Farmer driven monitoring of drainage water – perspectives for monitoring nitrogen loss in pilot scale catchments

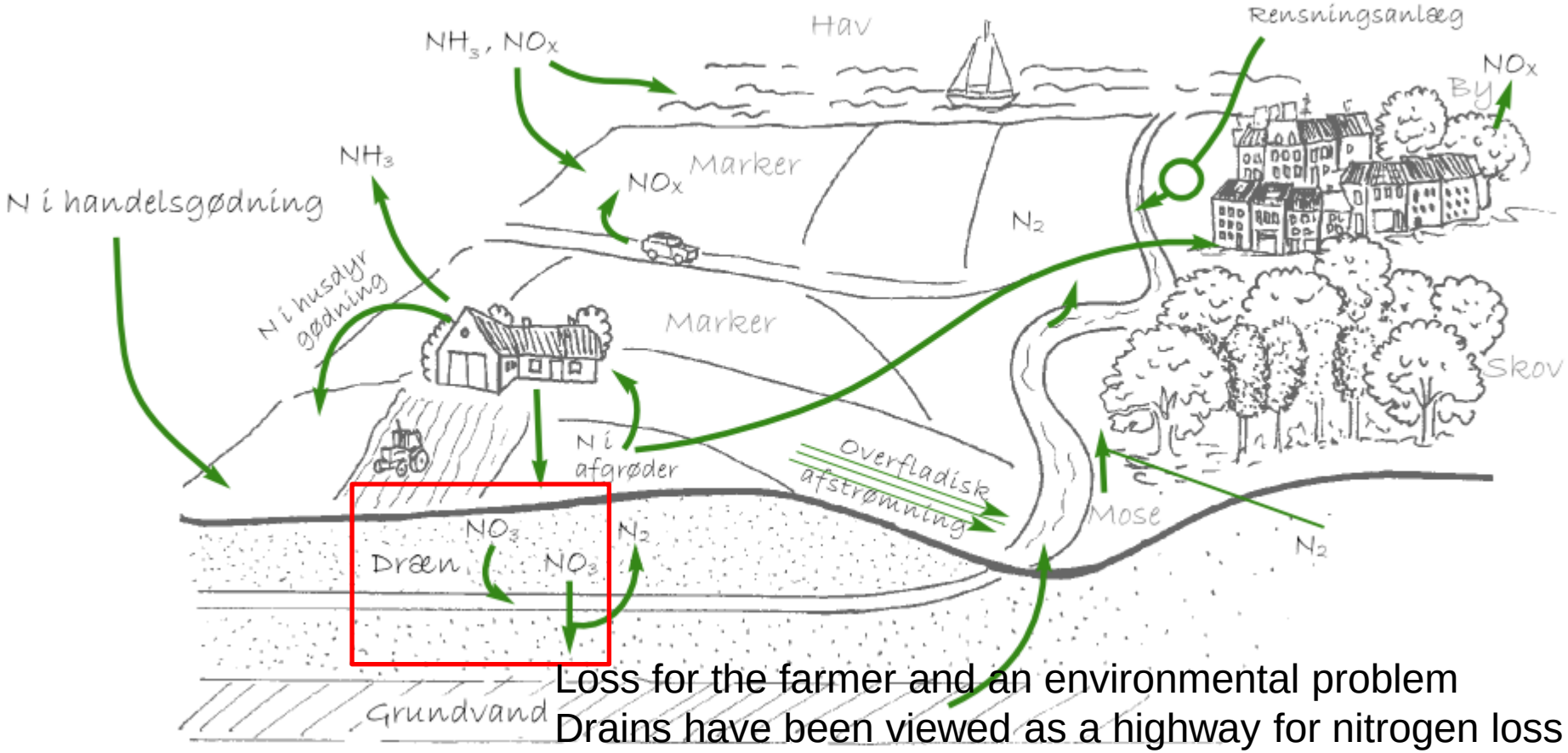
Ingvild Lauvland Høie, Stud. MSc. Agriculture
Department of Plant and Environmental Sciences
Faculty of Science, University of Copenhagen

Kristoffer Piil, Consultant, Ph.d.
Section for Crop Production
Knowledge Centre for Agriculture

Outline

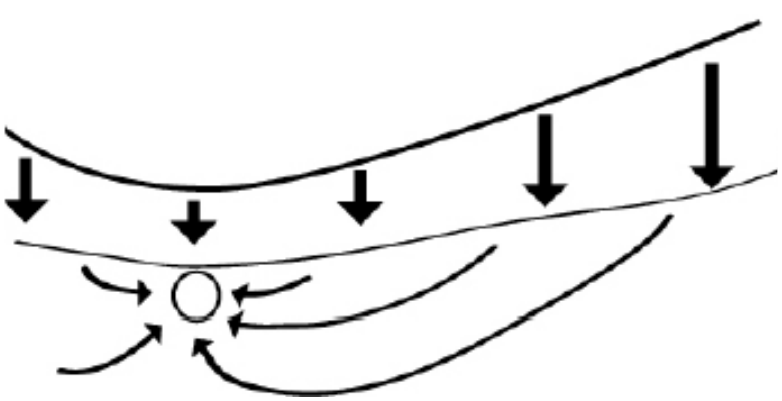
- Introduction
- Results from the national Danish drainage water monitoring
- Detailed results from Northern Jutland
- Perspectives for monitoring drainage water in pilot scale catchments

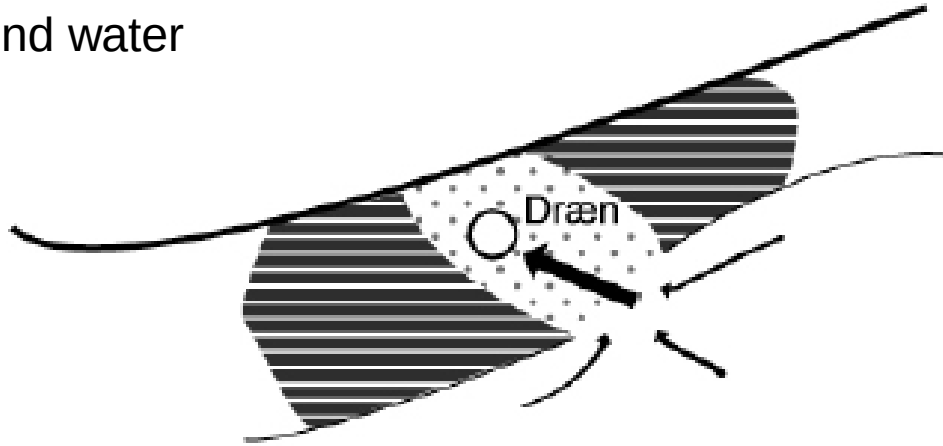
The Nitrogen Cycle

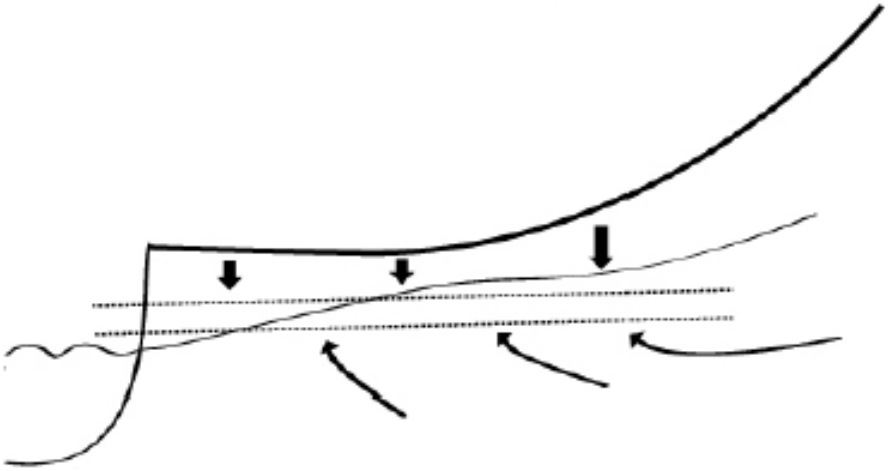


Loss for the farmer and an environmental problem
Drains have been viewed as a highway for nitrogen loss

Where does drainage water come from?







Knowing the origin of drainage water can be difficult

National monitoring of nitrogen concentrations in drainage water

- Typical concentrations were believed to be in the range 10 – 15 mg L^{-1}
- Currently only monitoring in 7 drain pipes (DCE)

Total nitrogen (TN)

Nitrate (NO_3^-)

Ortho-P

Year	Number of sites
2011/12	254
2012/13	503
2013/14	~450

Sites are chosen by the farmers

National monitoring of nitrogen concentrations in drainage water

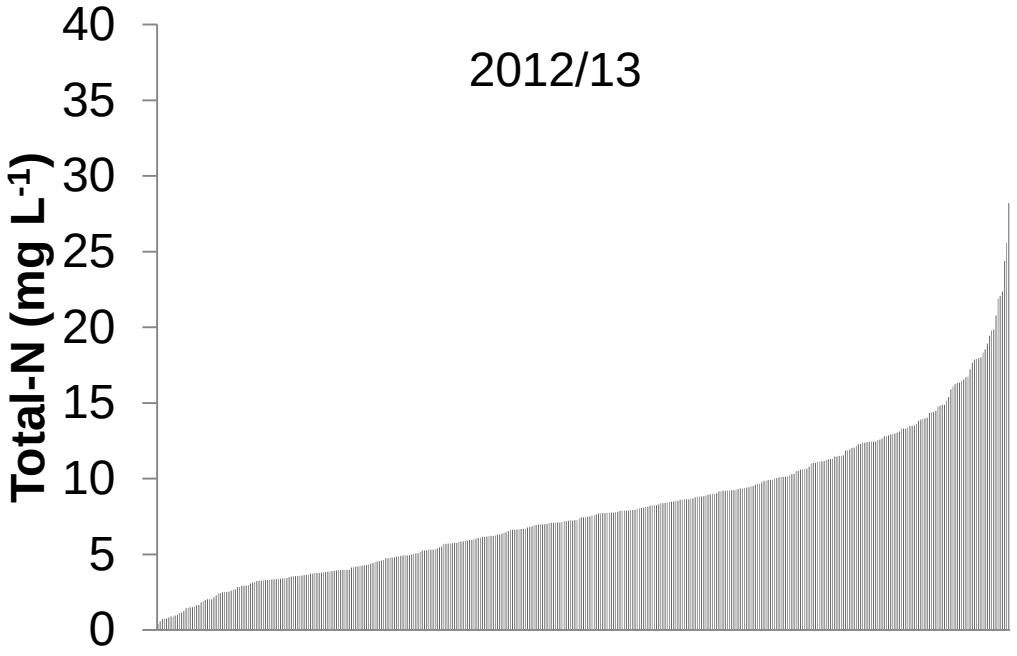
$$N\ loss = [NO_3^-] \times discharge$$

We are not measuring drainage water discharge so total nitrogen loss cannot be estimated

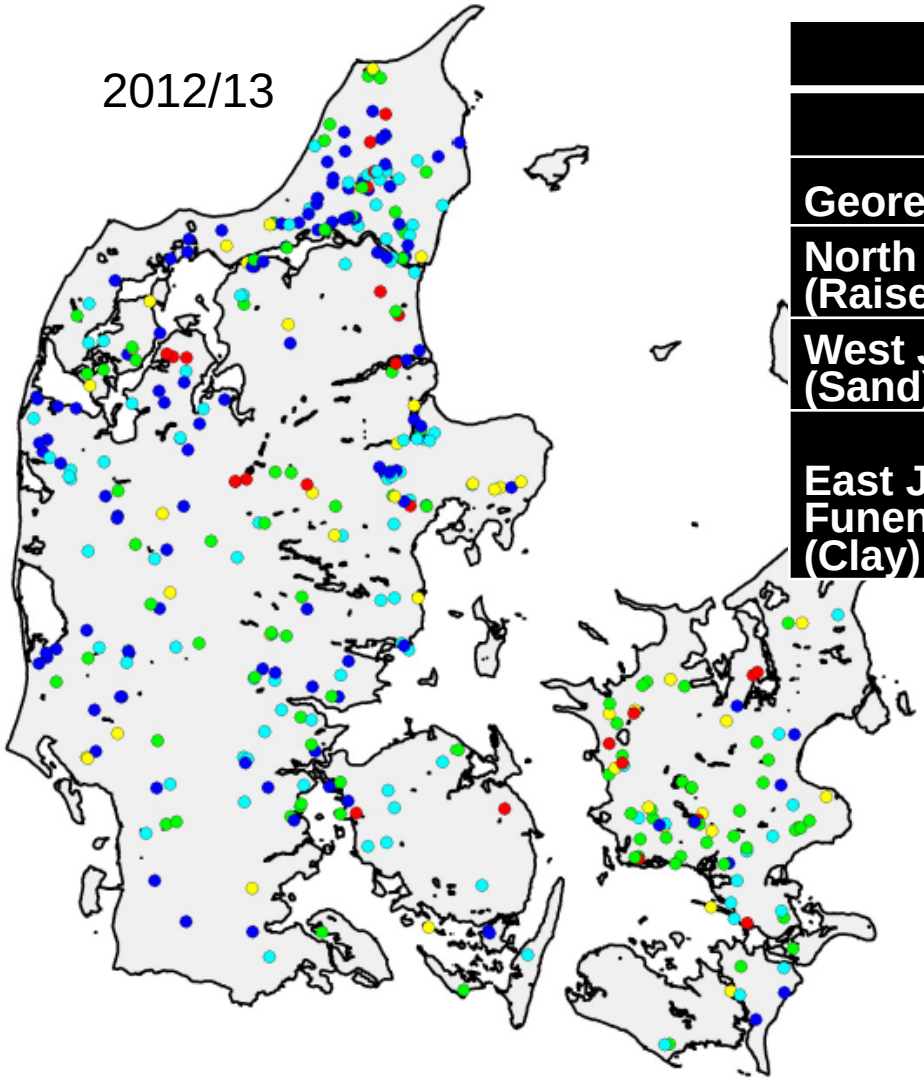
An indication of nitrogen loss only

National monitoring of nitrogen concentrations in drainage water - Results

	2012/13		2011/12	
	Total-N	Nitrate-N	Total-N	Nitrate-N
	Mg L^{-1}			
Average	8.0	6.7	6.7	5.8
Median	6.3	5.3	5.6	4.8
Standard deviation	4.7	4.5	4.7	4.7

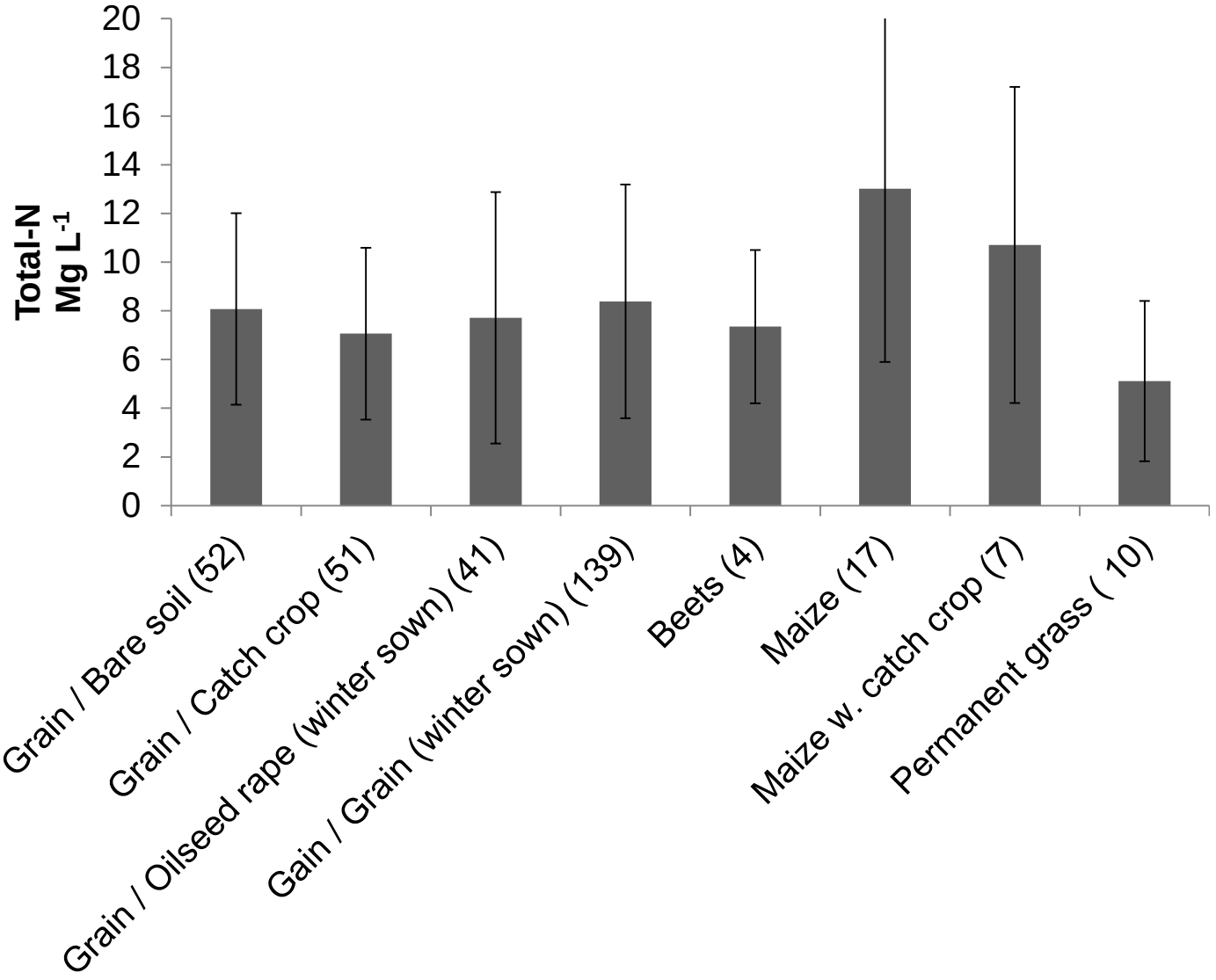


National monitoring of nitrogen concentrations in drainage water - Results



	2012/13		
	N	Total-N	Nitrate-N
Georegion		mg N L^{-1}	
North Jutland (Raised seabed)	84	6.8	5.2
West Jutland (Sand)	53	6.4	5.3
East Jutland, Funen, Zealand (Clay)	124	9.4	8.4

National monitoring of nitrogen concentrations in drainage water - Results



National monitoring of nitrogen concentrations in drainage water - Results

Nitrogen concentrations in drainage water is influenced by:

- Geography and geology
- Soil type
- Cropping system
- Year (precipitation, N uptake in crops etc.)

Ingvild Lauvland Høie
My thesis

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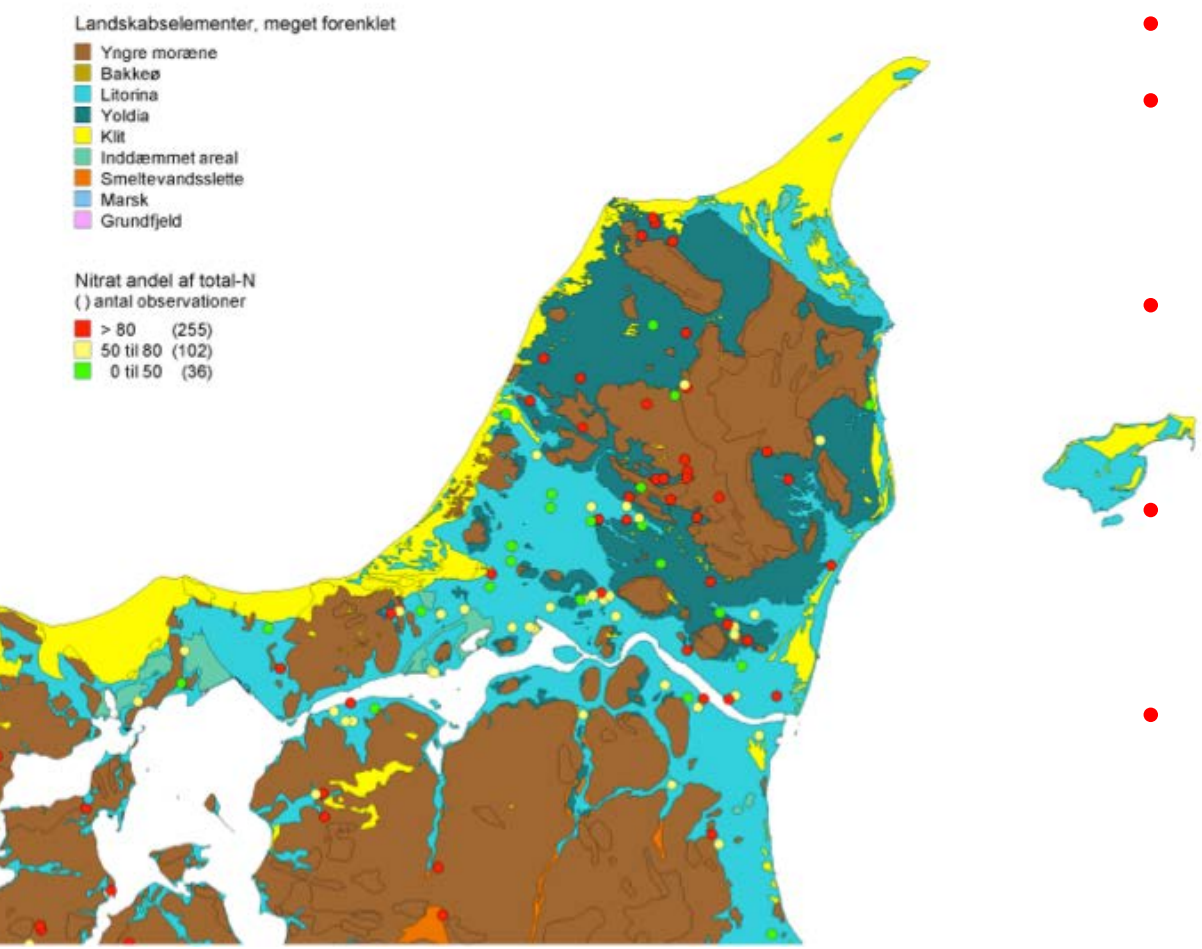
Objectives:

- Identify the factors that most significantly influences N- losses from drains.
- Investigate what the Danish Drainage Water Examinations show about N- leaching, and whether the examinations can explain some of the variables. Potentially distinguish between vulnerable and robust areas according to the results.
- Prioritize data and make recommendations for future applications of the examinations in order to make better predictions and explanations.

Background: Internship in LandboNord, winter 2013/14

- Water sampling
- Identification of sampling locations for further investigation
- Interviews with farmers
- Additional data collection: agricultural practice, drainage system, landscape and soil characteristics, climate data

Northern Jutland

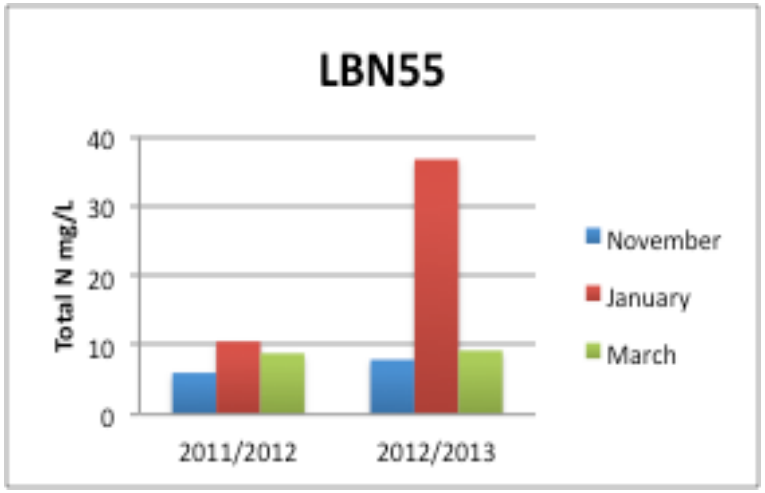


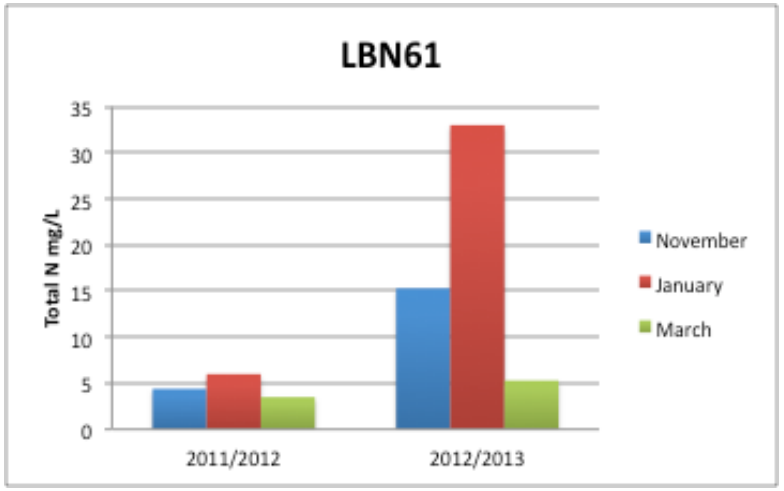
- Special geological conditions
- The lowest N- concentrations found in this geological region
- Nitrate-N represents a small part of total-N in the litorina sediments
- High groundwater table and highly situated redox boundary
- Potential denitrification around the groundwater table

Premliminary results

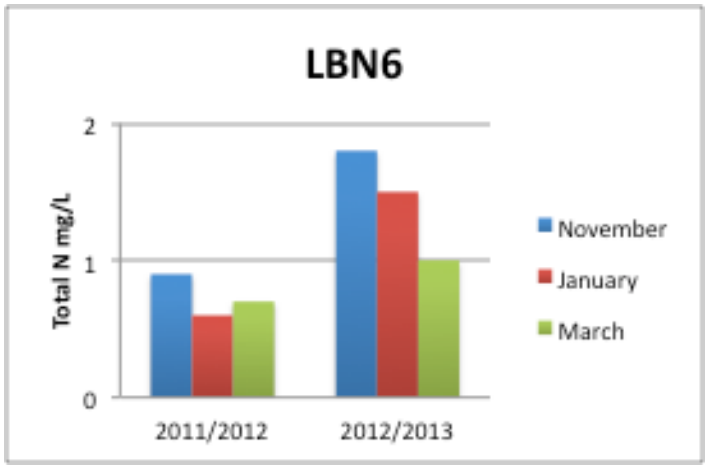
- great variations in N- concentrations

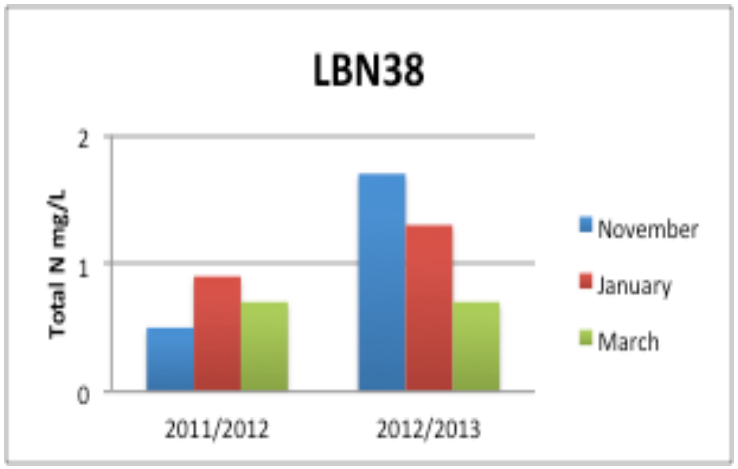
Explained by agricultural practice or geological/hydrological conditions at the sampling locations?



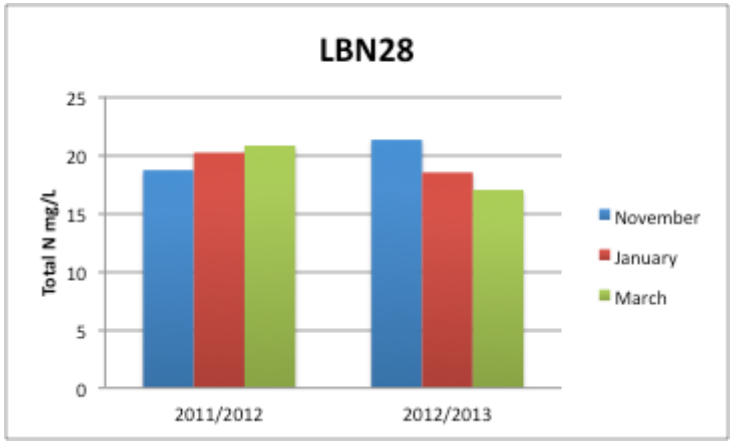


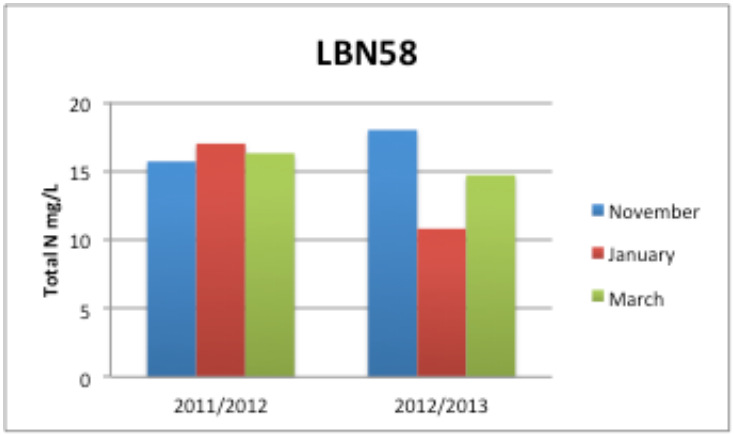
Low and stable concentrations





High and stable concentrations





Preliminary result analysis

- N dynamics in soil
  - peaks according to N- turnover processes, climate?
- Drain outflow rates
- Positive correlation between elevation and N- concentrations

- Great uncertainties attached to the results
- High risk of unrepresentative samplings

Monitoring nitrogen loss in a pilot scale catchment – Perspectives

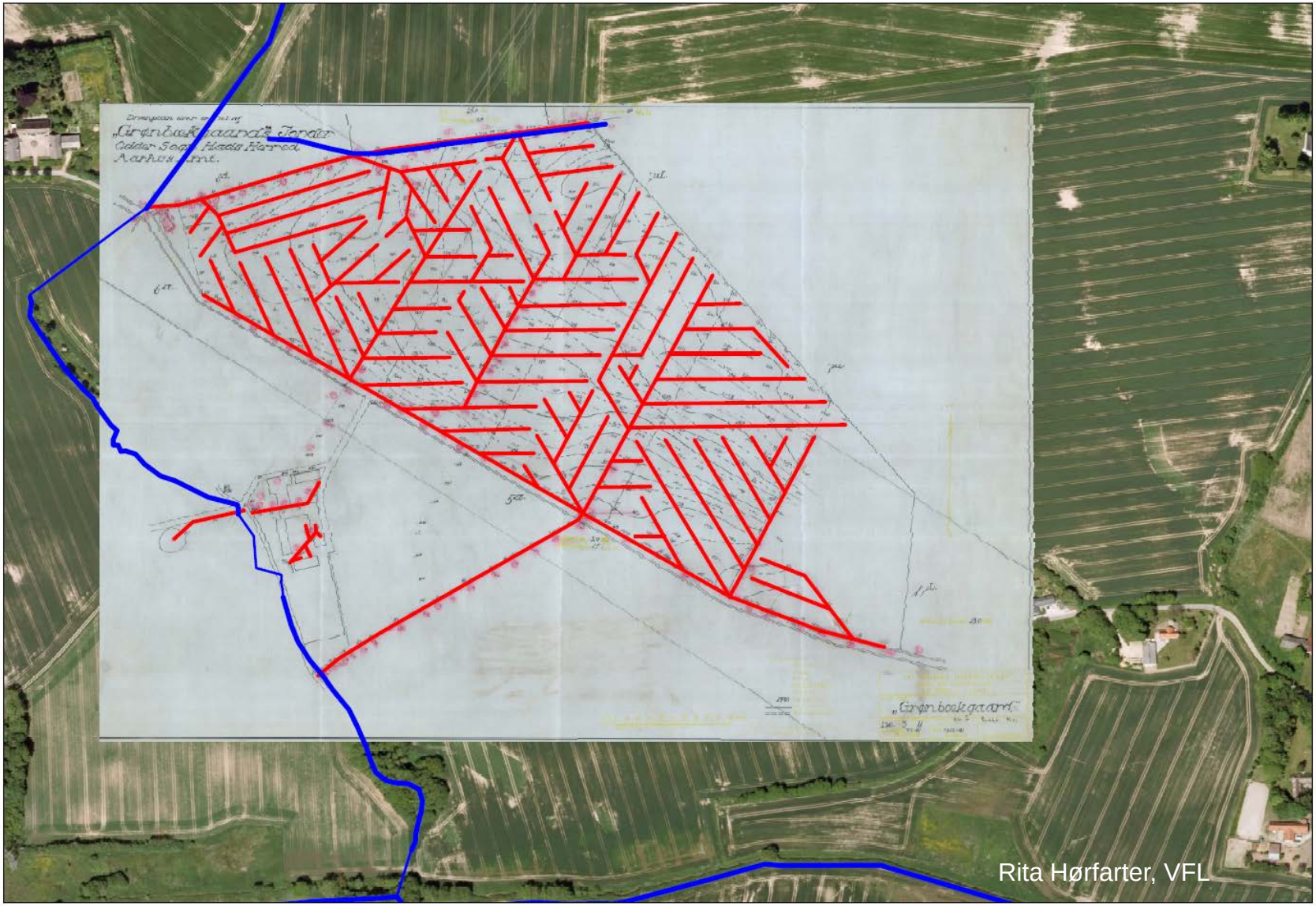
- Can the farmer use monitoring of drainage water to improve N utilization?
- Can drainage water monitoring give an indication of environmental impact?
- Do the answer to these questions vary between catchments?

Monitoring nitrogen loss in a pilot scale catchment – Perspectives

- To make a loss balance though drain pipes one must know:
  - The size of the drained catchment
  - The fraction of the total runoff that run off though drains
  - The total discharge of drain water over the winter season

This is needed both when monitoring on a pilot scale catchment or on a small drain system scale catchment

Mapping drainage systems



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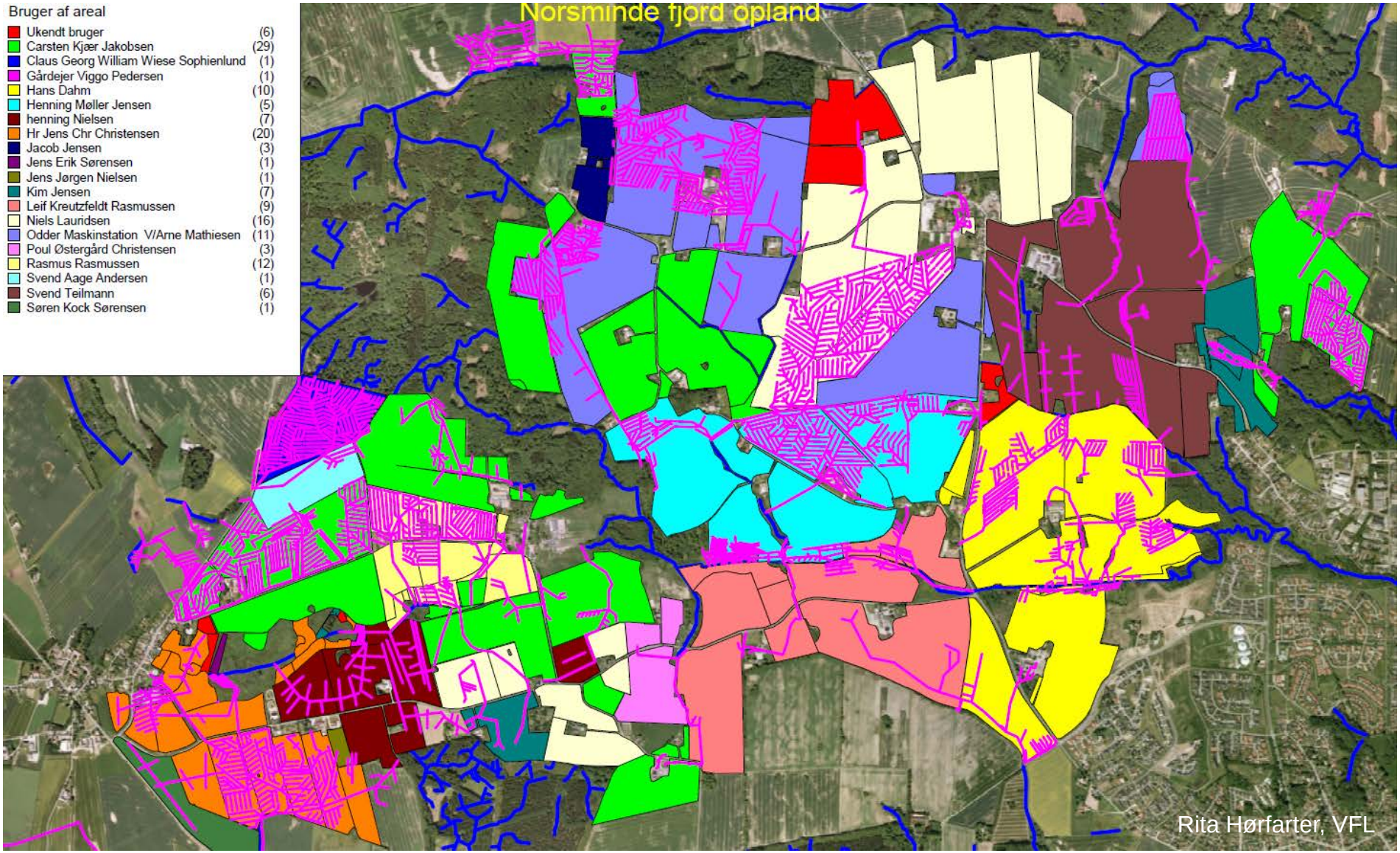
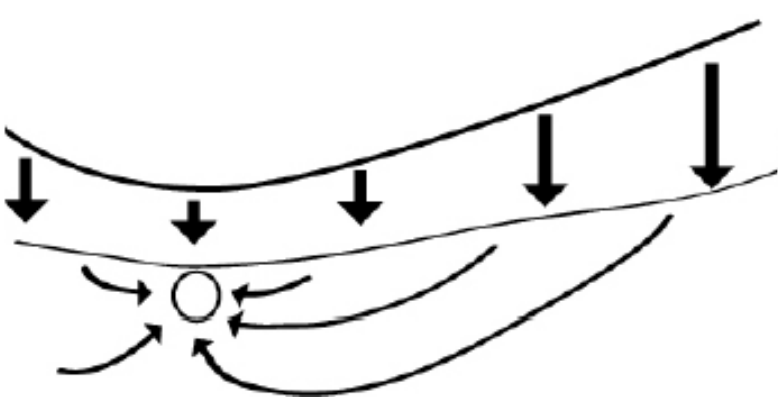
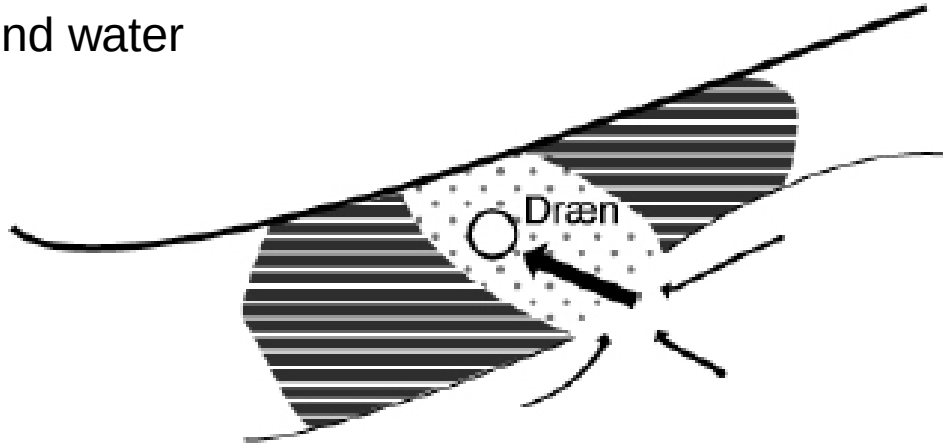
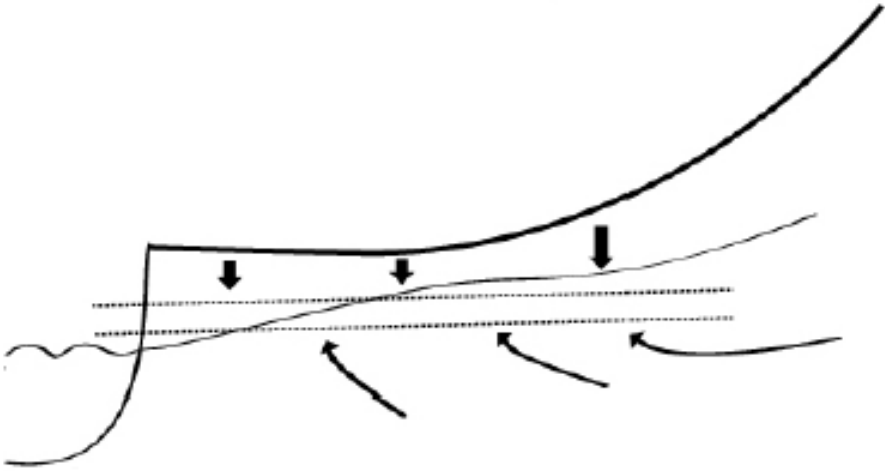


Where does drainage water come from?







Knowing the origin of drainage water can be difficult

Monitoring nitrogen loss in a pilot scale catchment – Perspectives

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Discharge measurements

- Expensive, ~50.000 dkk per monitoring station
- Alternative technologies are less costly to establish, but running costs are currently higher
- There have to be many hectares behind the station to justify the cost

Foto: Kristoffer Piil, VFL

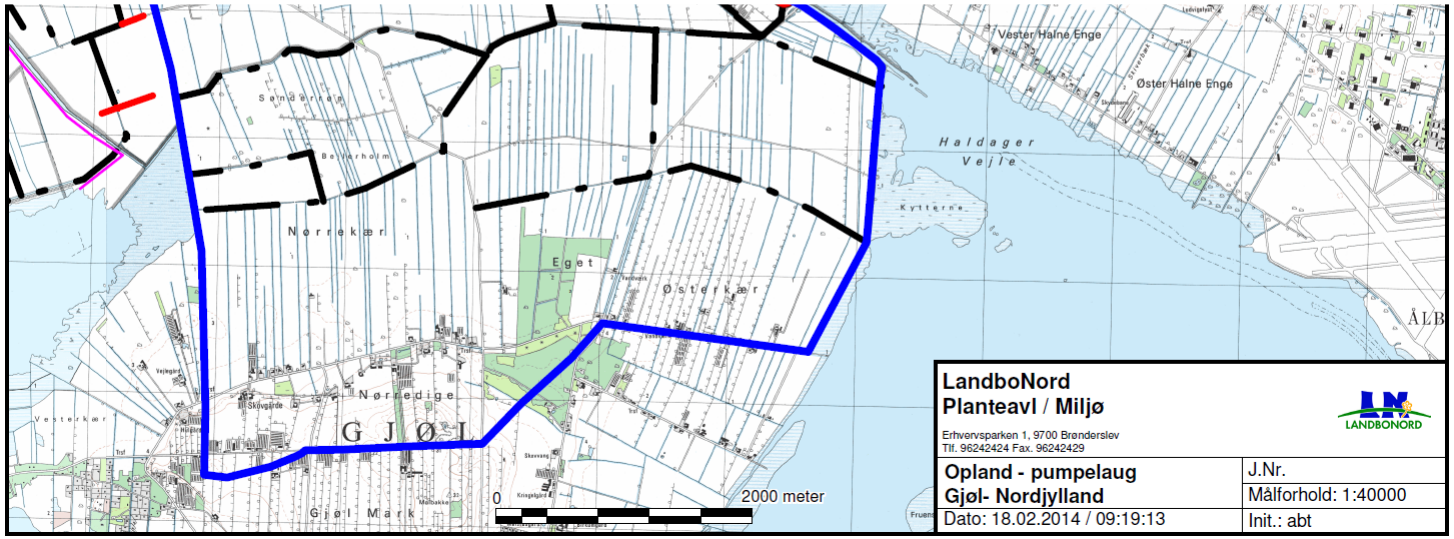
Monitoring nitrogen loss in a pilot scale catchment – Perspectives

- Eye-opener for the farmer
  - Am I loosing too much N?
  - Does it matter what I do on my field?

- For optimizing N utilization, a field balance is likely a cheaper solution
- If flow is measured and the drainage catchment is reasonably well constrained, monitoring drainage water can be used to asses environmental impact

Monitoring nitrogen loss in a pilot scale catchment – Perspectives

In some catchments monitoring drains can be a cost effective way of monitoring loss to the environment



Monitoring nitrogen loss in a pilot scale catchment – Conclusions

- DAAS have carried out a national drainage water monitoring which
  - Have demonstrated that nitrogen concentrations in drainage water were lower than in the national monitoring program, which monitors only a few drains
  - Have shown that there can be seasonal variation in drainage water concentration
  - Have given an indication of environmental impact of N-loss though field drains
  - Have demonstrated that N-loss through drains depends on climate, cropping system, elevation, geology/landscape type

- It is clear that monitoring drainage water in a catchment is sensible if:
  - The environmental impact is the main goal – N optimization is can likely be obtained cheaper by field balances
  - Increases the framers awareness of N-Loss
  - When drain water discharge can be measured in a cheap way or,
  - When there are so many hectares behind the monitoring station that is justifies the cost

Thank you for your attention!

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