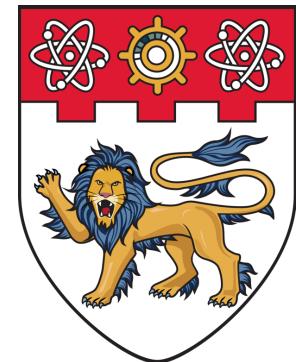


Conserving invertebrate biodiversity in agricultural landscapes

PhD Candidate: Tharaka S. Priyadarshana

Adviser: Eleanor Slade



The Asian School of the Environment, Nanyang Technological University, Singapore

Project 1: The effect of invertebrate communities on ecosystem functions: A global meta-analysis

Project 2: The effect of crop heterogeneity on farmland biodiversity: A global meta-analysis

Project 3: Agricultural pest butterfly *Pieris canidia* abundance can be suppressed by enhancing compositional crop heterogeneity

Project 4: Biodiversity in agricultural landscapes: Balancing crop production and biodiversity conservation by promoting crop heterogeneity

Project 1

The effect of invertebrate communities
on ecosystem functions: A global meta-
analysis

Biodiversity-ecosystem function (BEF) experiments were set up to see if biodiversity loss affects ecosystem function

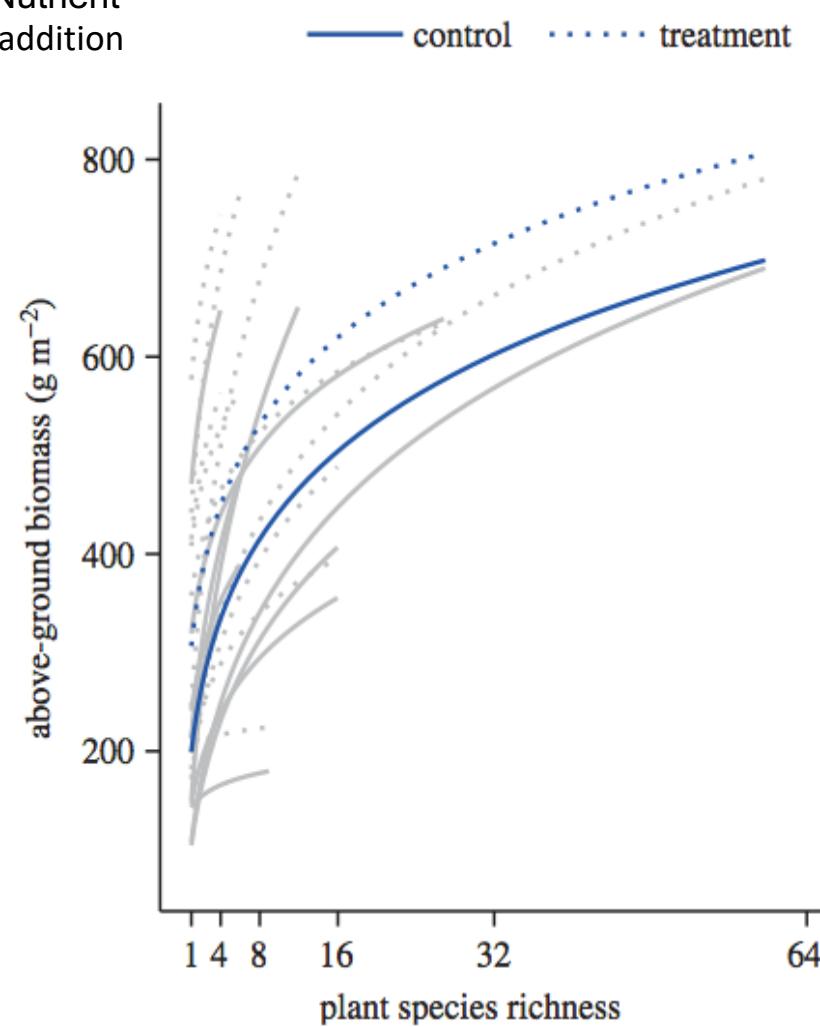


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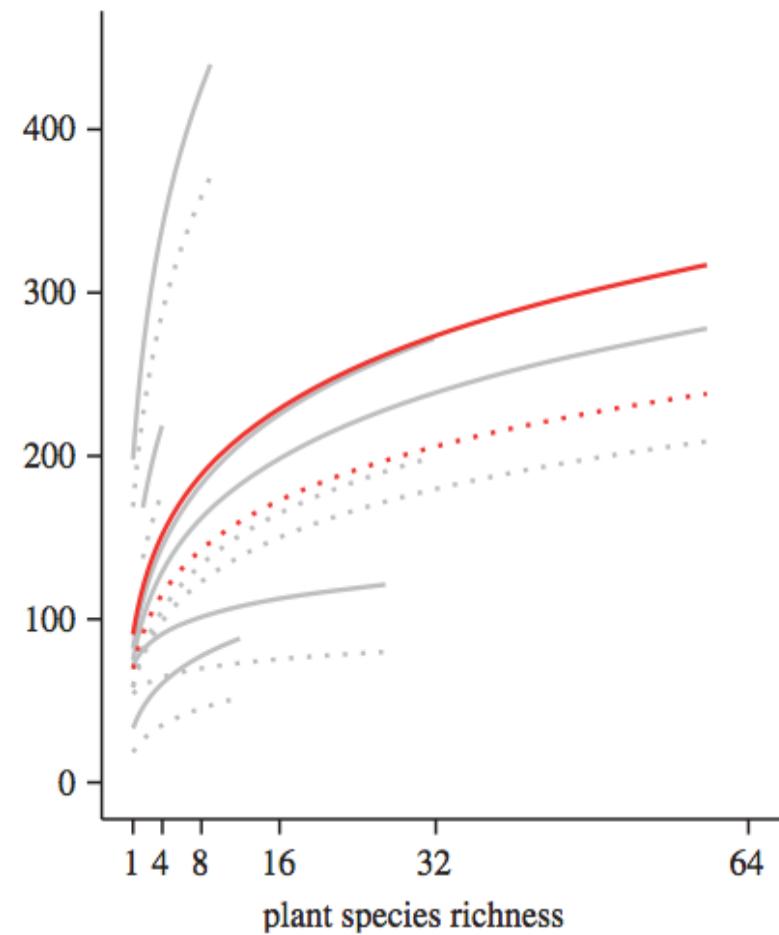
David Tilman's experiments at Cedar Creek Natural History Area (Bethel, MN)

What do these experiments show?

Nutrient
addition

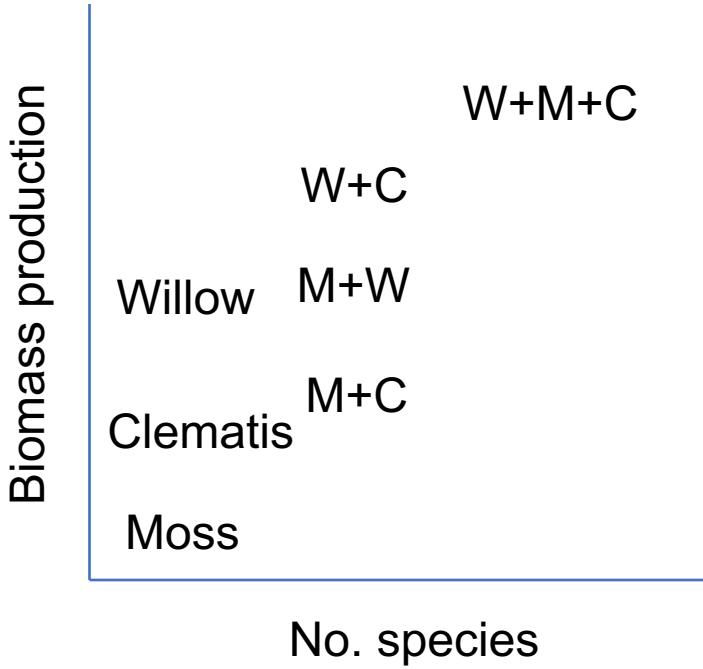


Drought



Biodiversity increases productivity regardless of drought and nutrient addition

How does biodiversity increase ecosystem functioning?



High diversity:

- More chance of a high performing species being present - *Selection effect*
- Species complement each other by having different niches, enemies and by facilitation- *Complementarity effect*



©Peter Manning

Loreau & Hector (2001). *Nature* 412, 72-76

The main point

- Experiments consistently show that biodiversity loss affects the functioning and stability of ecosystems

Plant communities

Microbial communities

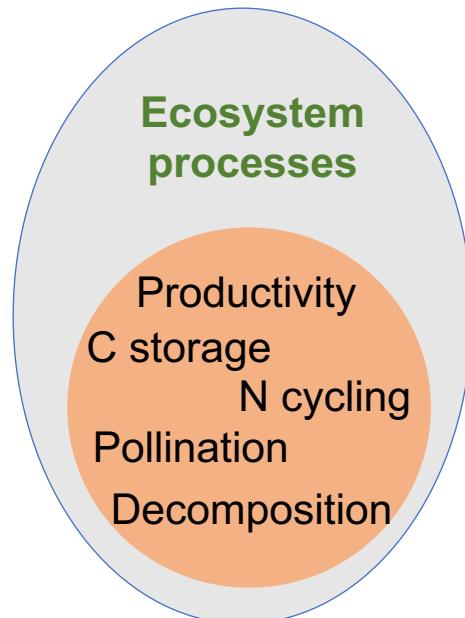
Vertebrate communities

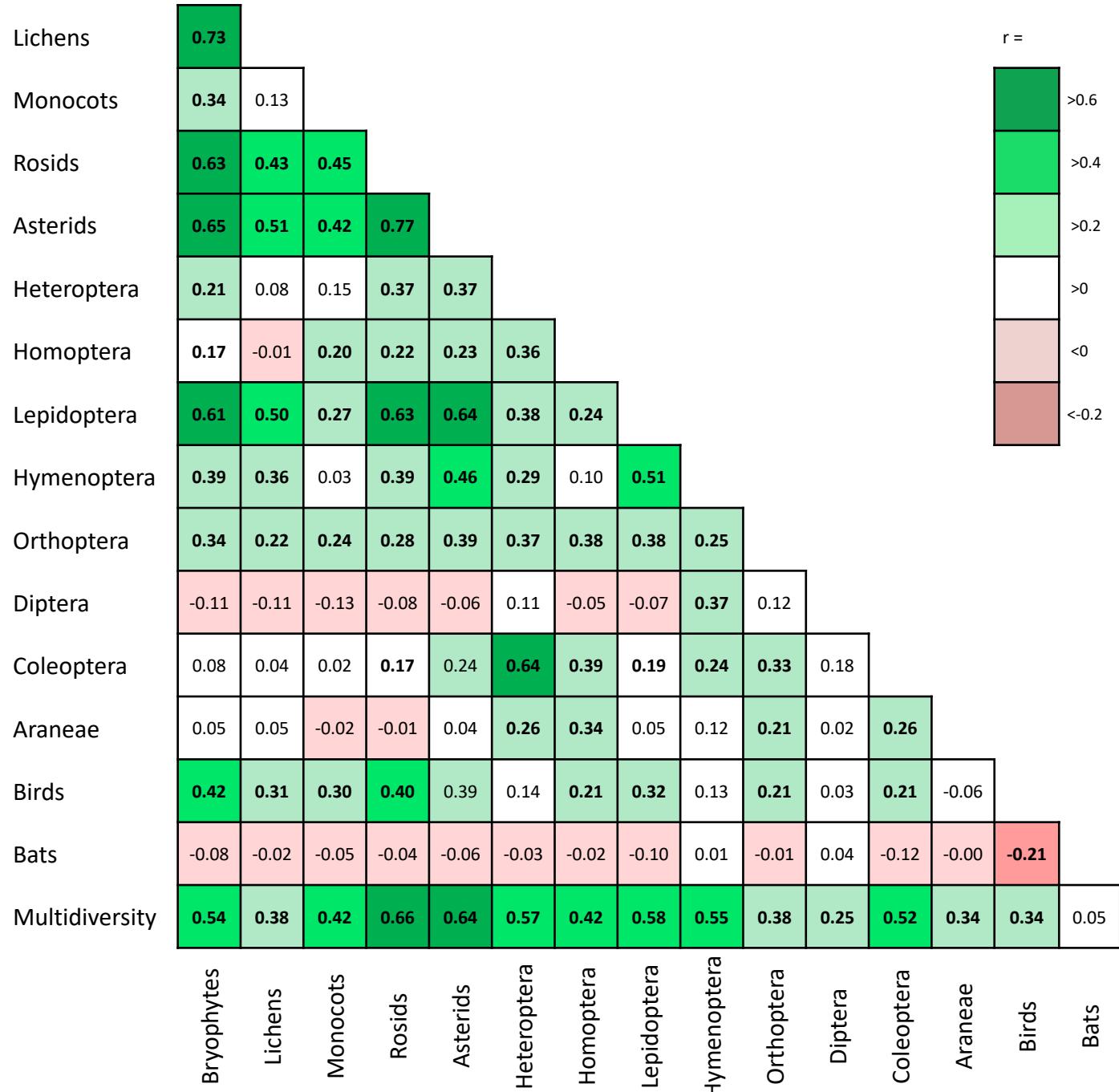
Invertebrate communities?

The main research question

How are ecosystem functions affected when (certain) invertebrate groups decline or are removed from a certain ecosystem (e.g. tropics vs temperate, aquatic vs terrestrial)?

Ecosystem functions





The diversity of many taxa are positively correlated and typically decline in response to land use intensity

Manning *et al.* (2015)
Ecology 96: 1492-1501

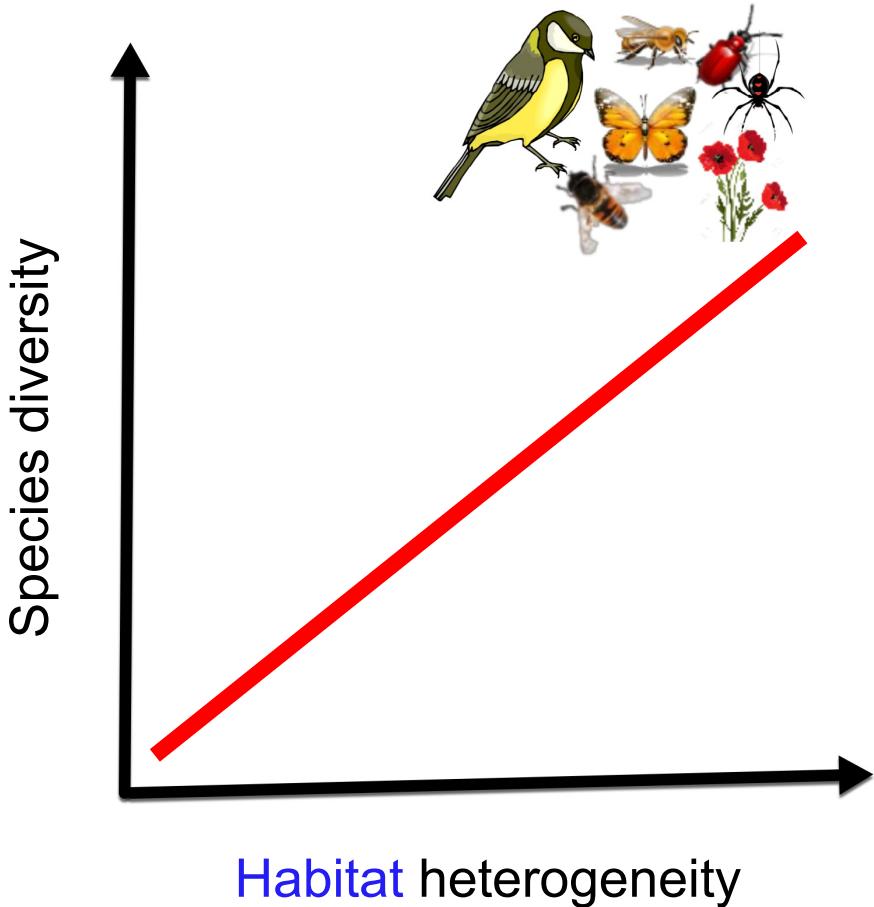
Crop heterogeneity

Project 2: The effect of *crop heterogeneity* on farmland biodiversity: A global meta-analysis

Project 3: Agricultural pest butterfly *Pieris canidia* abundance can be suppressed by enhancing compositional *crop heterogeneity*

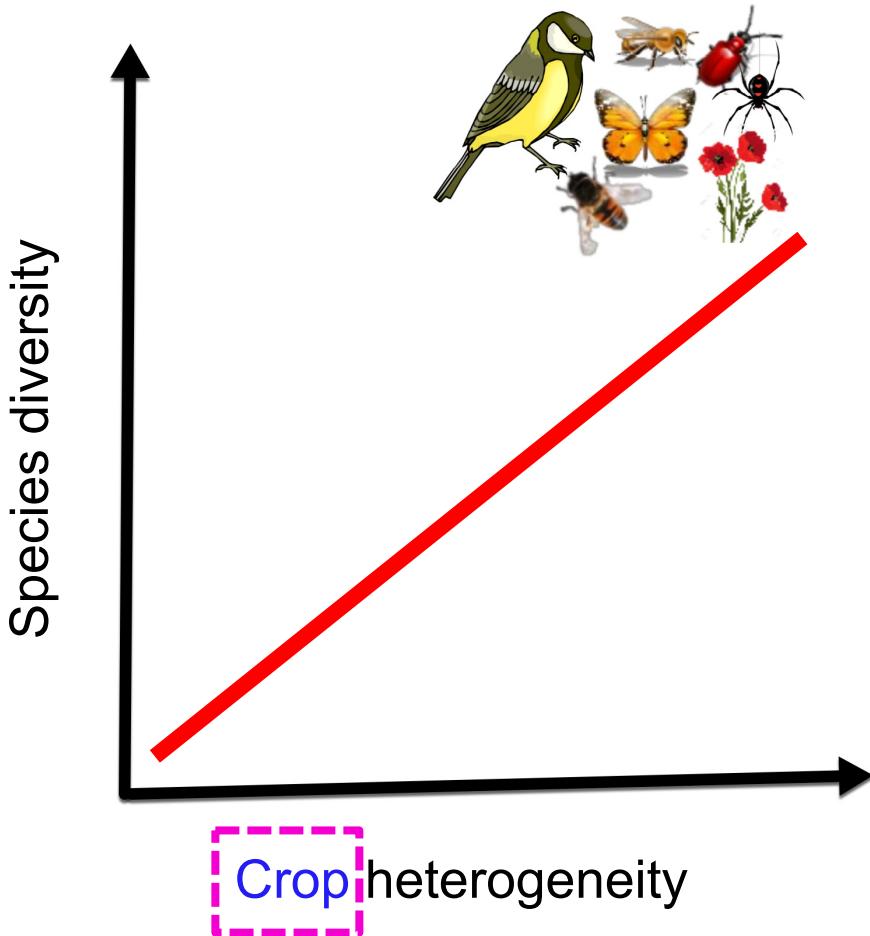
Project 4: Biodiversity in agricultural landscapes: Balancing crop production and biodiversity conservation by promoting *crop heterogeneity*

Habitat heterogeneity increases biodiversity

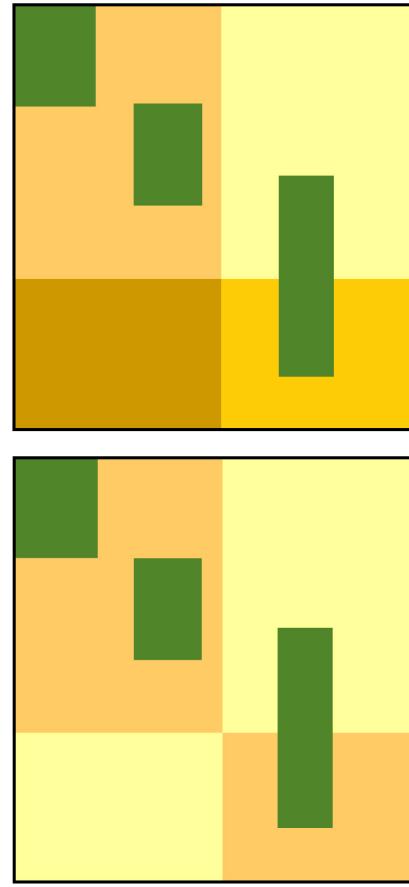


©Kasun Pradeepa

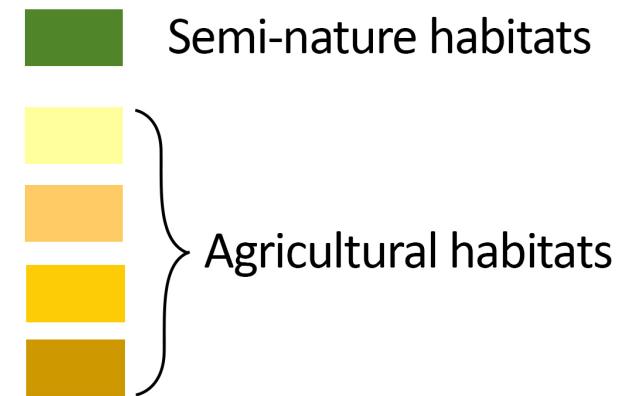
Crop heterogeneity increases biodiversity?



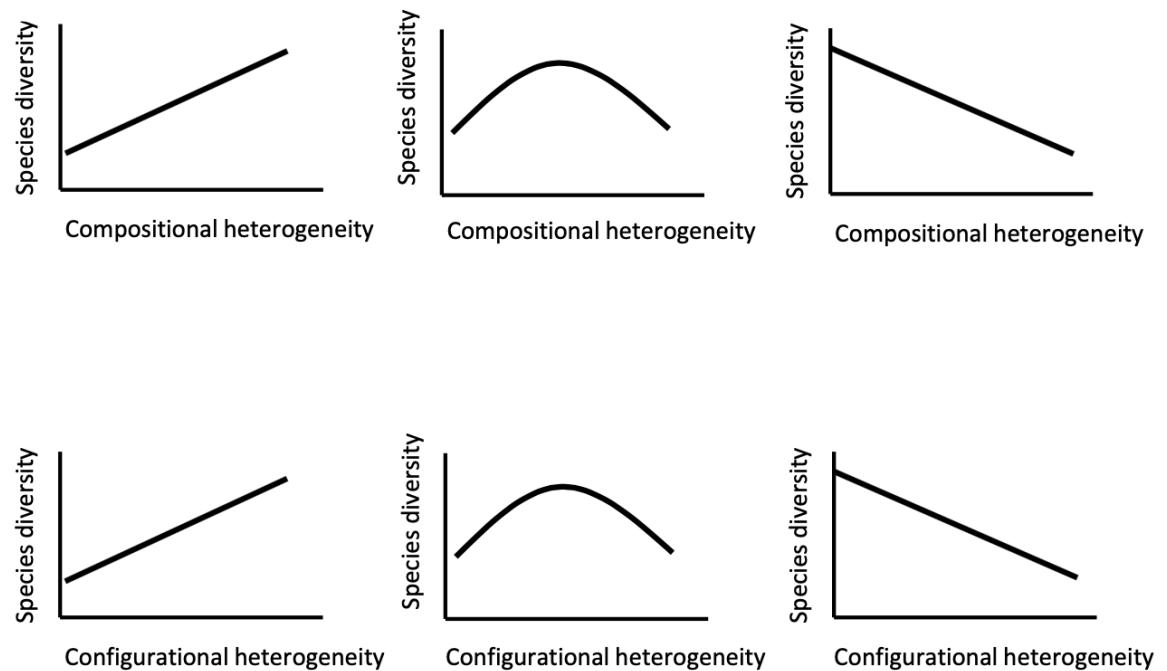
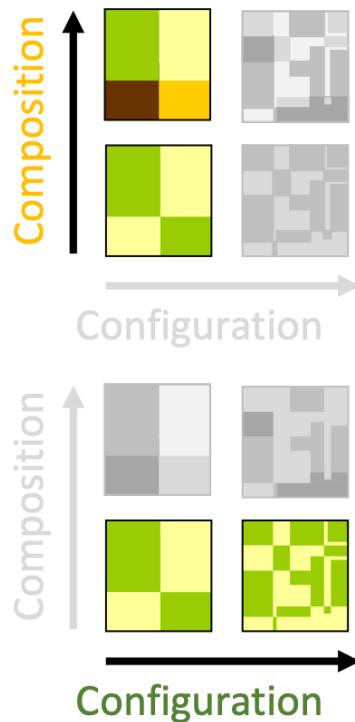
Compositional crop heterogeneity



Configurational crop heterogeneity



Mixed results across the world for different animal and plant species



Dunning et al. (1992) Allouche et al. (2012) Tscharntke et al. (2012)

Project 2

The main research question

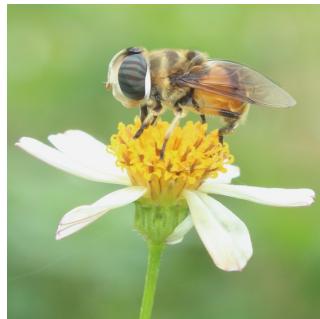
How does increasing crop configurational heterogeneity (spatial arrangement of crop fields) and crop compositional heterogeneity (number and evenness of crop types) affect farmland biodiversity and different functional groups (both vertebrate and invertebrate) across the globe?

Literature survey for a global meta-analysis

Web of Science, Scopus, Google Scholar, Dryad, Zondo, Figshare,
Dataset Search, Mendeley Data, ResearchGate, and Grey literature

Over **2334** studies on **beneficial biodiversity**

Pollinators



Enemies



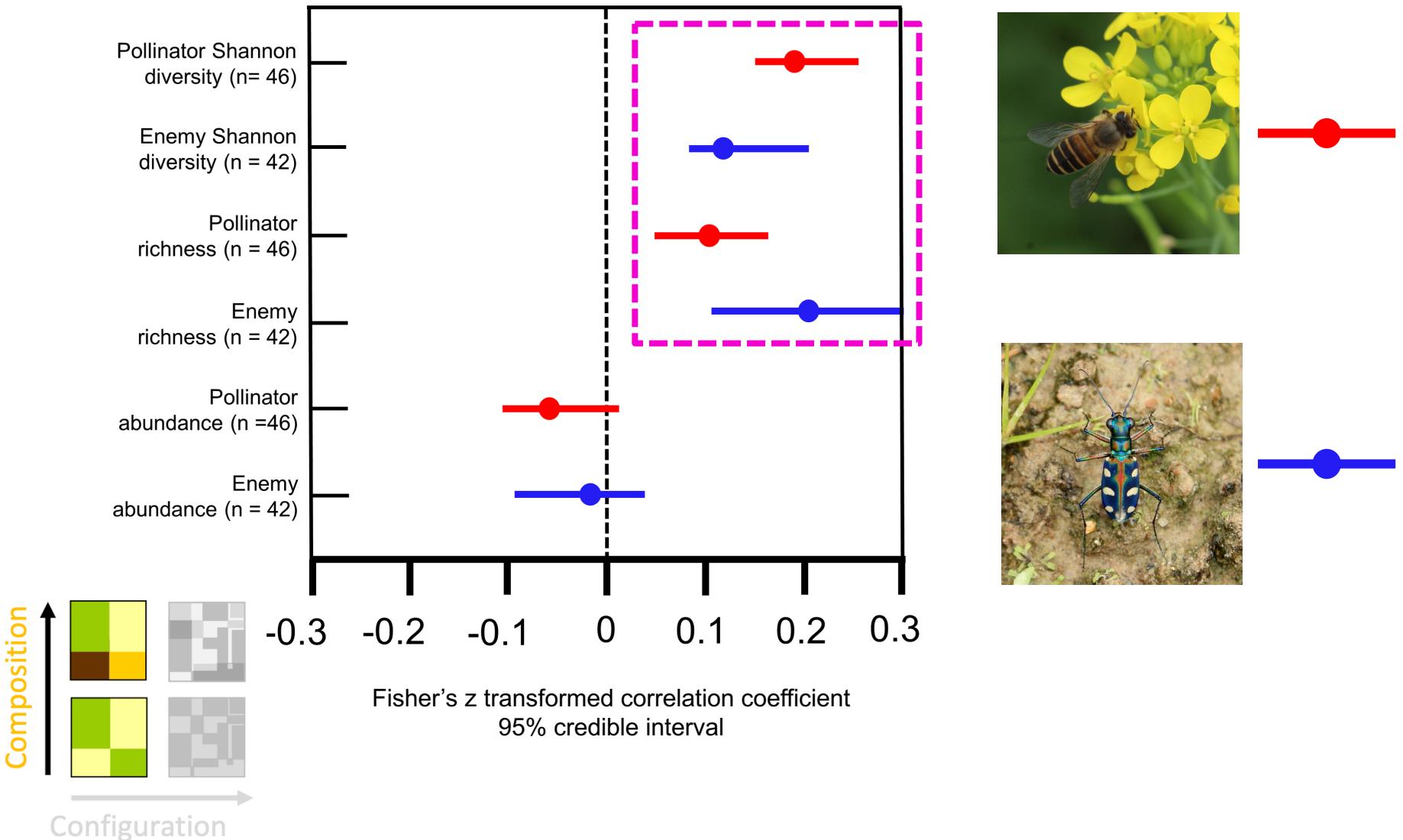
Bayesian multivariate meta regression models were fitted with Stan probabilistic programming language

252 effect sizes from European (Switzerland, France, Italy, Spain, Germany and United Kingdom) farmlands

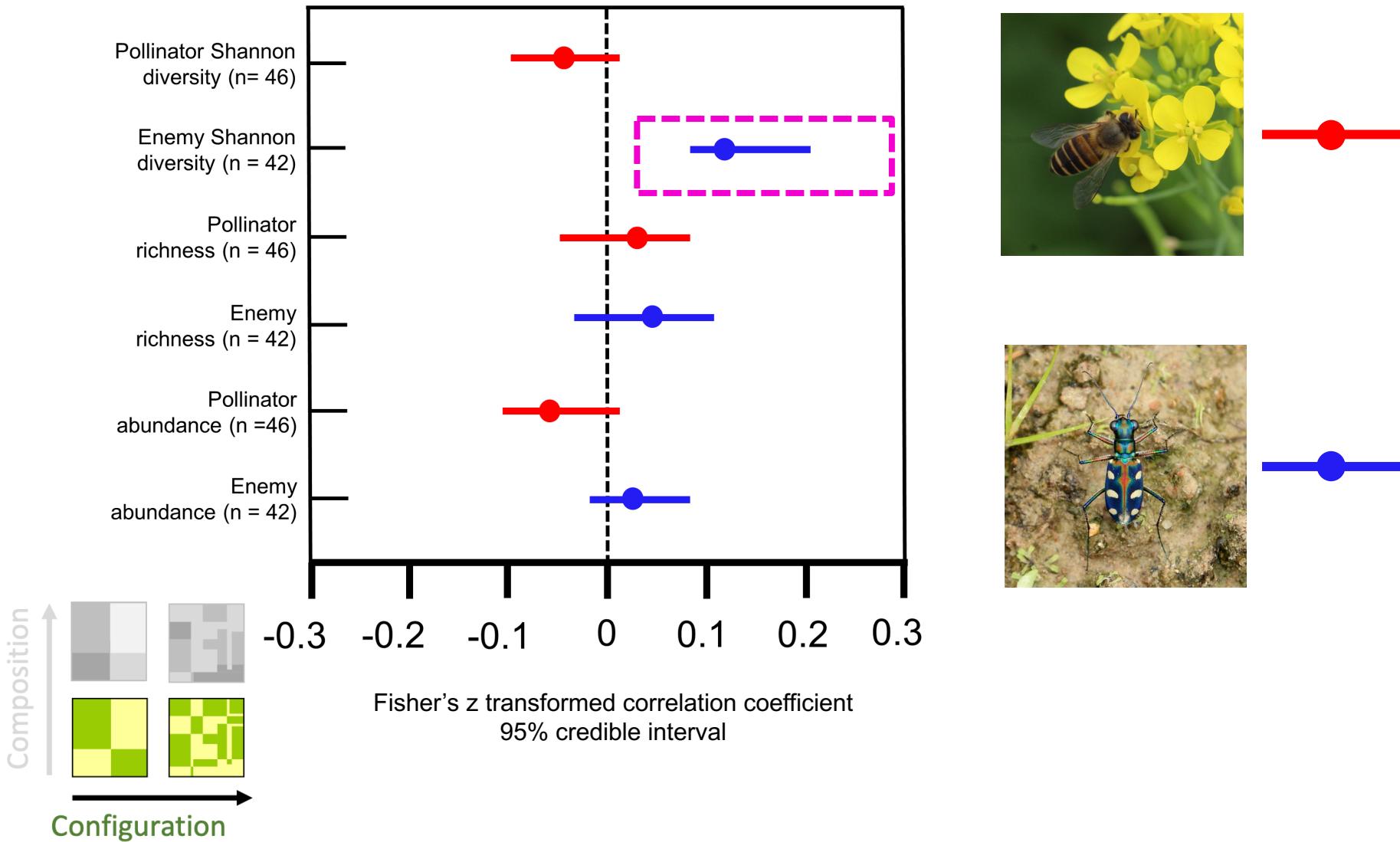
I have data from 31 study locations



Effect of increasing crop compositional heterogeneity



Effect of increasing crop configurational heterogeneity



Take-home messages

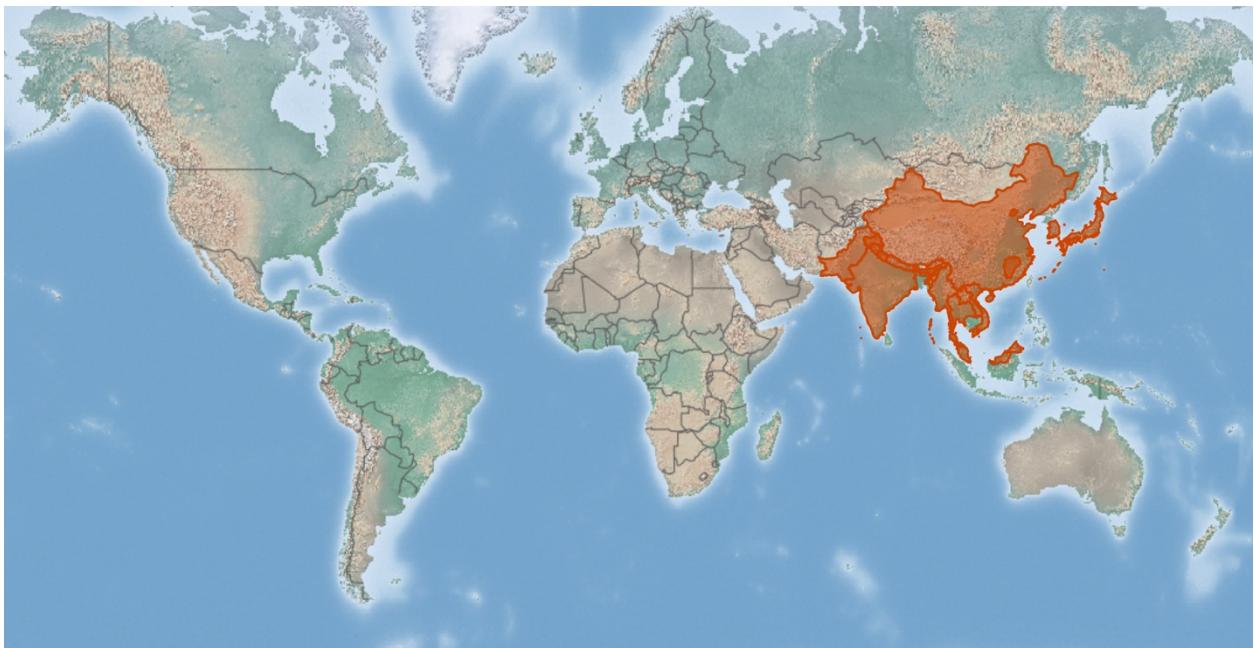
**Increasing crop heterogeneity can support the
beneficial biodiversity in agroecosystems**

If farmers' income is not adversely affected by crop heterogeneity, this study recommend policy aimed at encouraging crop heterogeneity

Project 3

Agricultural pest butterfly *Pieris canidia* abundance can be suppressed by enhancing compositional crop heterogeneity





Pieris canidia distribution (highlighted) in the world map (data was extracted from the *Invasive Species Compendium*, <https://www.cabi.org/isc/>)

Cruciferous (Brassicaceae) crops

Cabbage



Broccoli



Oilseed rape

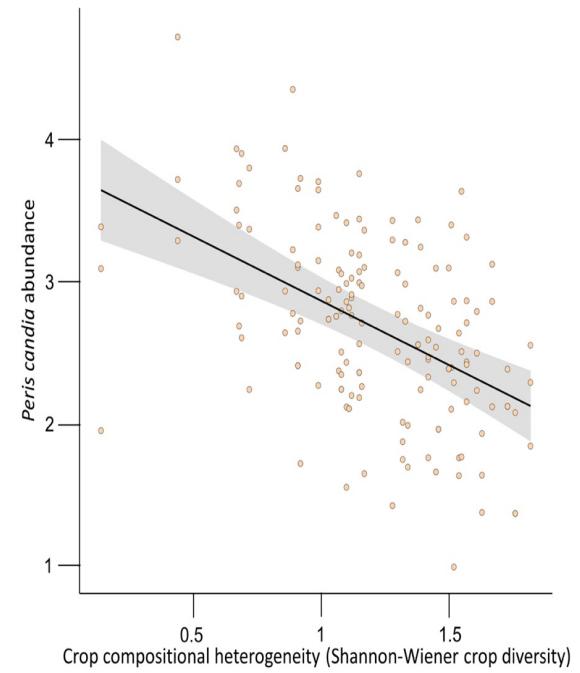
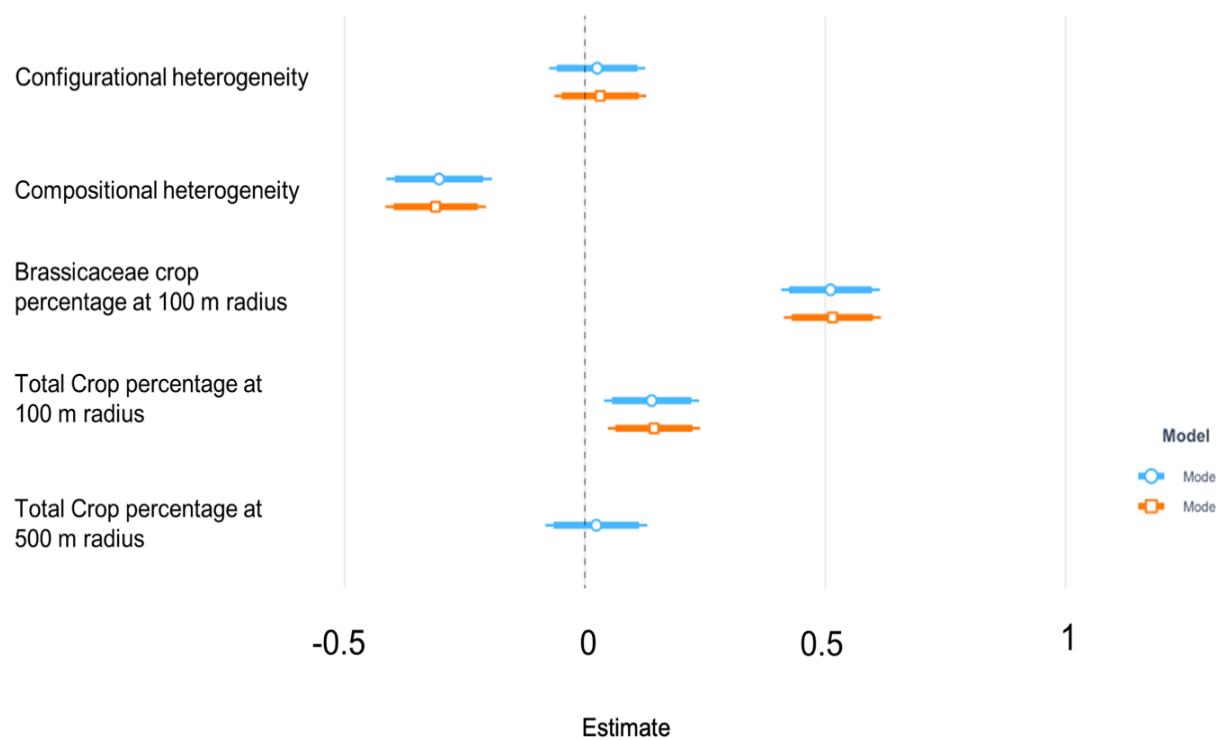


Pak choi



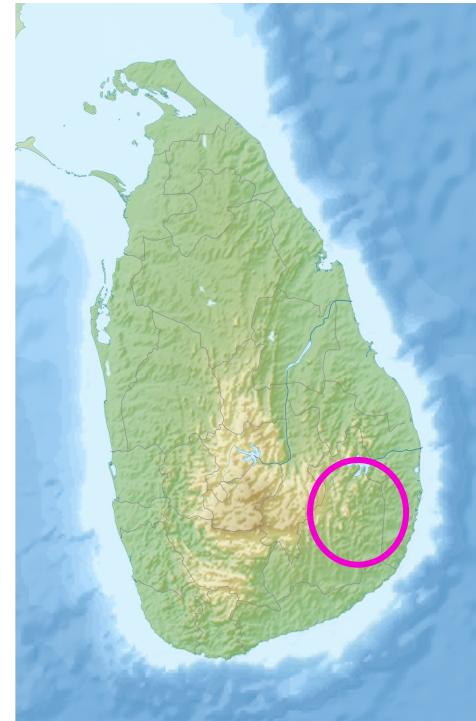
Take-home message

Promoting crop compositional heterogeneity can be a way of suppressing *Pieris canidia* damage



Project 3

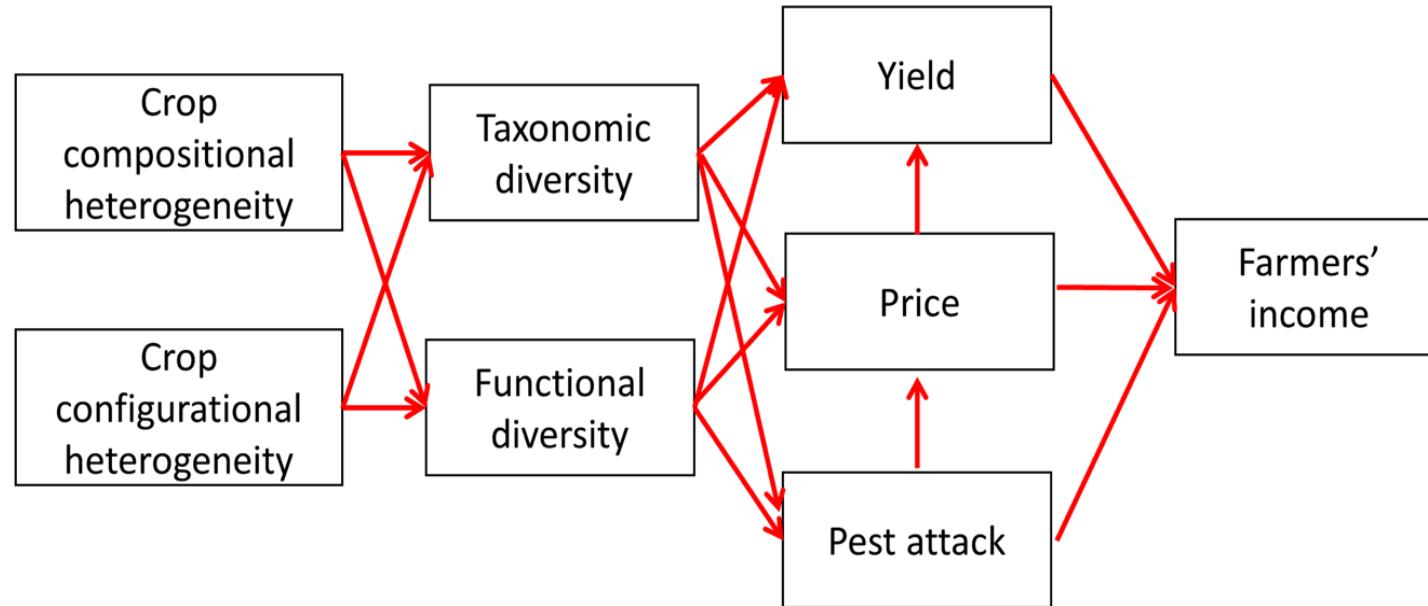
Biodiversity in agricultural landscapes: Balancing crop production and biodiversity conservation by promoting crop heterogeneity



The main research questions

1. How does higher crop heterogeneity at both local and landscape level affect the **functional composition** (i.e. mean trait values) and **taxonomic diversity** of above ground communities? Do responses at local and landscape level differ between taxa?
2. Does higher crop heterogeneity reduce **agricultural risks** and **increase famers income**?

Herbaceous plant, bees, dung beetles,
dragonflies/damselflies, butterflies, carabid beetle



Conceptual diagram of the project representing major elements and their interactions. Semi-structural equation modeling approach will be used to measure these relationships within the agroecosystems.

Alternative project ideas

Project 1

Assessing the impact of crop diversification on farmers' income and productivity of farmlands

Project 2

Contrasting functional structure of dung beetle assemblages associated in different land-use types

