Crop rotational diversity and cultural efficiency

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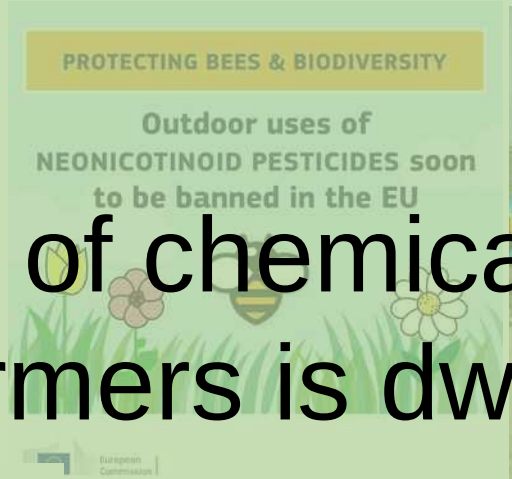
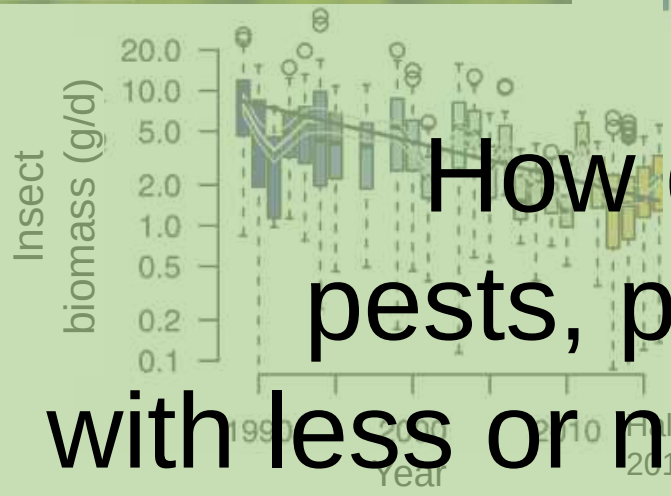
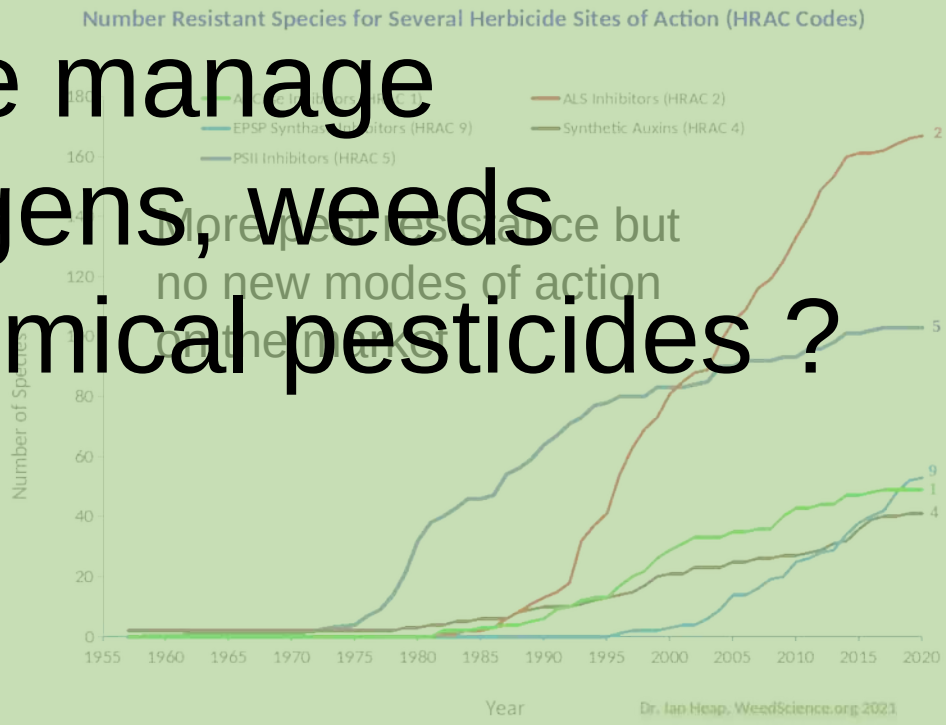
EURAGRI Virtual conference 2024-10-23



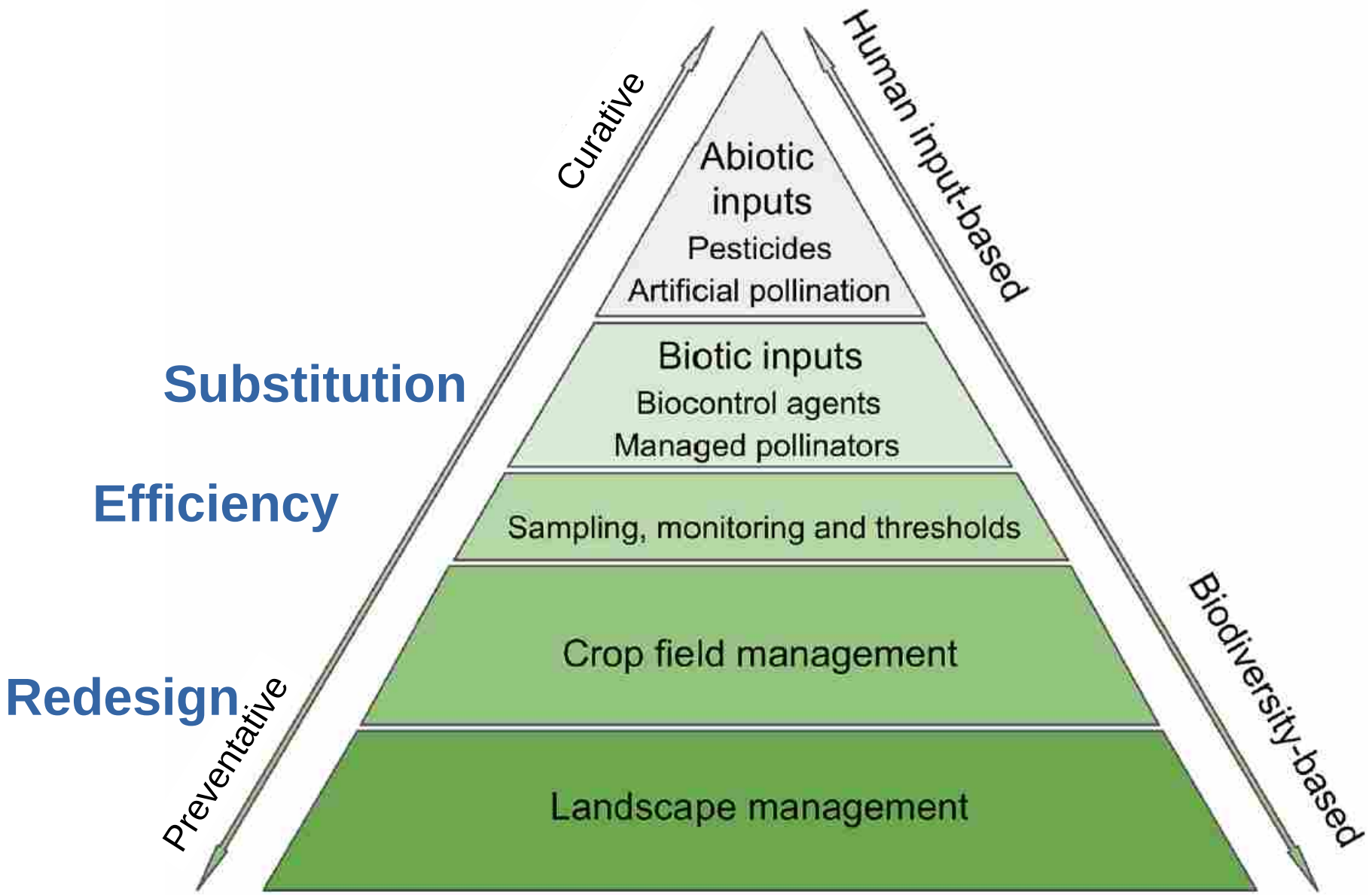
Availability of chemical pesticides to farmers is dwindling

How do we manage pests, pathogens, weeds with less or no chemical pesticides ?





Integrated Pest Management (IPM)



Lundin et al 2021 Frontiers Ecology Environment

Redesign of the crop ecosystem for sustainable crop protection

Substitute damaging inputs

Improve resource use efficiency

Bommarco 2024 Agron Sust Devel in press
Kremen & Merenlender 2018 Science

Cropping systems redesign aims to

Work *with* biodiversity (not replace its functions with pesticides and mineral fertilisers)

...strengthen ecological functions
which prevents pest outbreaks

...raise capture and use efficiency of on-farm resources
which increases autonomy in production

...maintain yields, enhance yield stability,
reduce risks and environmental impacts

e.g. Bommarco et al 2013, Titonell 2014, Liebman & Davis 1999, Maeder et al 2002, Wezel et al 2014, Duru et al 2015...

Diversified farming:
a promising (diverse) transformation pathway

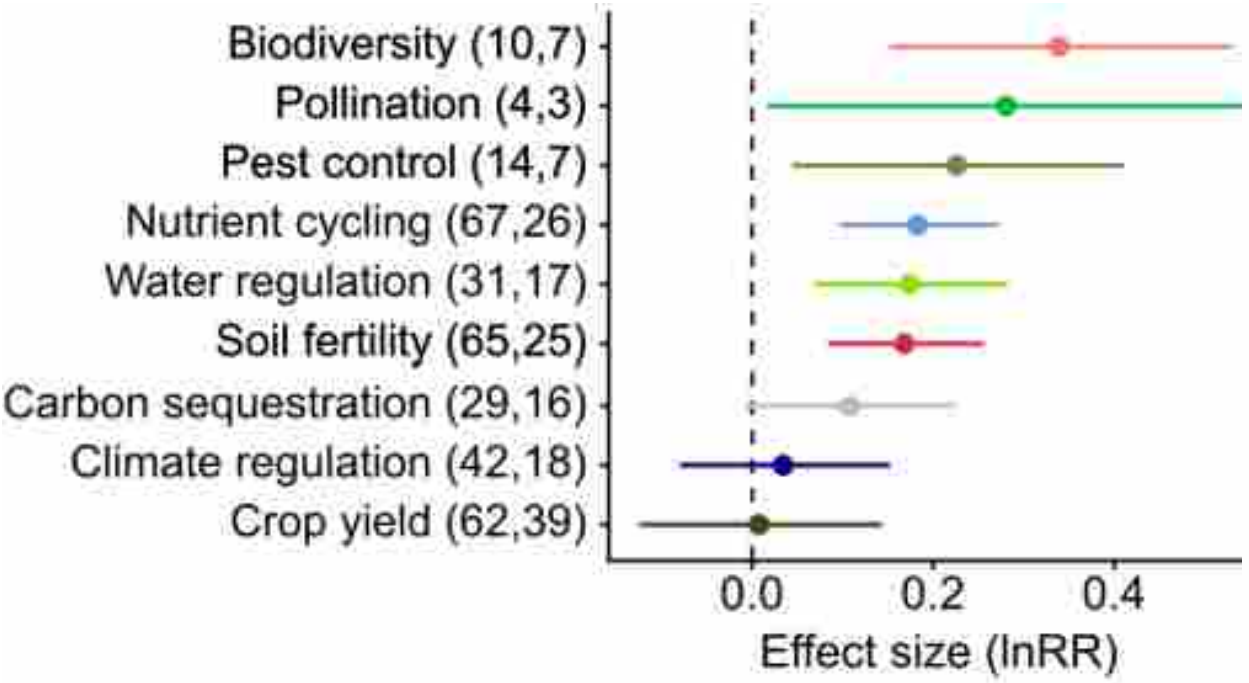
REVIEW ARTICLE
Agronomy for Sustainable Development

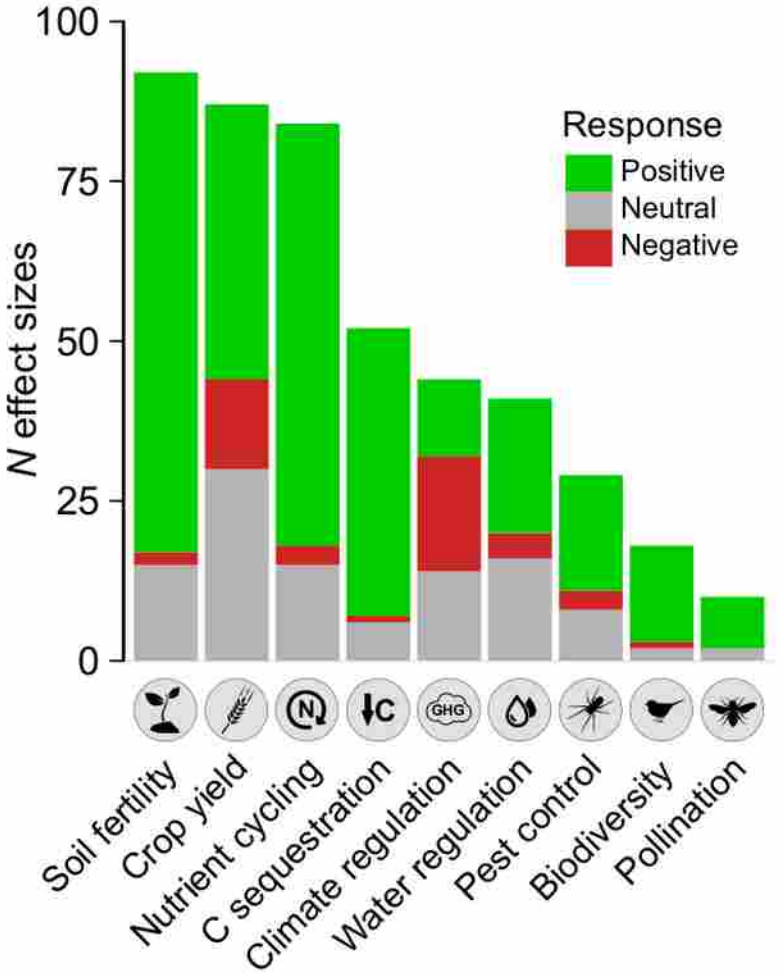
Ecological redesign of crop ecosystems for reliable crop protection. A review

Riccardo Bommarco[1]

Diversifications gives us multifunctional crop ecosystems without punishing yields

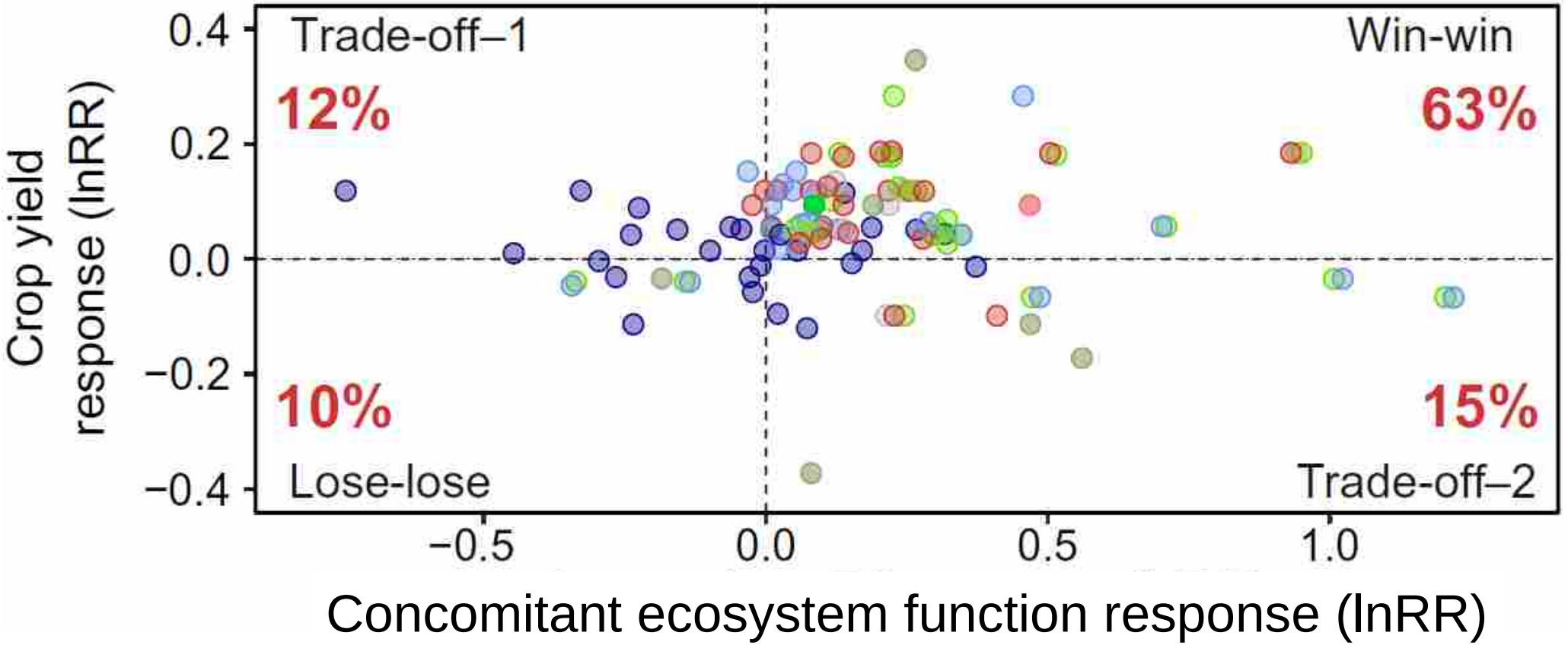
Meta-study based on ~42000 comparisons





Tamburini et al 2020 Science advances

Diversification for a function can trade-off with crop yield but win-wins dominate

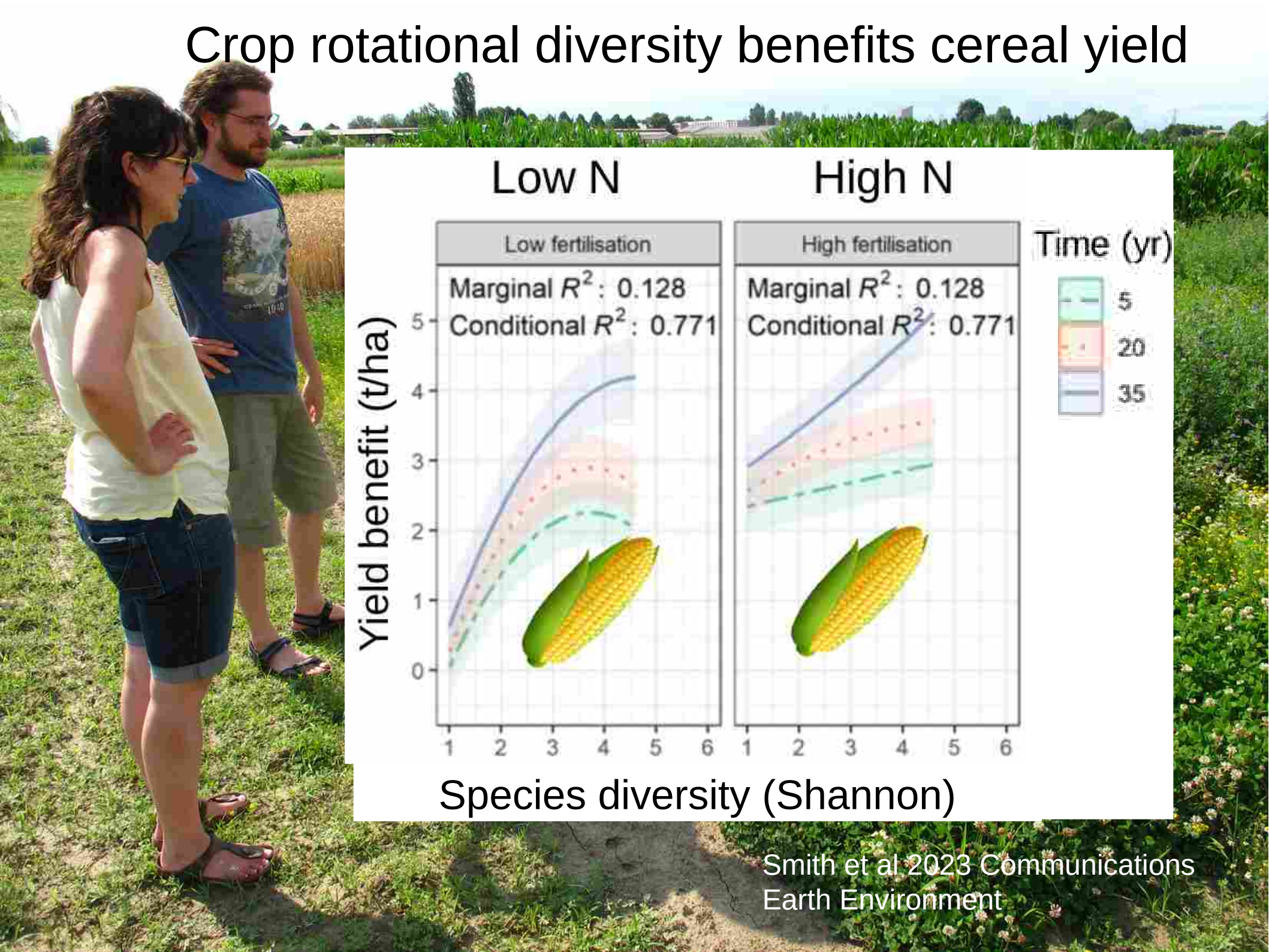


Tamburini et al 2020 Science advances

Diversified crop rotations

Smith et al 2023 Communications Earth Environment

Crop rotational diversity benefits cereal yield



Smith et al 2023 Communications Earth Environment

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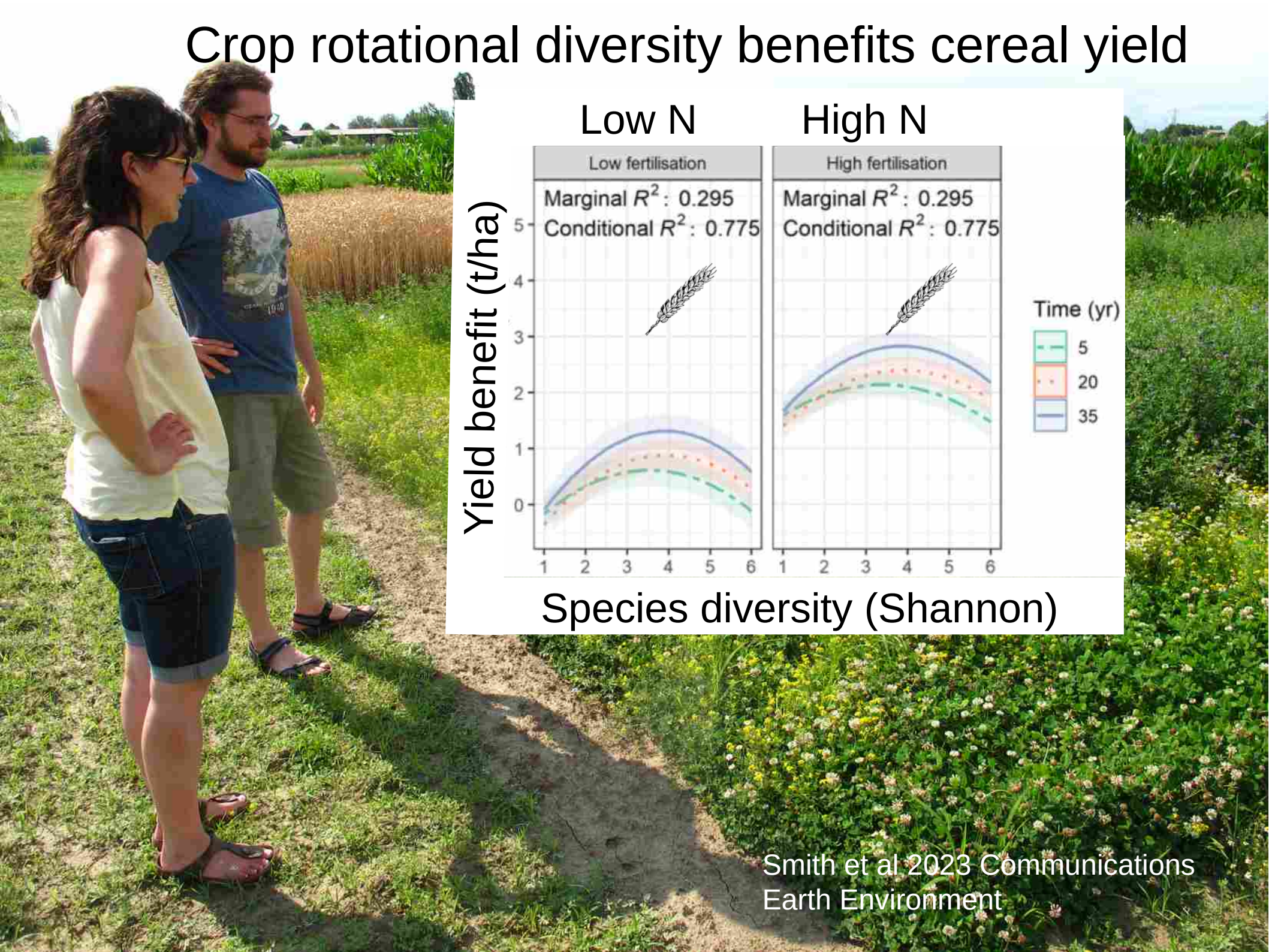
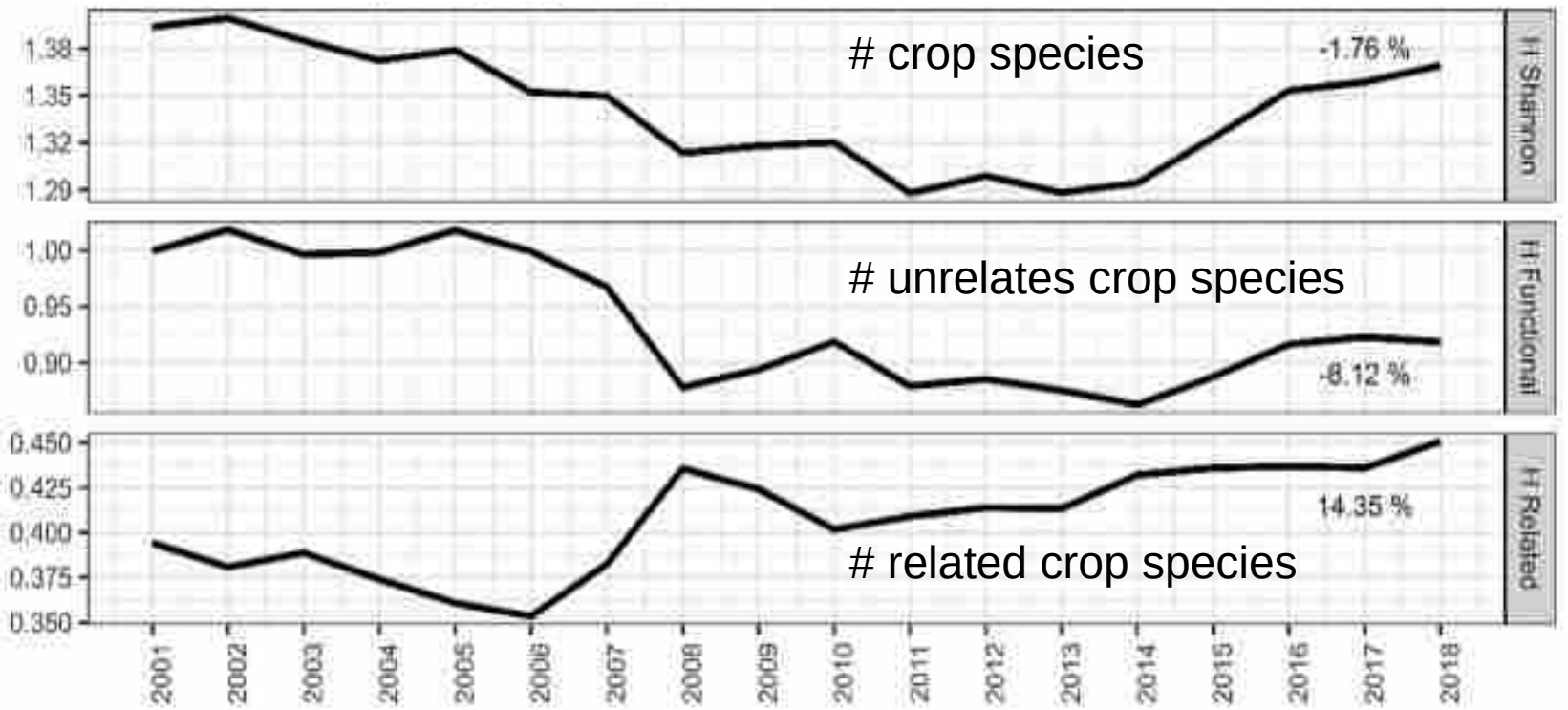


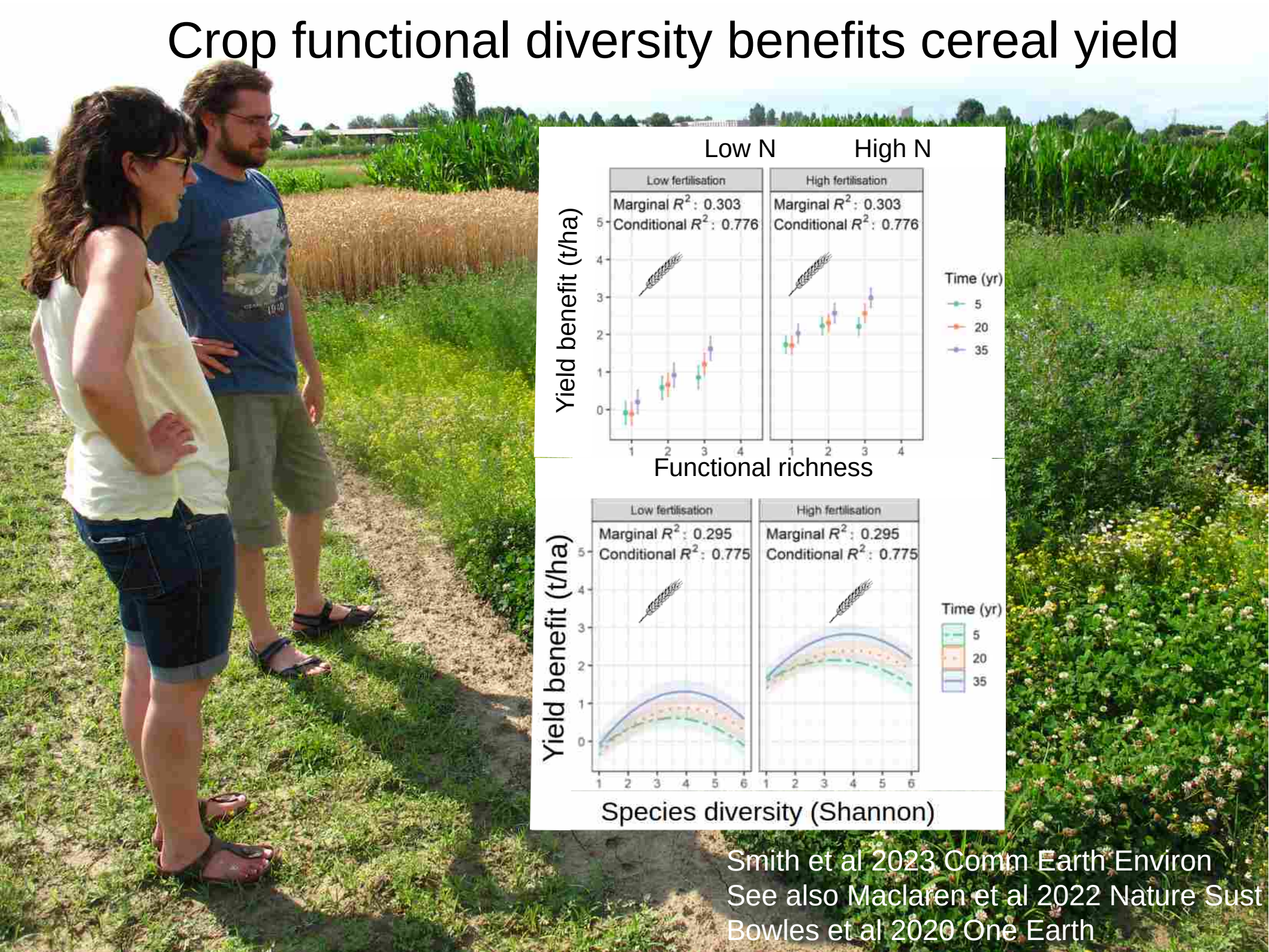
Smith et al 2023 Communications Earth Environment

Crop diversity per farm in Sweden over time



Schaak et al 2022 Agriculture, ecosyst, env

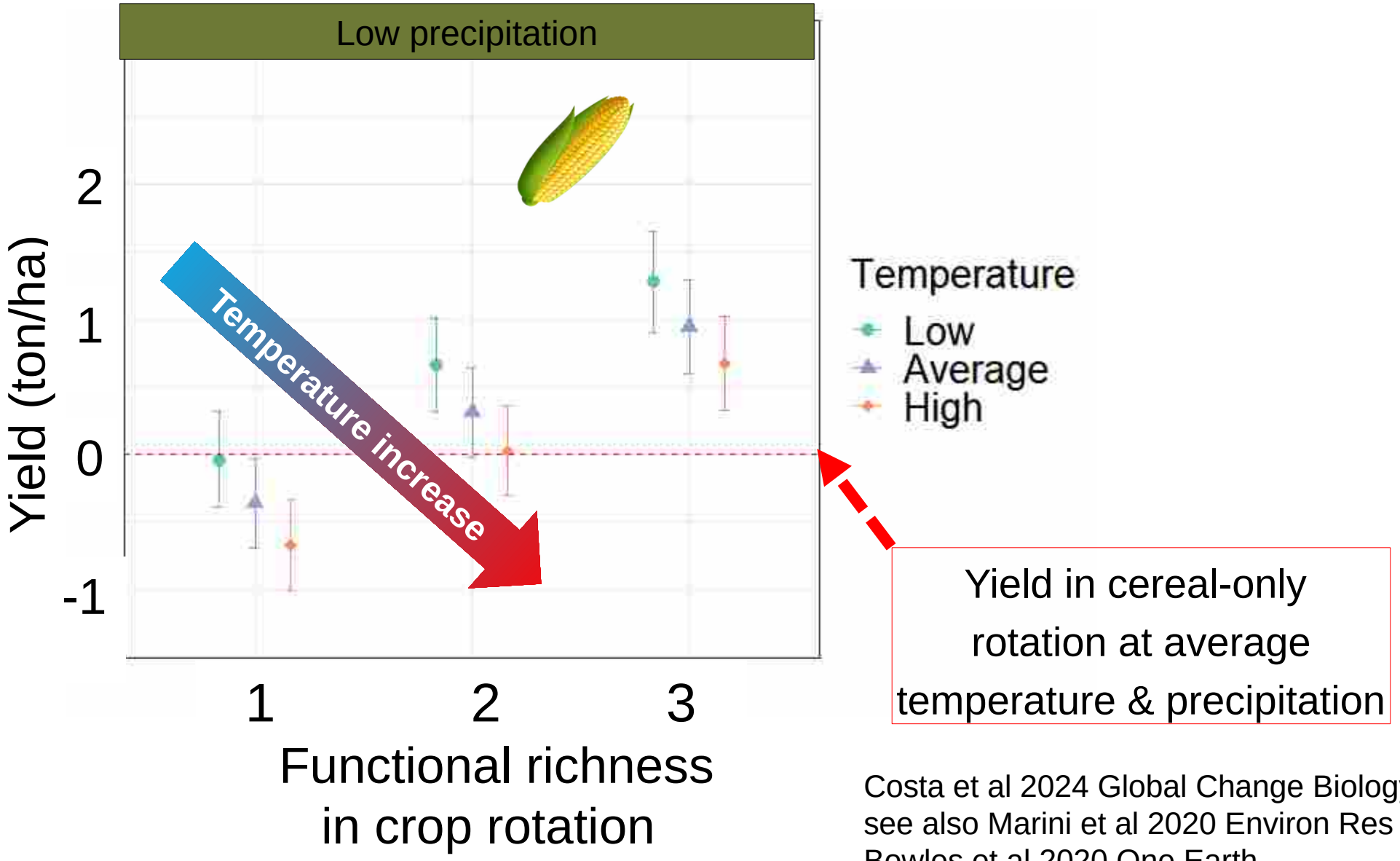
Crop functional diversity benefits cereal yield



Smith et al 2023 Comm Earth Environ
See also Maclaren et al 2022 Nature Sust
Bowles et al 2020 One Earth

In addition to portfolio insurance:

Crop rotational diversity over-compensates yield losses under adverse climatic conditions

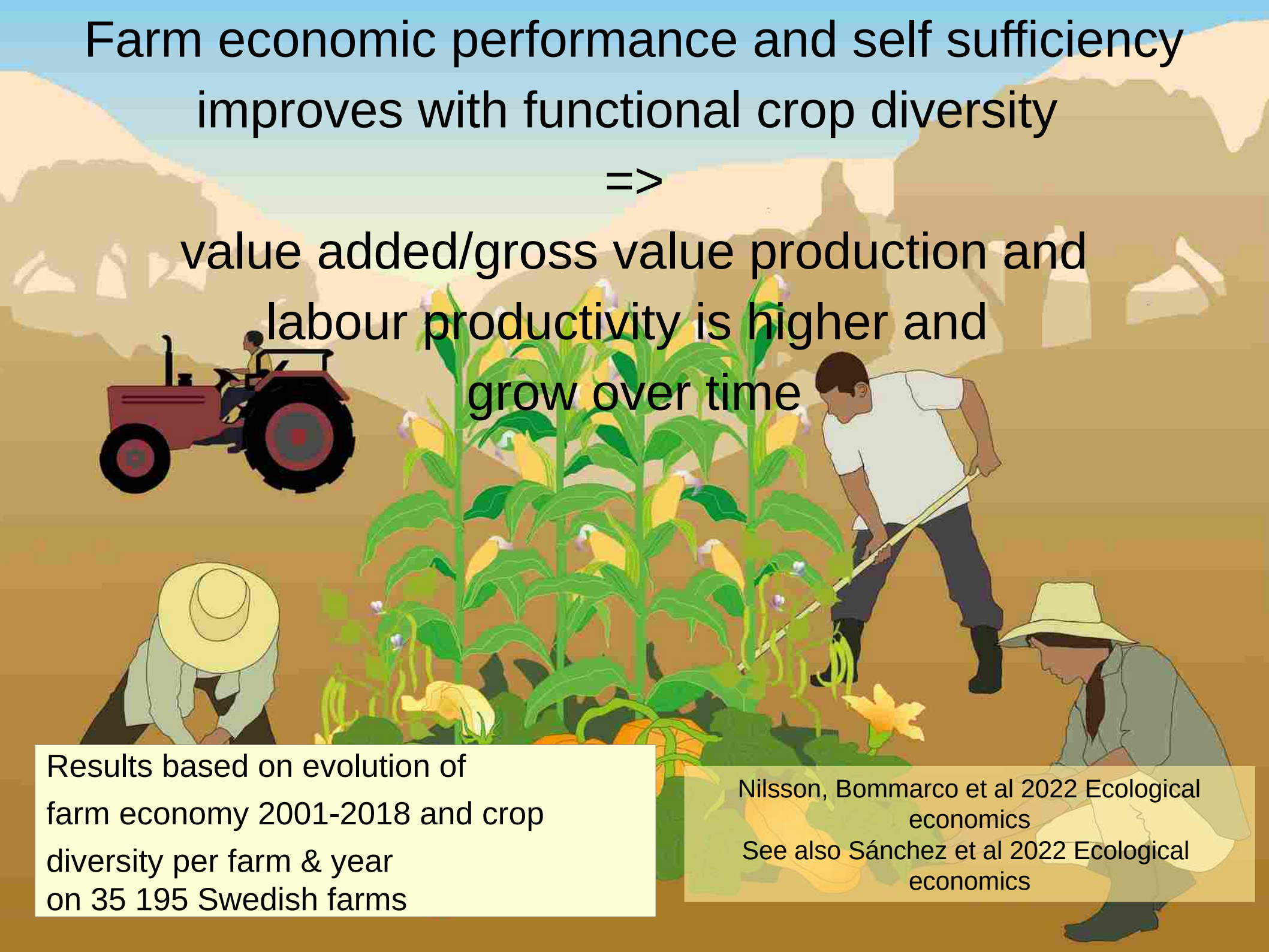


Costa et al 2024 Global Change Biology
see also Marini et al 2020 Environ Res Lett
Bowles et al 2020 One Earth

Farm economic performance and self sufficiency improves with functional crop diversity

=>

value added/gross value production and labour productivity is higher and grow over time



Results based on evolution of farm economy 2001-2018 and crop diversity per farm & year on 35 195 Swedish farms

Nilsson, Bommarco et al 2022 Ecological economics

See also Sánchez et al 2022 Ecological economics

Conclusions

- Emphasise prophylaxis/prevention in pest management
- Diversified farming is a fruitful strategy:
  it can enhance yields, resource use efficiency and farmers' economy in a changed climate with fewer or no pesticides
- Productivity and rational resource use do not trade off with environmentally friendly forms of production by default
- Farming systems redesign requires increased support from policy and R&D for IPM principle 1
- Challenge for researchers: develop crop protection and production systems without pesticides


Thank you for
your attention
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www.slu.se/bommarco-lab