



Cows & *Opportunity's*

From Annual Nutrient Cycling Assessment to Water Management Assessment in dairy farming

Gert-Jan Noij, Jouke Oenema, Jaap Schröder
(Wageningen Plant Research), Gerjan Hilhorst
(Wageningen Livestock research)

Cows and Opportunity's



- ❁ Sustainable dairy farming: good income within farm specific environmental limits
- ❁ 17 dairy farms incl. 1 pilot farm, spread over the NL
- ❁ Cooperation of research, farm consultants, dairy sector, national government, and since 2014 some waterboards and 1 drinking water company
- ❁ Nutrient management since 1998 and since 2014 also Water management

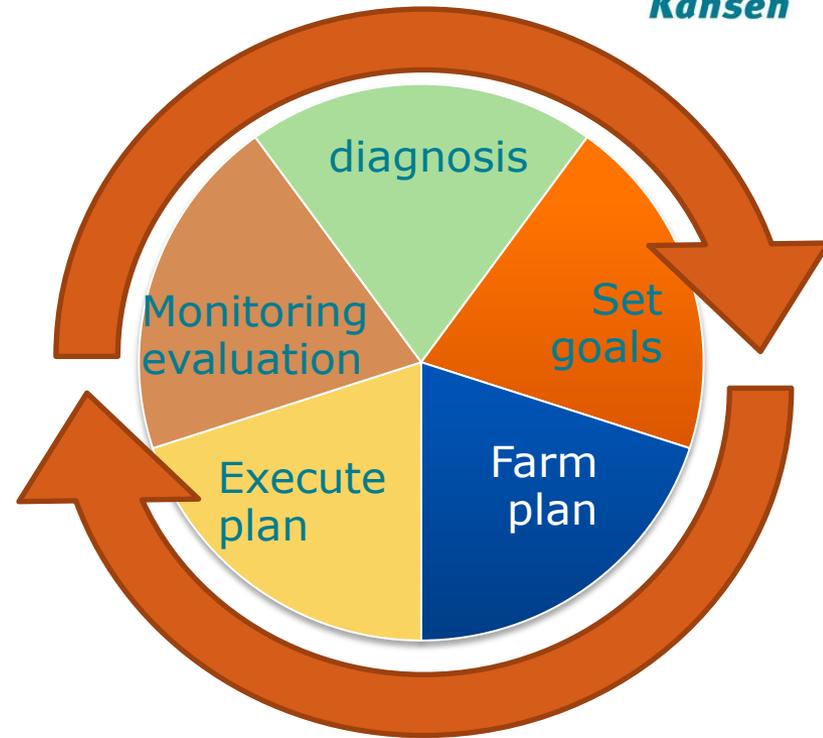


Cows and Opportunity's: Parallel Approach



Management or policy cycle:

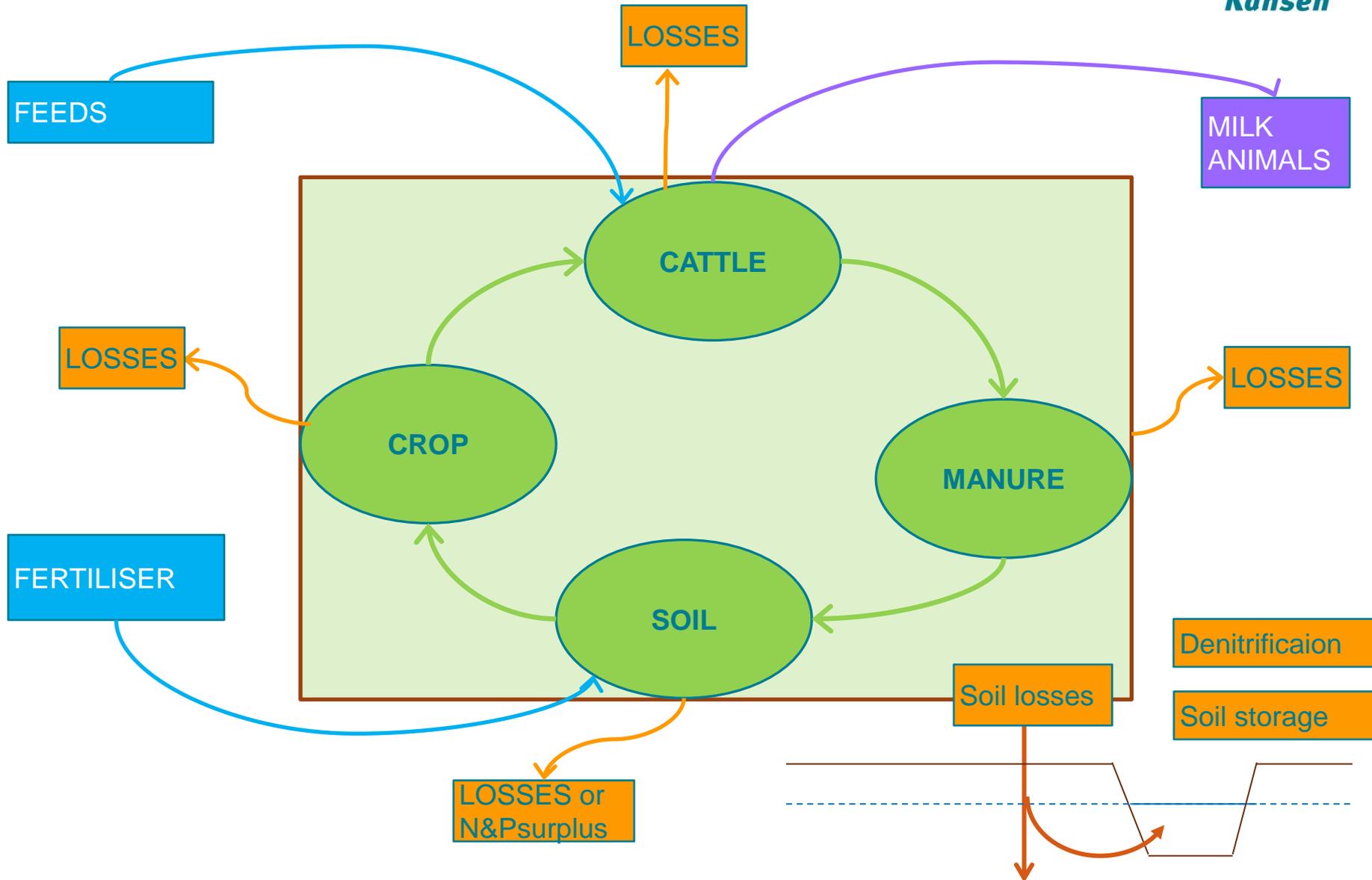
- ❁ Farm diagnosis → set goals
- ❁ Farm development plan
- ❁ Consultancy with new tools
- ❁ Monitoring & evaluation



Tools for upscaling

- ❁ ANCA: Annual Nutrient Cycling Assessment (obliged by the sector since 2016)
- ❁ FWI: Farm Water Index: water management (in development)

Farm nutrient cycle according to ANCA

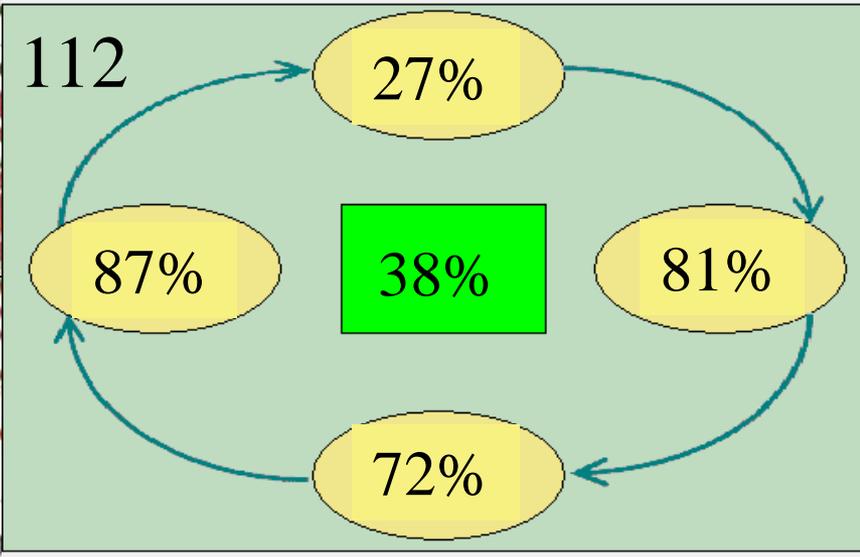
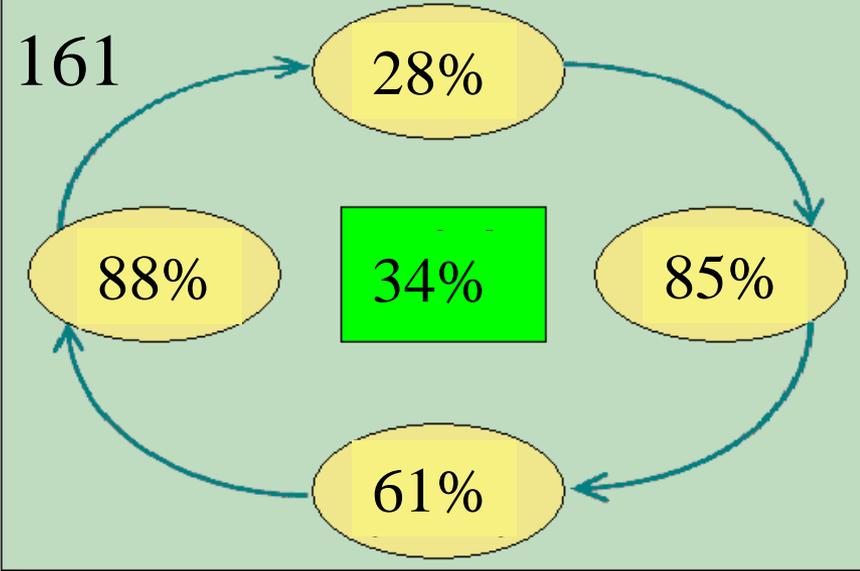
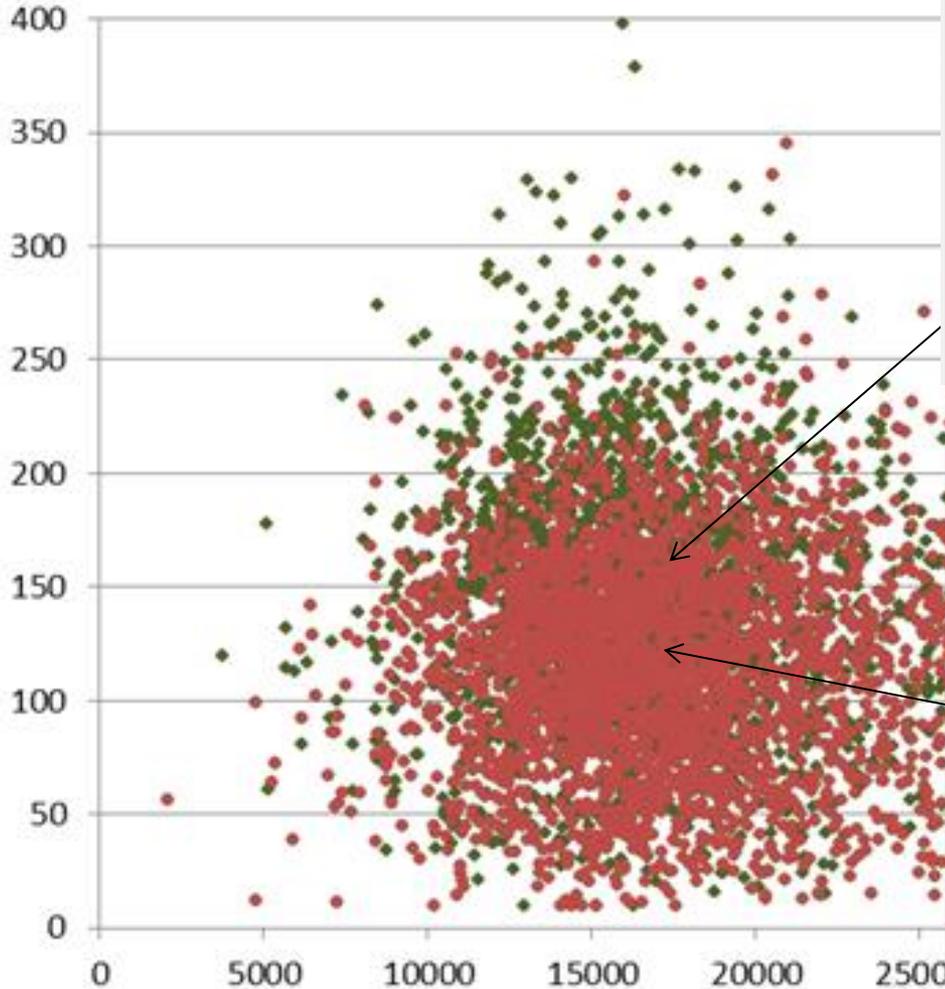


Variation in Soil N surplus

Similar farms sandy soil

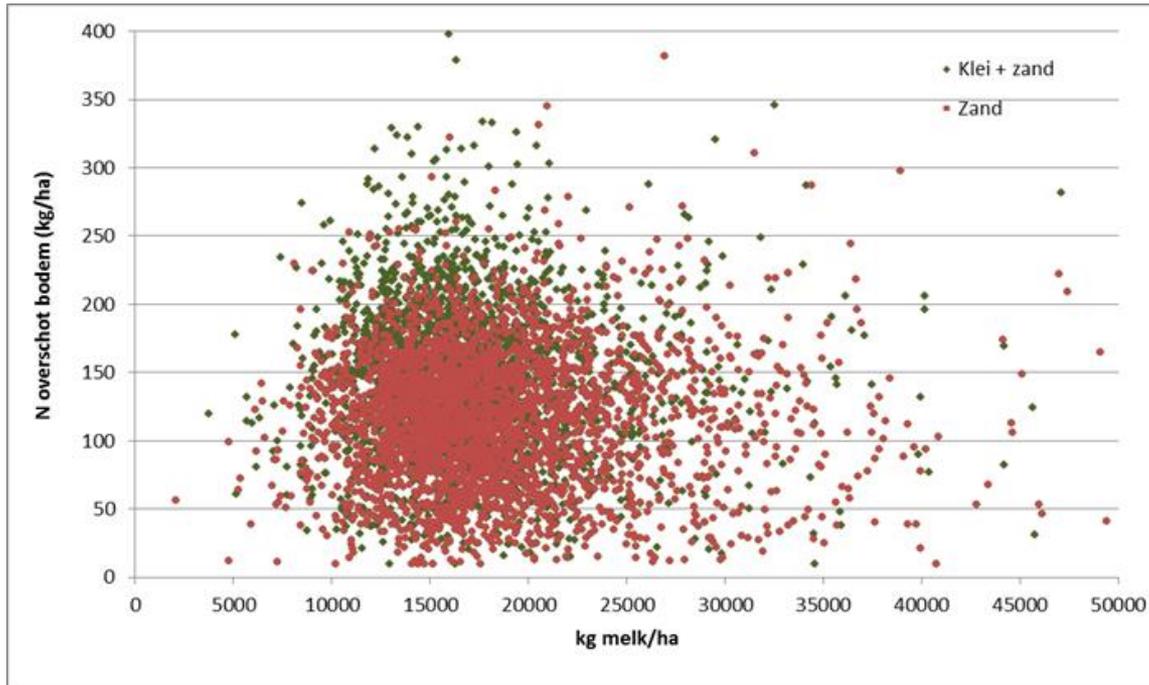


Soil N surplus (kg per ha per yr)



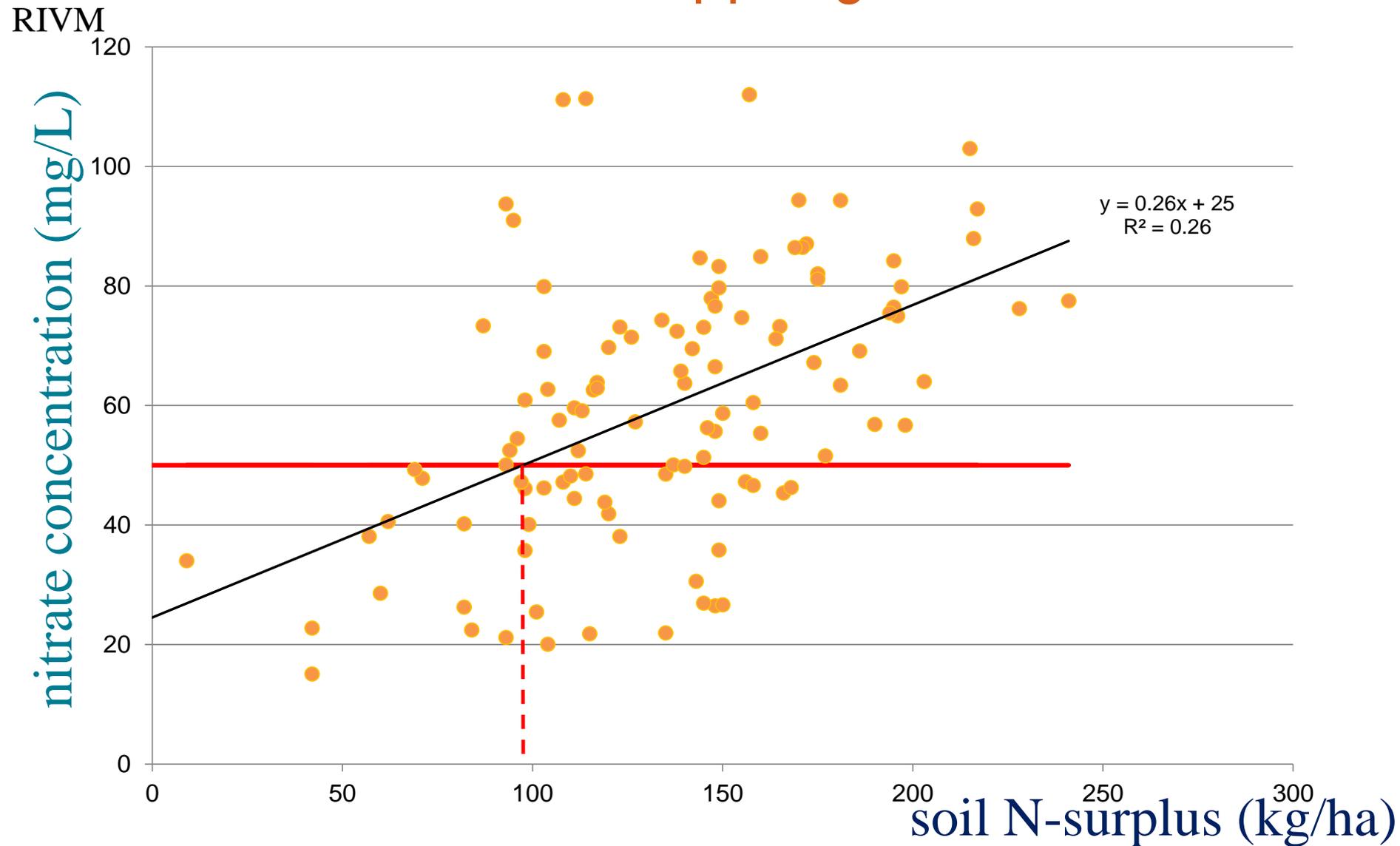
Farm intensity (kg milk per ha per yr)

Variation in Soil N surplus

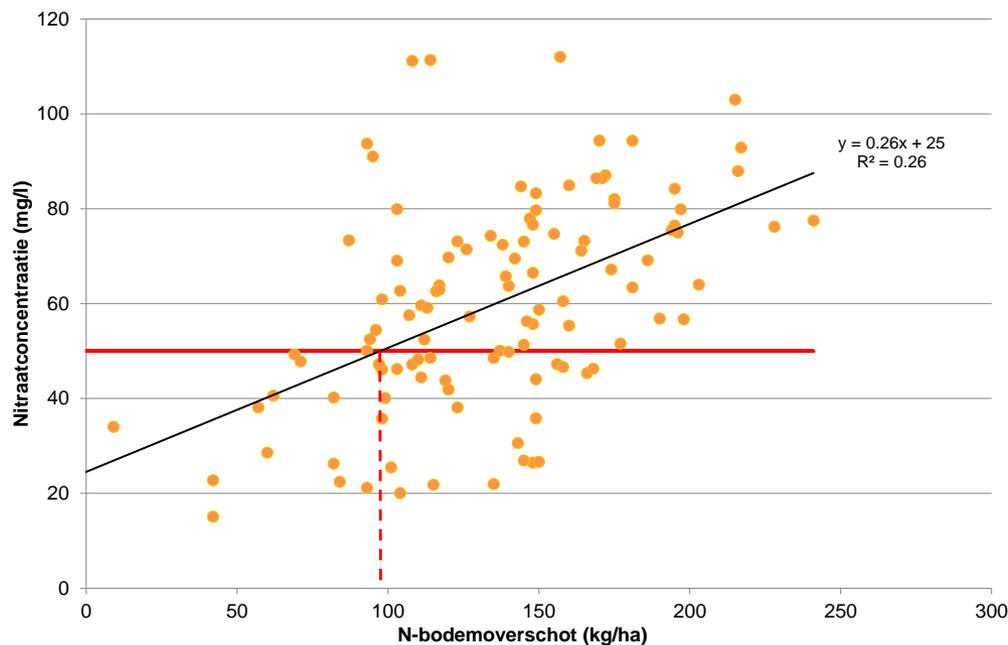


- ✿ Enormous variation between farms, due to both management and conditions
- ✿ There is a rationale for farm specific limits
- ✿ Little relation with intensity (nor grazing intensity)
- ✿ Relation with soil type not clear

Relation between soil N-surplus and nitrate concentration upper groundwater



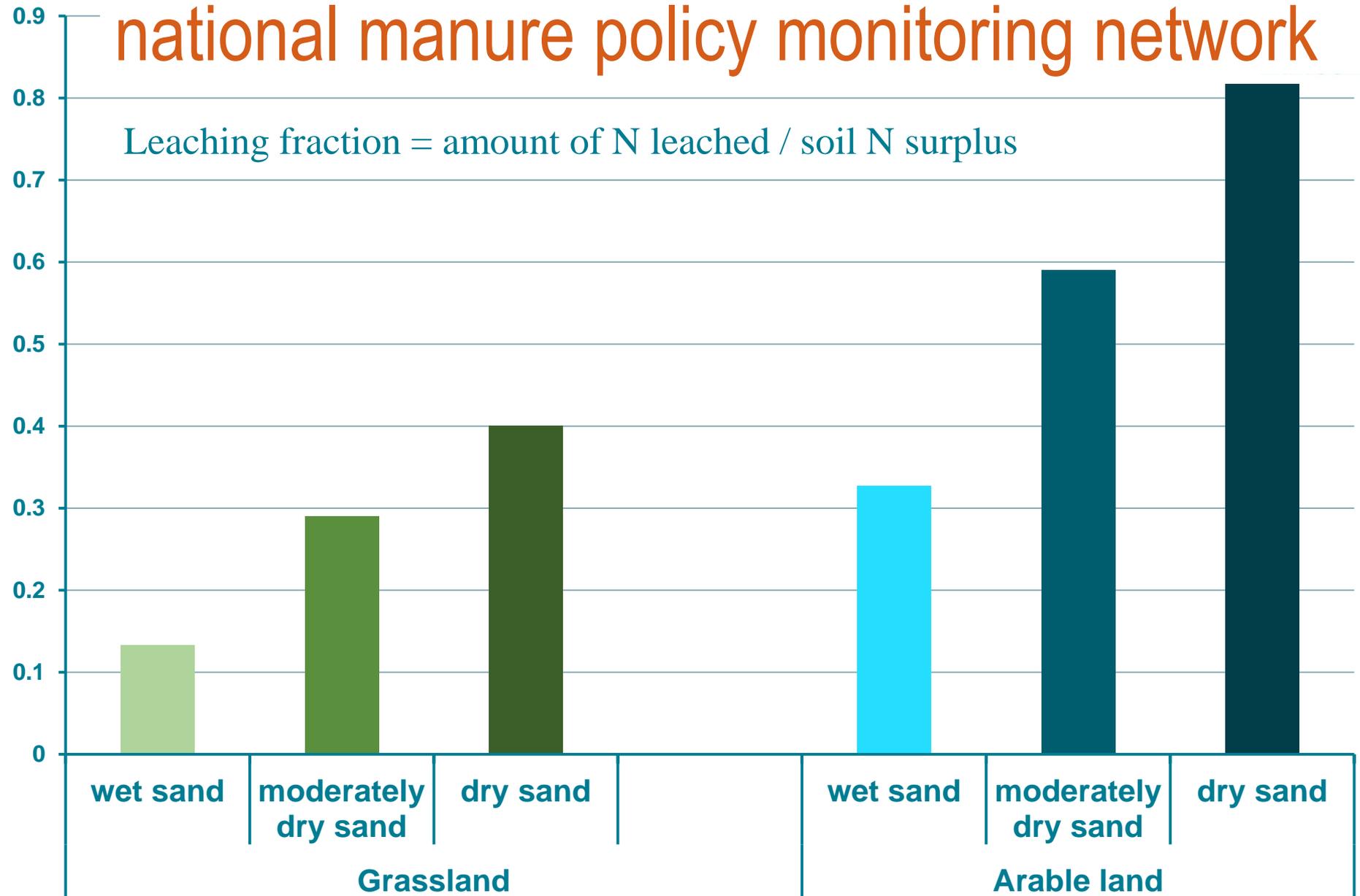
Relation between soil N-surplus and nitrate concentration upper groundwater



- ❁ There is a relation with low correlation coefficient
- ❁ Other factors than soil N-surplus need to be taken into account to explain N-leaching

N-leaching fraction as derived from the national manure policy monitoring network

Leaching fraction = amount of N leached / soil N surplus



N-leaching fraction for surface water as derived from the STONE model



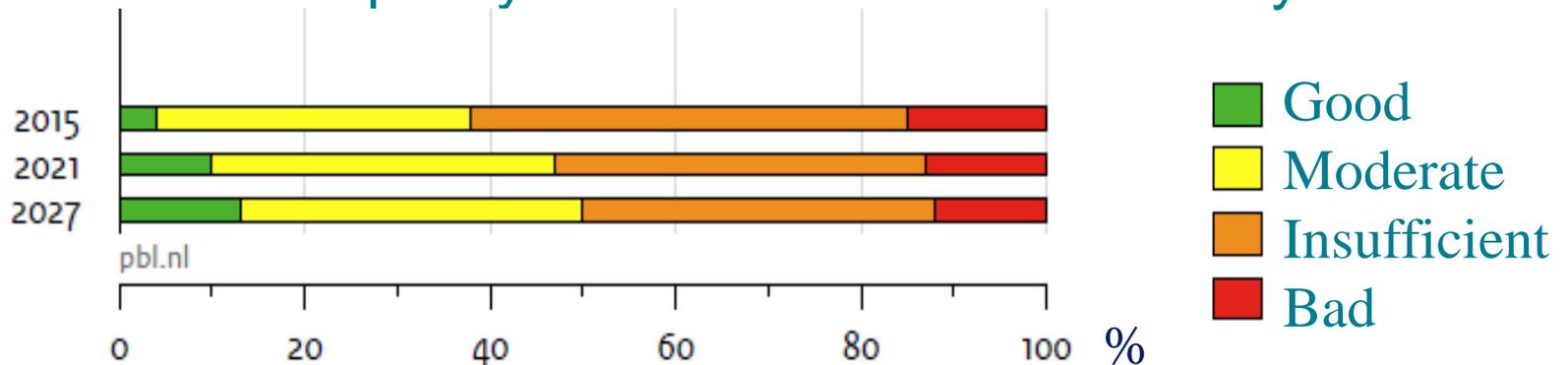
Leaching fraction = N load / soil N surplus

| Condition | grass | maïze |
|--------------------------------|---------|----------|
| Wet or tile drained sandy soil | 0.1-0.3 | 0.2-0.6 |
| Moderate to dry sand | 0.1-0.2 | 0.1-0.25 |
| Other soils | < 0.1 | < 0.1 |

So why Farm Water Index?



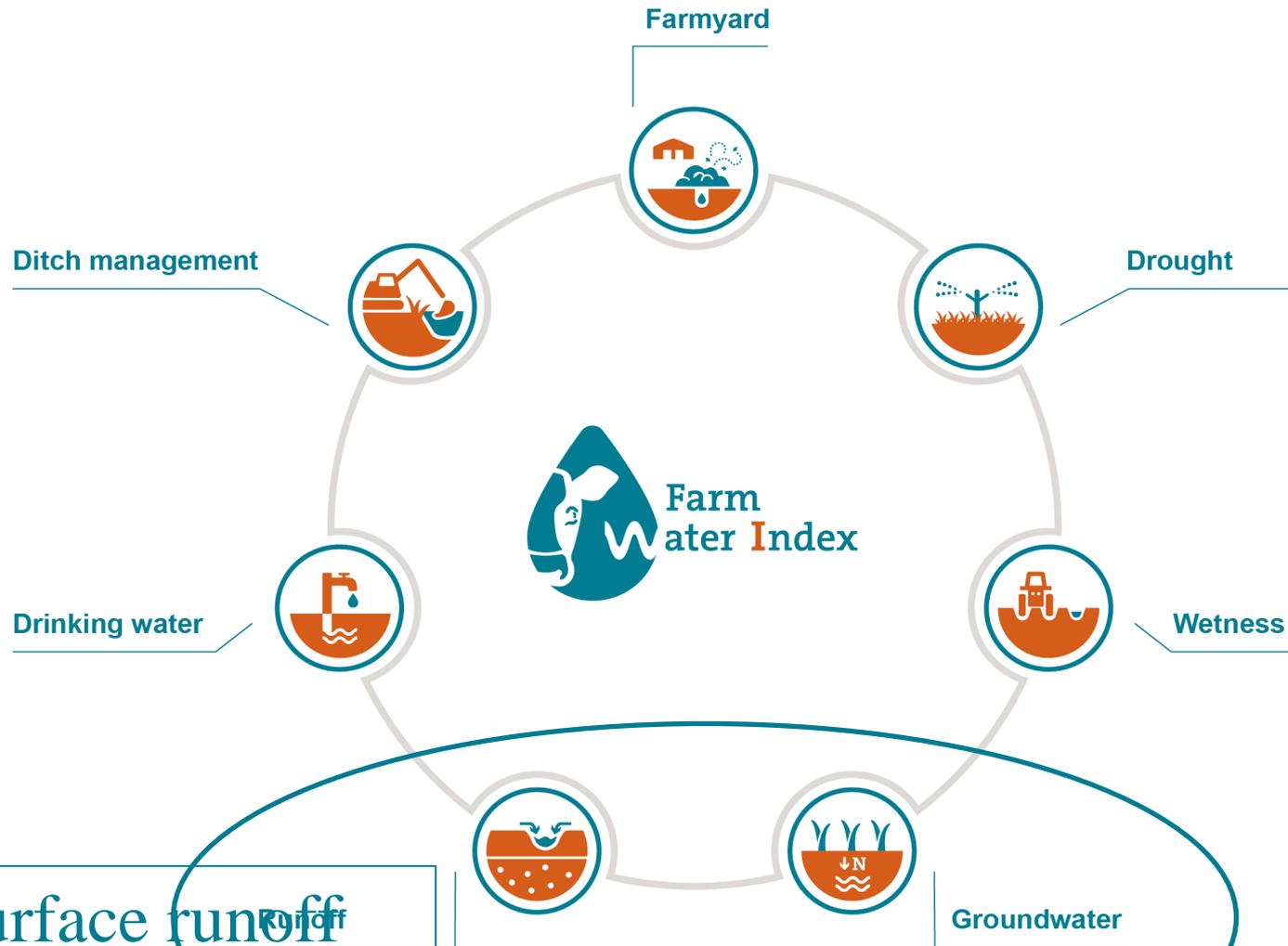
- ❁ ANCA is not enough to assess the effects of management and conditions on water quality.
- ❁ Expected water quality is not sufficient for WFD by 2027



!!Tailor made solutions are needed

- ❁ Water is a production factor for agriculture, therefore an integrated approach is necessary, not just water quality
- ❁ Stimulate communication between water boards and farmers

Farm Water Index includes 7 modules



- a) Surface runoff
- b) N-load risk
- c) P-load risk

Surface runoff

ANCA

KRINGLOOP
WIJZER



Surface runoff risk =

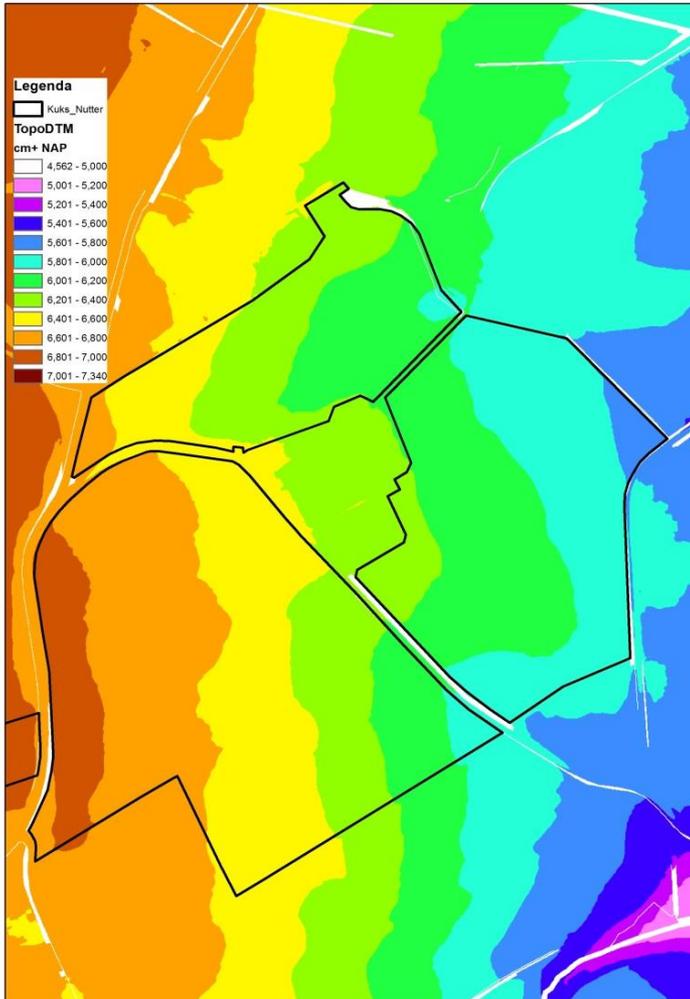
$f(\text{source risk, transport risk, connectivity})$

- ❁ Source risk = $f\{\text{N\&P-surplus, N\&P-fertilizer, P-status, erodability, ..}\}$
- ❁ Transport risk = $f(\text{slope, infiltration capacity, storage capacity})$
- ❁ Connectivity (DEM, flow accumulation)

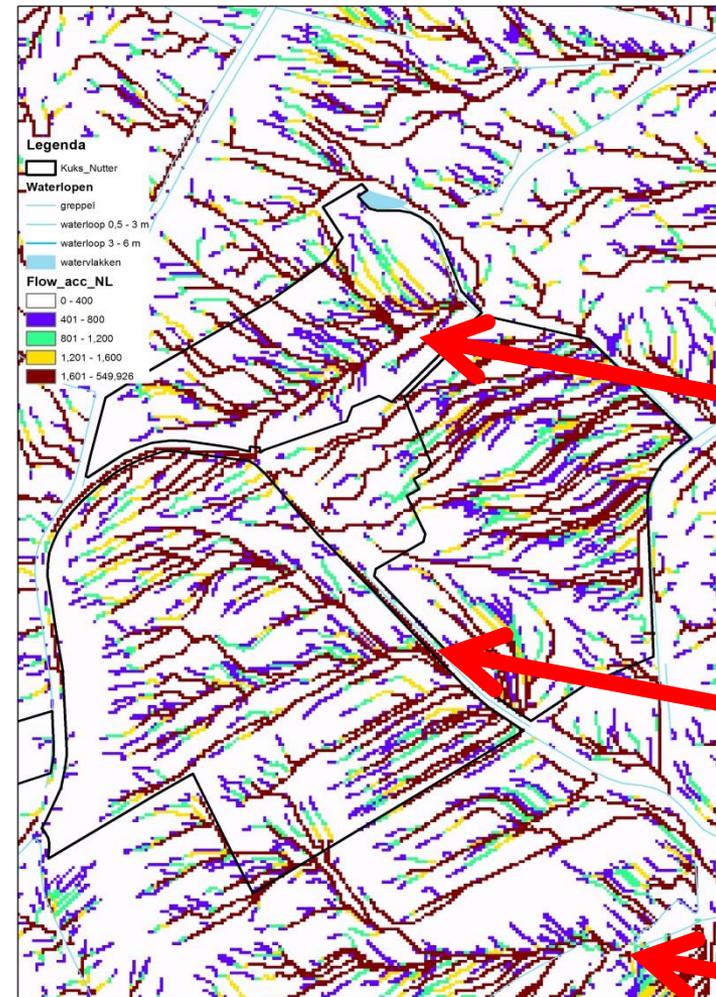
| Subindexes for risks | | | |
|----------------------|--------------|------------|------|
| 1 | 2 | 3 | 4 |
| Bad | insufficient | sufficient | Good |

Connectivity: flow accumulation

Elevation map



Flow accumulation



FWI Result tables



Resultaten

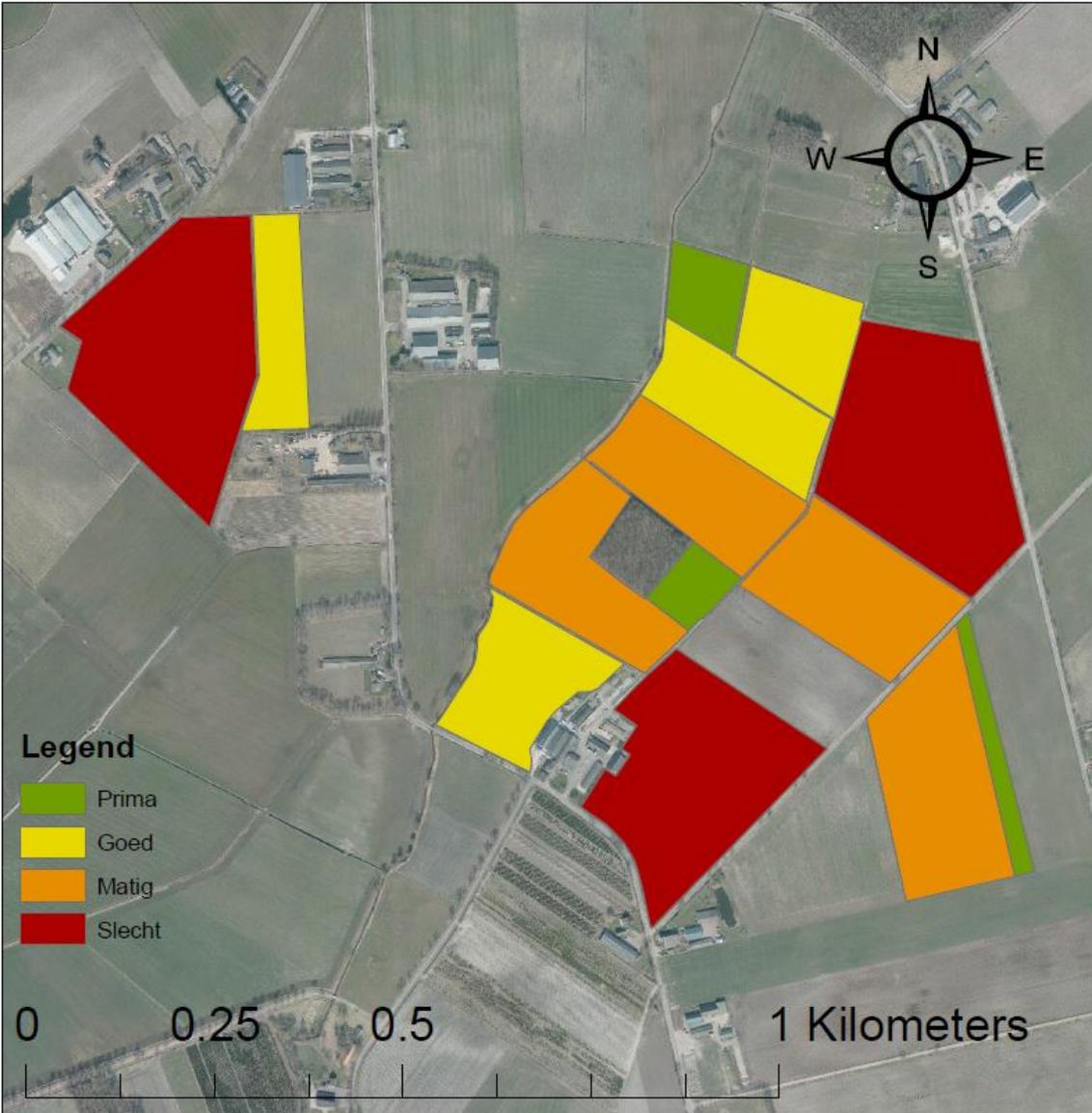
Bodem, gewas, water

| Risico | Waarde | Geen | Laag | Matig | Hoog | Uitleg |
|----------------------------|----------------|------|------|-------|------|--------|
| Bodemoverschot N (uit KLW) | KLW | | | ✓ | | |
| Bodemoverschot P (uit KLW) | KLW | | | | ✓ | |
| Risico op afspoeling | ja/nee | | ✓ | | | i |
| Risico op wateroverlast | ja/nee | | ✓ | | | i |
| Drainage | ja/nee | | ✓ | | | |
| Risico op droogte | ja/nee | | | ✓ | | i |
| Berekening | ja/nee | | ✓ | | | |
| Waterverbruik berekening | m ³ | | | | ✓ | |
| Ecologisch slootbeheer | ja/nee | ✓ | | | | |
| Verwerking maaisel | ja/nee | | | ✓ | | |

Vee

| Risico | Waarde | Geen | Laag | Matig | Hoog | Uitleg |
|---|--------|------|------|-------|------|--------|
| Vervuiling oppervlaktewater door koepaden | ja/nee | | | | ✓ | |
| Beschikbaarheid drinkwater vee in de wei | ja/nee | ✓ | | | | |
| Impact beweiding op oppervlaktewater | ja/nee | | | | ✓ | |
| Impact beweiding op grondwater | ja/nee | ✓ | | | | |

FWI Result maps (in development)



FWI features



| Subindexes for risks | | | |
|----------------------|--------------|------------|------|
| 1 | 2 | 3 | 4 |
| Bad | insufficient | sufficient | Good |

- ❁ Scores risks:
- ❁ Includes groundwater and surface water quality
- ❁ Conditions: soil type, groundwater table, soil compaction, tile drainage, surface reliëf, etc.
- ❁ Management: grazing intensity, tillage practices, rotation, catch crops, etc.
- ❁ Spatial components: farm, fields, hot spots, ditches, vulnerable strips and flow paths (connectivity)



***Koeien &
Kansen***

Thanks for your attention!