National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Nitrate leaching from dairy farms in the Sand region in the Netherlands

Causes for higher nitrate leaching from maize land than from grassland

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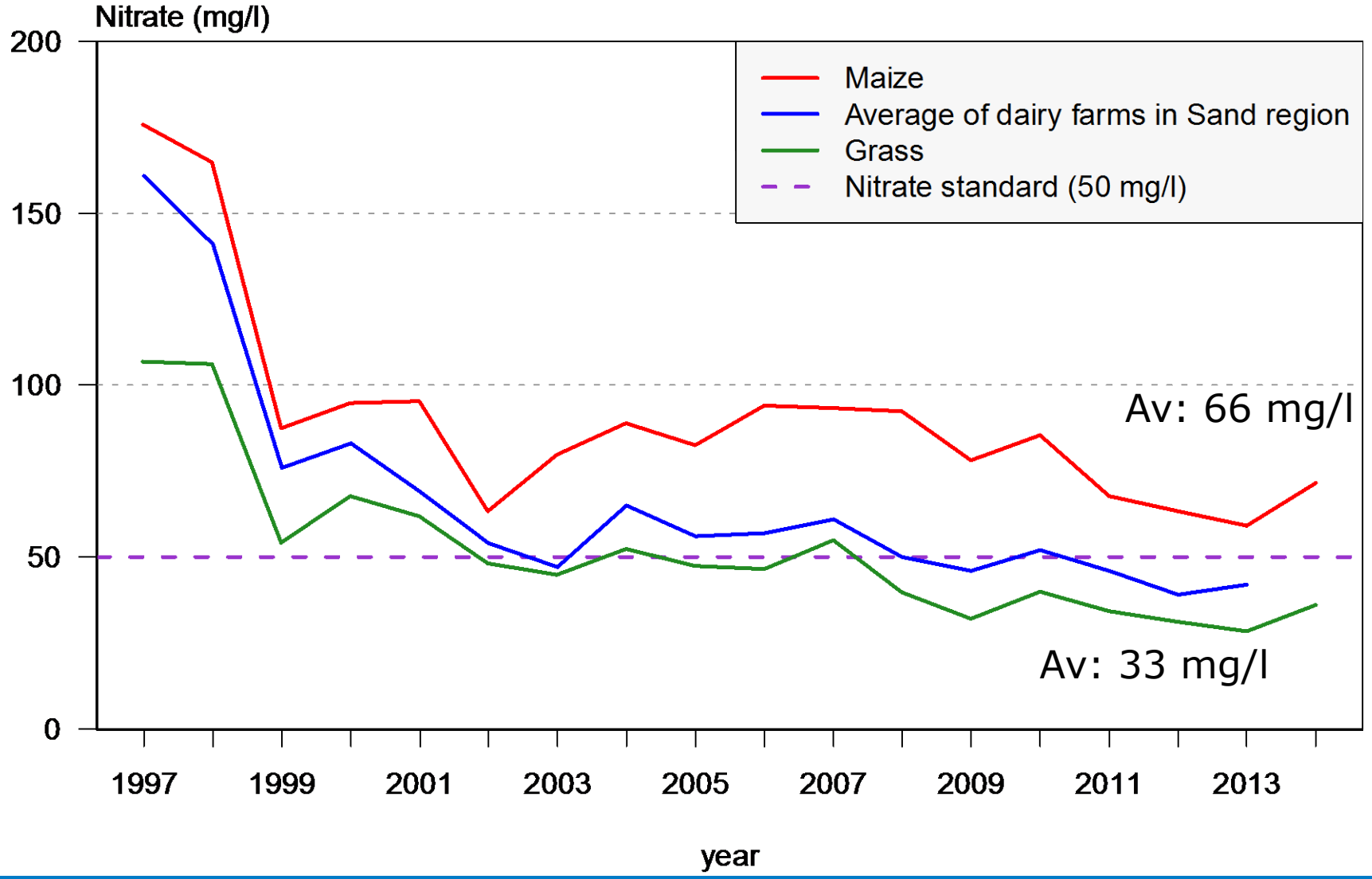
Nitrate (mg/l)
200
150
100
50
0
Maize
Average of dairy farms in Sand region
Grass
Nitrate standard (50 mg/l)
Av: 66 mg/l
Av: 33 mg/l
1997
1999
2001
2003
2005
2007
2009
2011
2013
year

Object of this study

What are the causes for higher nitrate leaching under maize land compared to grass land

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Outline

1. Three hypotheses
2. Methods
3. Results from data analyses
4. Conclusions

Three hypotheses

1. Maize is grown preferentially on the most well-drained and sandy parcels on the farm, more prone to nitrate leaching.
2. Maize land is more fertilized than grass land.
3. The crop maize itself leads to higher leaching. Grassland is better able to retain or reduce nitrate

Or a combination….

Methods

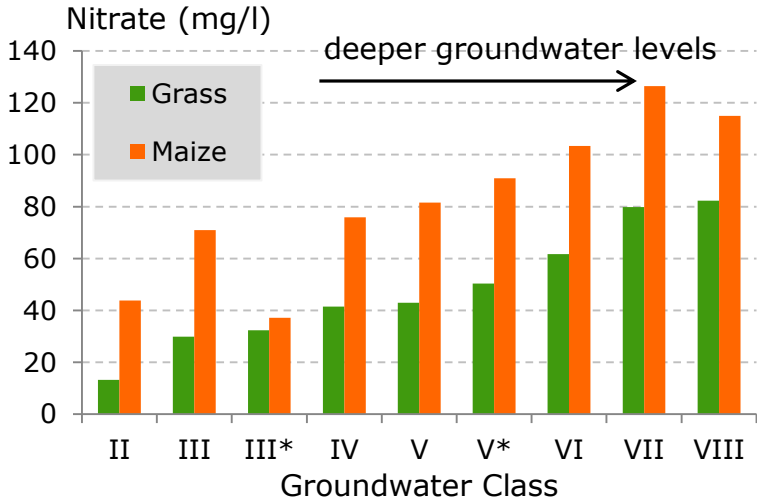
- Data come from the Minerals Policy Monitoring Programme
  - Started in 1992, grown gradually to 400 farms
  - Random choice of Dutch farms
  - Both water quality and agricultural practice monitored

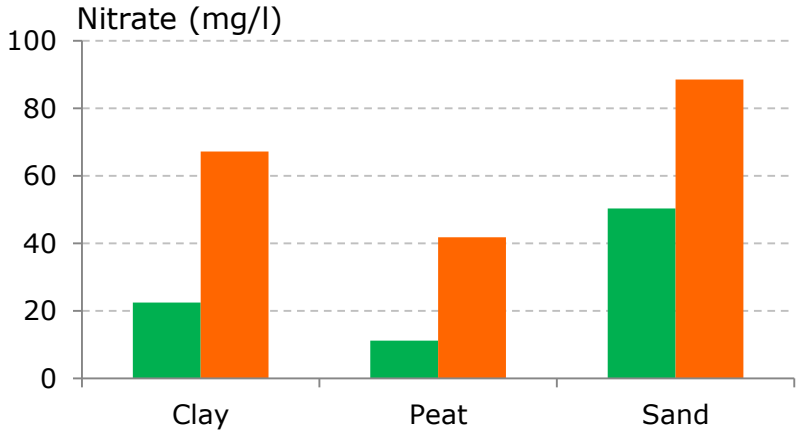
- Selection in this study:
  - Dairy farms in the Sand region
  - Farms with both grass and maize

- On each farm 16 sample points
- First meter of groundwater in temporary wells.
- Field nitrate test on every sample point.
- Groundwater level and soil type available from map overlays

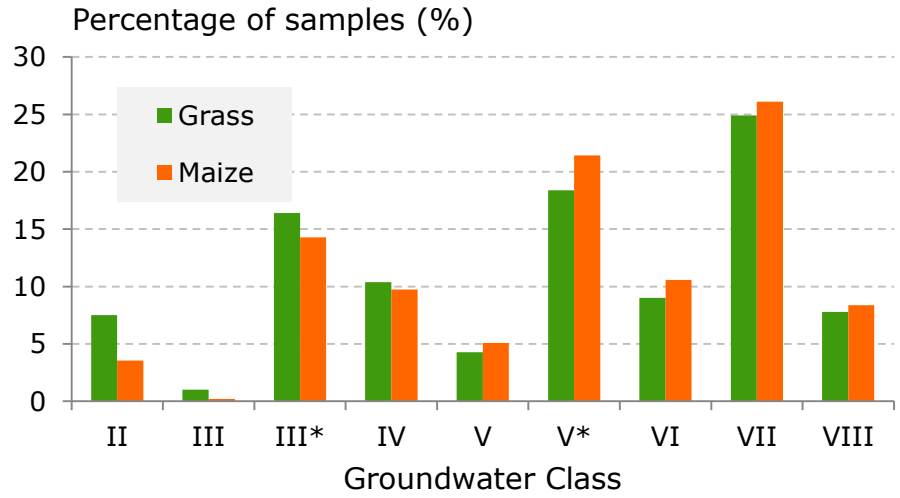
Hyp 1: Soil and groundwater class

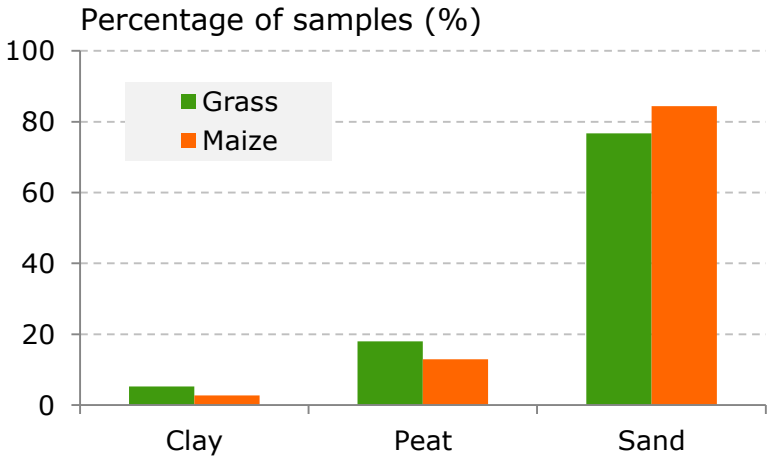
- Deeper groundwater levels have less nitrogen reduction
- Nitrate increases by increasing groundwater class
- Peat and clay soils have higher nitrate reduction than sand soils
- Effect both on both grass land and maize land.



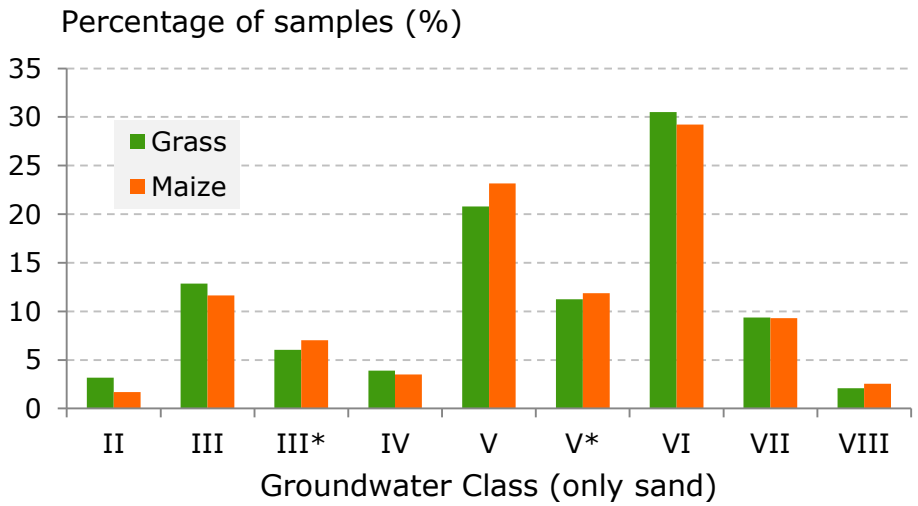


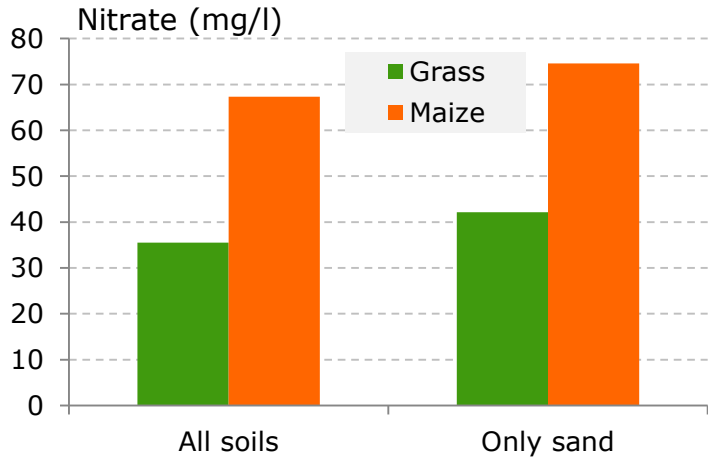
Hyp 1: Soil and Groundwater Class





Hyp 1: Groundwater Class: only sand samples

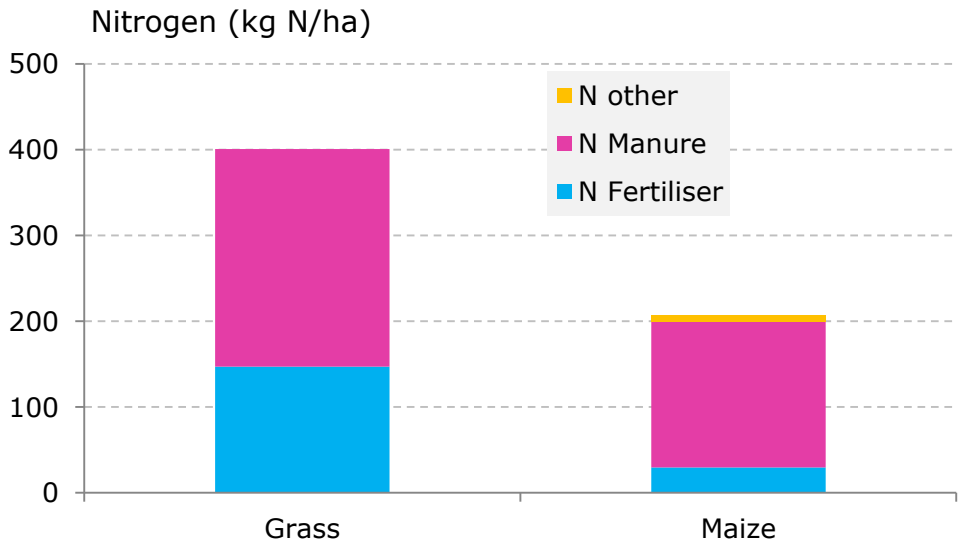




Difference between grass and maize decreases with 0.6 mg/l

Hyp 2: Use of fertilizer

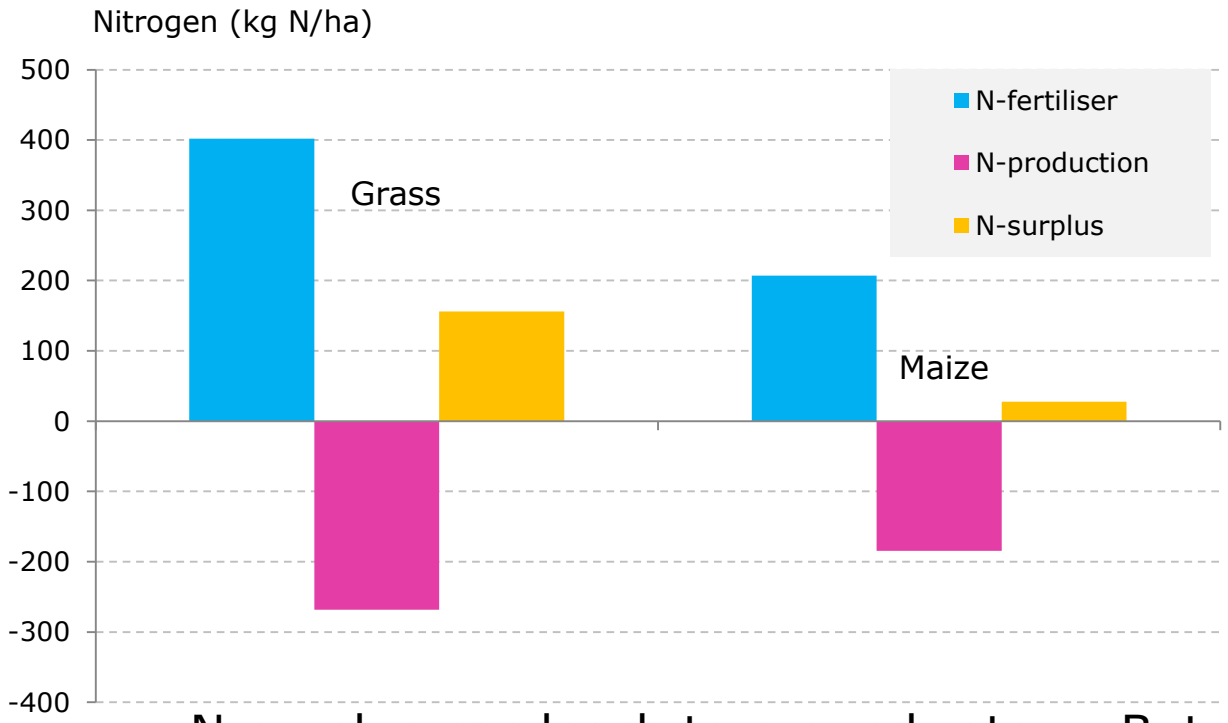
- Total amount of fertilizer on maize is half of that used on grass



Hyp 2: Nitrogen balance on maize and grass

N-surplus ≈ N fertilizer – N production

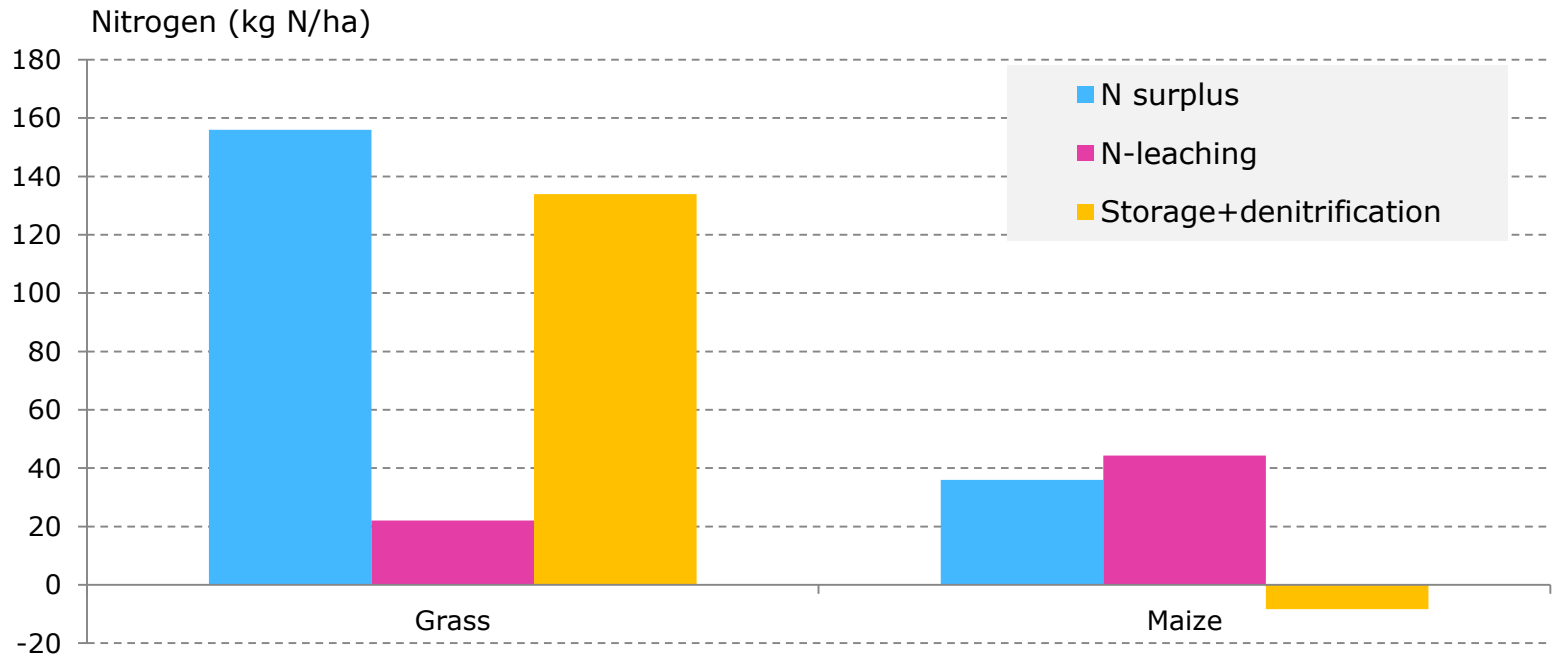
Also including: N-precipitation, NH3 volatilization and fixation



N-surplus *can* leach to groundwater…. But does it?

Hyp 3: crop type and cultivation

N-leaching (kg N/ha) = nitrate concentration * precipitation surplus



N surplus = nitrate leaching + denitrification ± storage

Conclusions / Discussion

Hypothesis 1: soil and groundwater

- Slight preference for maize on sand parcels
- No preference for maize on more drained sandy soils

Hypothesis 2: fertilizer

- Fertilization on maize is much lower than on grass land
- N-surplus is also smaller on maize land

Hypothesis 3: crop properties and cultivation

- Denitrification is larger on grassland
- Grassland is building up N-storage, maize production is removing organic N-storage from the soil.

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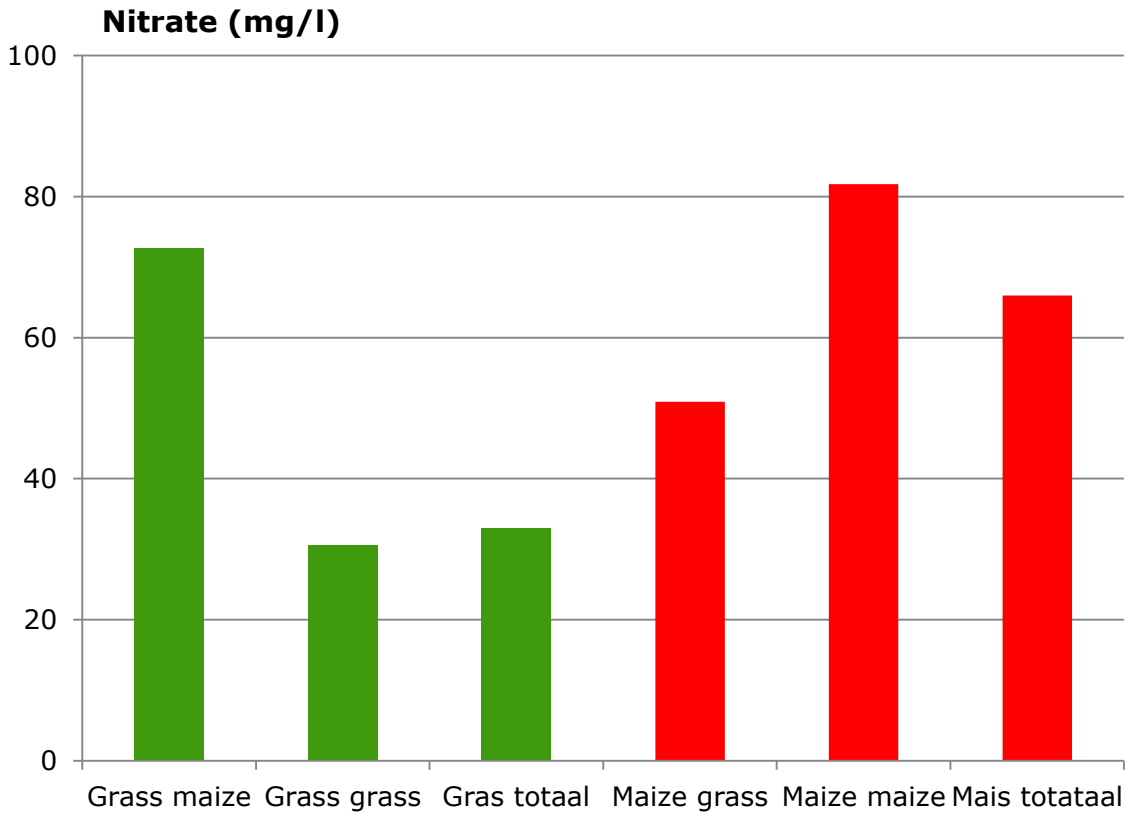
Thank you for your attention!

Crop rotation



Surplus also includes:

- N-precipitation,
- NH3 volatilization,
- mineralization and
- fixation

- Grass: 33 mg/l = 22 kg N/ha
- Maize: 66 mg/l = 44 kg N/ha