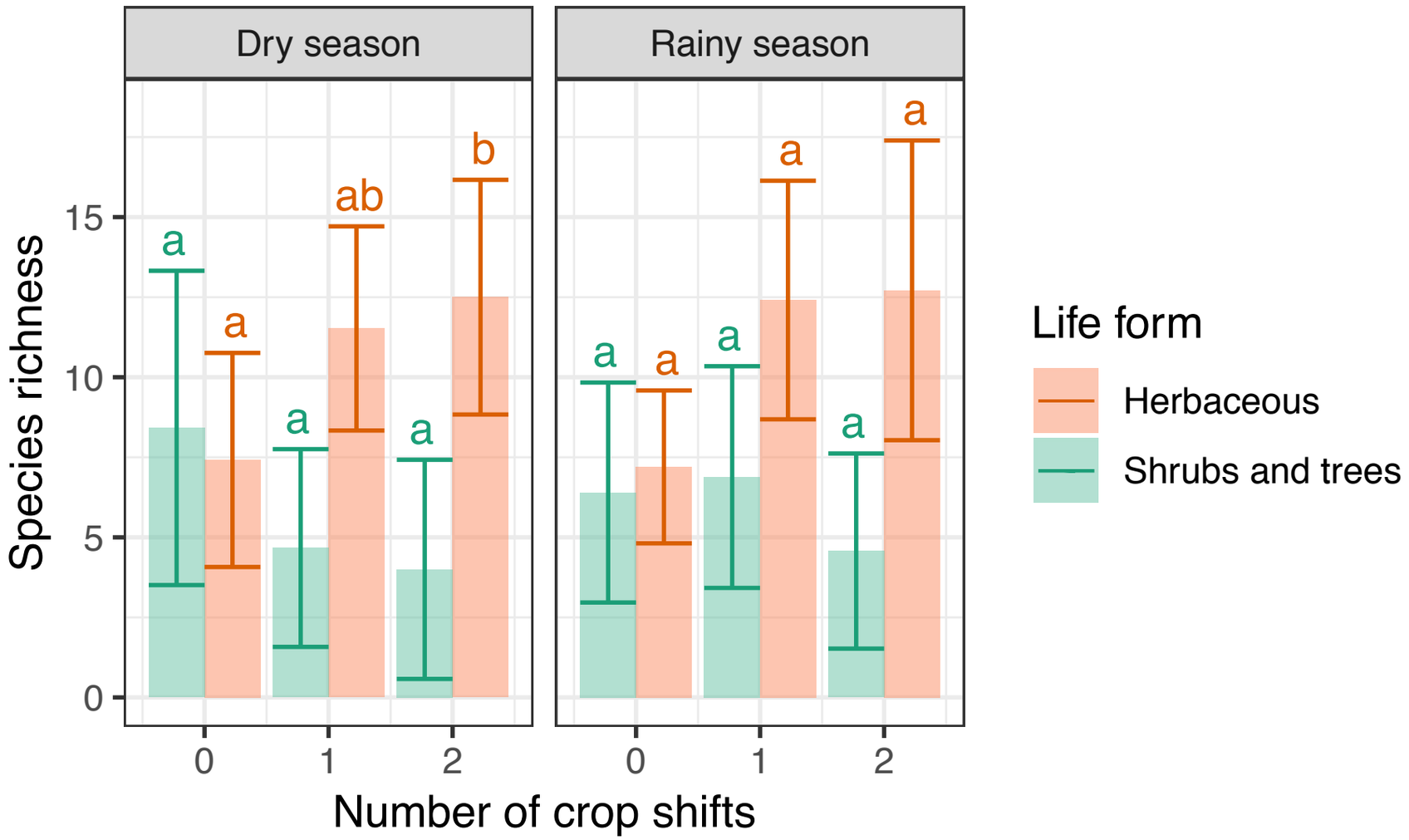
Land use temporal diversity



➢ **Herbaceous species richness increases with the number of crop shifts**

Mixed model analysis, ≠ letters: $P < 0.05$

Land use temporal diversity

0 shift

2 shifts

Species richness

Soil resources diversity

Species diversity/evenness

Heterogeneity of growing conditions

Total weed abundance

Dominance by invasive species

Frequency of disturbance

Land use temporal diversity

0 shift

Crop sequence

2 shifts

Weed community

Species richness

Species diversity/evenness

Total weed abundance

Dominance by main species

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Landscape and local factors impact on plant communities

Land use

Landscape

Local factors

(soil, slope, etc.)

Spatial coordinates

(Northing/ Easting)

Gaba *et al*. (2007)

Landscape and local factors impact on plant communities

Land use

Landscape

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Spatial coordinates

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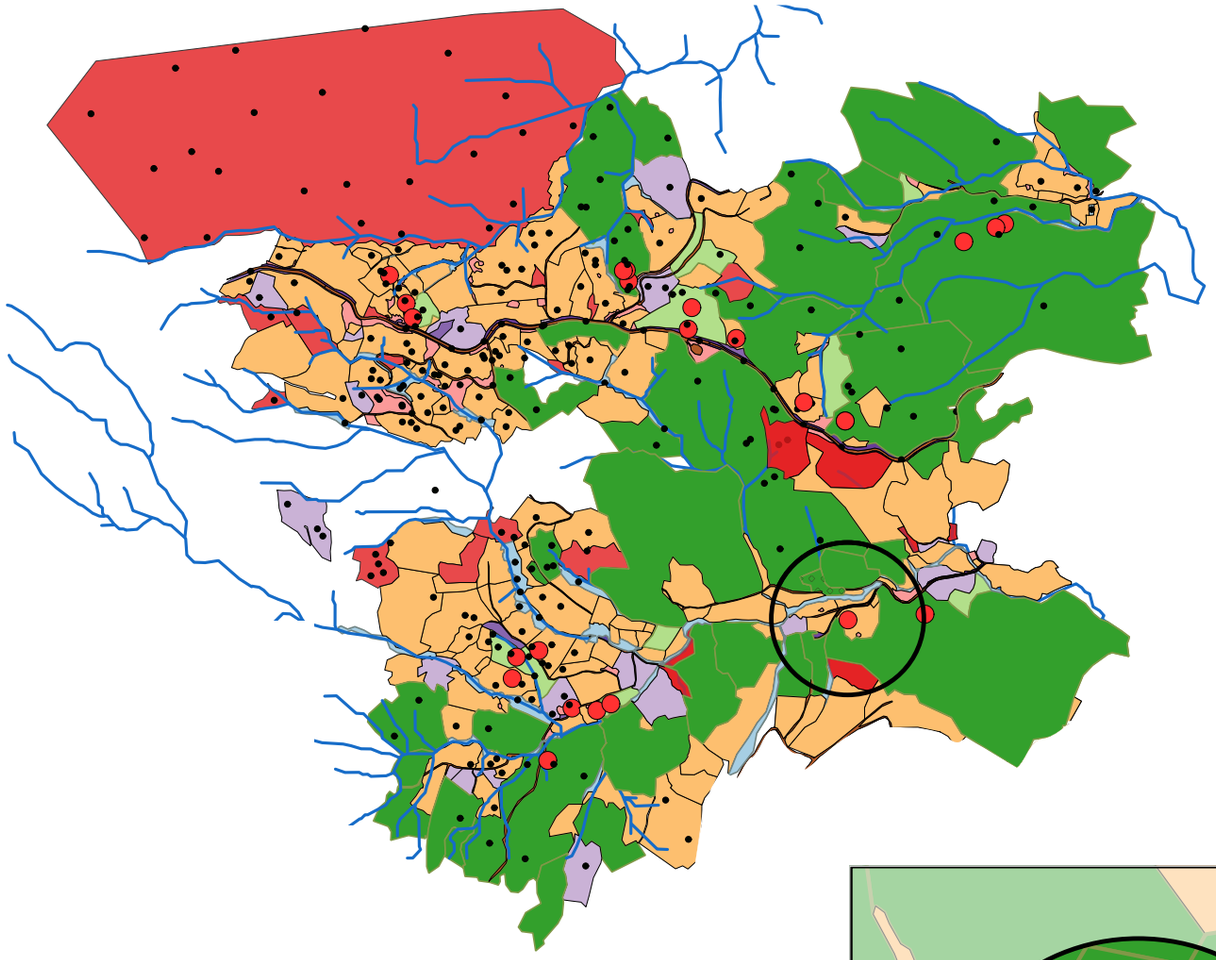
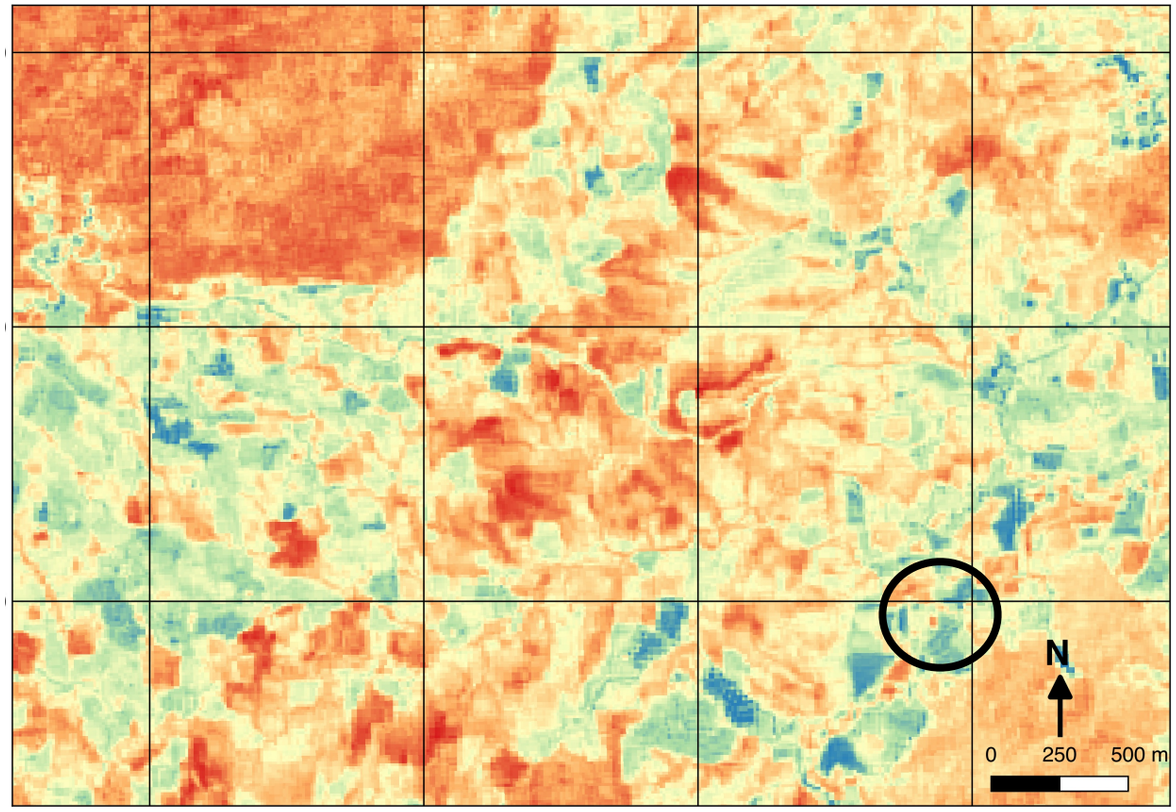
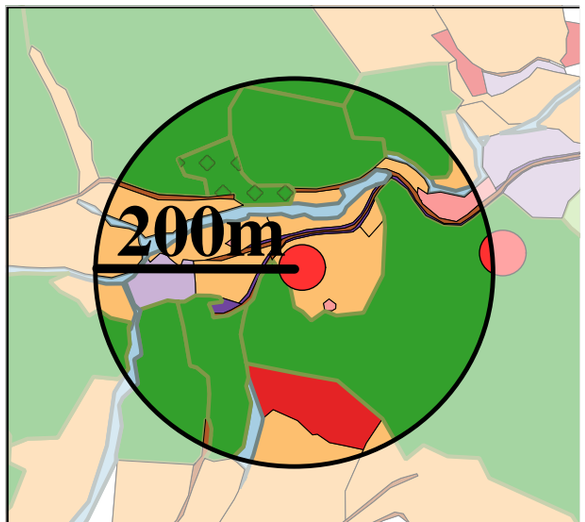
Landscape and local factors impact on plant communities

Landscape composition and configuration



Vegetation health and variability (NDVI)





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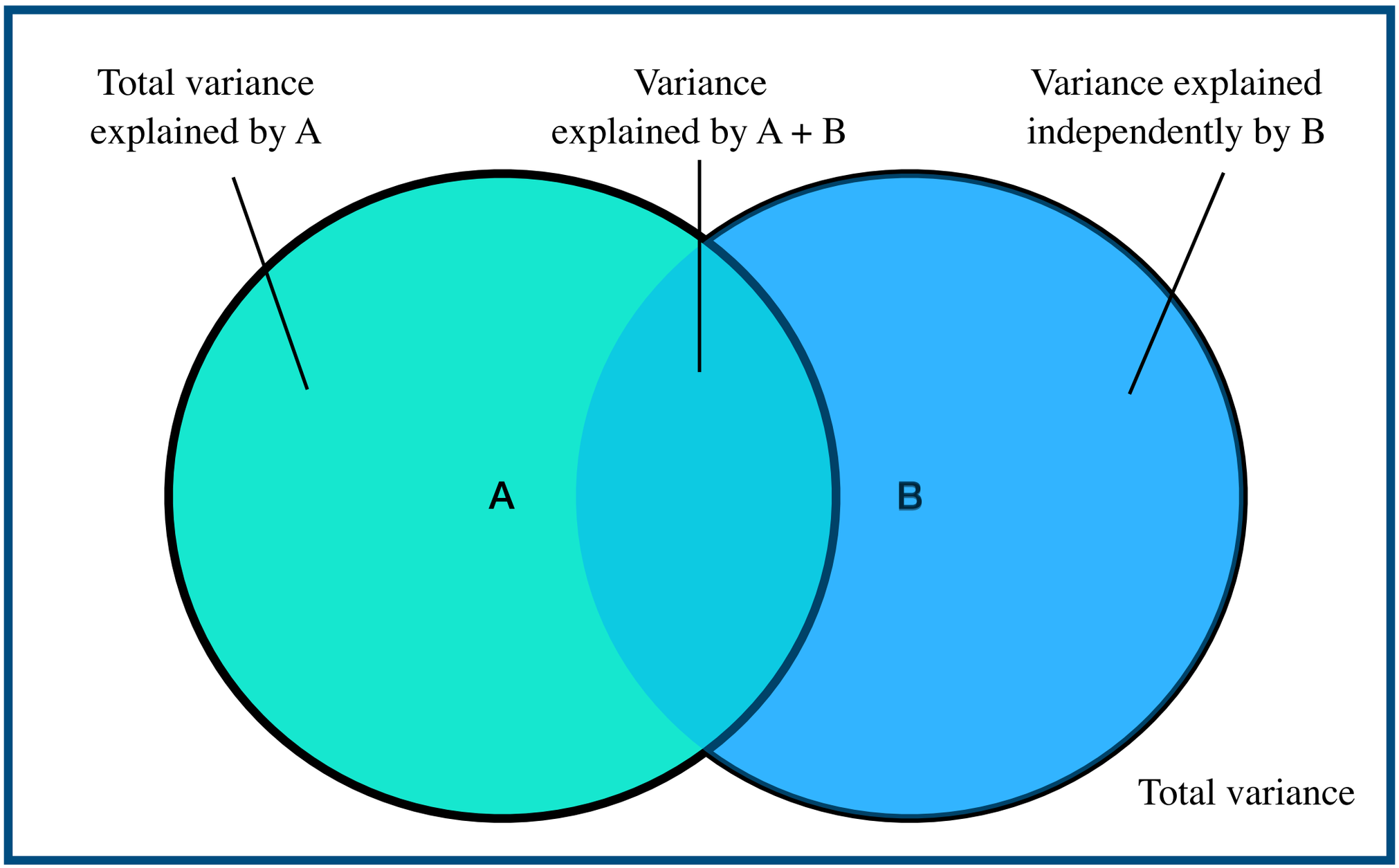
Landscape and local factors impact on plant communities

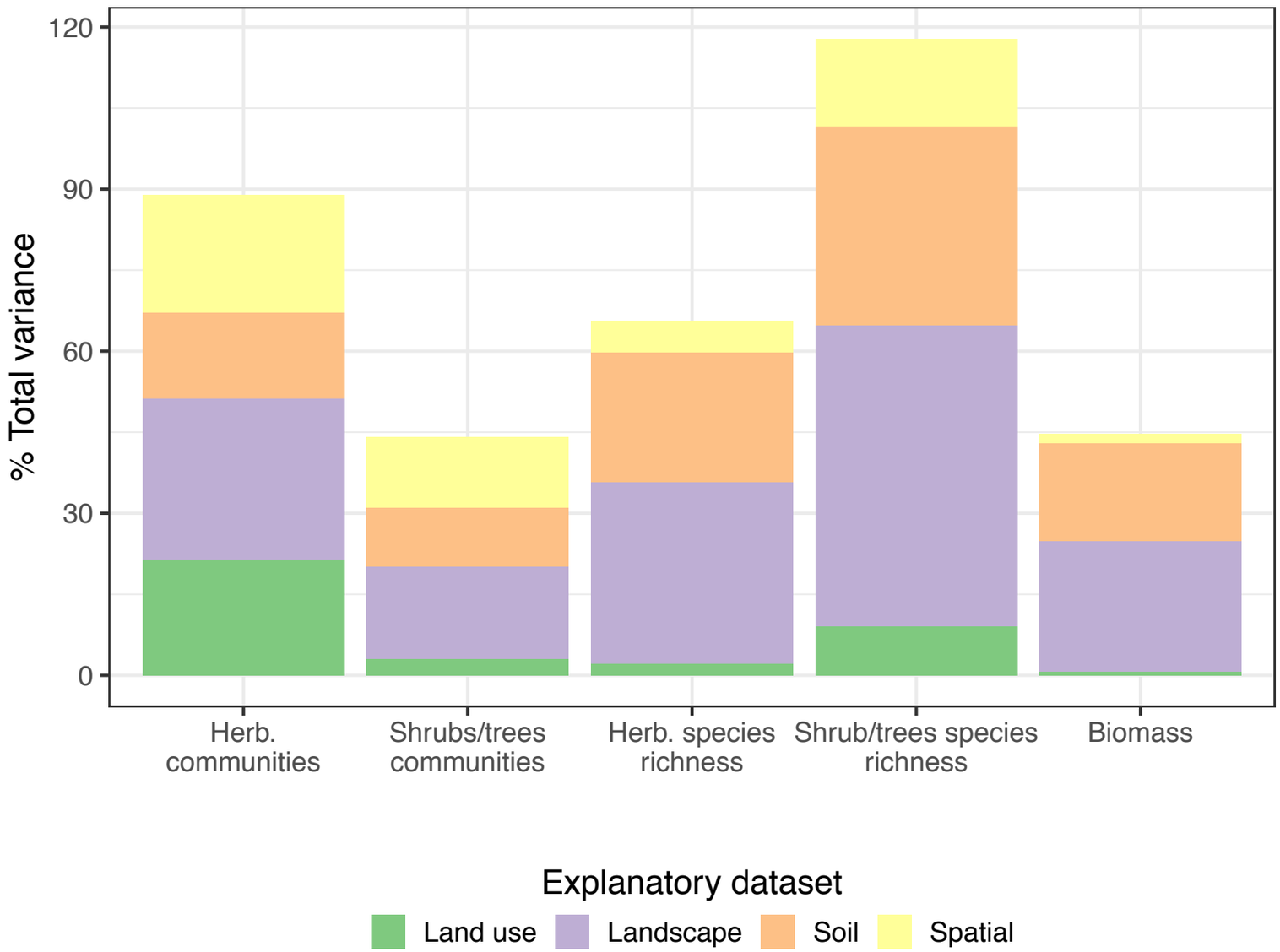


Landscape and local factors impact on plant communities

- Landscape plant determinants of shrub and tree communities, plant richness, and biomass (e.g. presence of field margins)

Variance partitioning for herbaceous communities

Total effects of individual explanatory tables on five descriptors of plant communities (∑ ≠ 100)



Total expl indivi

Total adj. R2

explained

Fried *et al*. (2009)

Take-home message

Diversified crop rotations: ↑ weed diversity, → biomass.

➢ **↓ competitivity**

Landscape: huge impact on weed communities

composition and richness

Smith *et al*. (2010)

Take-home message

➢ **Conservation action to promote biodiversity and restore agroecosystems in the area should take into account both field-level and landscape-level management**

➢ **Need to inform and promote communication between governments and smallholders**

Acknowledgements

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