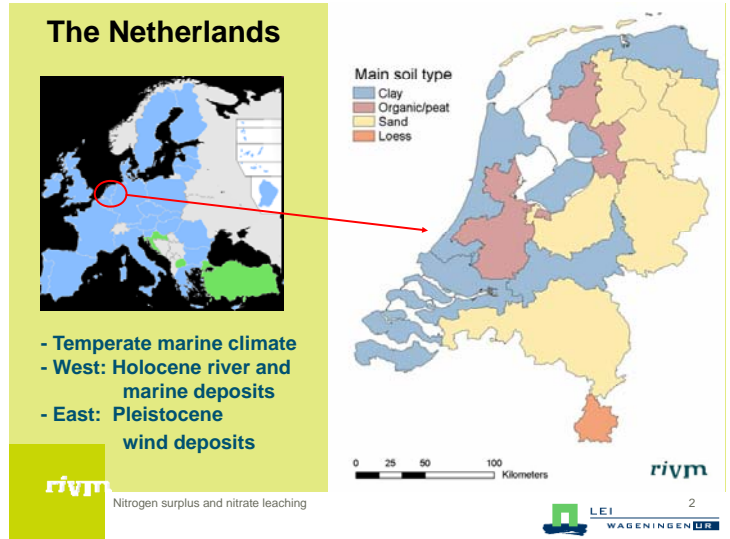




Dico Fraters and Leo Boumans (RIVM)
Joan Reijs and Ton van Leeuwen (LEI)

Relationship between nitrogen surplus and nitrate leaching on sandy soils

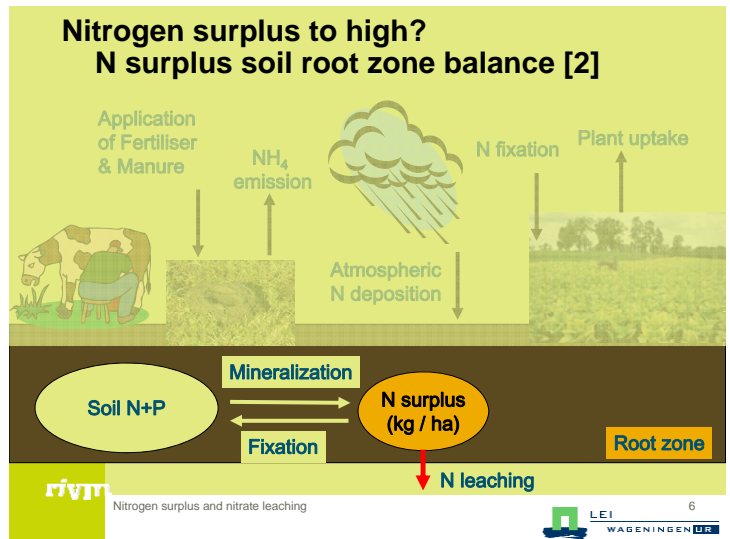
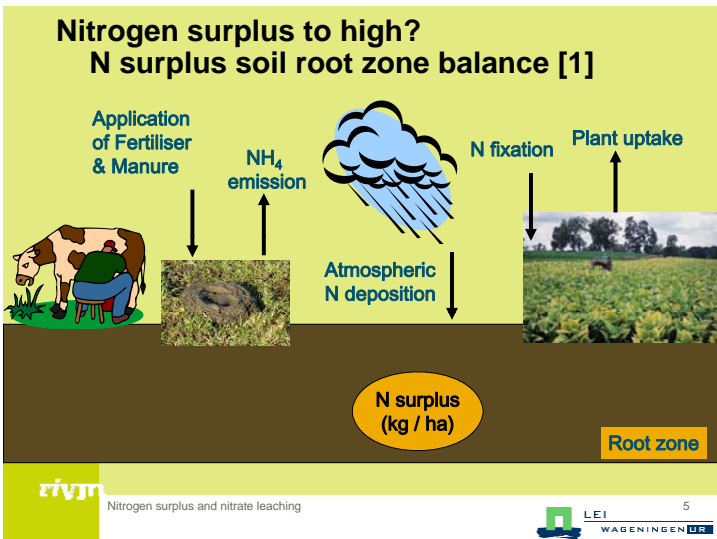
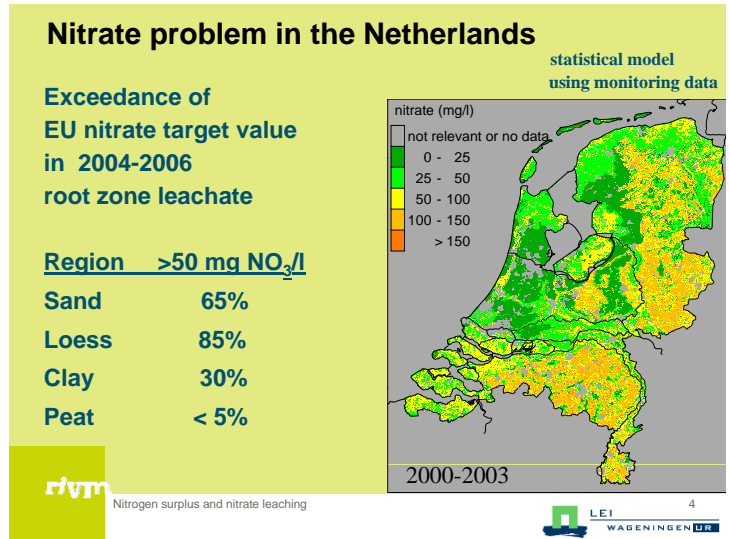


Compare California and the Netherlands

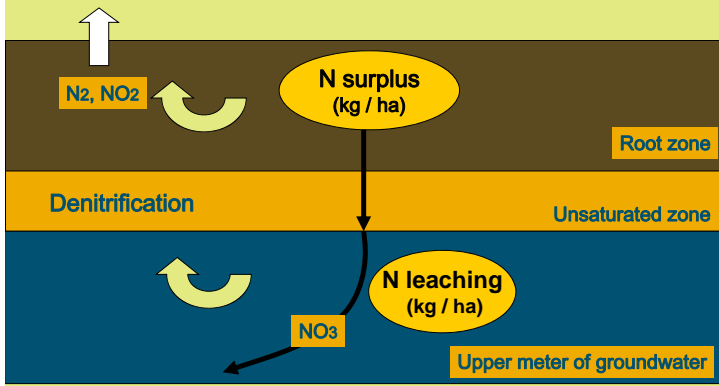
Intensive agriculture in NL

Compare	California	The Netherlands
Area (1000 km ²)	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

Nitrogen surplus and nitrate leaching



Destiny of nitrogen surplus



Problem definition and solution

Problem

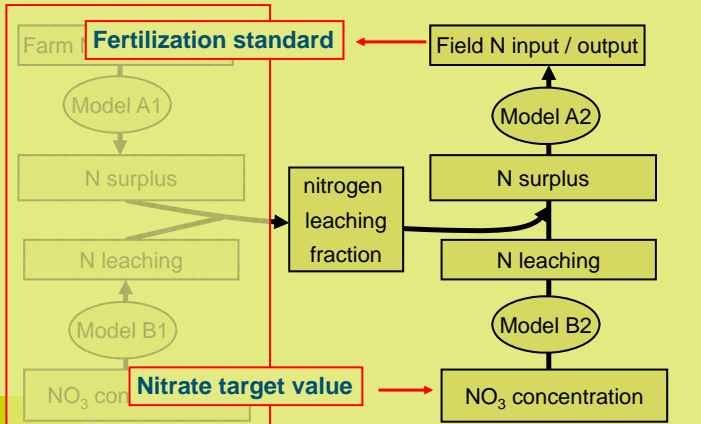
How much nitrogen can be applied without exceeding the EU nitrate target value (50 mg/l)

Solution: 'black box' empirical model

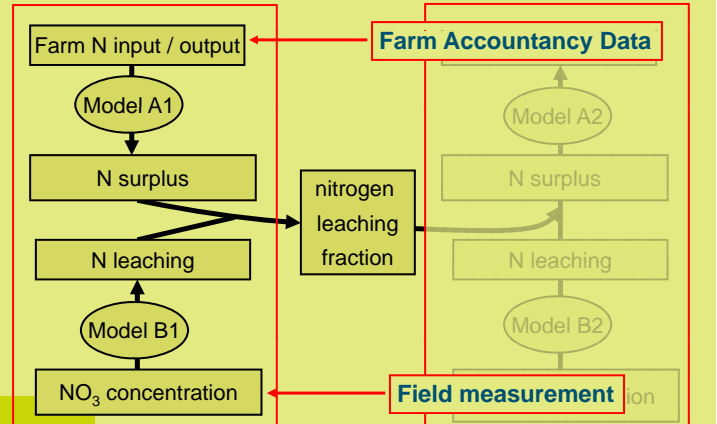
Use existing data to derive relationships between

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

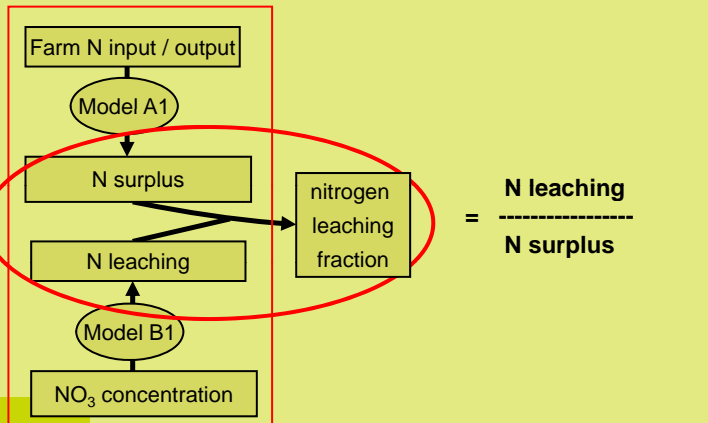
Deriving nitrogen fertilization standards



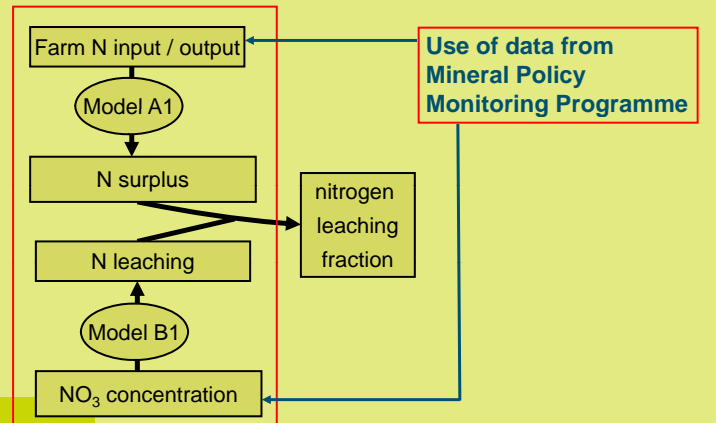
Deriving a nitrogen leaching fraction (NLF)



Relation between N surplus and N leaching



Deriving a nitrogen leaching fraction (NLF)

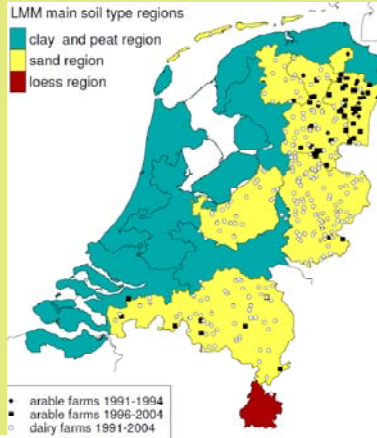


Minerals Policy Monitoring Programme

- 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)



• arable farms 1991-1994
• arable farms 1996-2004
• dairy farms 1991-2004

Nitrogen surplus and nitrate leaching

Sand region of the Netherlands



heath

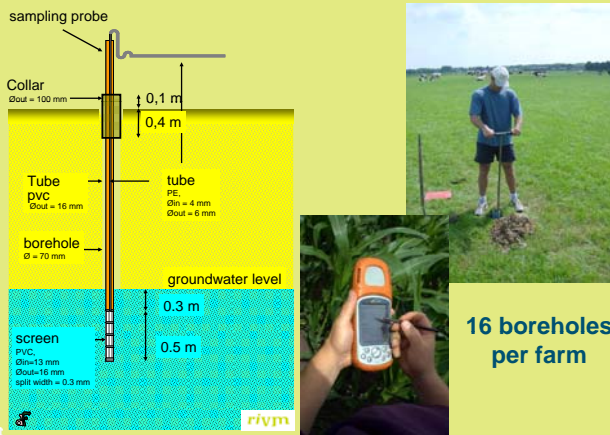
old ag field

sandy soils (podzol)

rivm

Nitrogen surplus and nitrate leaching

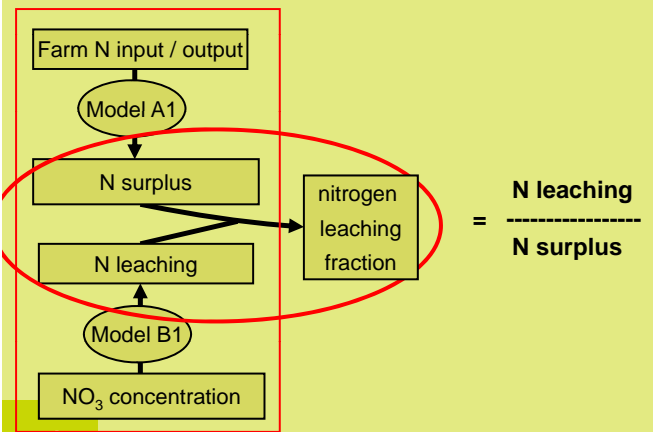
Sampling of upper meter of groundwater



16 boreholes per farm

Nitrogen surplus and nitrate leaching

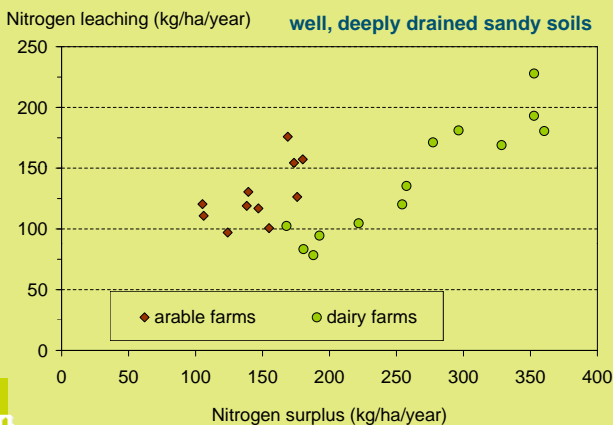
Deriving a nitrogen leaching fraction (NLF)



rivm

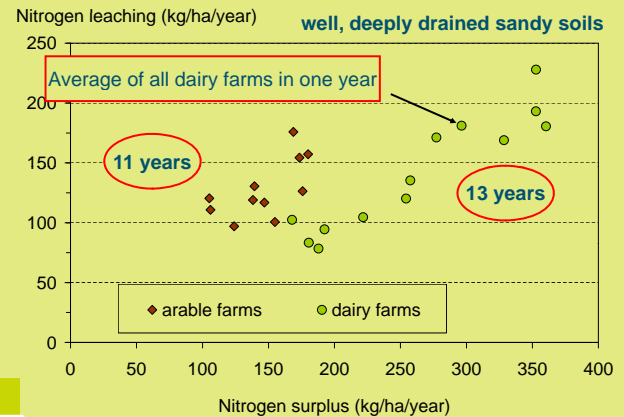
Nitrogen surplus and nitrate leaching

N leaching versus N surplus



Nitrogen surplus and nitrate leaching

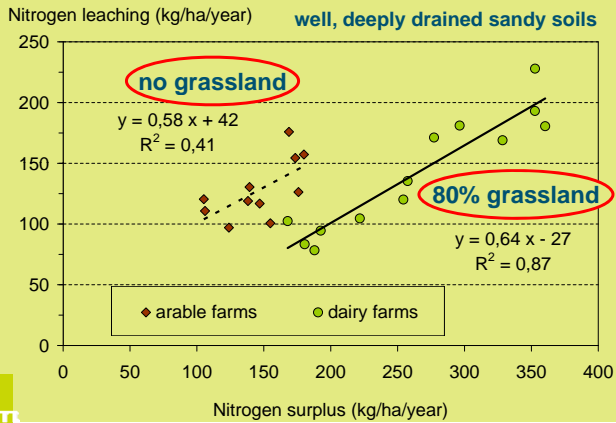
N leaching versus N surplus



rivm

Nitrogen surplus and nitrate leaching

N leaching versus N surplus



Nitrogen surplus and nitrate leaching

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 \Rightarrow full denitrification
 NLF = 1.0 \Rightarrow no denitrification

Nitrogen surplus and nitrate leaching

Nitrogen leaching fraction (NLF)

Question

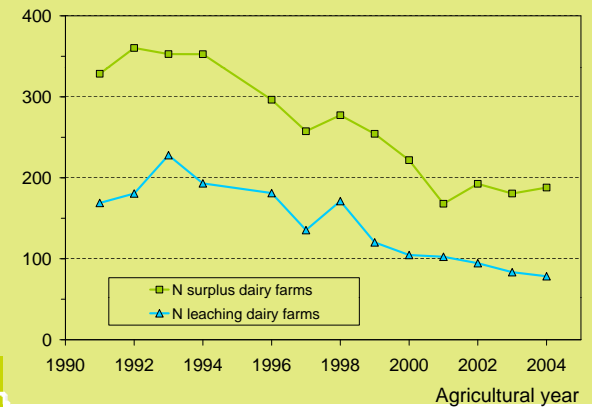
Is there an effect of time lag?

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

Nitrogen surplus and nitrate leaching

Trend in N surplus and N leaching

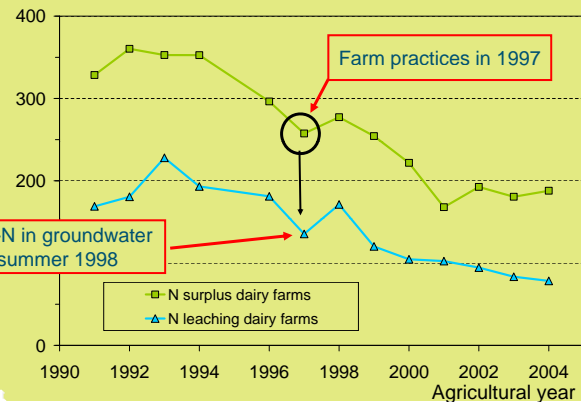
N (kg/ha/year) [N surplus or N leaching]



Nitrogen surplus and nitrate leaching

Trend in N surplus and N leaching

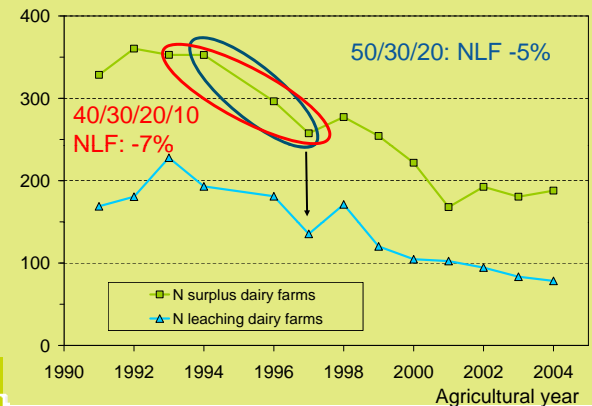
N (kg/ha/year) [N surplus or N leaching]



Nitrogen surplus and nitrate leaching

Accounting for time lag

N (kg/ha/year) [N surplus or N leaching]



Nitrogen surplus and nitrate leaching

Findings

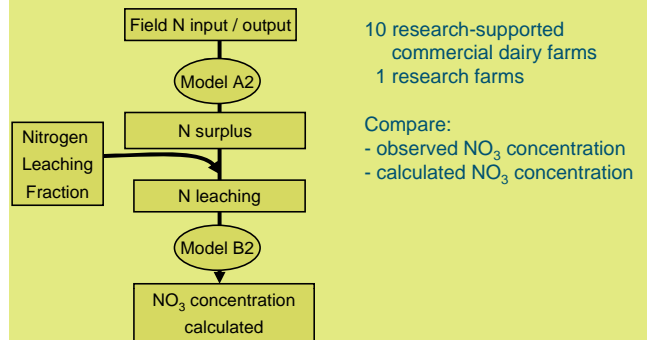
- Leaching fraction (NLF) from arable land is higher than from grassland
- Leaching fraction (NLF) for well drained soils is higher than from poor drained soils
- Accounting for time lag gives 5-7%-points lower values for NLF's

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



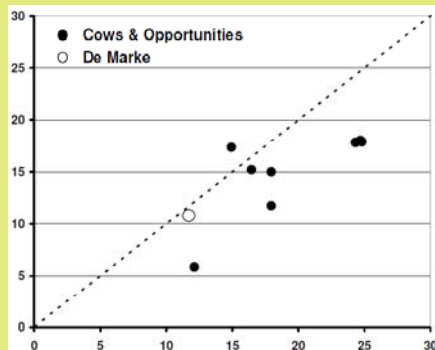
Validation of NLFs with special project data

Observed NO₃ concentration in upper meter of groundwater (mg/l)

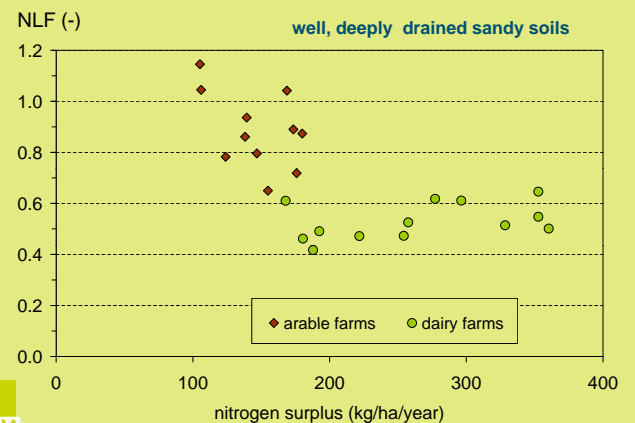
Conclusion:

model slightly overestimates NO₃ concentrations

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



NLF versus N surplus



NLF versus precipitation surplus

