



18-19 NOVEMBER 2019

## Needed improvements in nitrogen use efficiency to achieve environmental quality objectives: the EU case

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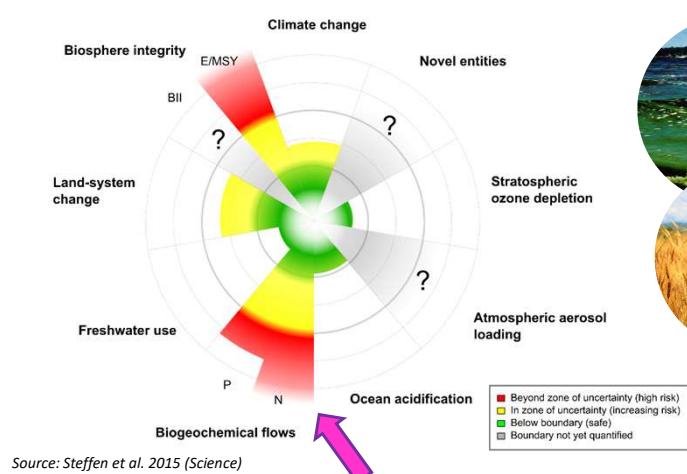


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### The problem:

'Planetary boundaries' related to human N fixation have been exceeded...

... but nitrogen is both a matter of 'too much' and 'too little'.



→ ***Can we derive spatially explicit 'nitrogen boundaries'?***



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## Three core questions of our research:



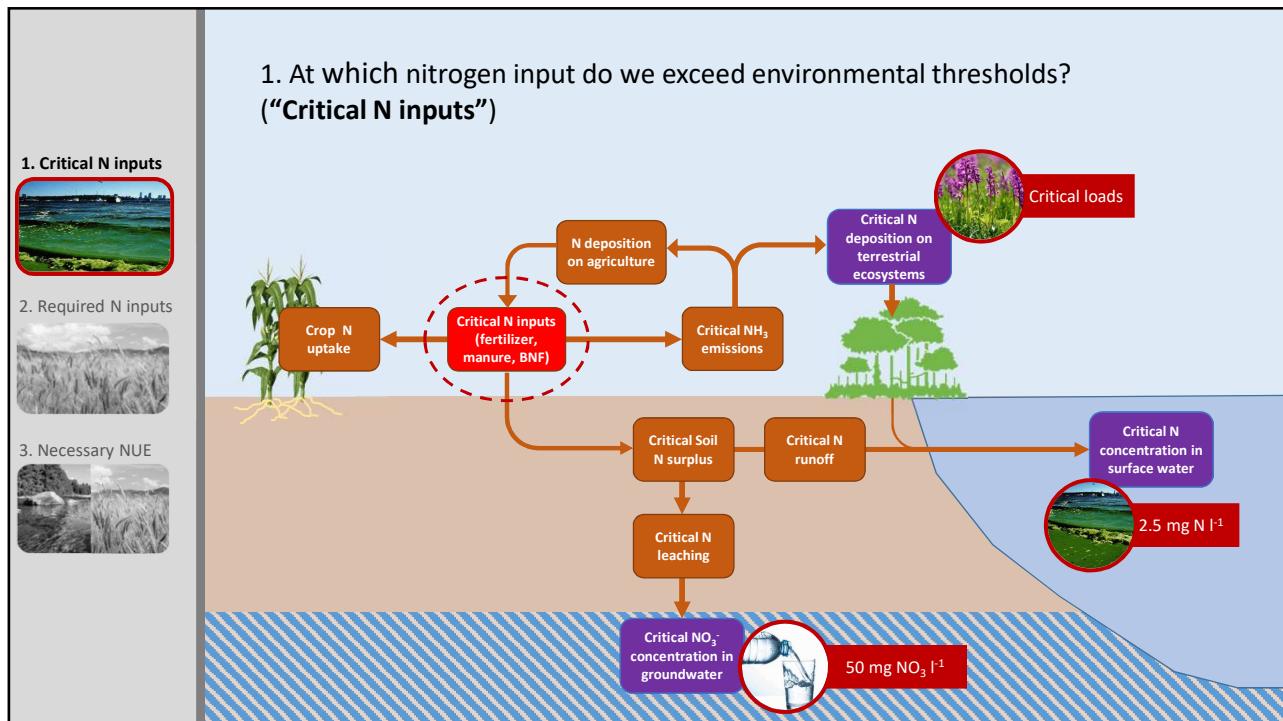
1. At which nitrogen input do we exceed environmental thresholds? (“**Critical N input**”)

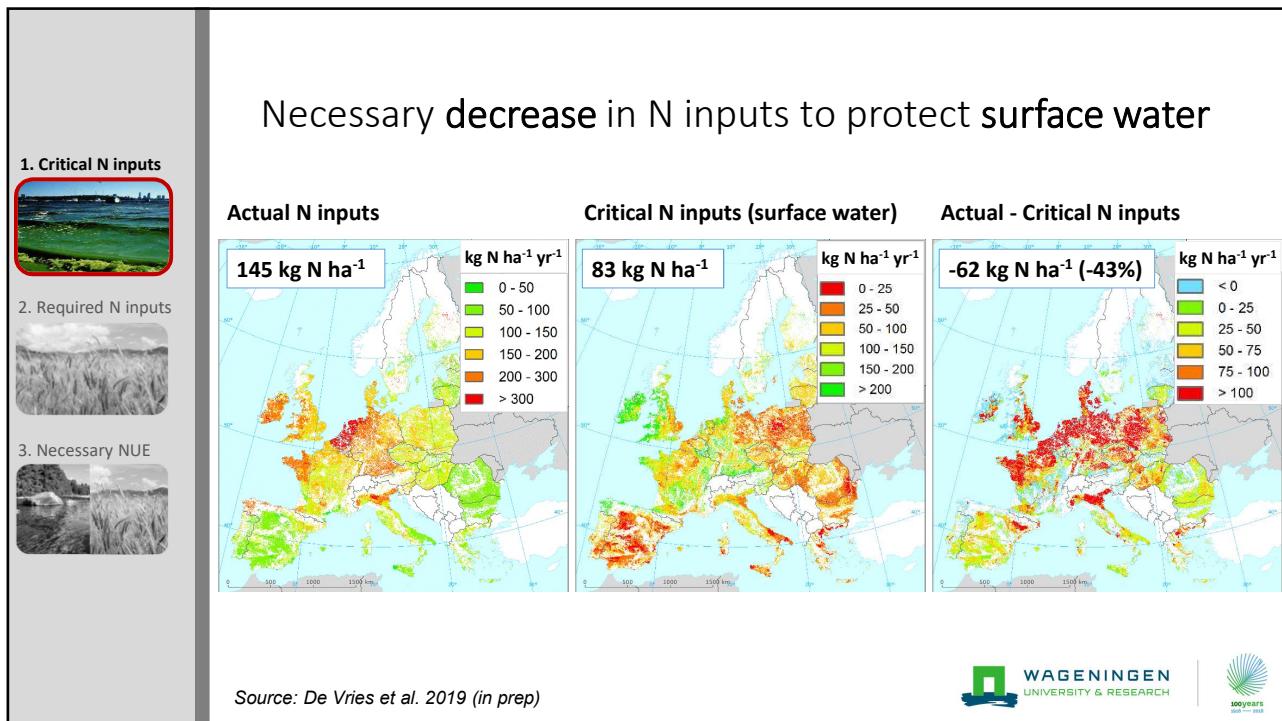


2. How much nitrogen input is required for crop production? (“**Required N input**”)

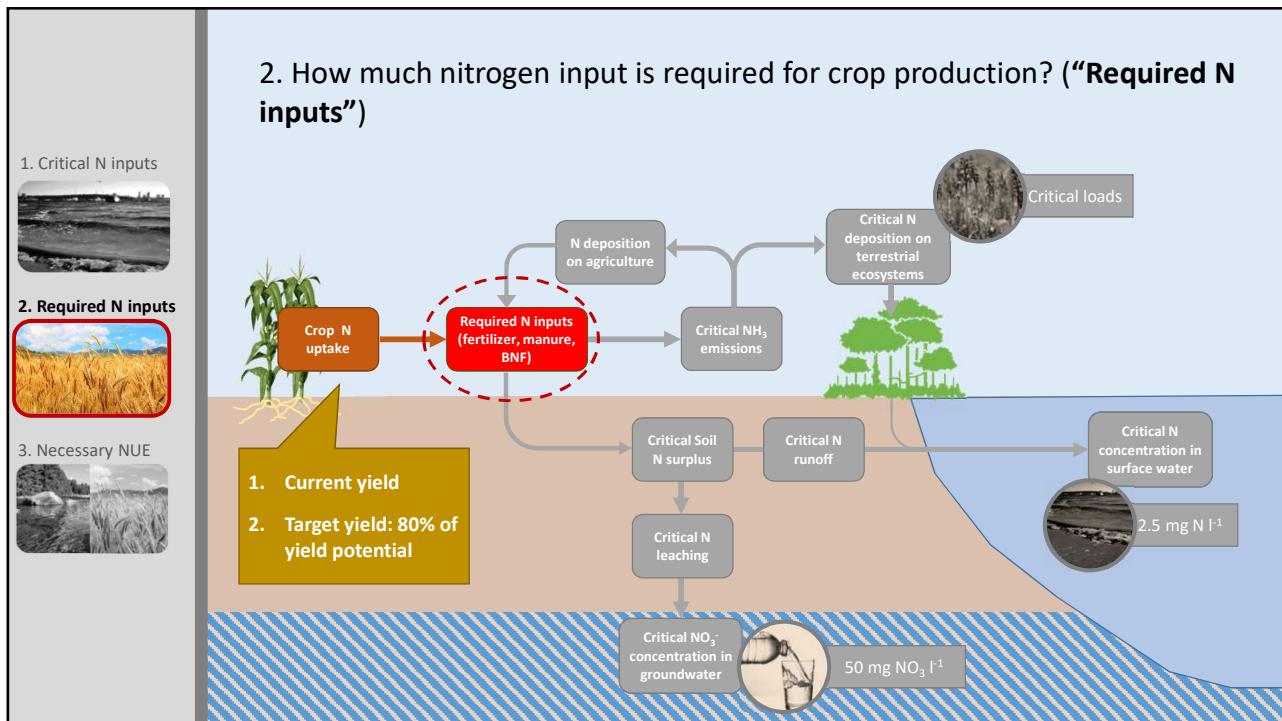


3. How can environmental and crop production targets be reconciled? (“**Necessary improvements in nitrogen use efficiency**”)

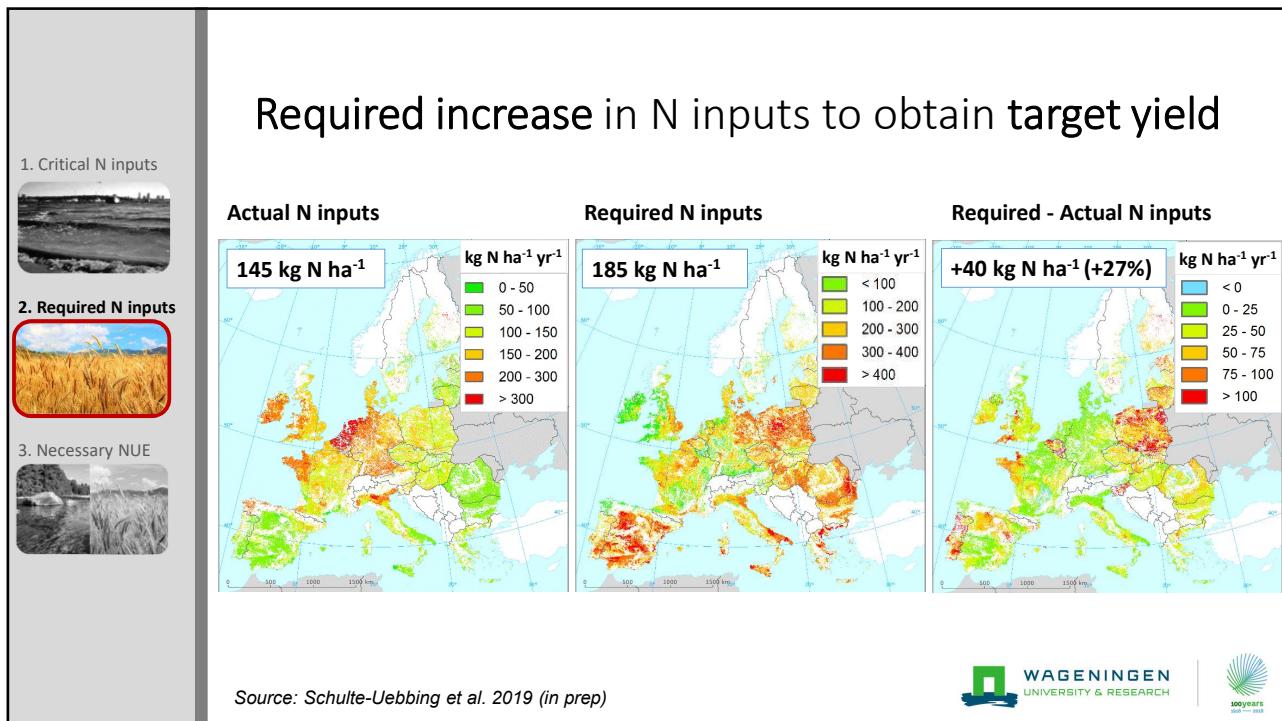




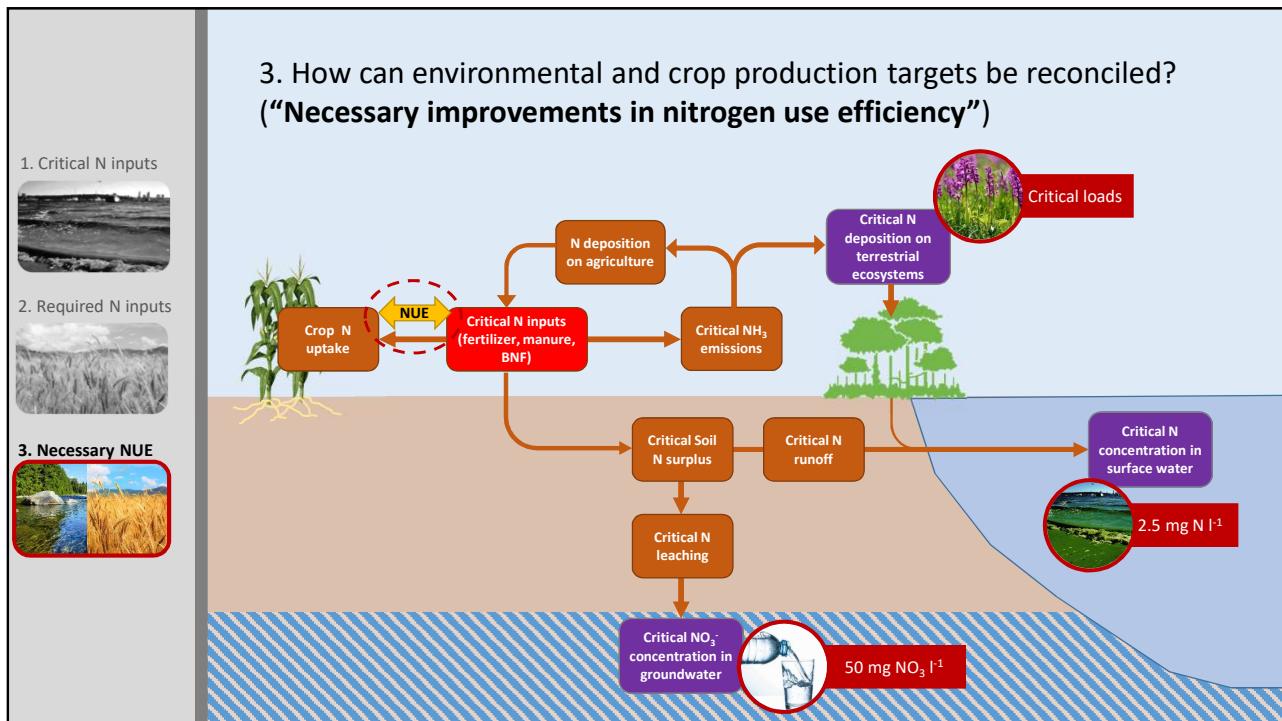
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**1. Critical N inputs**

**2. Required N inputs**

**3. Necessary NUE**

## Necessary increase in NUE to protect surface water

**Necessary NUE surface water**

**Can current yields be reconciled with critical runoff by increasing NUE?**

- No, required NUE is > 90% (Red)
- ... 80-90% (Orange)
- ... 70-80% (Yellow)
- ... max. 70% (Light Green)
- Yes, even at current NUE (Green)

Share of agricultural land (%)

Source: Schulte-Uebbing et al. 2019 (in prep)

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**Summary & Outlook**

**1. Critical N inputs**

**2. Required N inputs**

**3. Necessary NUE**

**Summary: Actual, critical and required N inputs for EU27**

Input Type	Actual (kg N ha⁻¹ yr⁻¹)	Critical: surface water (kg N ha⁻¹ yr⁻¹)
N fertilizer	~70	~40
N fixation	~30	~20
N excretion	~10	~10
N biosolids	~5	~5
N deposition + mineralization	~10	~10

**Future work: from European scale to global scale...**

Sum of critical N inputs for all grid cells can be considered a 'planetary boundary' for nitrogen

Source: Steffen et al. 2015

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## The Dutch “stikstofcrisis” (“nitrogen crisis”)

Last 40 days: nitrogen front page news 16 times!

**A ‘social’ or ‘juridical’ boundary rather than a natural one?**



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Thank you

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