Economic gain from targeted measures at the field level - the NICA project

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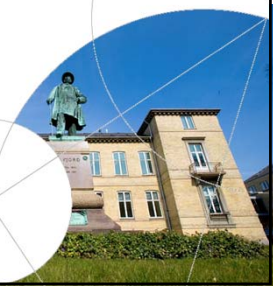

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Nitrogen reduction in geological heterogene catchments (DSF)

Purpose:

- ✓ **Mapping of geological structures and N transport in the sub surface level in order to locate where measures have the largest effect.**
- ✓ **Geological Survey of DK and Greenland were project leaders**
- ✓ **2010 – 2014**

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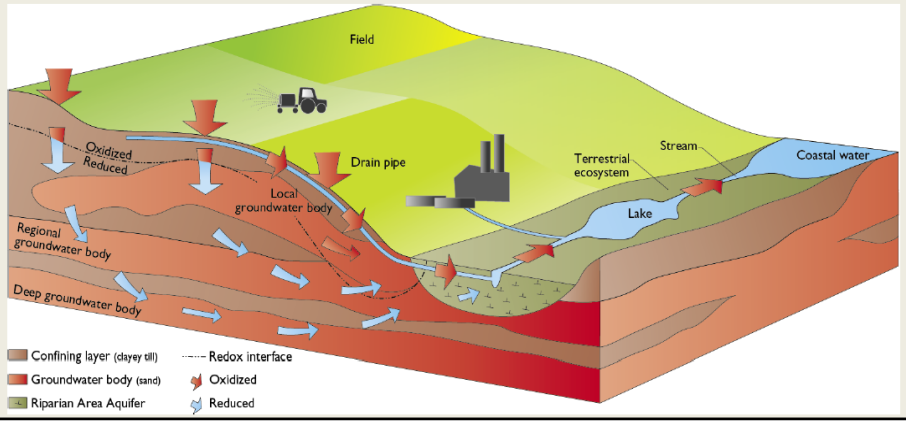
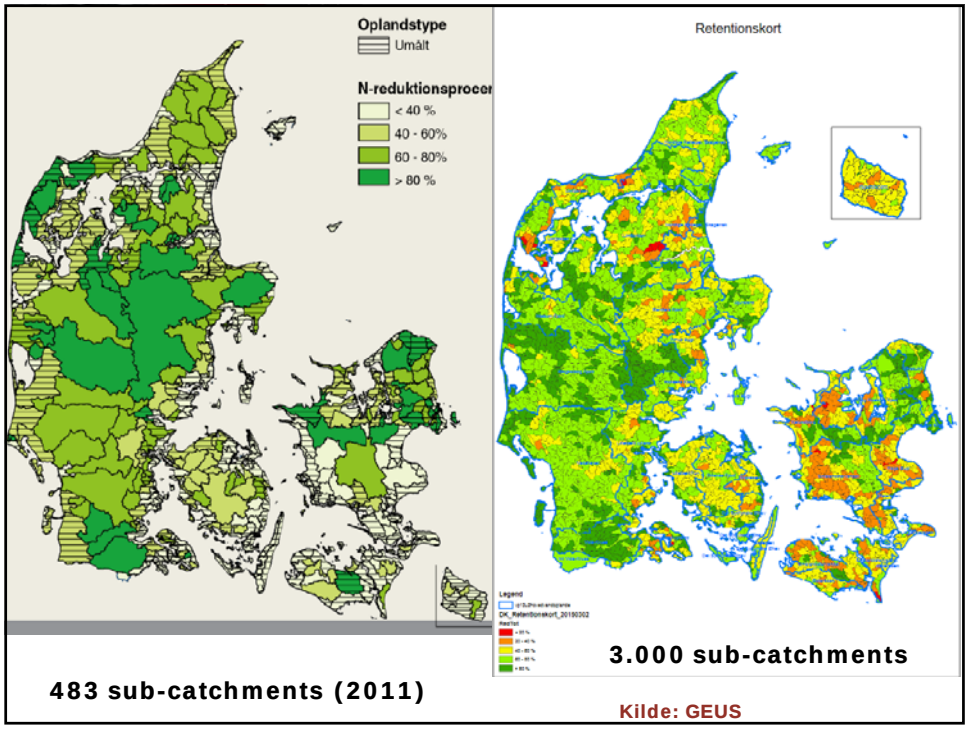
NiCA project – www.nitrat.dk

2/3 of the nitrate leaching from the root zone is reduced/disappears in the subsurface when flow lines cross below the redox interface





483 sub-catchments (2011)

3.000 sub-catchments

Kilde: GEUS

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Reseach questions:

- How can we improve the local estimation of the N-transport to the aquatic environment?
- What is the smallest scale where the retention can be identified with reasonable certainty?
- What are the economic gains from targeting measures?

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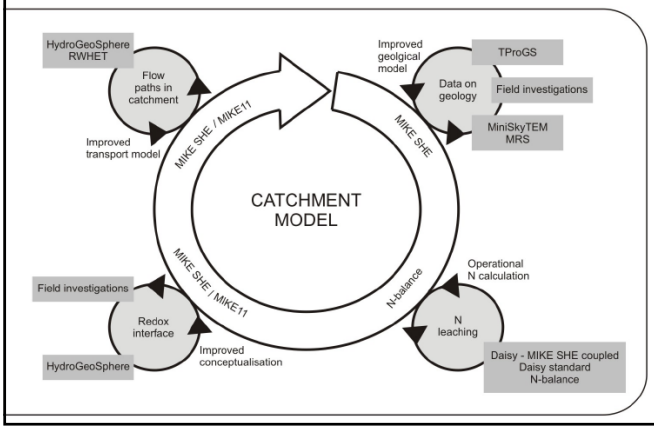
Model approach : New, better and cheaper technology to establish N-flow



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The analyses

1. Geology
   2*10 stochastic descriptions of the geology. One based on bore holes and the other is based on SKYTEM

2. Hydrology
   MIKE SHE analysis based on 100*100 m grids

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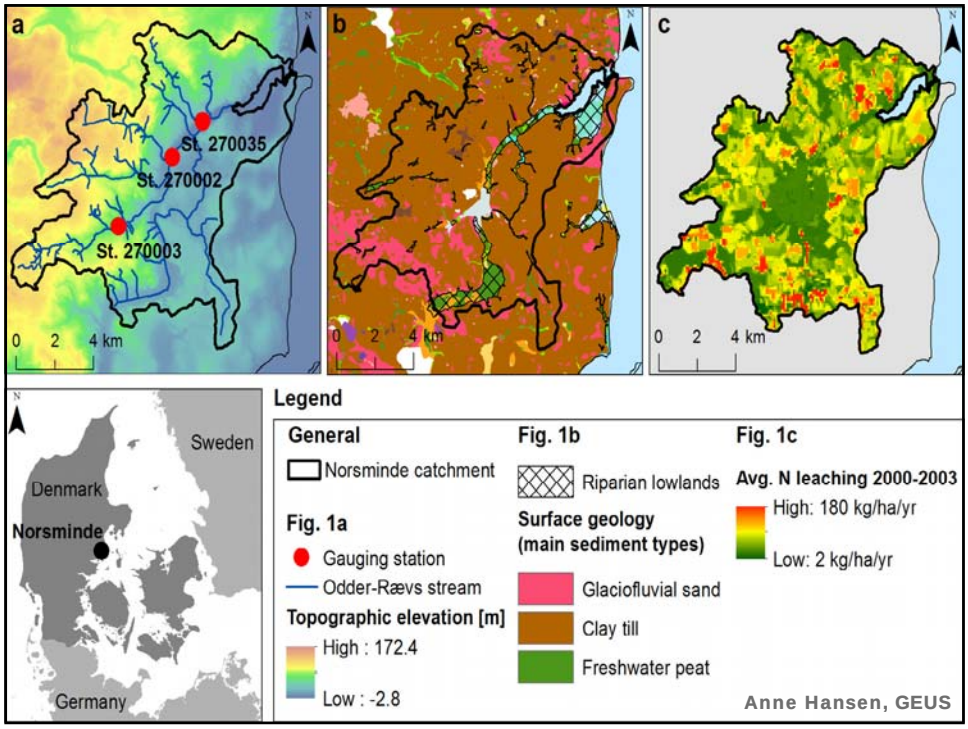
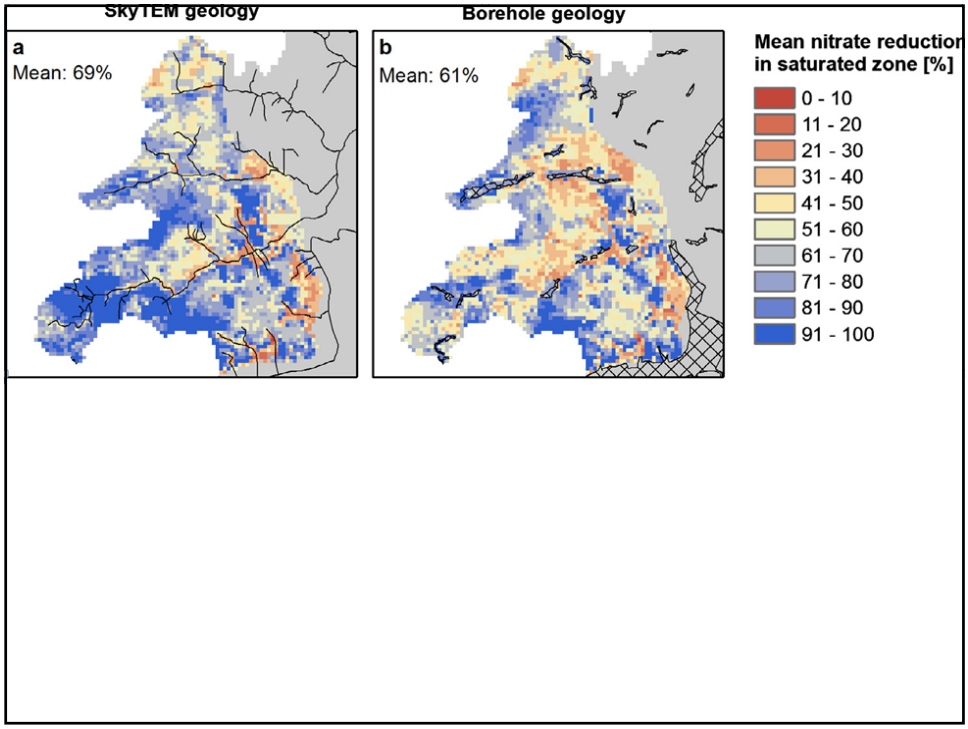
The analyses (part 2)

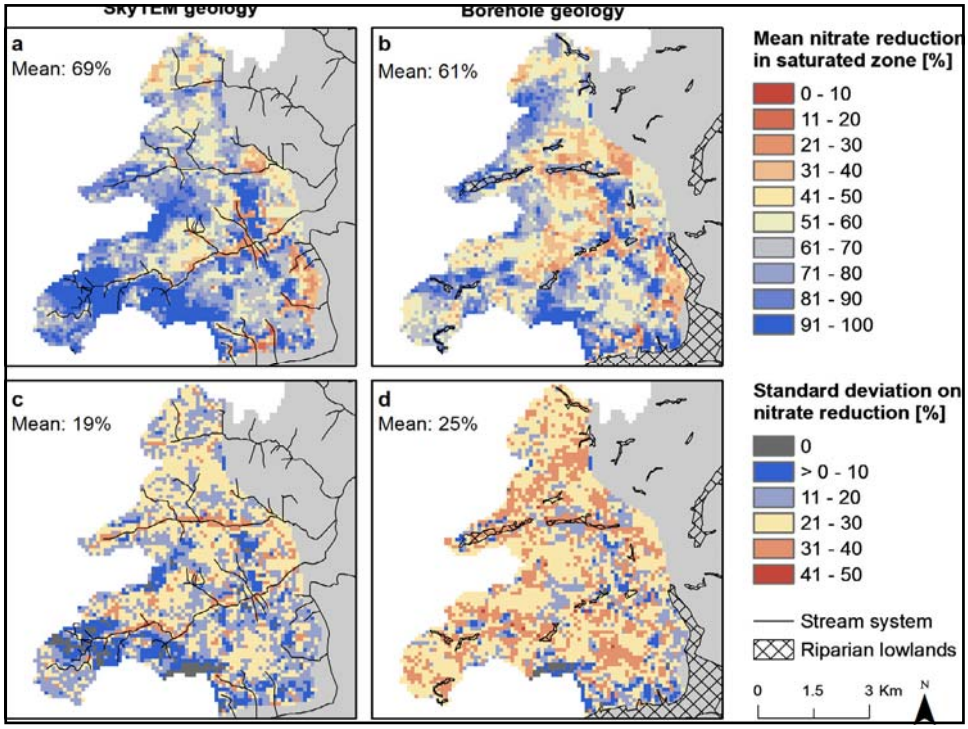
3. N-retention is estimated
   3 scenarios covering likely levels of the redox zone (3*20=60 maps)

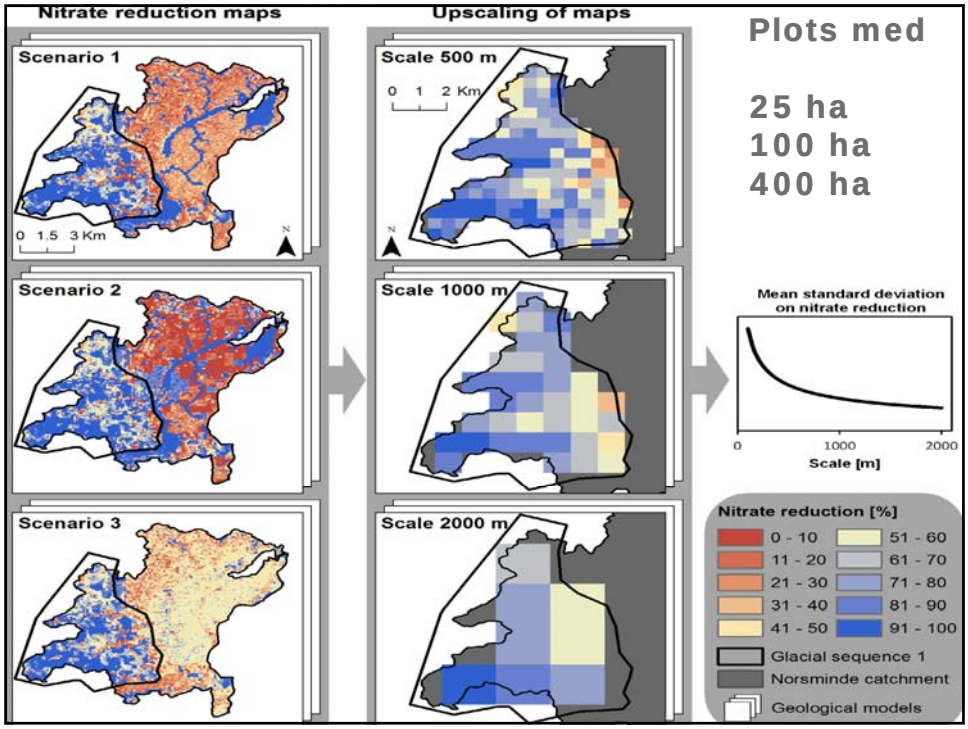
4. N-reduction maps based on N-leaching calculation (N-Les III)

5. Uncertainty and up-scaling
   a) Variation in results at farm level (STD)
   b) Going from 100 – 2000 m in plot size


a
St. 270035
St. 270002
St. 270003
0 2 4 km
b
0 2 4 km
c
0 2 4 km
Sweden
Denmark
Norsminde
Germany
Legend
General
Norsminde catchment
Fig. 1a
Gauging station
Odder-Rævs stream
Topographic elevation [m]
High : 172.4
Low : -2.8
Fig. 1b
Riparian lowlands
Surface geology
(main sediment types)
Glaciofluvial sand
Clay till
Freshwater peat
Fig. 1c
Avg. N leaching 2000-2003
High: 180 kg/ha/yr
Low: 2 kg/ha/yr
Anne Hansen, GEUS


SkyTEM geology
a
Mean: 69%
Borehole geology
b
Mean: 61%
Mean nitrate reduction
in saturated zone [%]
0 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100


SkyTEM geology
Borehole geology
a
Mean: 69%
b
Mean: 61%
c
Mean: 19%
d
Mean: 25%
Mean nitrate reduction in saturated zone [%]
0 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Standard deviation on nitrate reduction [%]
0
> 0 - 10
11 - 20
21 - 30
31 - 40
41 - 50
Stream system
Riparian lowlands
0 1.5 3 Km
N


Nitrate reduction maps
Upscaling of maps
Scenario 1
Scenario 2
Scenario 3
0 1.5 3 Km
N
Scale 500 m
Scale 1000 m
Scale 2000 m
0 1 2 Km
Plots med
25 ha
100 ha
400 ha
Mean standard deviation on nitrate reduction
0
1000
2000
Scale [m]
Nitrate reduction [%]
0 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
Glacial sequence 1
Norsminde catchment
Geological models

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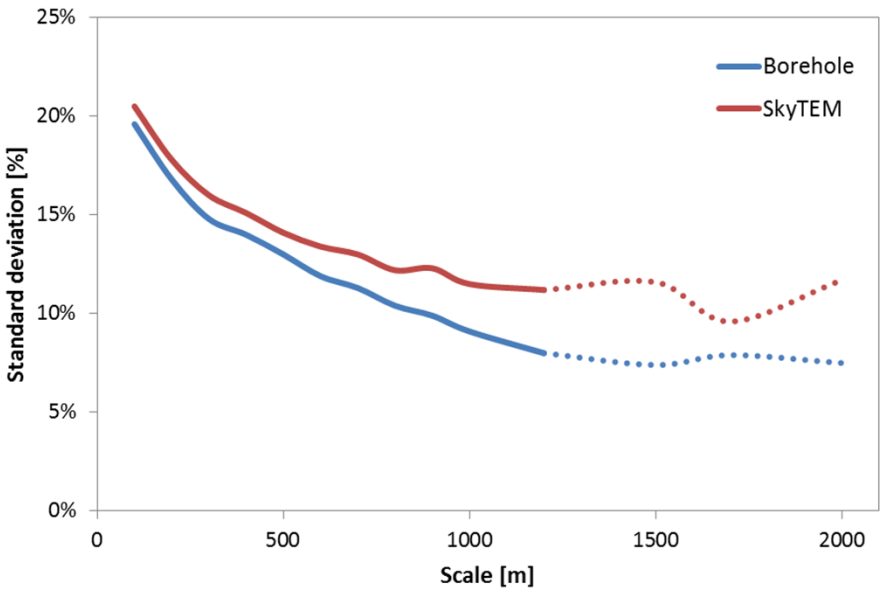

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Opsummering

- **Both the location of the Redox zone and the geology affects the N-retention**
- **Large variation within the fields**
- **Uncertainty increase with plots under 500*500 m (25 ha)**
- **Costs of mapping is 500-800 pr. ha (SKYTEM + adm.) (50-100 DKK/ha/year)**

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The economic gain

1. What is the effect of geographical targeted measures at the fields level?

2. What is the link between farm variation and economic gain at the farm level?

The calculations are carried out in co-operation between SEGES and IFRO using the Pilot project model

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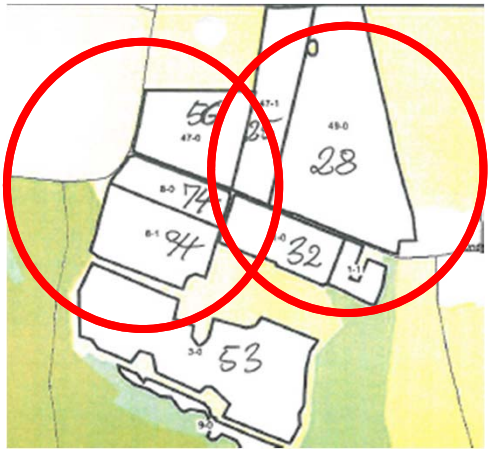
Method

- Total economic gain for plant production from targeting of measures
- N-measures in step 1 are : catch crops and in-between crops
- N-measures in step 2 are : also mini wetlands and early sowing
- Change in N-application change yield, amount of straw and protein content
- N-leaching : N-Les III model

N-reduction map for farm A



Scenarios for 10 farms

Scenario	Description	Measures	Targeting
A	**Economic opt.**	**No regulation**	
C	**Present N-quota and N-loss**	Present options	No
D	**Present N-quota and N-loss**	Catch and in-between crops	**Yes**
E	**Optimal N and present N-loss**	Catch and in-between crops	**Yes**

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Scenarier for 10 bedrifter

Scenario	Description	Measures	Targeting
A	Economic opt.	No regulation	
C	Present N-quota and N-loss	Present options	No
D	Present N-quota and N-loss	Catch and in-between crops	Yes
E	Optimal N and present N-loss	Catch and in-between crops	Yes
F	Reduced N-loss (18%)+present quota	Present options	No
G	Reduced N-loss (18%) + optimal N	Catch and in-between crops	Yes
H	Reduced N-loss (18%) + Optimal N	All measures etc. mini wetlands	Yes

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Results – present N-loss

	C	D Target	E Target
N-quota (%)	100	100	119
Winter crops (%)	64	66	60
Catch Crops (%)	11	8	16
In between crops %)	3	2	7
Change in profit (DKK pr. ha)	0	101	157

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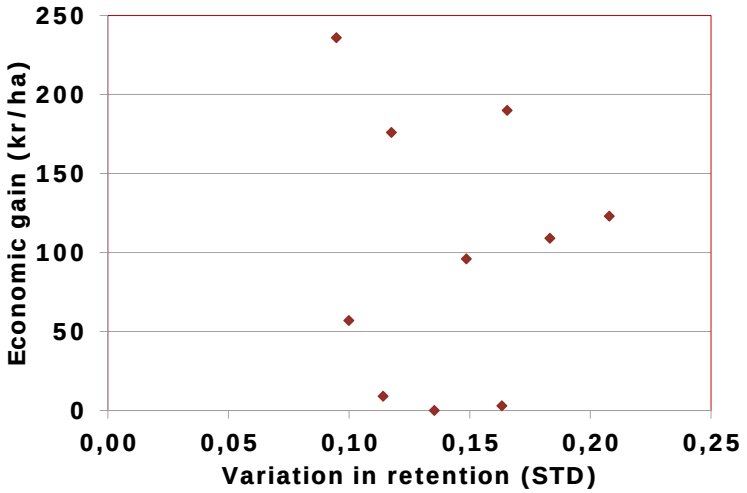
Retention and economic gain



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Resultater med 18% reduktion i udledning

	F	G Target	H Target
N-quota (%)	100	119	115
Winter crops (%)	53	53	64
Catch Crops (%)	25	28	20
In between crops (%)	11	15	12
Mini wetlands (%)	0	0	21
Early sowing (%)	0	0	13
Change in profit (DKK pr. ha)	0	206	394

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Comments

- Some farms cannot utilize the targeting due to crop rotations
- Link between variation in retention and economic gain at the farm level is not clear
- High share of catch crops / in between crops can be a problem
- Many choose mini wetlands (realistic share, effect and costs?)

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CONCLUSION

- Targeting at the field level gives an economic gain of 100 DKK per ha (optimal N)
- Cost of NICA data 50-100 DKK/ha/yr.
- Higher reduction –> higher gain
- New measures gives a large effekt (200 DKK per ha)
- Mini wetlands and early sowing are populare measures

Read more www.ifro.ku.dk

and www.nitrat.dk