

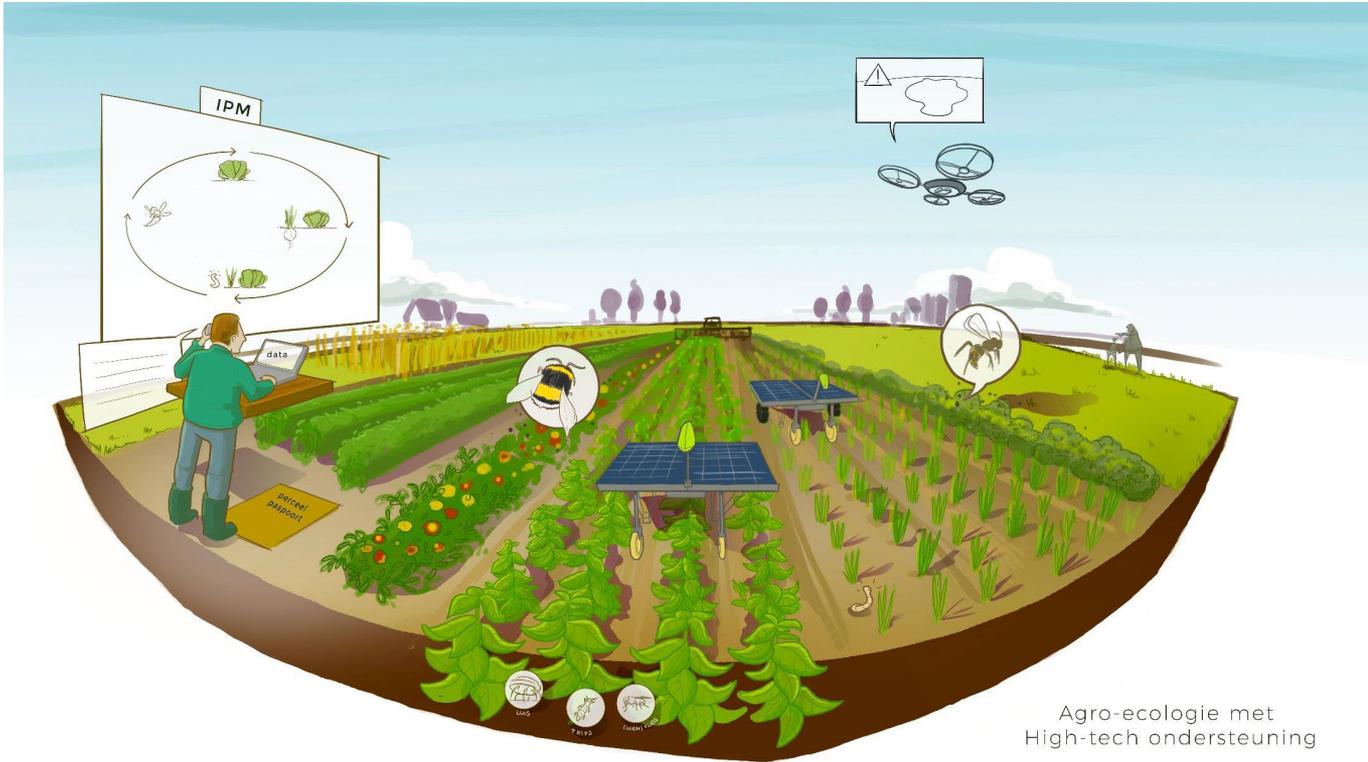
# Agrodiversification: what can it bring and what does it take?

November 2018

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# What does this image actually imply



Agro-ecologie met  
High-tech ondersteuning

# Where will agriculture move to?



# OVERVIEW

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- Why diversify in field at all?
- A lock-in we need to break through
- Options with emerging technologies
- Circular agriculture what is the elephant in the room?

# Intercropping yield advantage

An example

48.4 ha wheat  
6.4 tonnes ha<sup>-1</sup>

**Total output:**  
310 tonnes wheat

80.2 ha maize  
10.1 tonnes ha<sup>-1</sup>

**Total output:**  
810 tonnes maize

Land needed for total output under monocropping 48.4+80.2=128.6 ha

100 ha wheat/maize intercrop  
Wheat grain 3.1 tonnes ha<sup>-1</sup>  
Maize grain 8.1 tonnes ha<sup>-1</sup>

**Total output:**  
Wheat grain 310 tonnes  
Maize grain 810 tonnes

Land needed for total output under intercropping 100 ha

Most used performance indicator:

Land Equivalent Ratio = sum of the relative yields

$$\text{LER} = \frac{Y_1}{M_1} + \frac{Y_2}{M_2} \left[ \text{or} \sum_{i=1}^{i=n} \frac{Y_i}{M_i} \right]$$

$Y_i$ : yield crop  $i$  in intercrop

$M_i$ : yield crop  $i$  in sole crop

$n$ : number of crops in the system

$$\text{LER}_{\text{example}} = \frac{3.1}{6.4} + \frac{8.1}{10.1} = 1.286$$

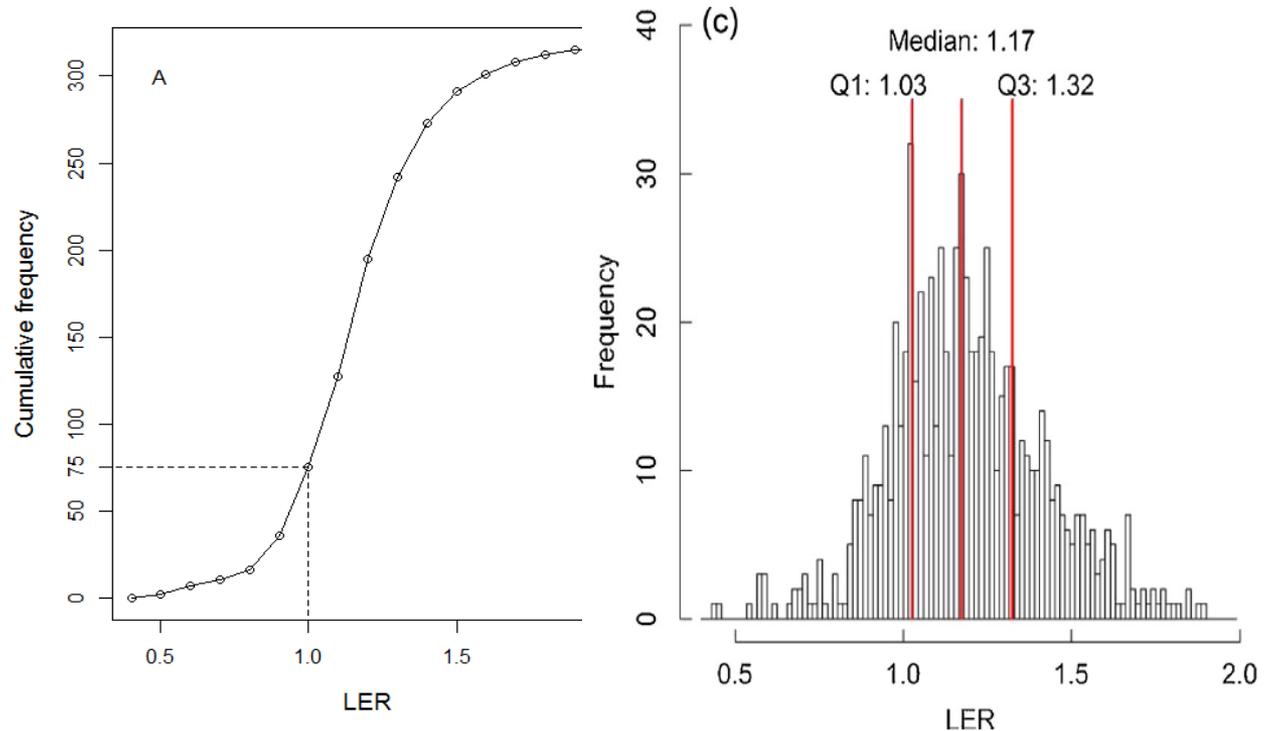
# What can be gained with diversity? - intercropping

## ■ Meta-analysis of factors affecting Land equivalent ratio (LER)



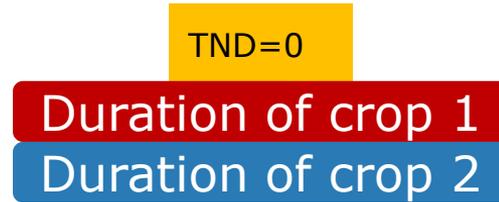
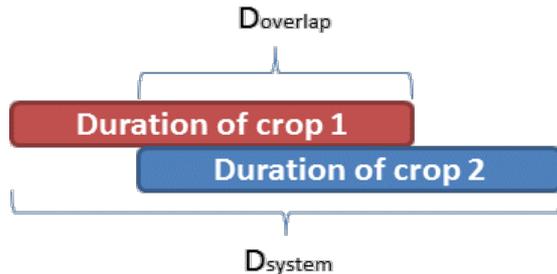
Yu Yang

Median: 1.17  
Mean: 1.22



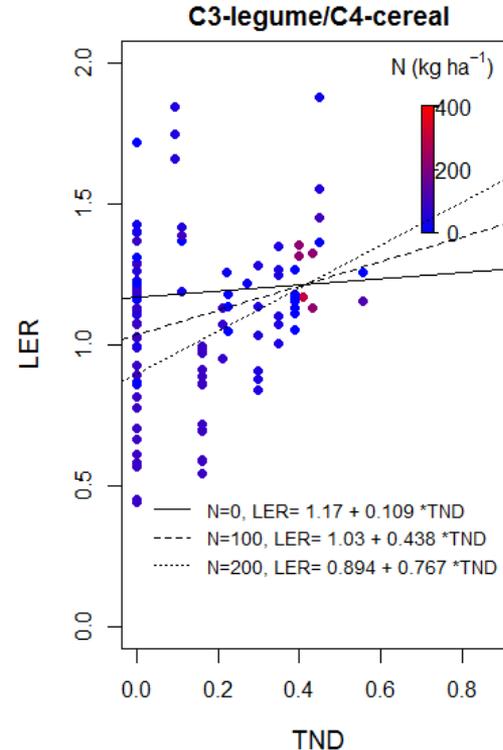
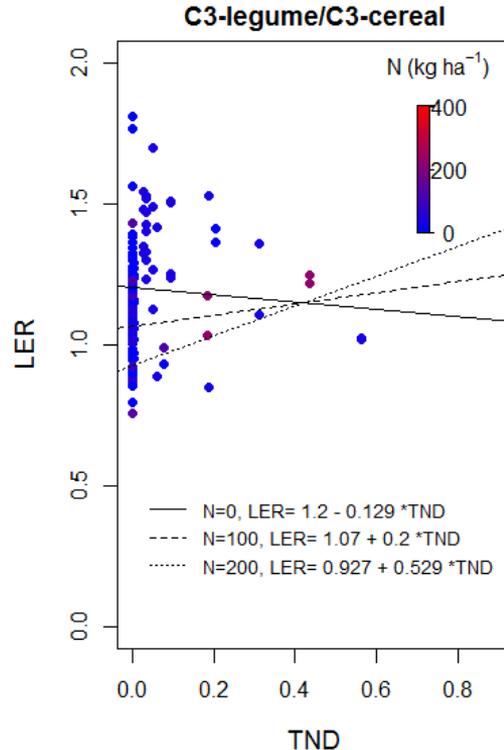
# Temporal niche differentiation (TND)

$$\text{TND} = \frac{D_{\text{system}} - D_{\text{overlap}}}{D_{\text{system}}} = 1 - \frac{D_{\text{overlap}}}{D_{\text{system}}}$$



# Is intercropping interesting at high inputs?

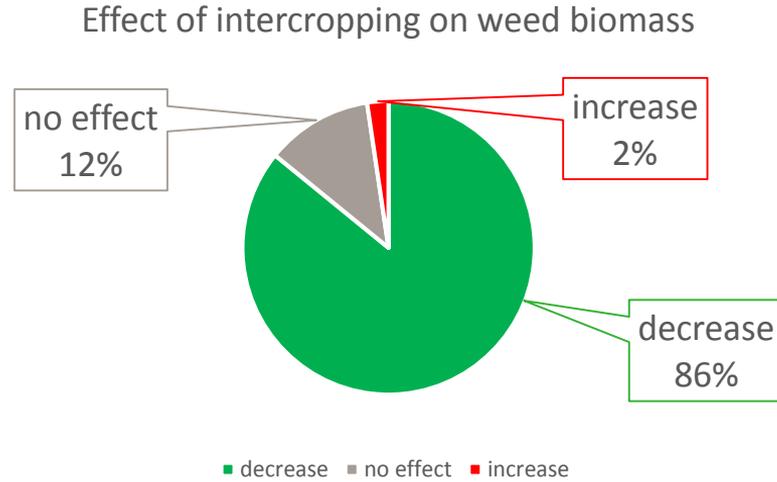
At higher N input and low TND LER decreases



At higher N input and TND above 0.4 LER increases

# Effects of intercropping on weeds

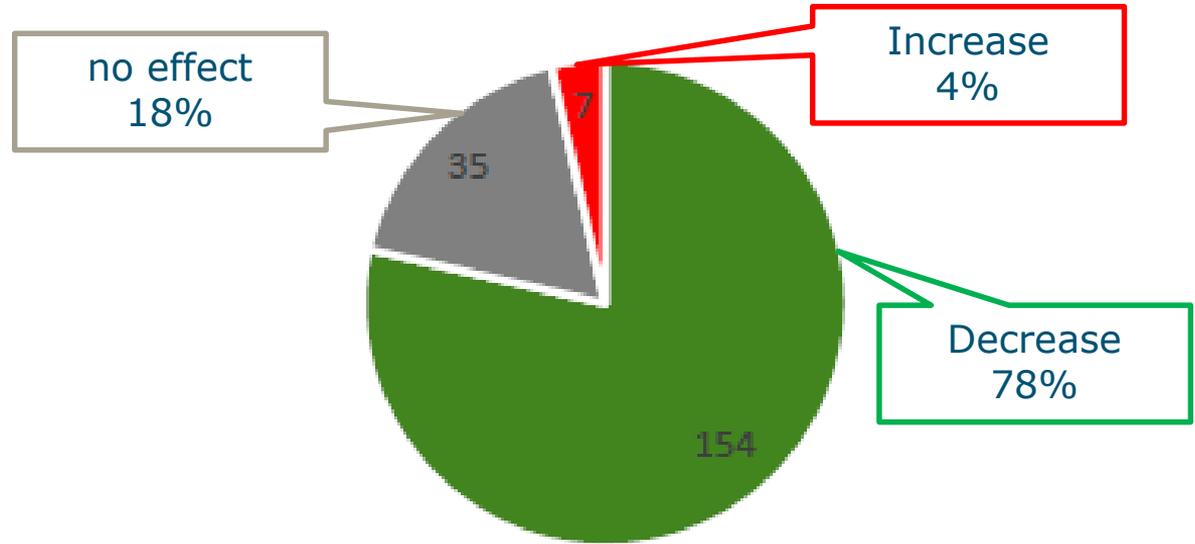
- 662 paper
- 115 selected
- 212 'votes'



- Overall intercropping lowers weed biomass, though, not always.

# Disease effects of intercropping

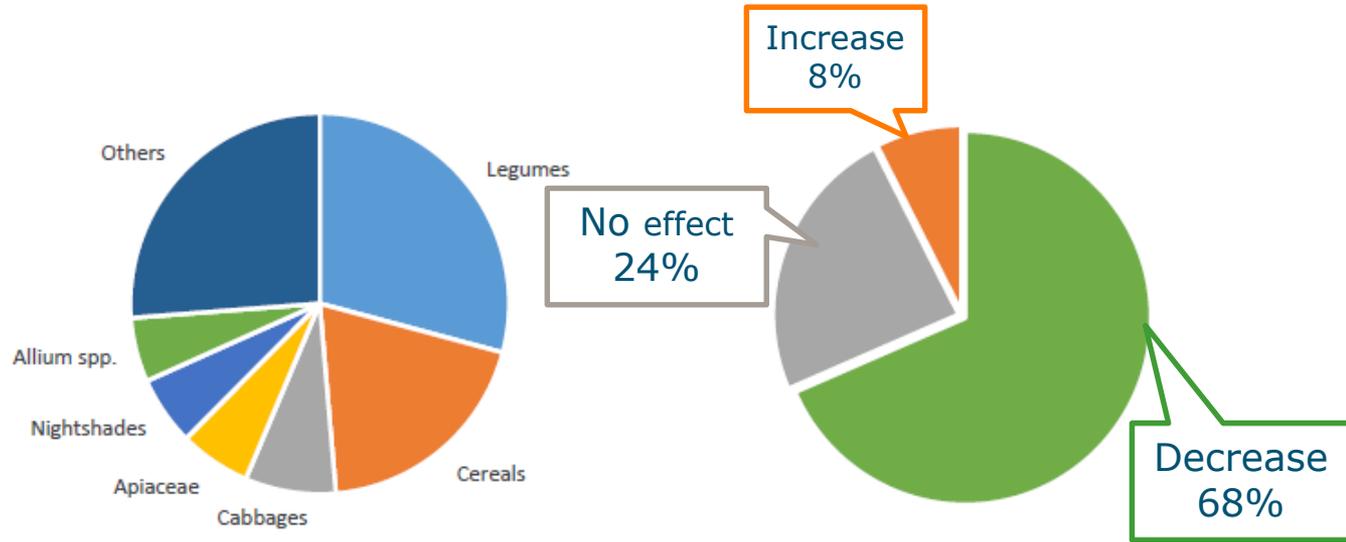
- 575 paper
- 101 selected
- 196 'votes'



- Overall intercropping lowers disease scores, though not always.

# Pest density effects of intercropping

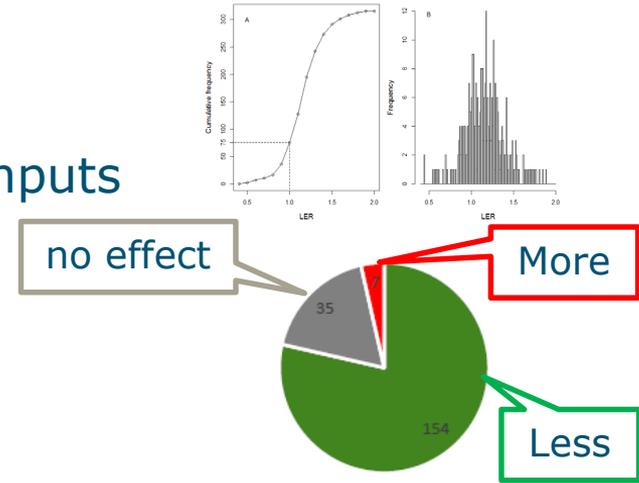
- 326 paper
- 153 selected
- 546 'votes'



- Overall intercropping lowers pests, though, not always.

# What can be gained with intercropping?

- Larger production per unit area **or**
  - The same production with less external inputs
  - Lower pressure of diseases and pests
  - Reduction of weed biomass
  - More in field biodiversity
- 
- Why then is it not used and/or the conversion not happening?



# What are trends in mechanisation

- Further increasing implement size? or
  - Miniaturisation in the near future?
  - The use of robots
- 
- Can we break through the current lock-in with smart technologies?
  - Or will we mount all new technologies on larger and larger tractors



Cartoons: © Wageningen Plant Research  
Lelystad



# Closing cycles? ≠ using more animal manure

- All nutrients in animal manure are plant derived
- Animal manure is already largely returned to the field



‘In een stelsel van kringlooplandbouw gebruiken akkerbouw, veehouderij en tuinbouw in de eerste plaats grondstoffen uit elkaars ketens en reststromen uit de voedingsmiddelenindustrie en de voedingsketens.’

- All nutrients in human food are plant derived
- Closing cycles will require returning human ‘manure’ to our fields



Example unsustainable inputs into our food system:  
**Rock phosphate**



14 MT/year  
P from rock  
phosphate



Animal manure



3 MT P

Ingested with food

Food chain losses?

Other losses?

Erosion losses?

Adsorbed/Fixated  
later released?

From toilet back to field?



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Thank you



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Dank voor de aandacht

Cartoon: © WPR Lelystad