

Fertiliser use and climate change mitigation: scientific insights

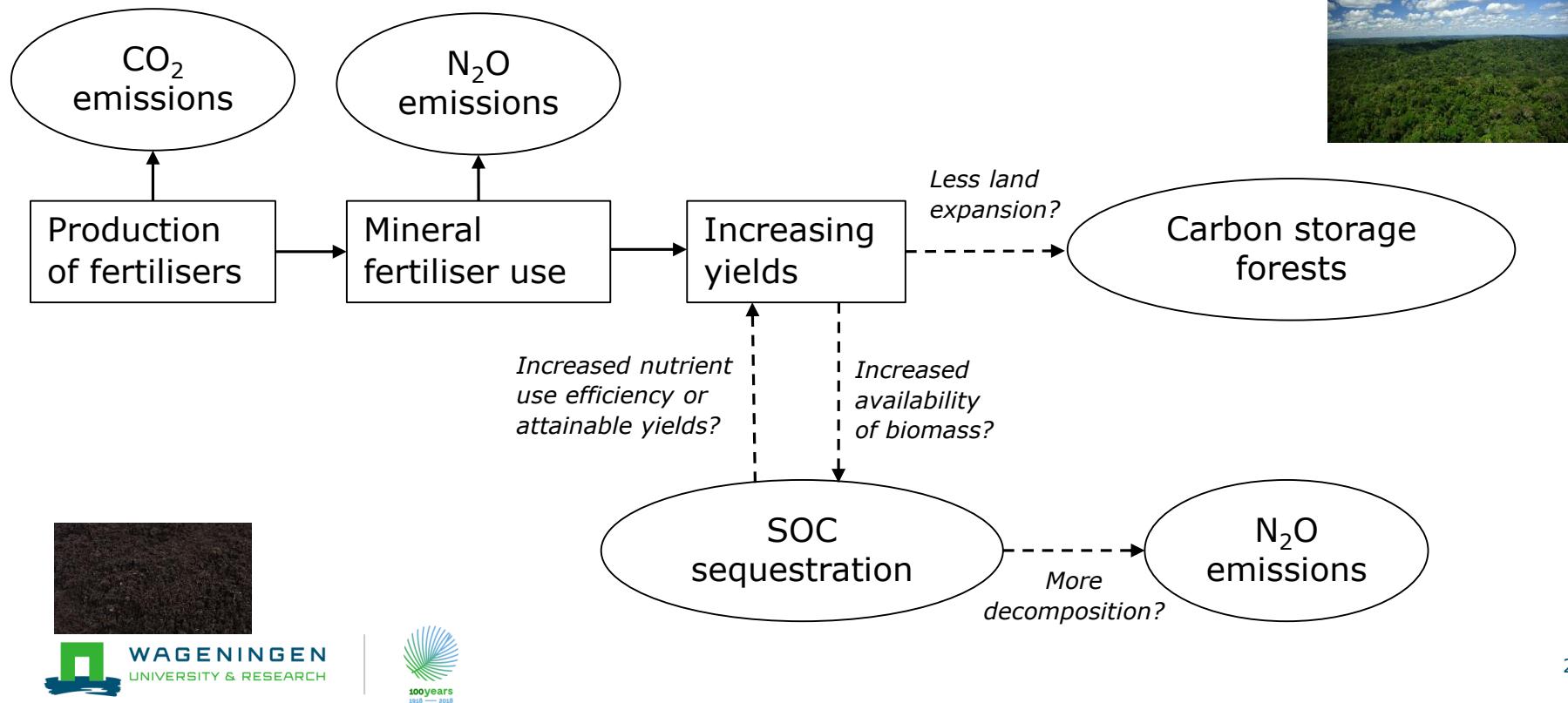
2019 IFA Joint Agricultural and Communication Meeting

Renske Hijbeek & Martin van Ittersum

with contributions from Hein ten Berge, Marloes van Loon and many others

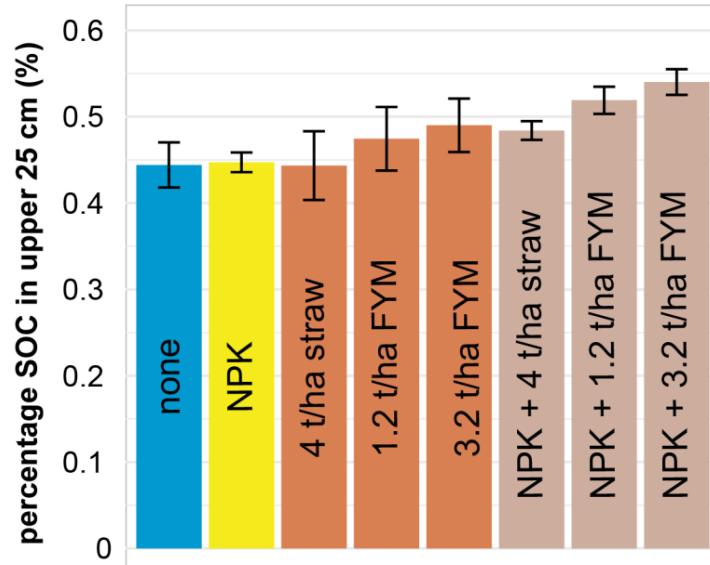


Background – relations between fertiliser use and GHG emissions

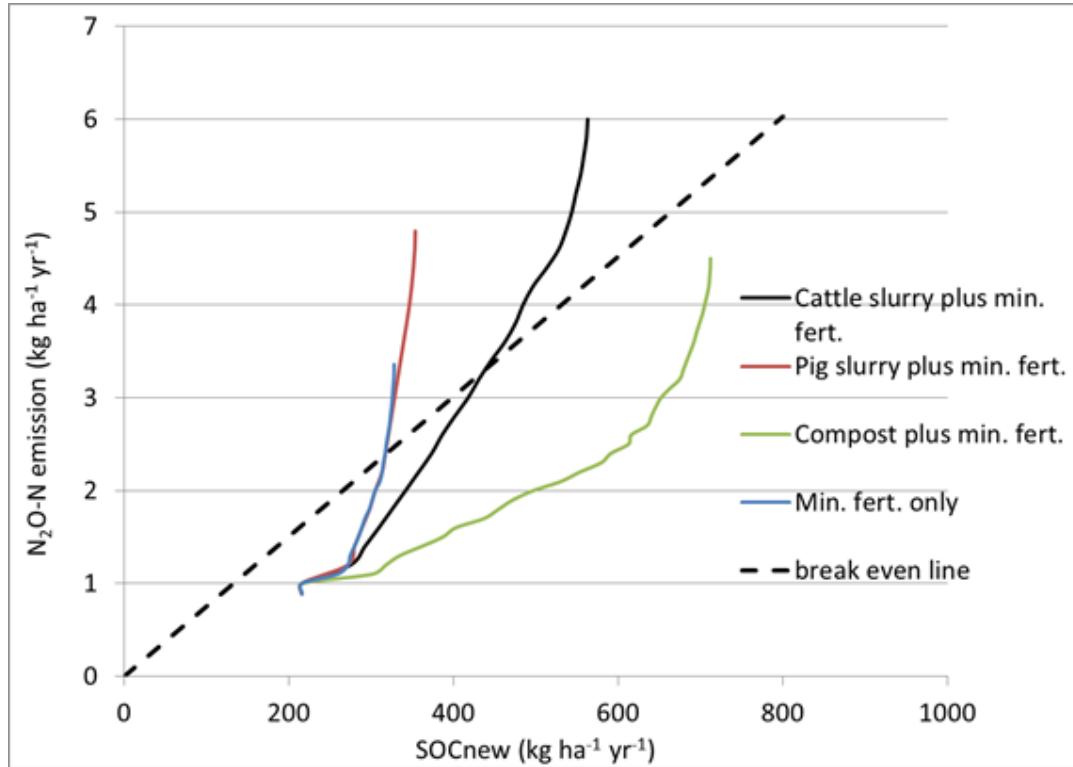


Fertiliser use and soil carbon sequestration

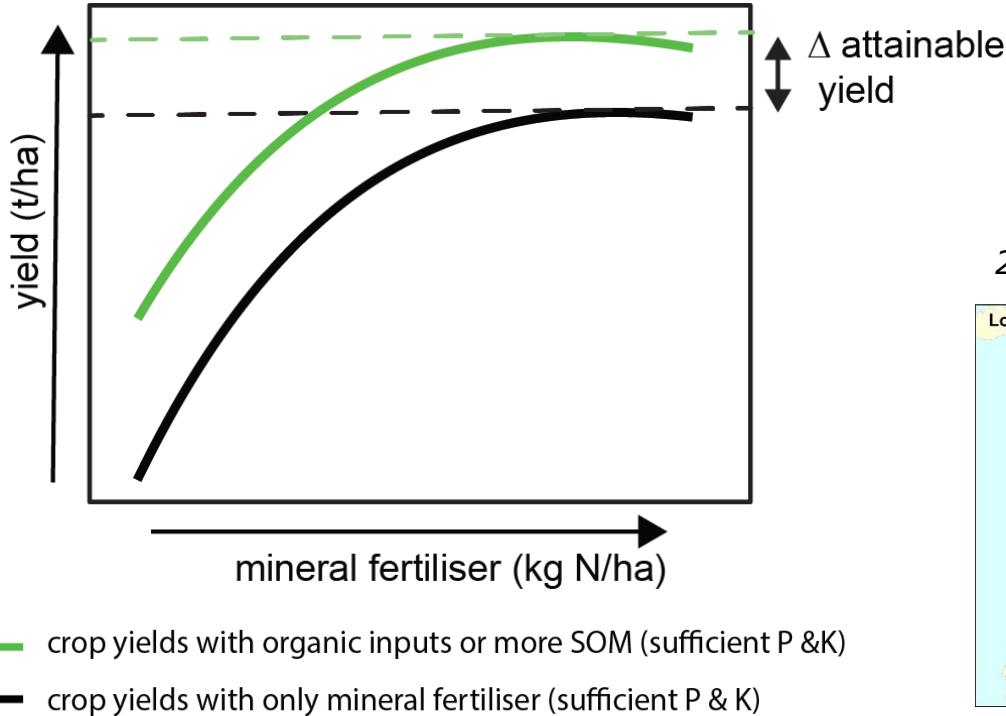
SOC built up after 41 years (1963-2004) in experiment Muencheberg



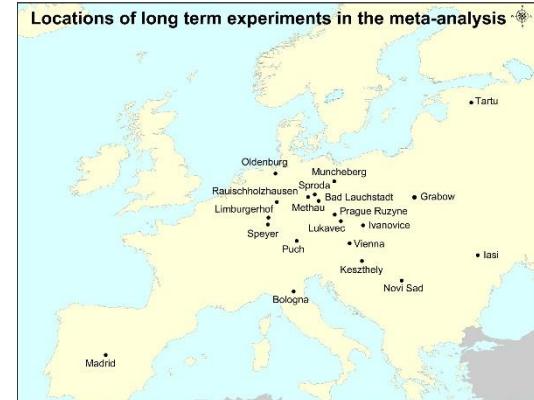
Soil carbon sequestration and N₂O emissions



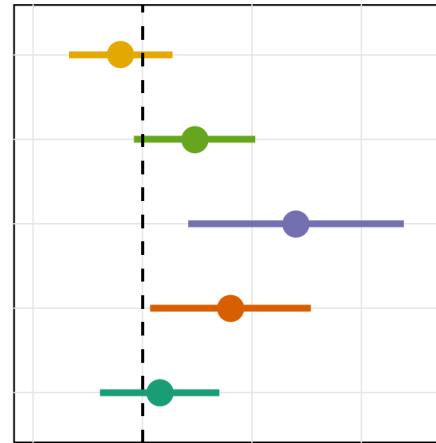
Soil carbon sequestration and crop yields



20 experiments across Europe



Soil carbon sequestration and crop yields



wheat (31)
sugar beet (21)
potatoes (11)
maize (15)
barley (27)

-5% 0% 5% 10%

increase in attainable yield

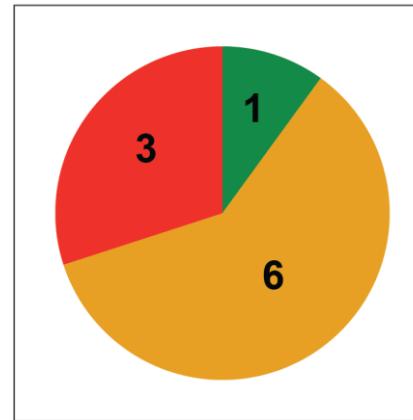


Soil carbon sequestration and crop yields

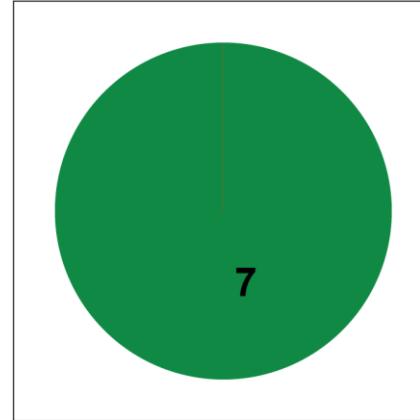
A meta-analysis of meta-analyses?

- 14 meta-analyses
- across all continents
- 17 different methods
- >1000 experiments
- Outcome depends on method used

A. Mean yield effect of increasing SOM - N, P, K effects excluded

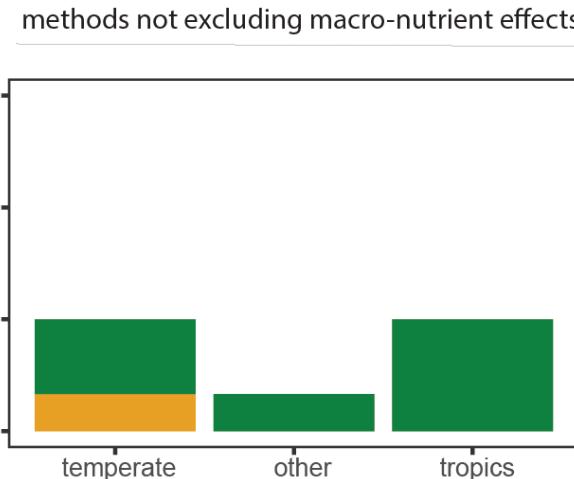
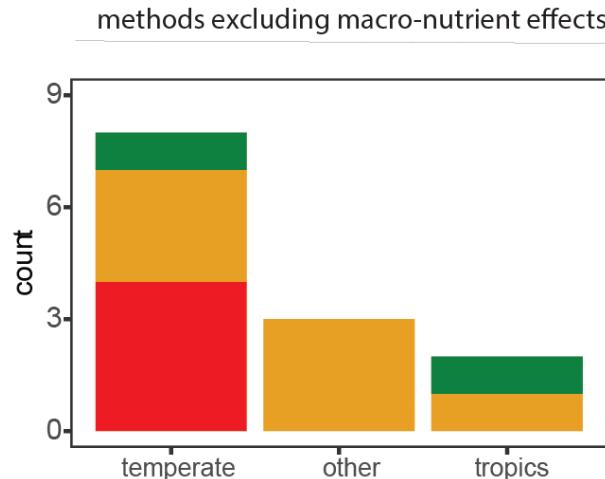


B. Mean yield effect of increasing SOM - N, P, K effects cannot be ruled out



negative
no effect
positive

Soil carbon sequestration and crop yields



yield effect of organic inputs or soil organic matter: ■ negative ■ zero ■ positive

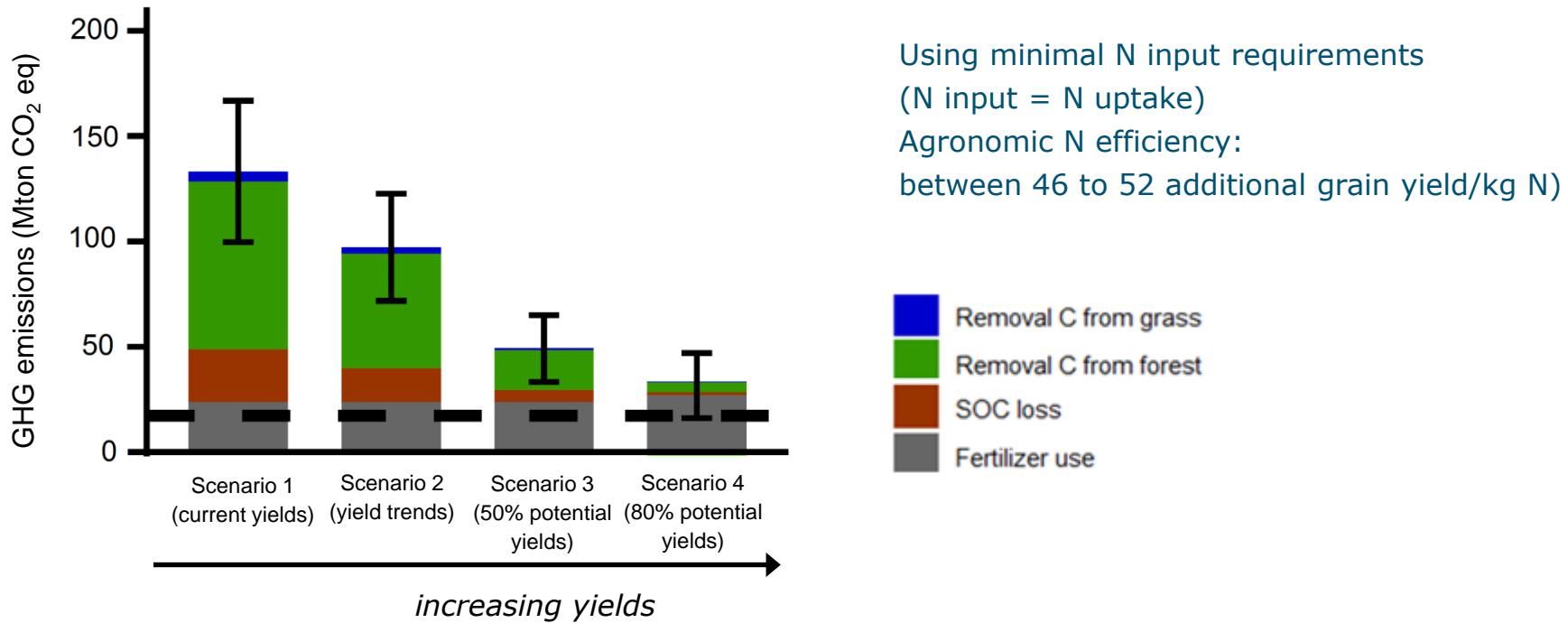
Increasing yields and GHG emissions in SSA

How to achieve self sufficiency for maize in 2050?

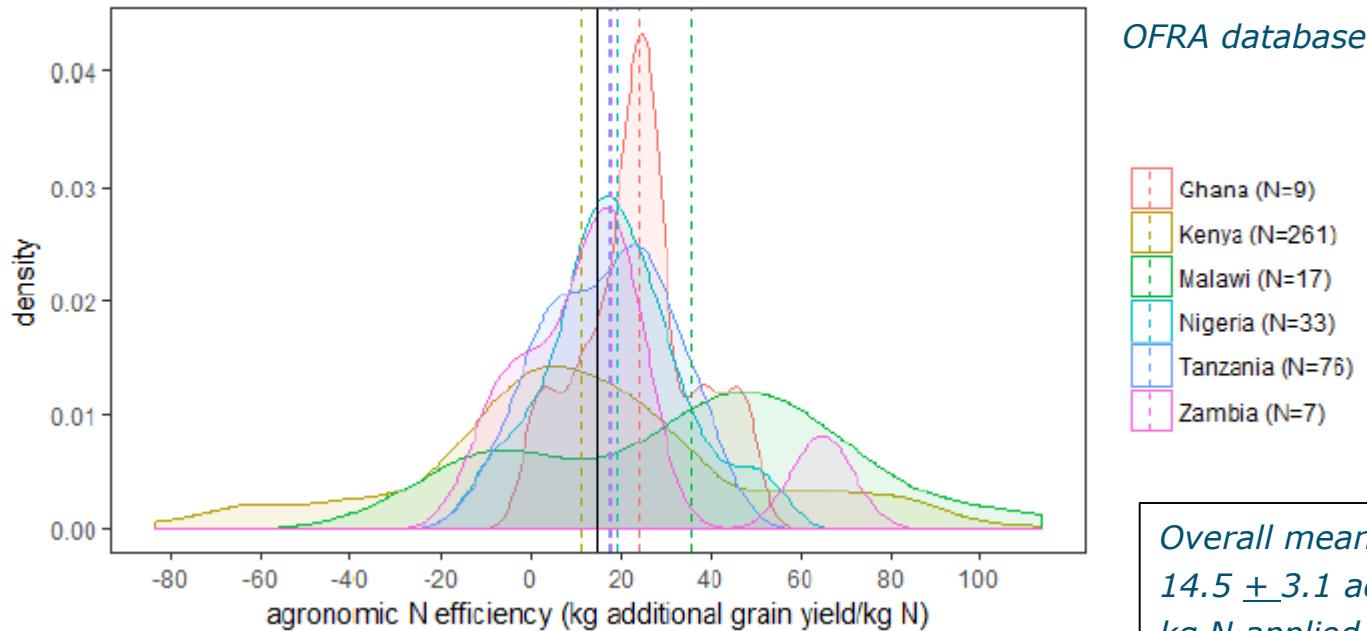
- Scenario 1: yields as in current situation
 - Scenario 2: yield trends extrapolated
 - Scenario 3: yields increase to 50% of potential yield
 - Scenario 4: yields increase to 80% potential yield
- 
- increasing
yields*

Nine countries: Ethiopia, Kenya, Tanzania, Uganda, Zambia, Burkina Faso, Mali, Ghana, Nigeria

Increasing yields and GHG emissions in SSA

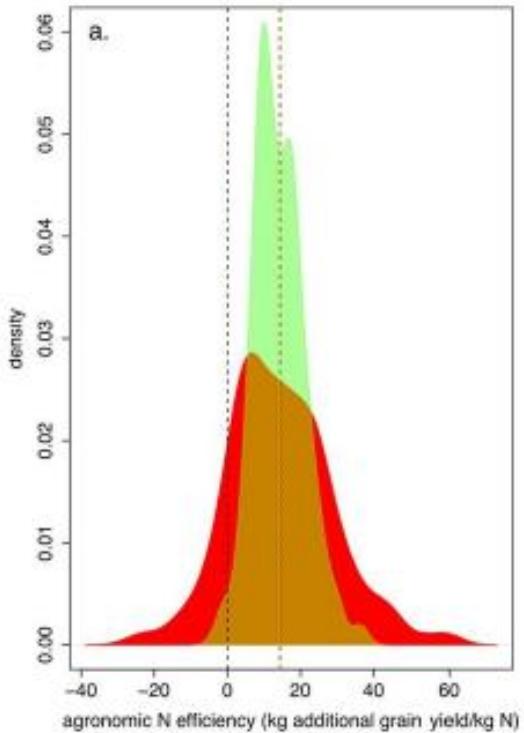


What are current levels of Agronomic N efficiency in SSA?



Overall mean ANE:
 14.5 ± 3.1 additional kg grain yield/
kg N applied

What are current levels of Agronomic N efficiency in SSA?

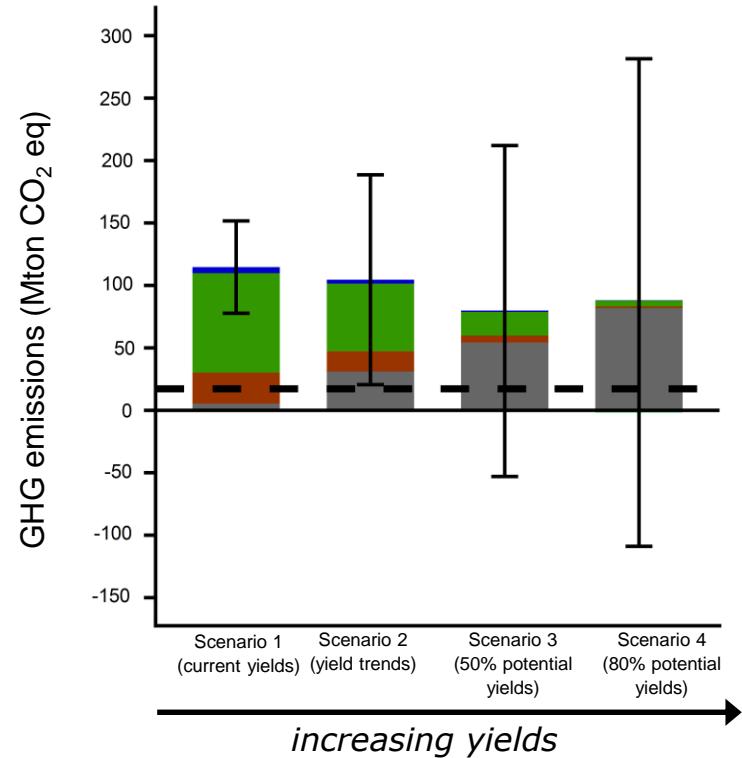


TAMASA nutrient omission trials (NOTs):

- *Ethiopia (n=82)*
- *Tanzania (n=202)*
- *Nigeria (n=167)*

Overall mean ANE:
 14.3 ± 0.8 additional kg grain yield/
kg N applied

Increasing yields and GHG emissions in SSA (current agronomic N efficiency)



Using current mean Agronomic N efficiency:
14.3 additional grain yield/kg N

- Removal C from grass
- Removal C from forest
- SOC loss
- Fertilizer use

Reflection and conclusions

- Still many unknowns on fertiliser use and climate change mitigation
- Fertiliser use might contribute to SOC sequestration – but effects are always temporarily and trade-offs exist with N₂O emissions
- Increasing Agronomic N efficiency might be most promising for CC mitigation with mutual benefits for farmers

Questions?

