Over efficiëntie in de plantaardige productie

Prof. Martin van Ittersum - Plant Production Systems group,
Wageningen University

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Resource use efficiency

- kg product per kg input (kg N, kg pesticide, etc.)
- kg product per unit resource (hour labour, hectare, etc.)
- products, inputs and resources can also be expressed in monetary values

Agricultural Systems **40** (1992) 125–151

Resource Use Efficiency in Agriculture

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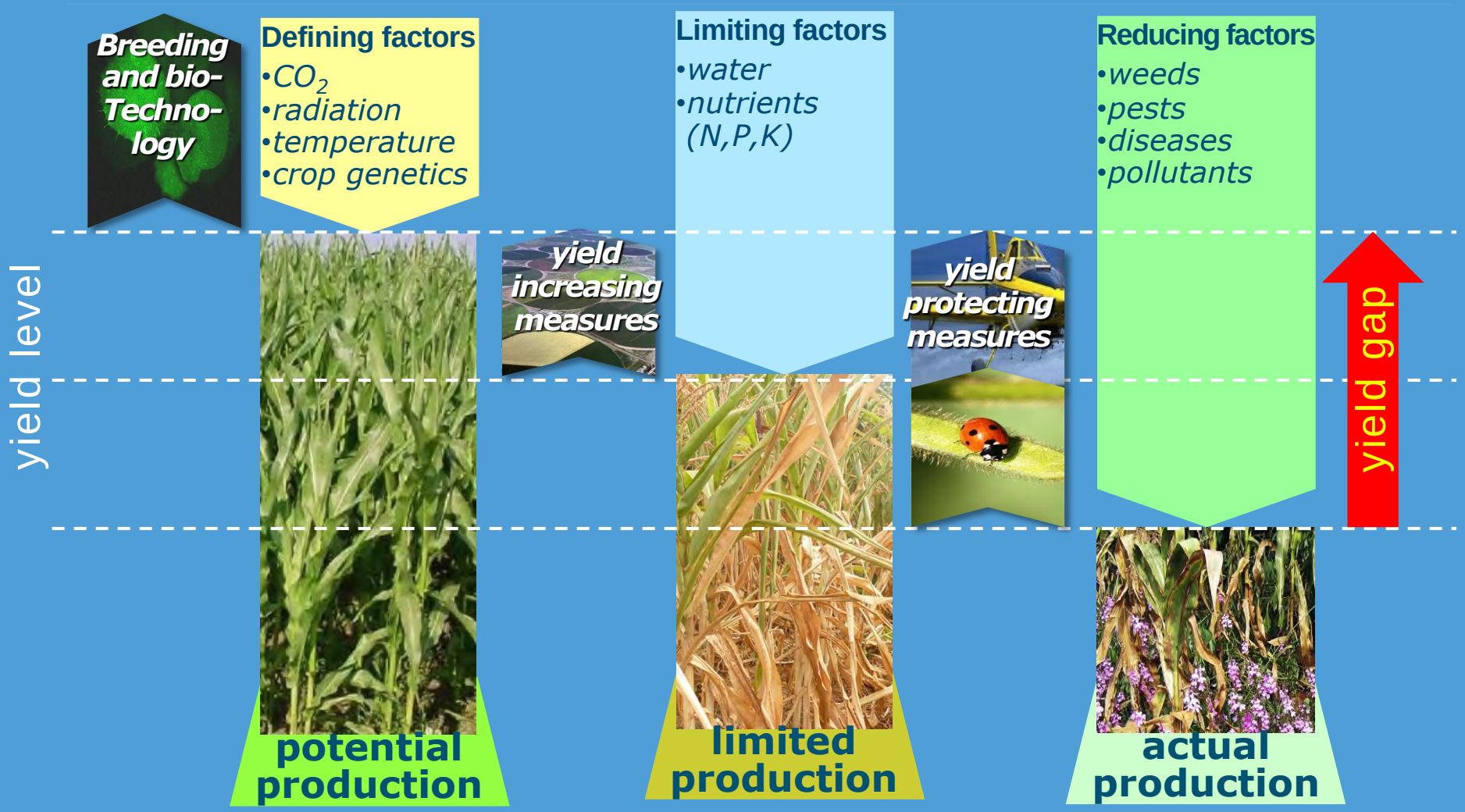
- *Accordingly. no production resource is used less efficiently and most production resources are used more efficiently with increasing yield level due to further optimizing of growing conditions*
- *Therefore strategic research that is to serve both agriculture and its environment should not be so much directed towards the search for marginal returns of variable resources, as towards the search for the minimum of each production resource that is needed to allow maximum utilization of all other resources*

Production-ecological principles & practice



PRODUCTION SITUATION

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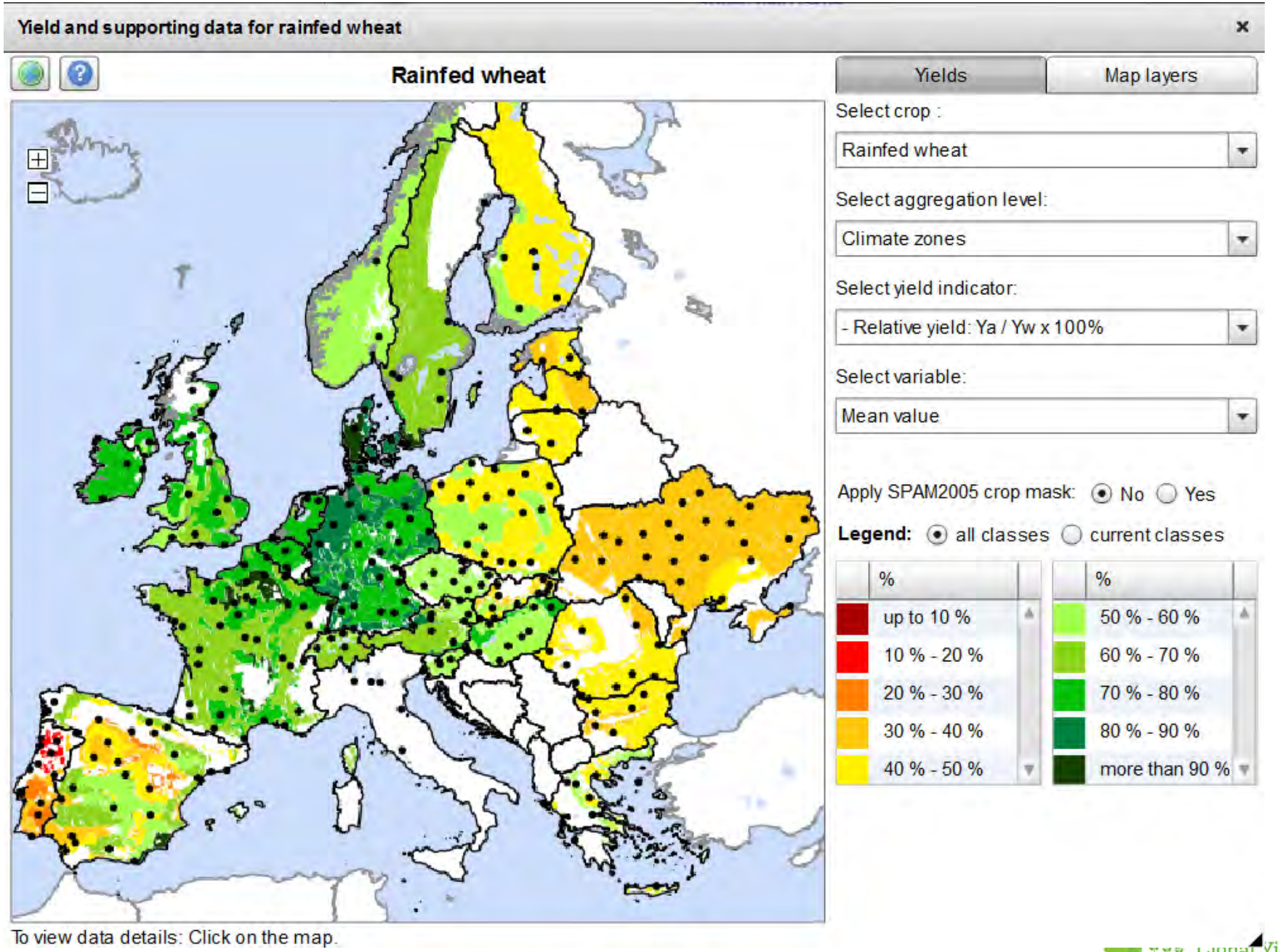
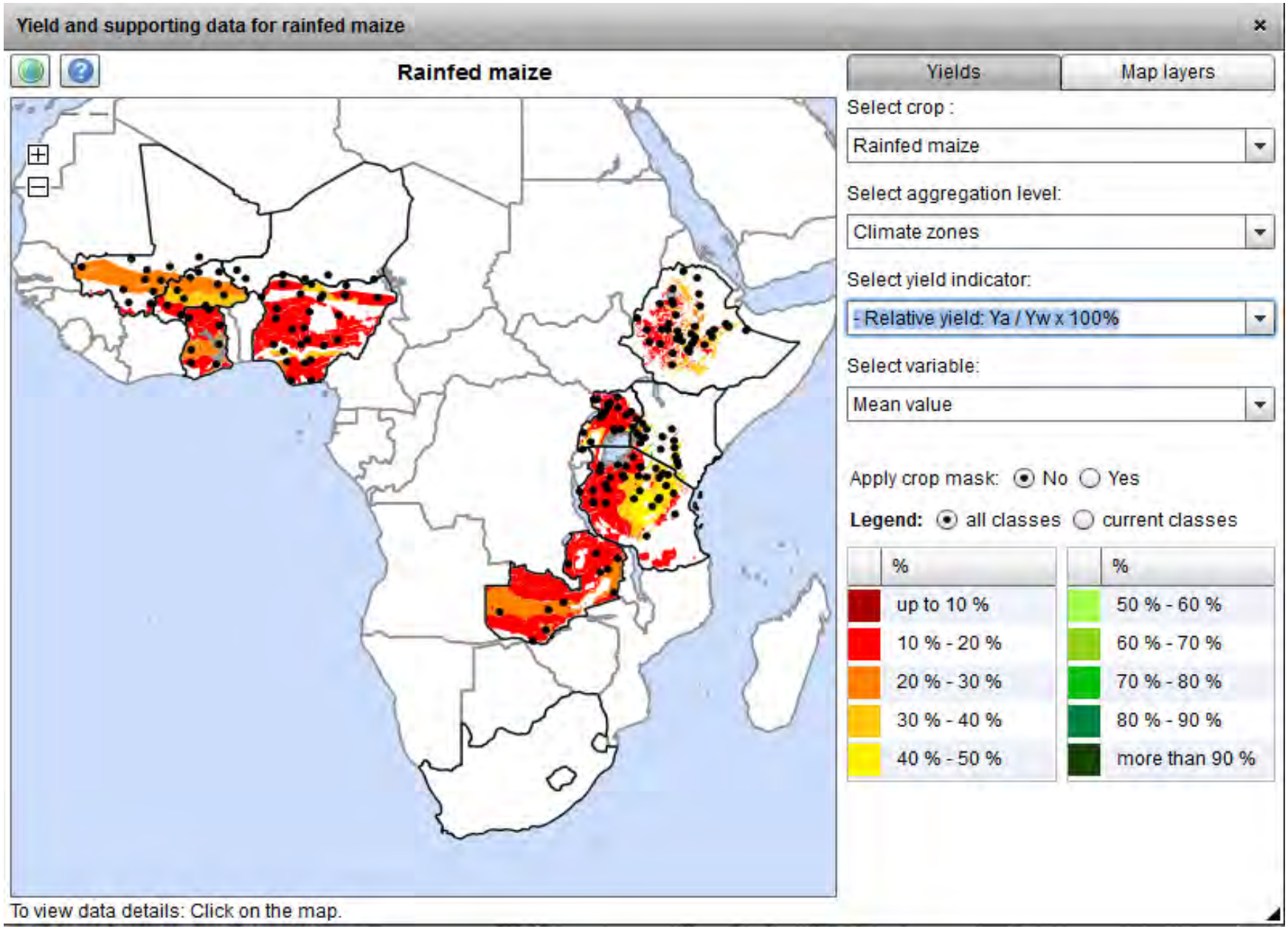
Van Ittersum and Rabbinge, 1997. Field Crops Research
Slide: Harrie Lovenstein



www.yieldgap.org

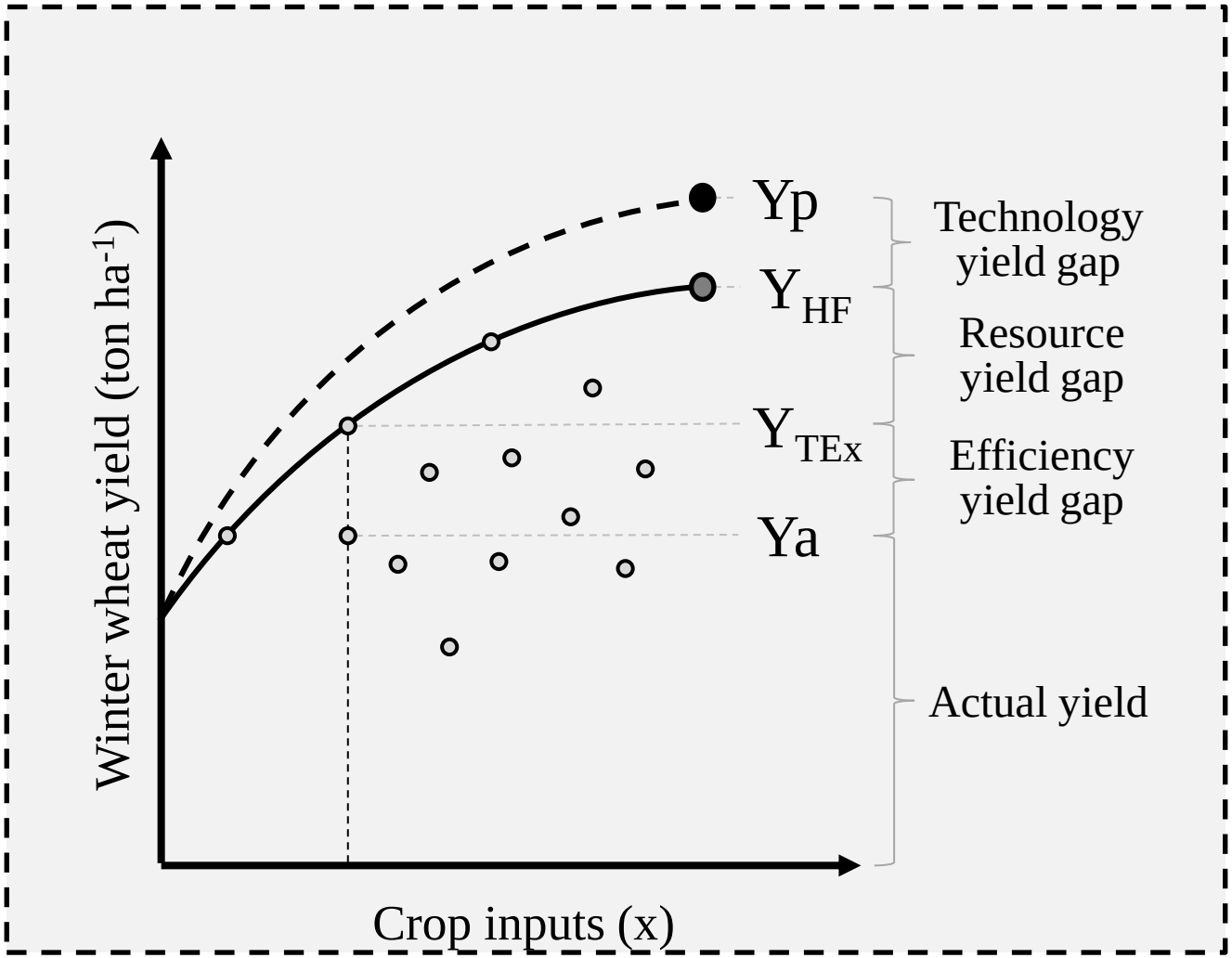
Global Yield Gap Atlas



www.yieldgap.org

Global Yield Gap Atlas

Decomposing the yield gap



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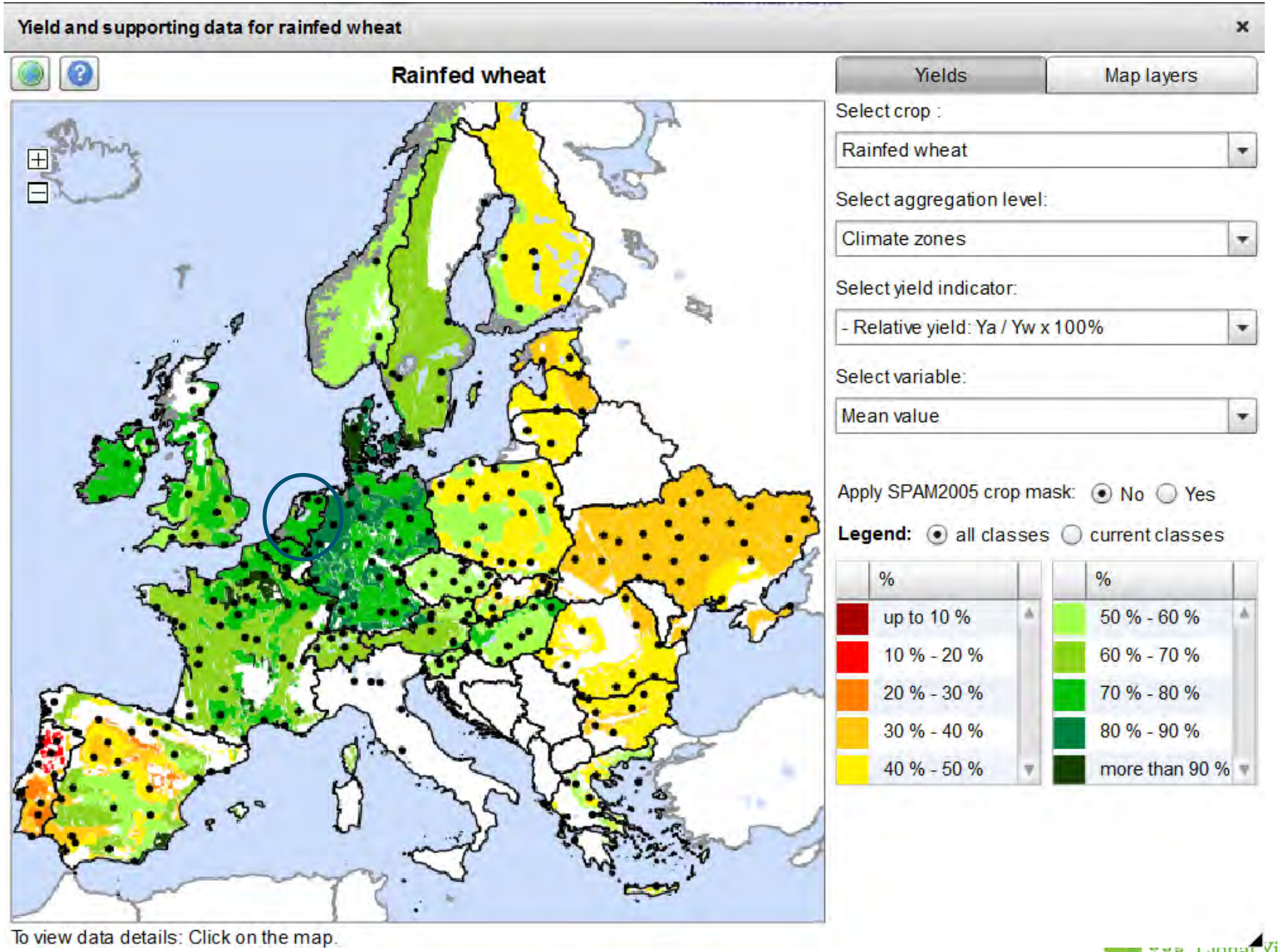
Silva et al., 2017. Eur. J. of Agron.

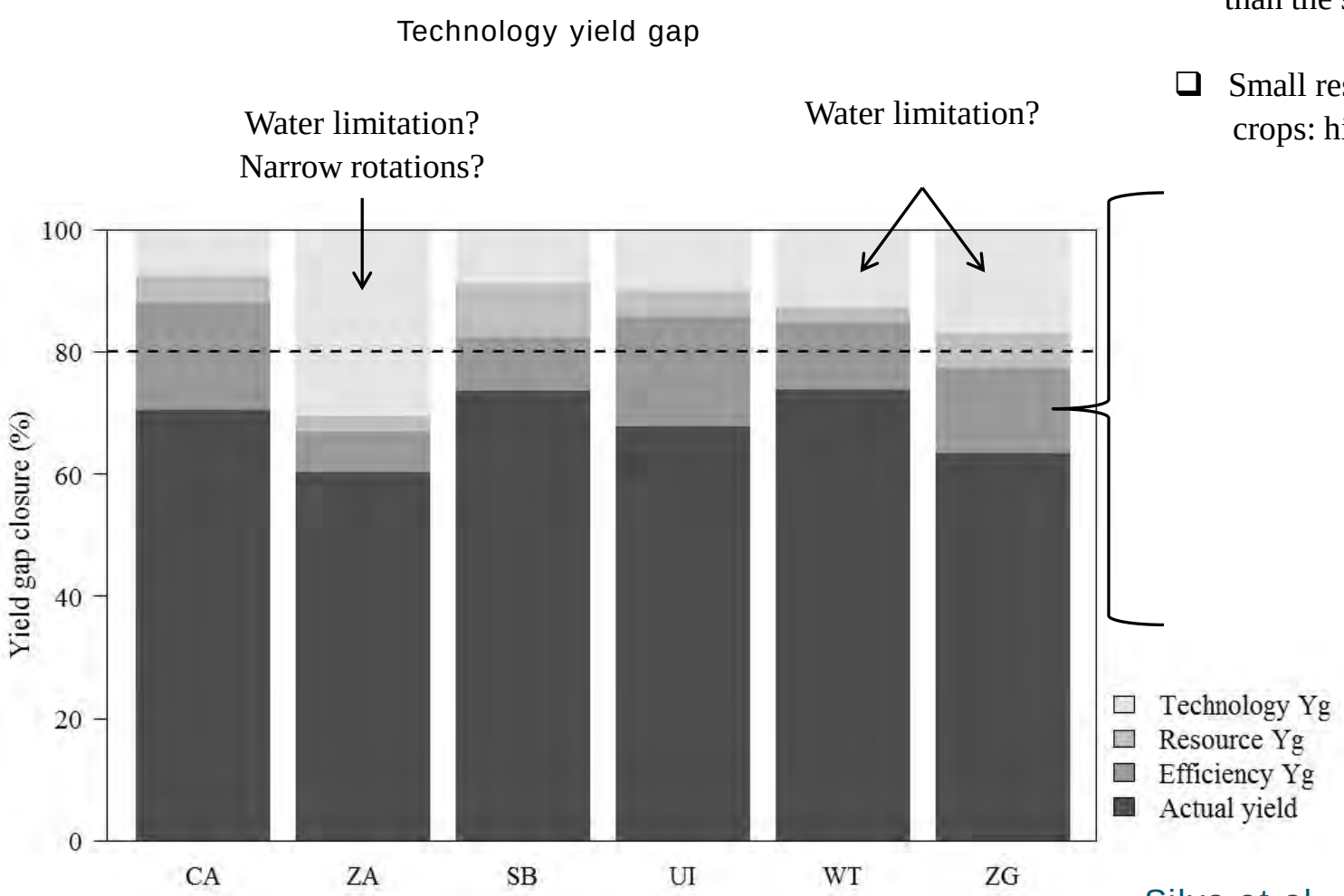


www.yieldgap.org

Global Yield Gap Atlas

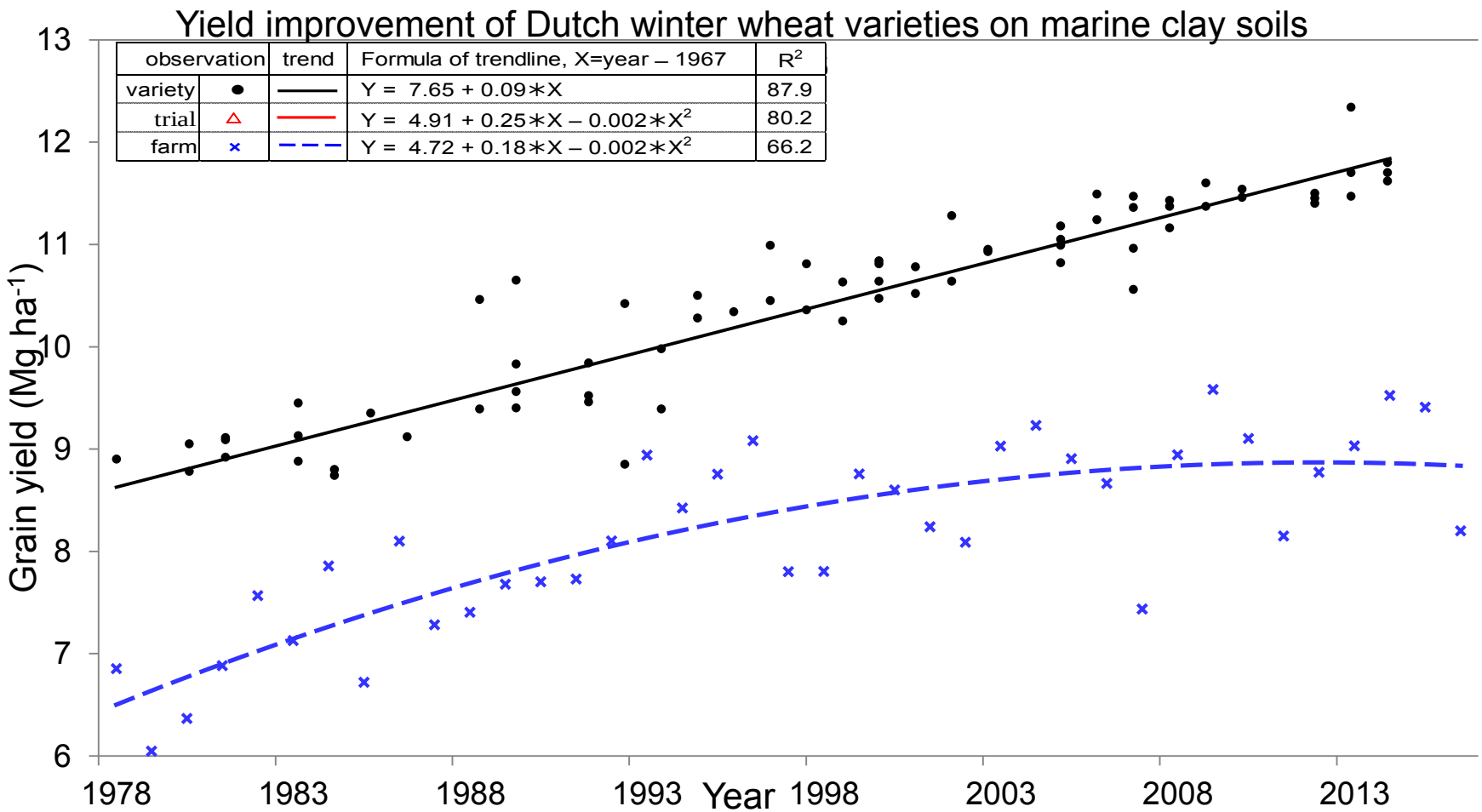
Magnitude of yield gaps for major arable crops in NLs

- Crop yields slightly lower than the suggested 80% Yp
- Small resource Yg for all crops: high input levels



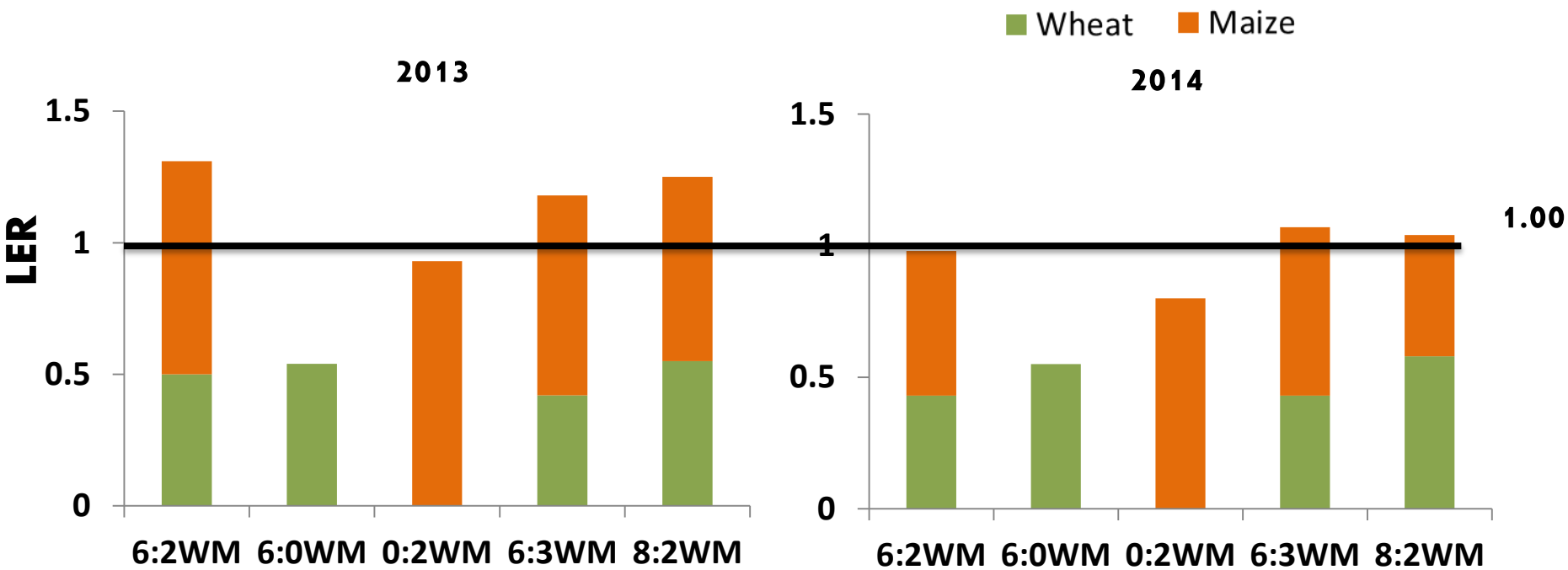
Silva et al., 2017. Ag. Systems

Genetic progress



Update of: Rijk et al., 2013. Field Crops Research

Intercropping



Fang et al., Eur. J. Agron., 2016

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Available online at www.sciencedirect.com

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Current Opinion in Environmental Sustainability

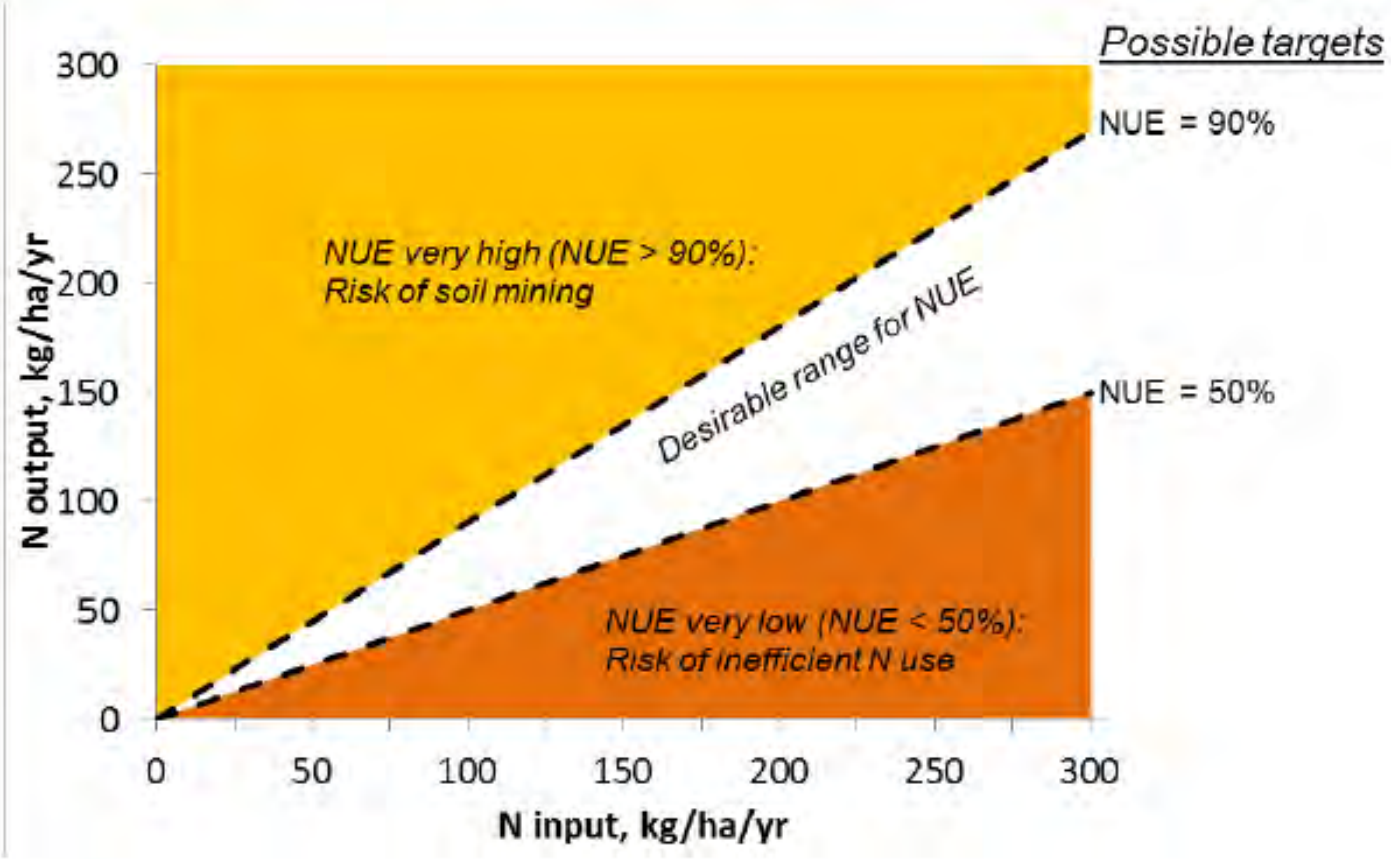
Minimizing the ecological footprint of food: closing yield and efficiency gaps simultaneously?

Meine van Noordwijk[1,2] and Lijbert Brussaard[3]

CrossMark

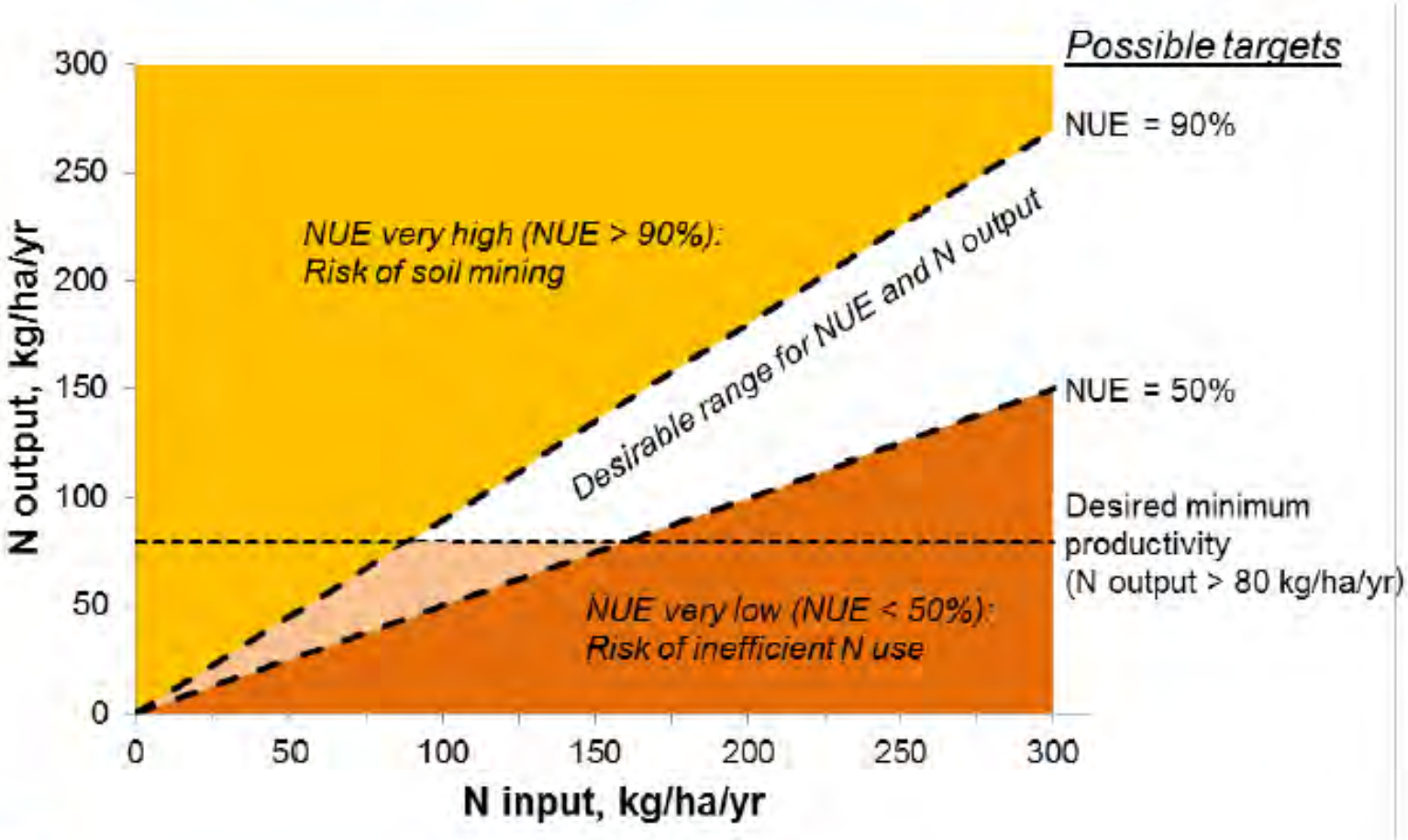
- Efficiencies are scale-dependent (see presentation Imke de Boer)
- *"Efficiency gaps, next to yield gaps, result in environmental impacts per unit area that are higher than desirable"*
- Global *and* local focus

A graphical presentation, in three steps: (i) NUE



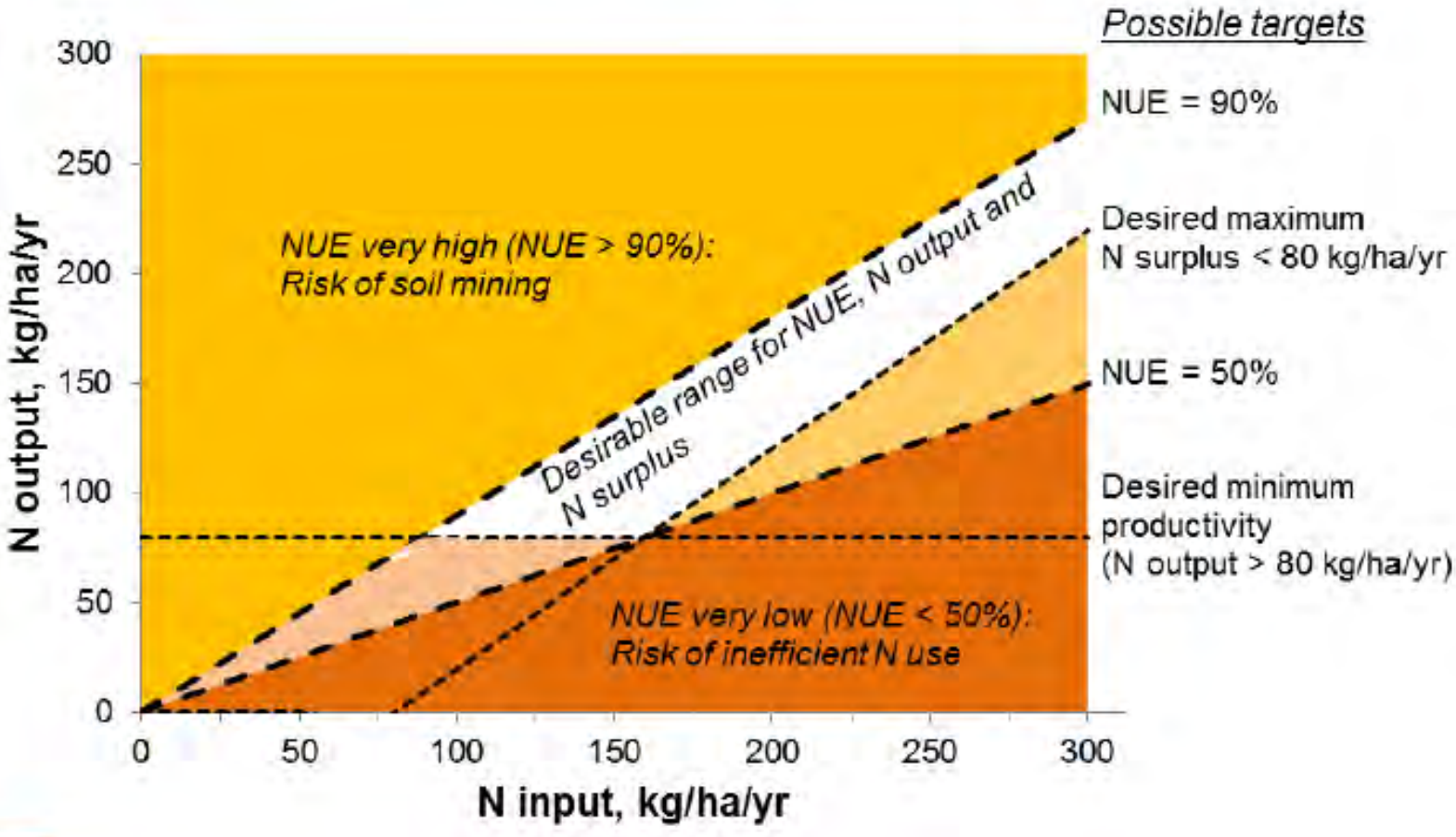
Oene Oenema, Wageningen Univ.

A graphical presentation, in three steps: (ii) N output



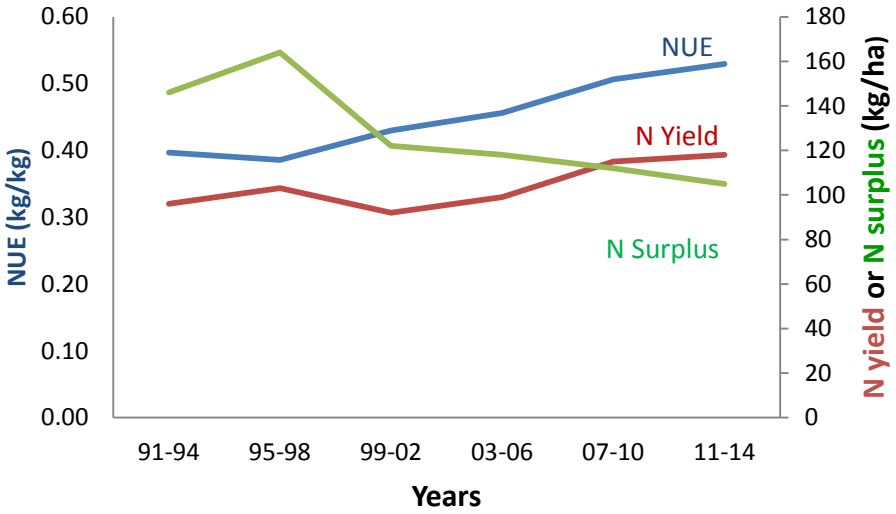
Oene Oenema, Wageningen Univ.

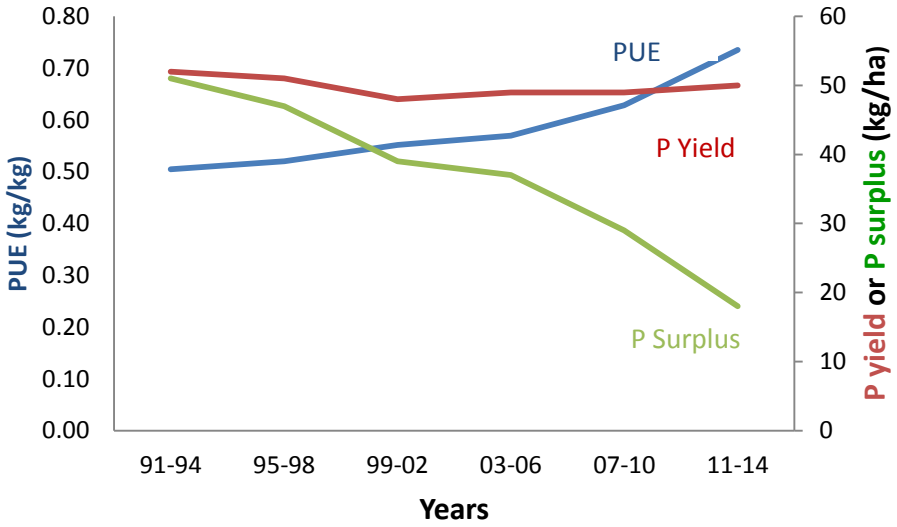
A graphical presentation, in three steps: (iii) N surplus



Oene Oenema, Wageningen Univ.

Yield – Use efficiency - Surplus





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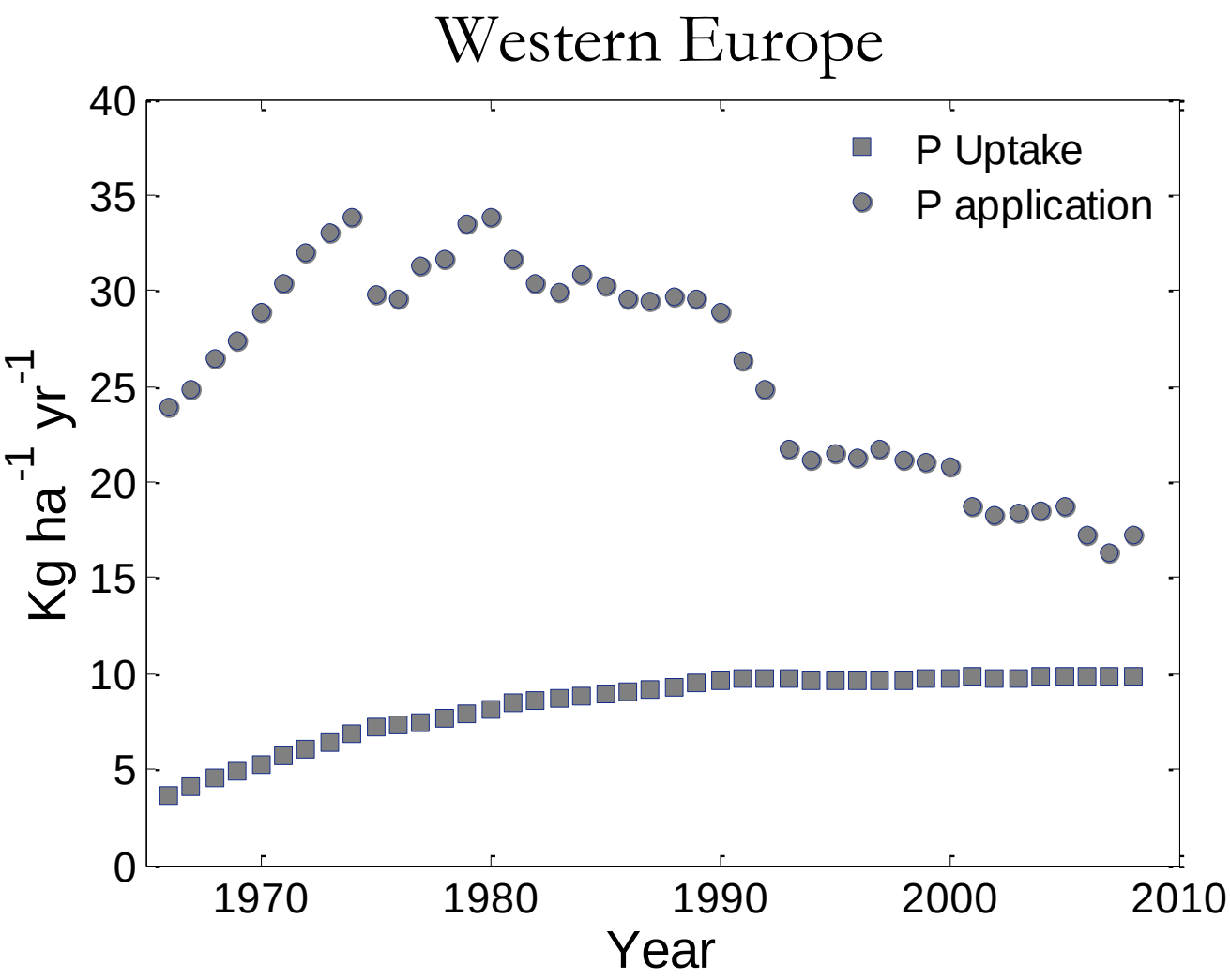
Prins, H., C. Daatselaar & T. de Koeijer (2016) Bemesting en bodemoverschotten van stikstof en fosfaat 1991-2014. Evaluatie Meststoffenwet 2016: deelrapport vraag 2 en vraag 10 ex post. Wageningen Economic Research.

P application and P uptake



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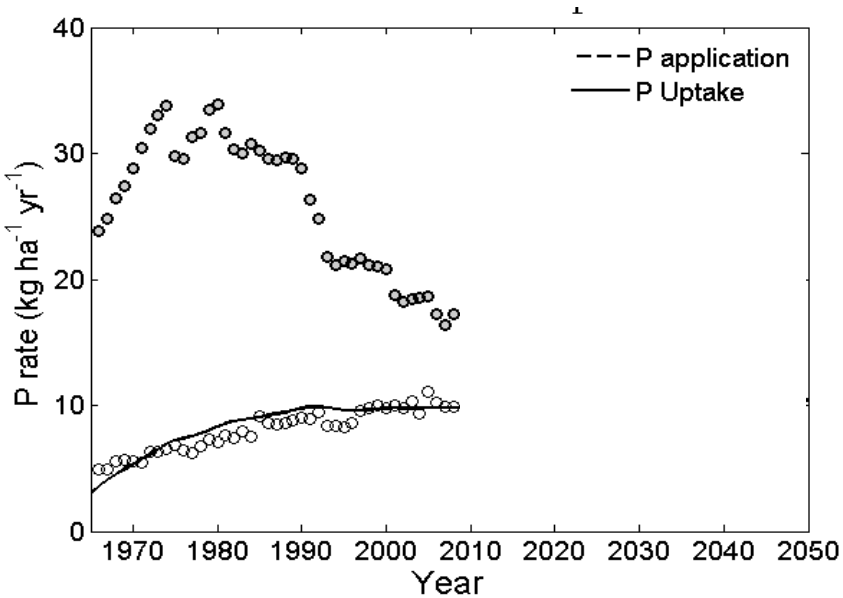
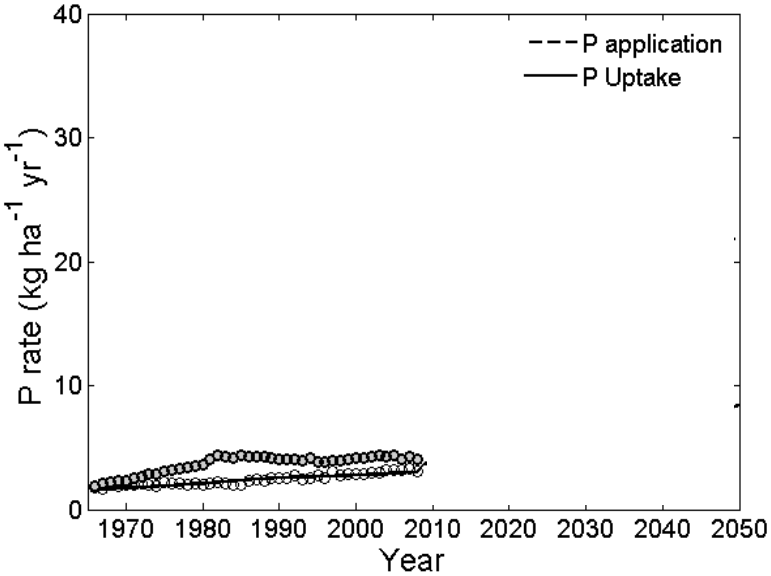
Sattari, Bouwman, Giller and Van Ittersum, 2012 - PNAS

Regional differences



Western Europe



Africa

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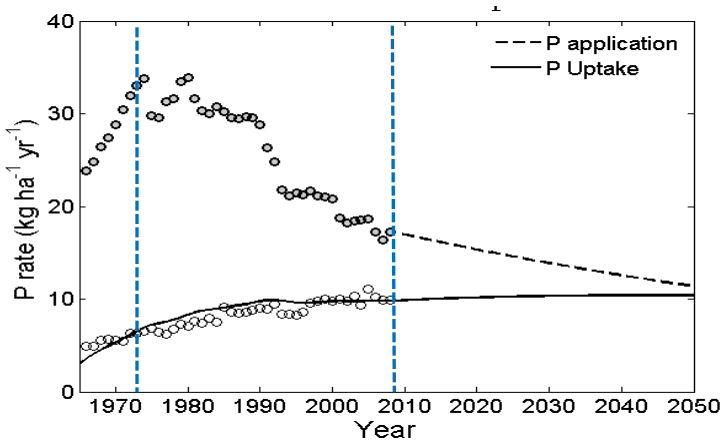
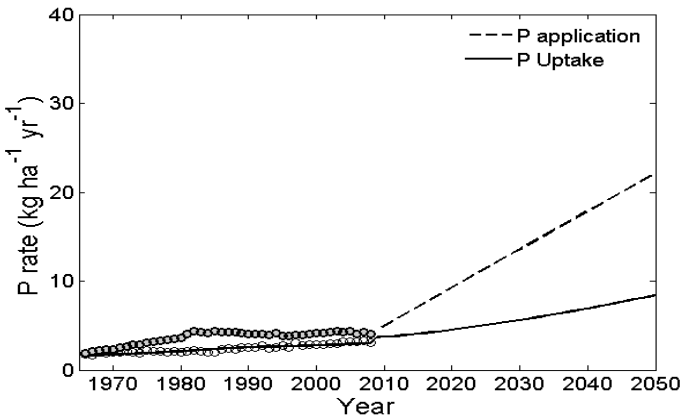
Sattari, Bouwman, Giller and Van Ittersum, 2012 - PNAS

A learning curve!

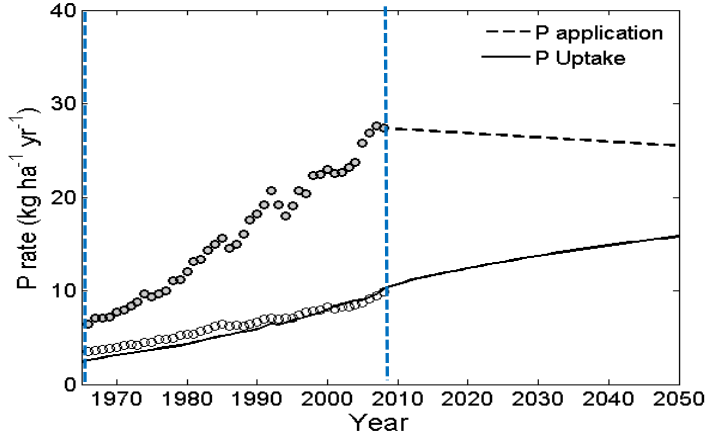
W-Europe



Africa



Asia



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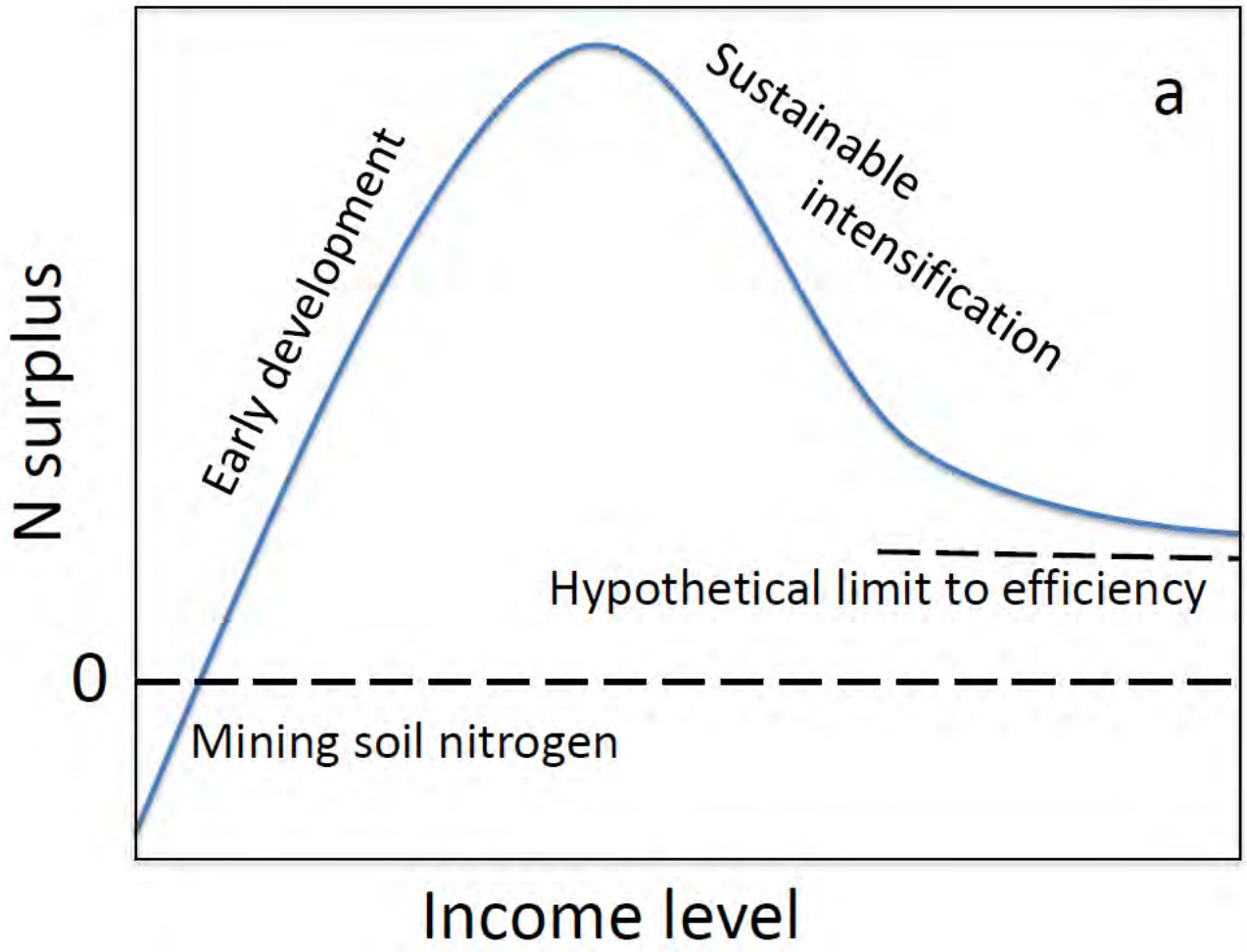
Sattari, Bouwman, Giller and Van Ittersum, 2012 - PNAS

Intensification or Ecologisation?



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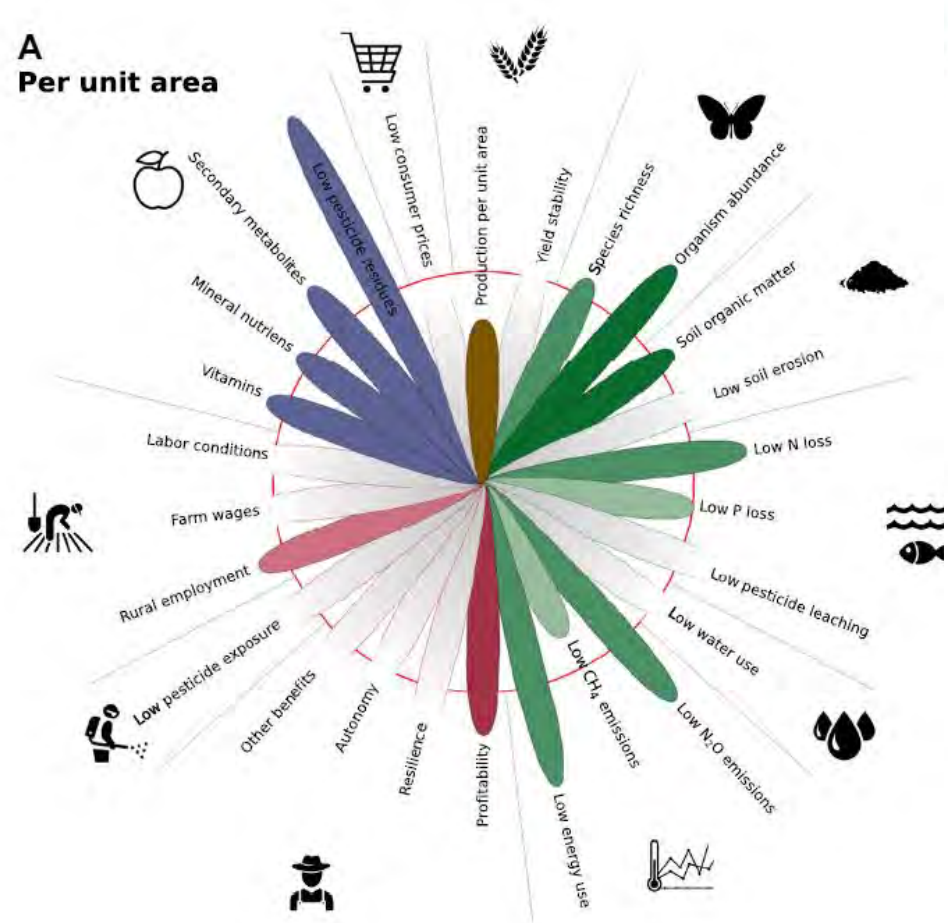
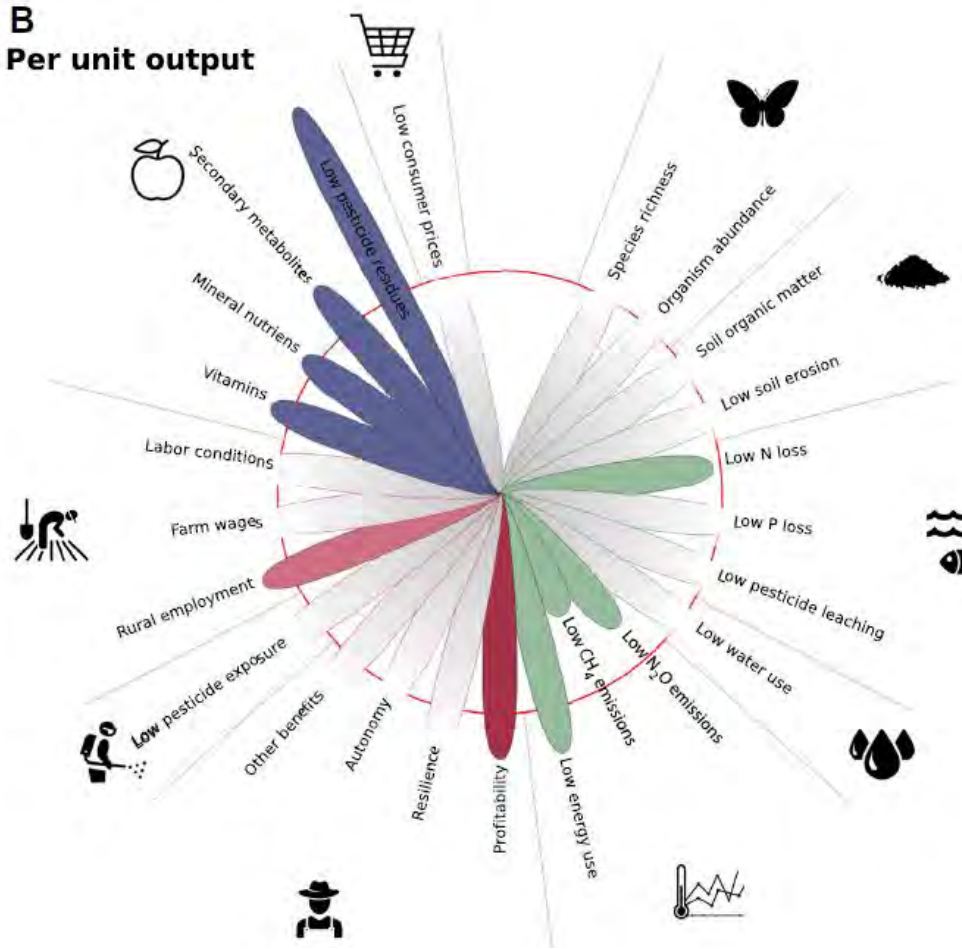
Zhang et al., 2015. Nature

Organic vs Mainstream agriculture





Seufert and Ramankutty, 2017. Science Advances

How to ecologise ….

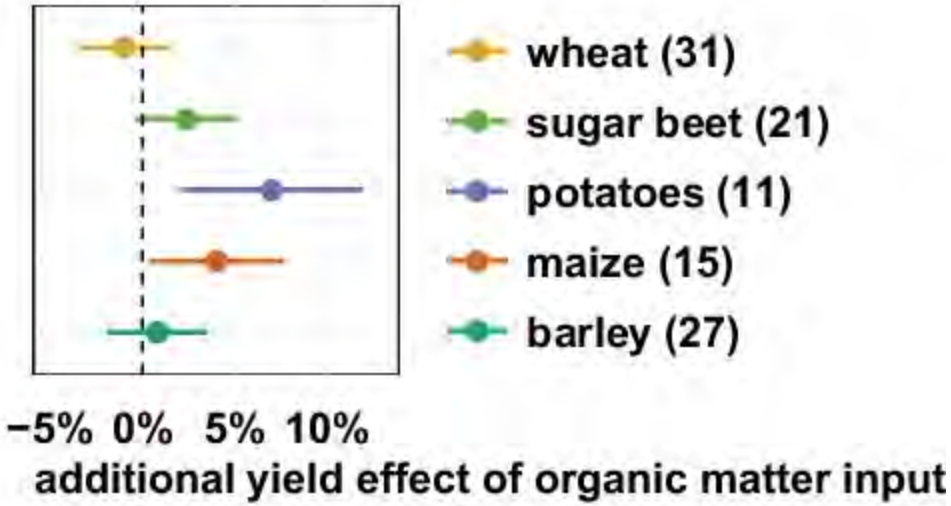
- Consider objectives, trade-off and re-design at different levels
- Diversify rotations
- Precision management in time and space (e.g. 4 Rs)
- Using organic inputs – organic matter and circularity
- Integrated pest management

Adding organic (fertilizer) inputs

- Meta-analysis of long-term experiments in Europe:
  - If macro nutrients (NPK) are in ample supply:
  - Mean additional yield effect of organic inputs is not significant (+1.4% ± 1.6)
- But…

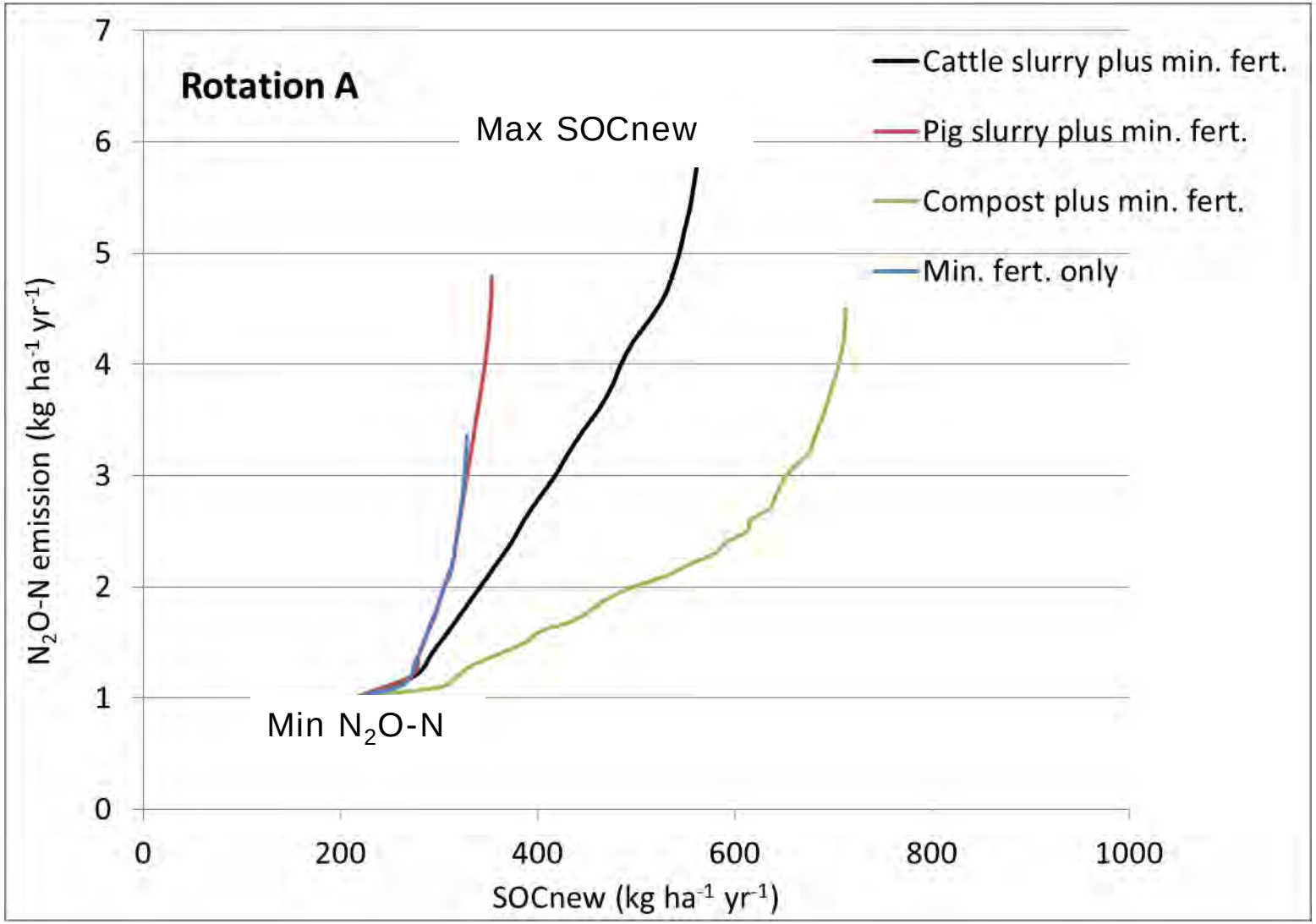
Hijbeek et al., 2017. Plant and Soil

Results – per crop type



Hijbeek et al., 2017. Plant and Soil

Expect trade-off....



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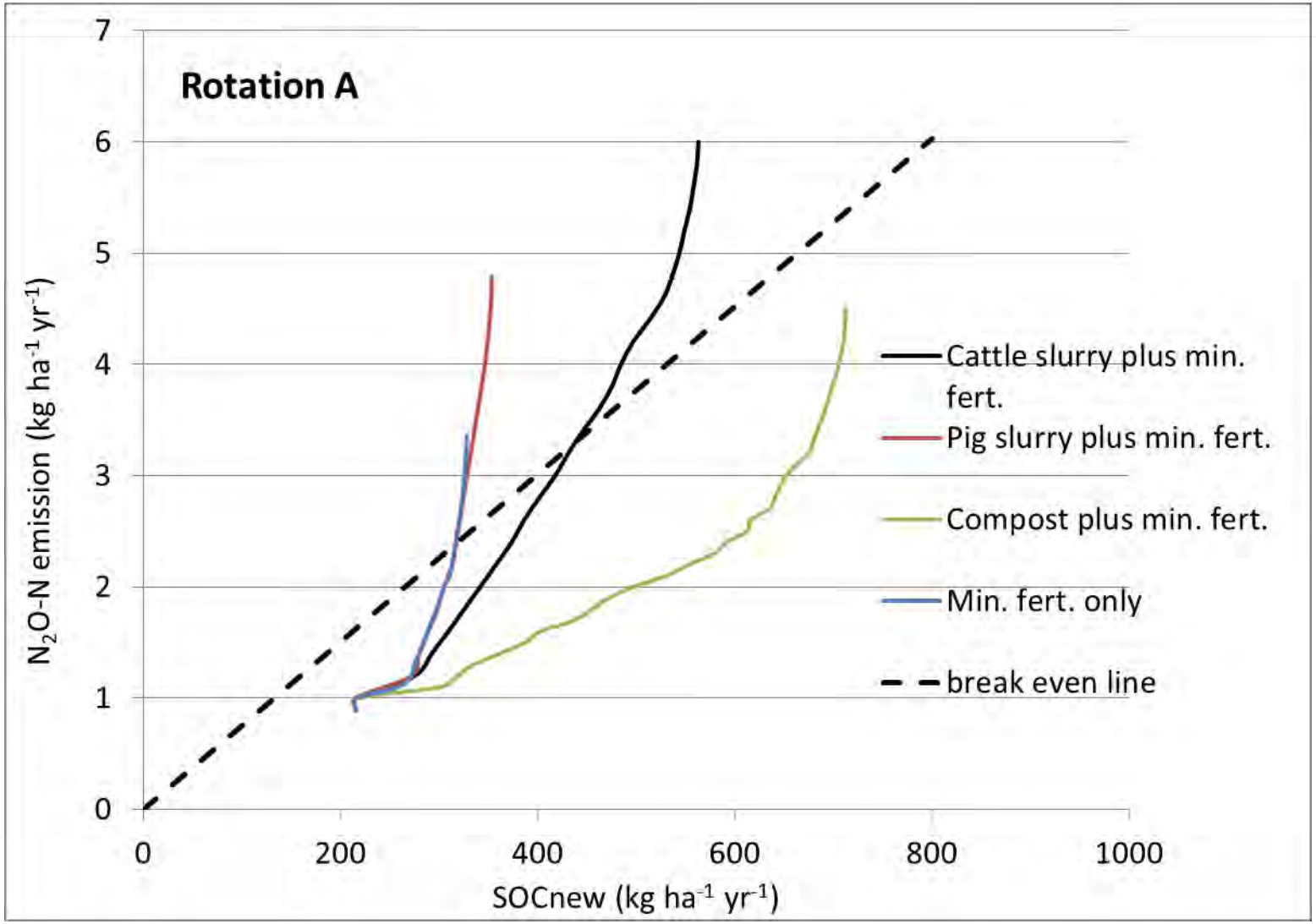
Bos et al., 2017. Agricultural Systems

Expect trade-off....



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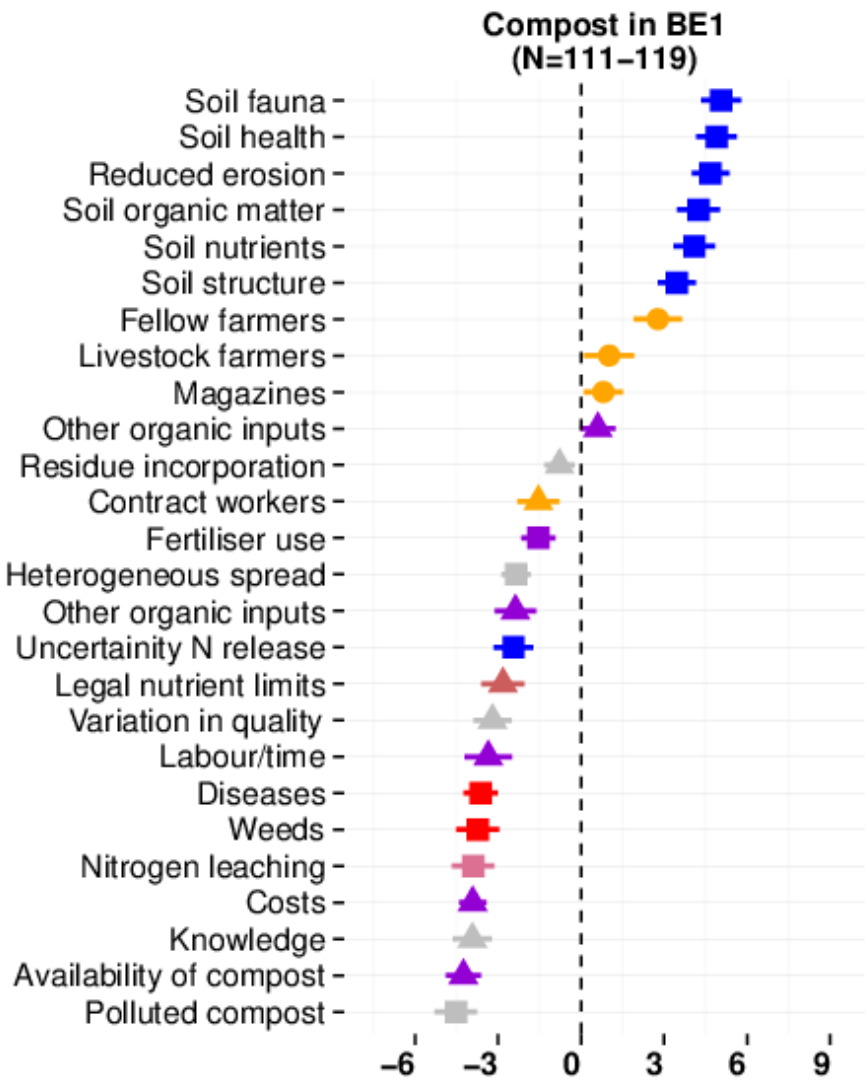
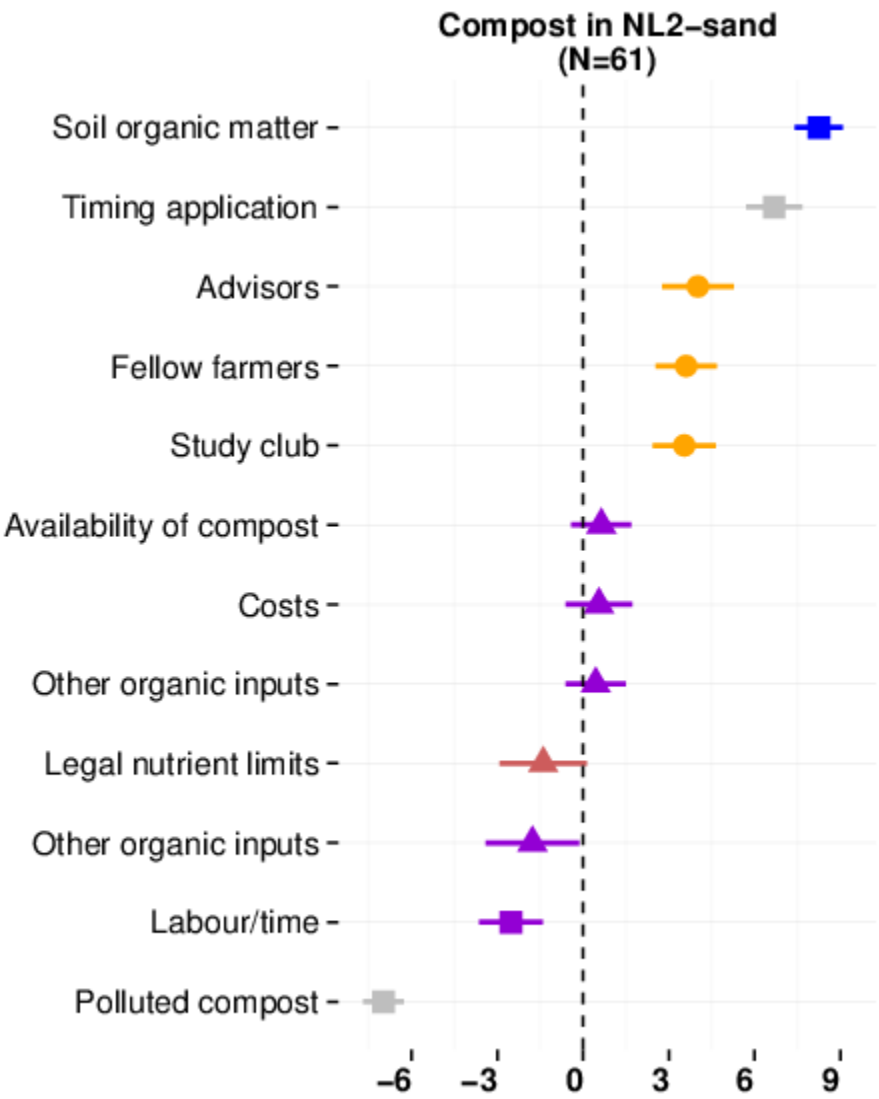
Bos et al., 2017. Agricultural Systems

Drivers and barriers - compost





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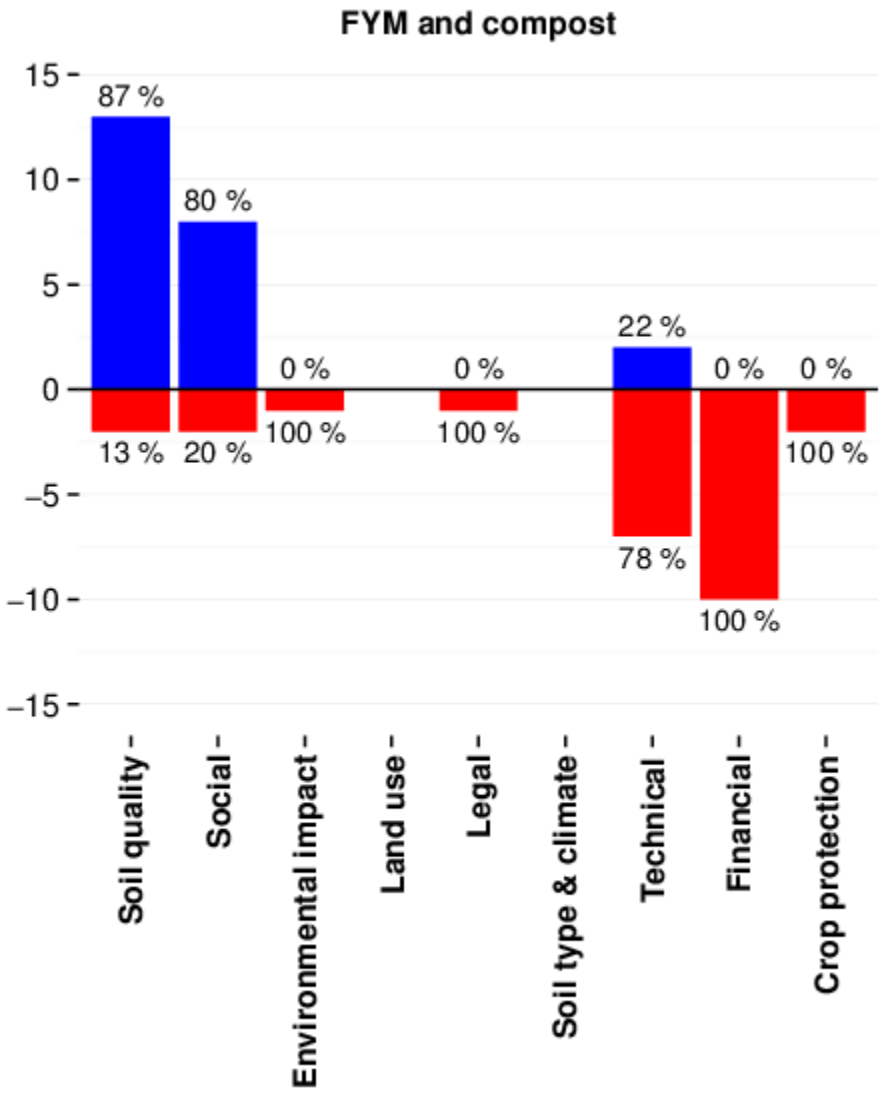
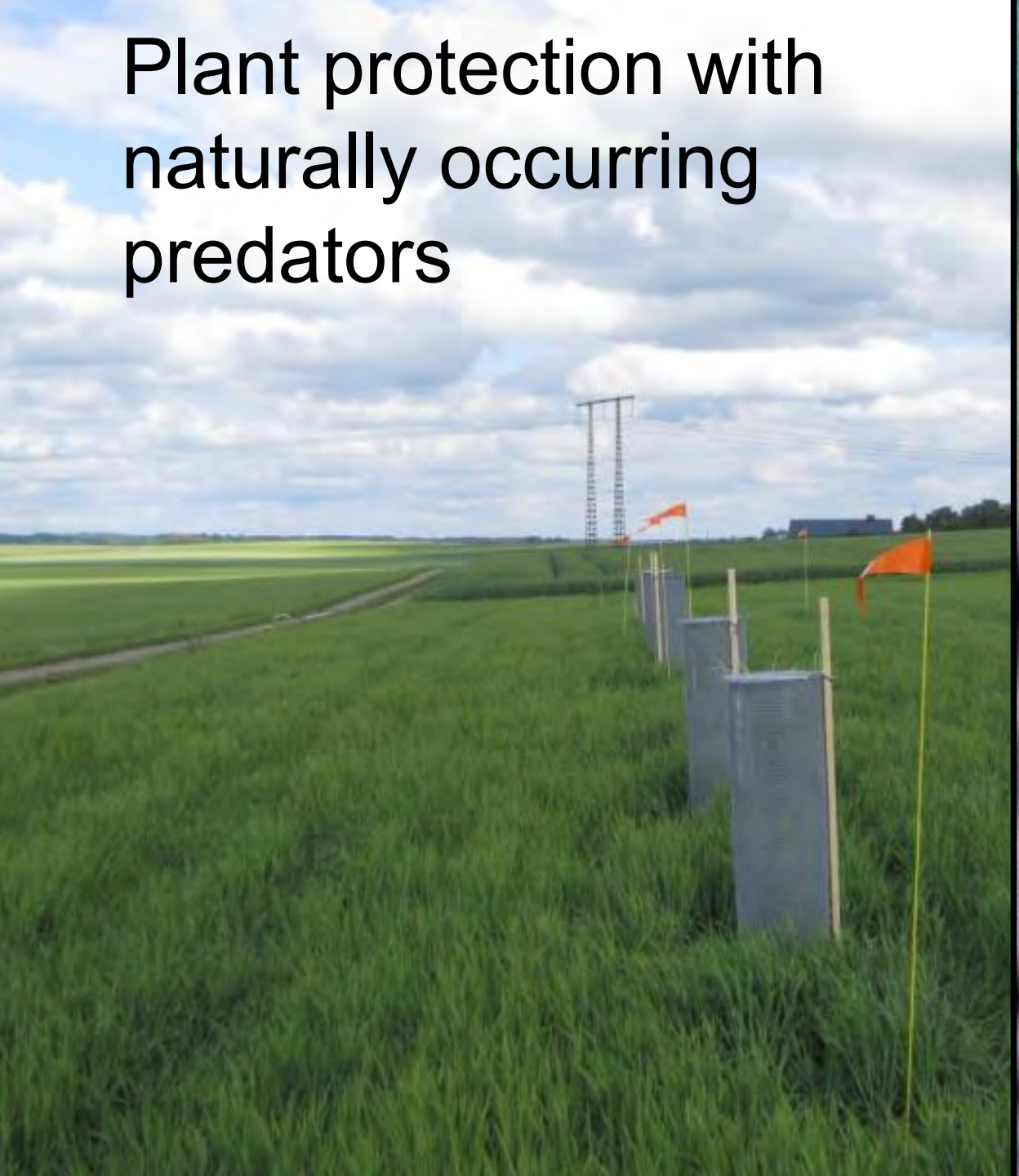
Hijbeek et al., 2017

Drivers and barriers - farmyard manure & compost



Hijbeek et al., 2017

Plant protection with naturally occurring predators



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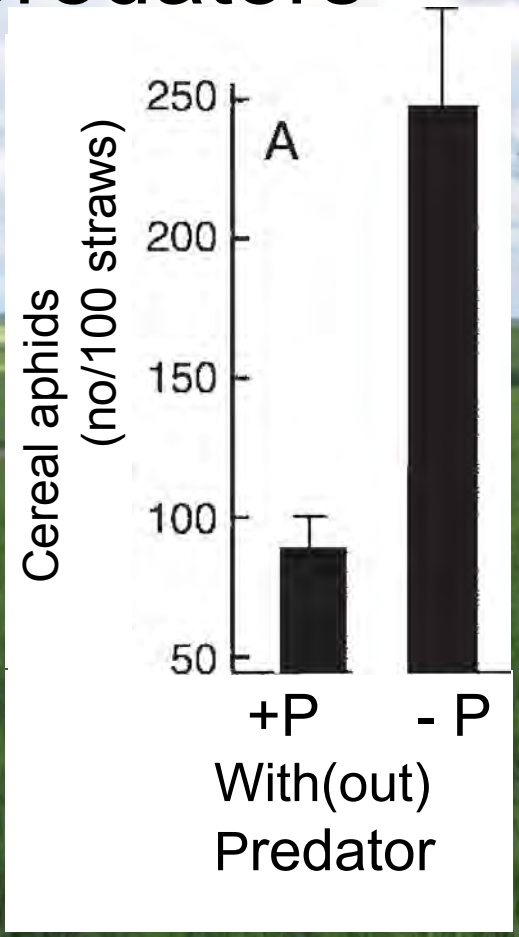
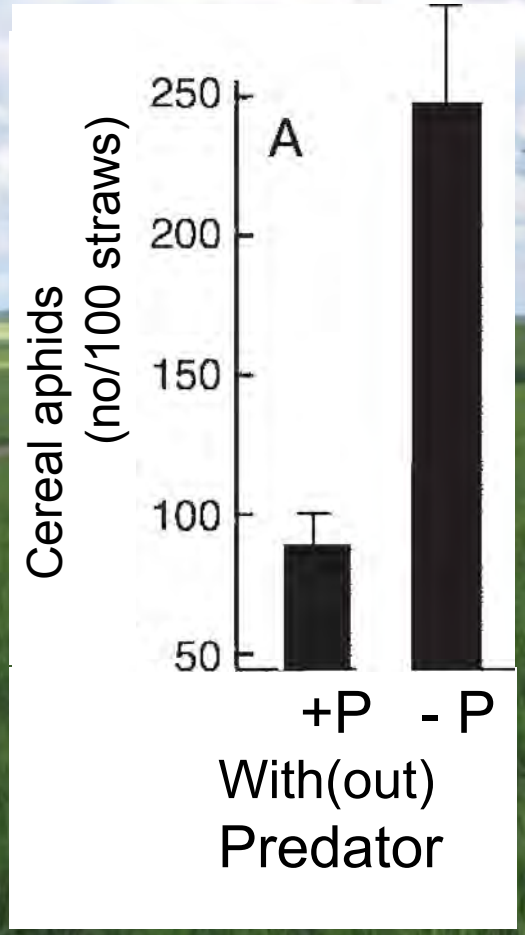
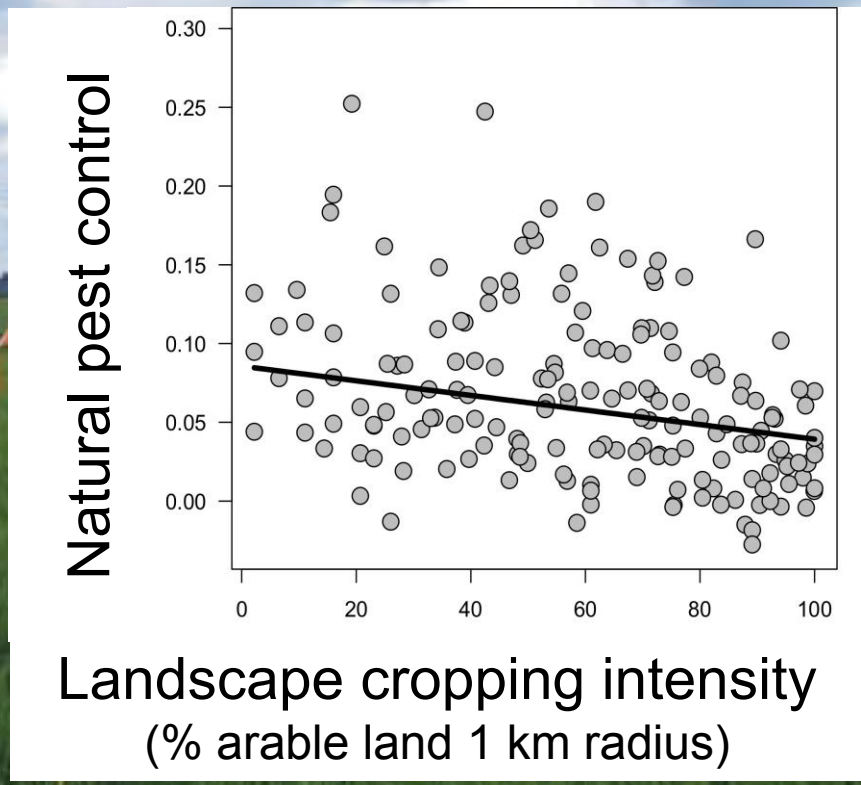


Thies et al 2011 Ecol Appl

Insect communities - pest control





Rusch et al 2016 AGEE

Concluderend

- Hoge opbrengsten en efficienties kunnen goed samengaan, maar ....
- De kunst is (ook) goede balans te vinden met emissies per hectare
- We boeken (nog steeds) vooruitgang
- Nadruk op intensiveren of ecologiseren afhankelijk van waar we zijn op de wereld
- Gebruik van organic inputs:
  - Geen wondermiddel
  - Niet zonder trade-off
  - Meer aandacht voor 'drivers & barriers' boeren
- Effect op veerkracht onzeker

Future harvest

Dank voor uw aandacht

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