rivm
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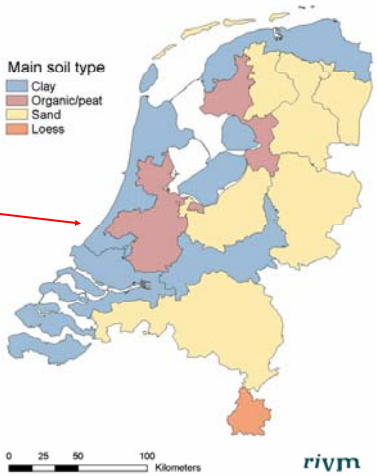
Relationship between nitrogen surplus and nitrate leaching on sandy soils

LEI WAGENINGEN UR

The Netherlands

- Temperate marine climate
- West: Holocene river and marine deposits
- East: Pleistocene wind deposits



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Compare California and the Netherlands

Intensive agriculture in NL

Compare	California	The Netherlands
Area (1000 km²)	411	42
Population (million)	37	17
Agricultural land (million ha)	10	2
Cattle (million heads)	5.2	4.0
Dairy cows	1.8	1.5
Pigs (million heads)	0.2	12

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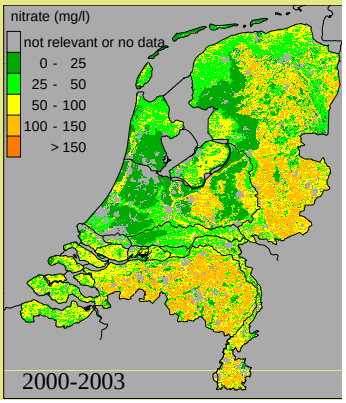
Nitrate problem in the Netherlands

Exceedance of EU nitrate target value in 2004-2006 root zone leachate

Region	>50 mg NO_3/l
Sand	65%
Loess	85%
Clay	30%
Peat	< 5%

statistical model using monitoring data



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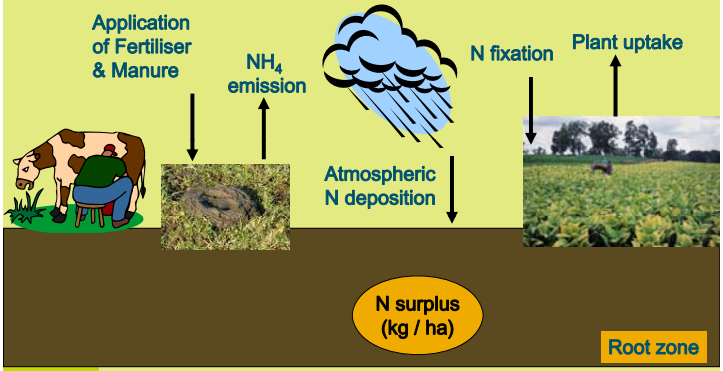
Nitrogen surplus to high? N surplus soil root zone balance [1]



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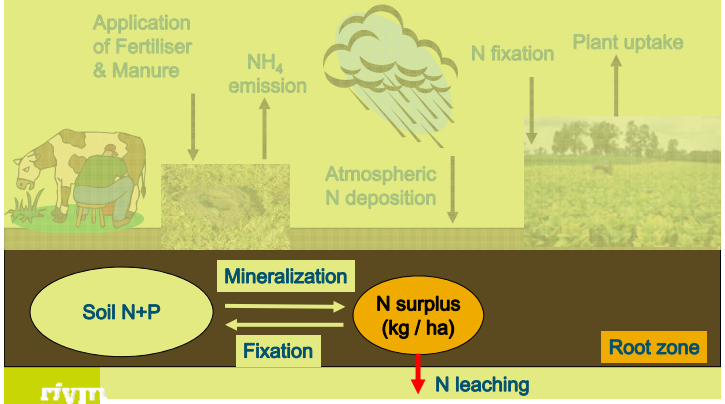
Nitrogen surplus to high? N surplus soil root zone balance [2]



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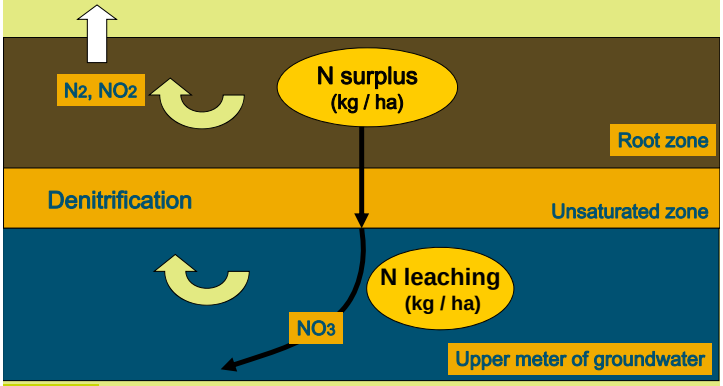
Destiny of nitrogen surplus



Problem definition and solution

Problem

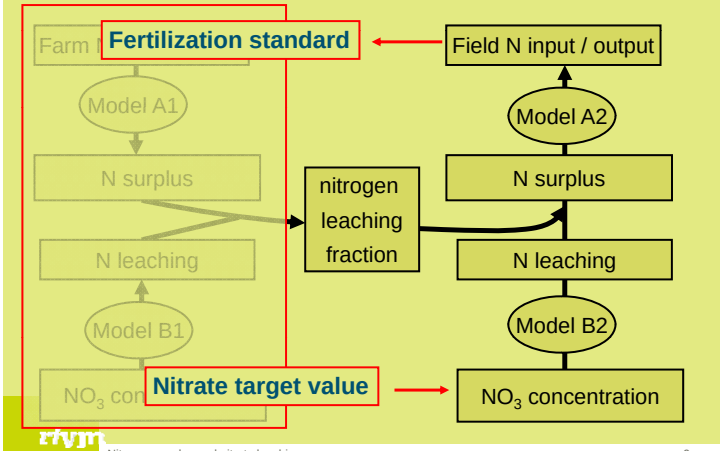
How much nitrogen can be applied without exceeding the EU nitrate target value (50 mg/l)

Solution: 'black box' empirical model

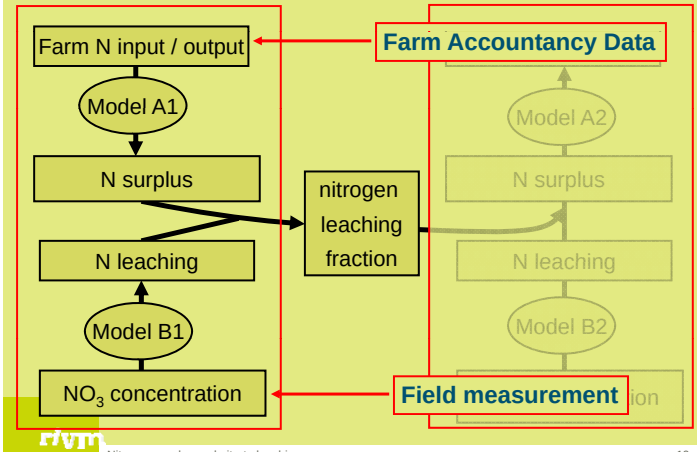
Use existing data to derive relationships between

- N fertilization and N surplus (agricultural research)
- N surplus and N leaching (trend monitoring network)
- N leaching and nitrate concentration (environmental research)

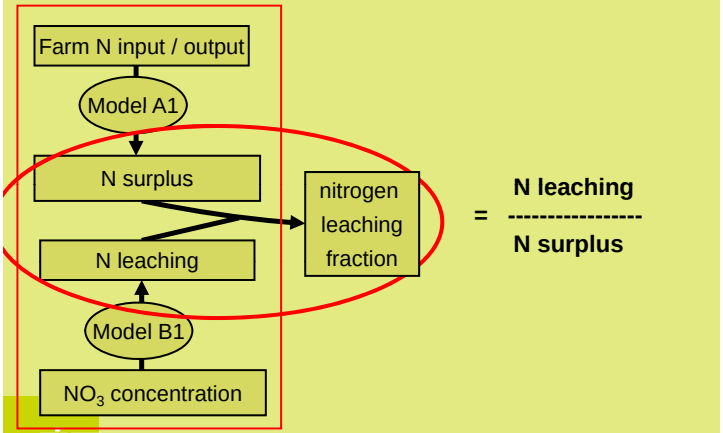
Deriving nitrogen fertilization standards



Deriving a nitrogen leaching fraction (NLF)



Relation between N surplus and N leaching



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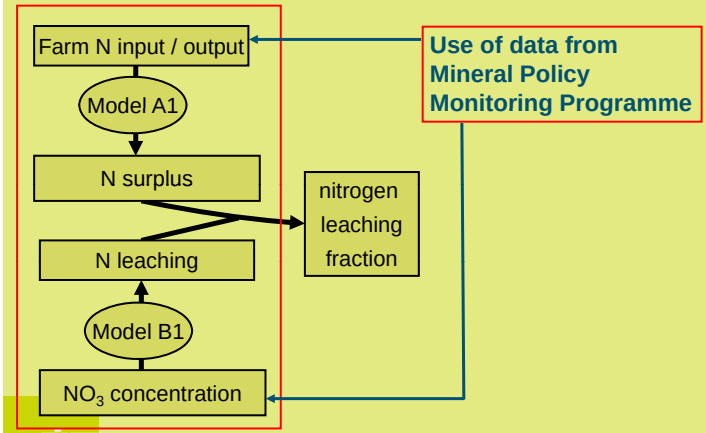
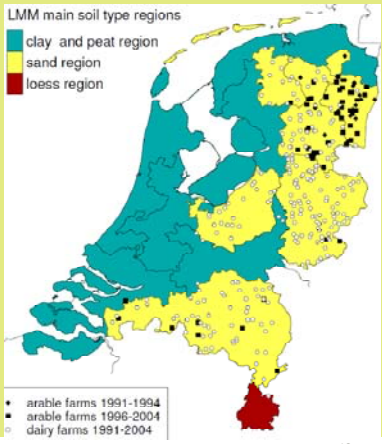


Minerals Policy Monitoring Programme

1. Monitoring water quality
2. Registering of farm practices with Farm Accountancy Data Network

Sand region (yellow) 1992 – 2005
360 farms, sampled 1-6 years

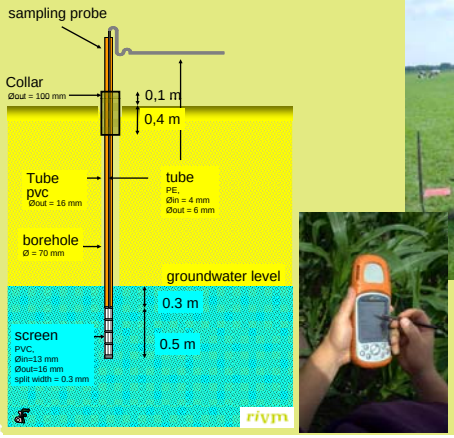
210 dairy farms (2.5 years)
70 arable farms (2.2 years)
80 pig and crop-livestock farms (1.8 years)



Sand region of the Netherlands

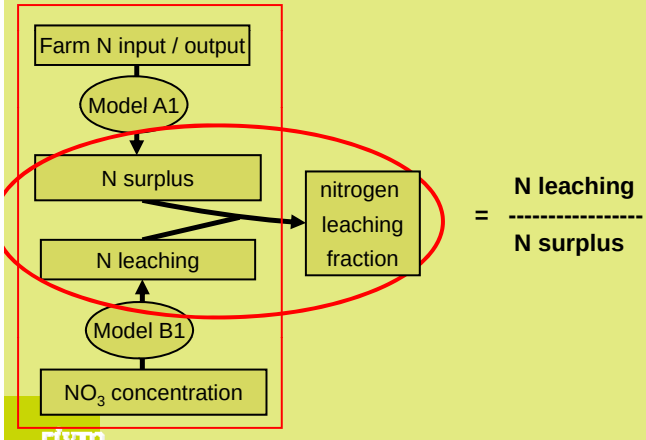
sandy soils (podzol)

Sampling of upper meter of groundwater

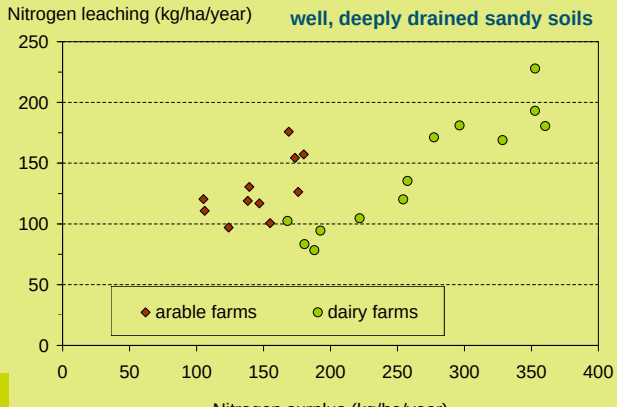


16 boreholes per farm

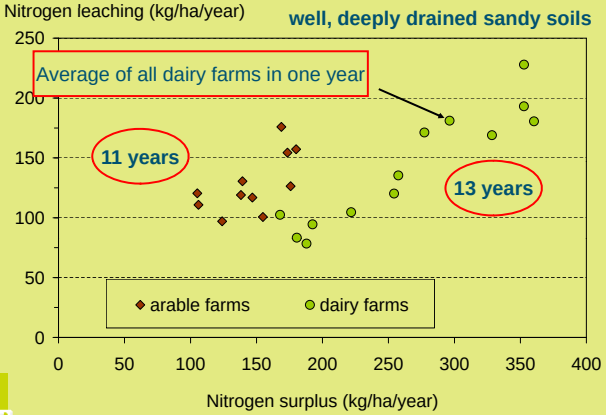
Deriving a nitrogen leaching fraction (NLF)



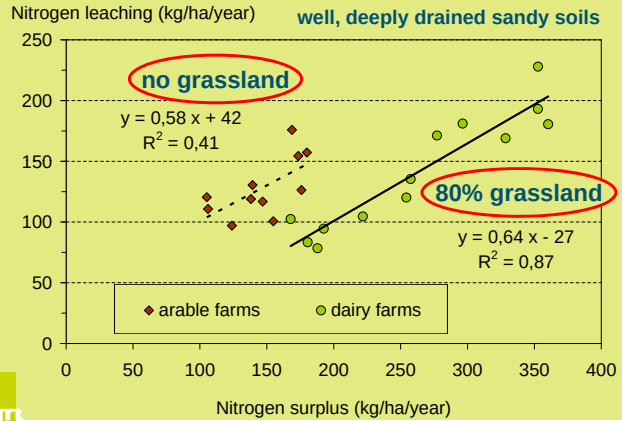
N leaching versus N surplus



N leaching versus N surplus



N leaching versus N surplus



Nitrogen leaching fraction (NLF)

Soil type	Drainage type	Arable land	Grassland
Sand	Well and deep	0.89 ± 0.10	0.46 ± 0.06
	Moderately	0.58	0.30
	Poor and shallow	0.38	0.20
Clay		*0.36 ± 0.14*	*0.12 ± 0.03*
Peat		*-*	*0.04 ± 0.02*

NLF is indication for the influence of denitrification
NLF = 0.0 ⇨ full denitrification
NLF = 1.0 ⇨ no denitrification

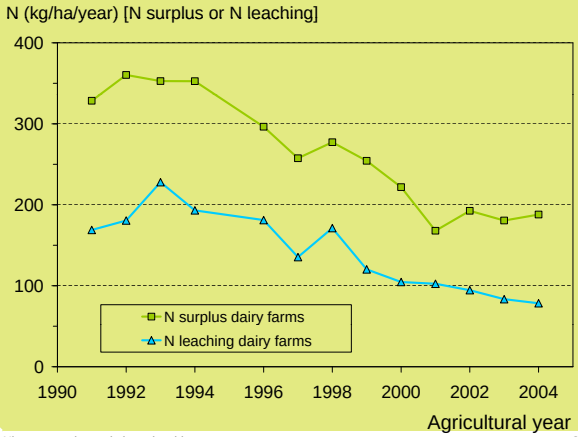
Nitrogen leaching fraction (NLF)

Question

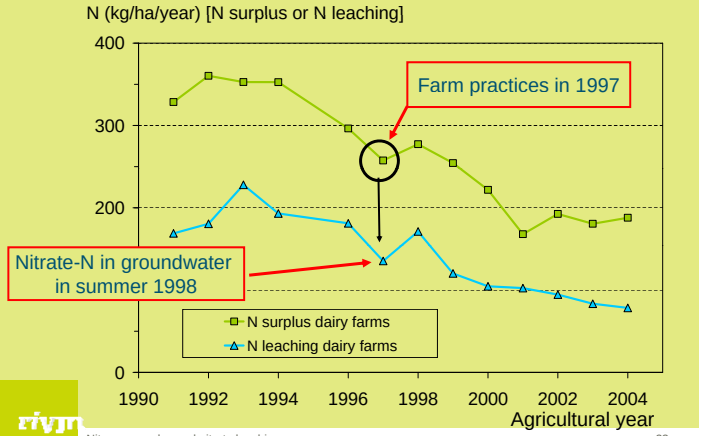
Is there an effect of time lag?

- *N surplus decreased with time*
- *we related N leaching to the N surplus of only the previous year*
- *this might overestimate the NLF*

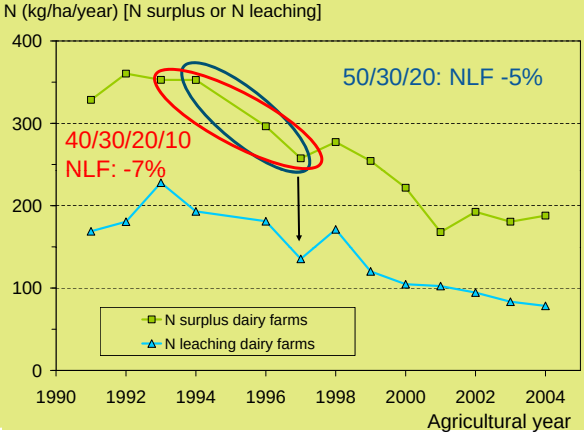
Trend in N surplus and N leaching



Trend in N surplus and N leaching



Accounting for time lag



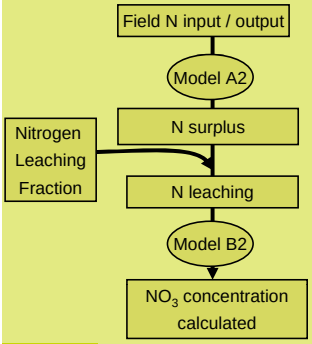
Findings

- Leaching fraction (NLF) from arable land is higher than from grassland
- Leaching fraction (NLF) for well drained soils is higher than from poor drained soils
- Accounting for time lag gives 5-7%-points lower values for NLF's

Consequences for policy makers

- Integration of monitoring farm practices and the quality of the environment has many advantages
- Data acquired by trend monitoring networks may be used for underpinning policy decisions
- Small investment in additional measurements to underpin models may pay off

Validation of NLFs with special project data



10 research-supported commercial dairy farms
1 research farms

Compare:
- observed NO_3 concentration
- calculated NO_3 concentration

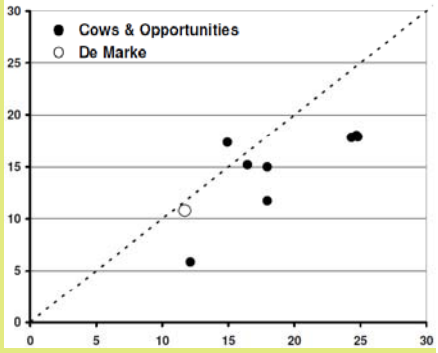
Validation of NLFs with special project data

Observed NO_3 concentration in upper meter of groundwater (mg/l)

Conclusion:

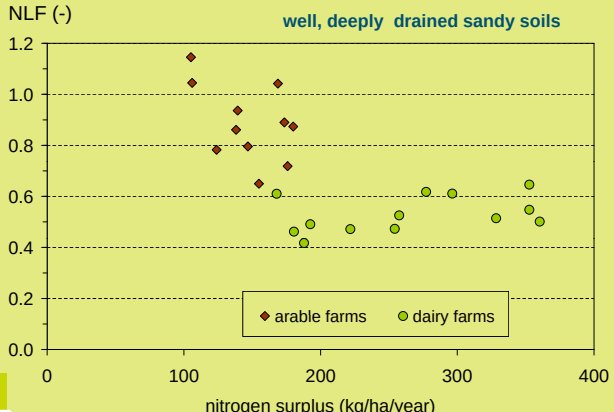
model slightly overestimates NO_3 concentrations

NLFs should be lower?
- local rainfall?
- immobilization?



Calculated NO_3 concentration in upper meter of groundwater (mg/l)

NLF versus N surplus



NLF versus precipitation surplus