

Dutch manure policy and the Nitrates Directive, backgrounds and implications

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This is me

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Content

- Nitrates Directive
- History Dutch Manure Policy
- Current Dutch Manure Policy
- Fertilization and Water Quality in the Netherlands
- Implications on crop production and soil quality
- 6th Action Program Nitrate Directive
- Outlook

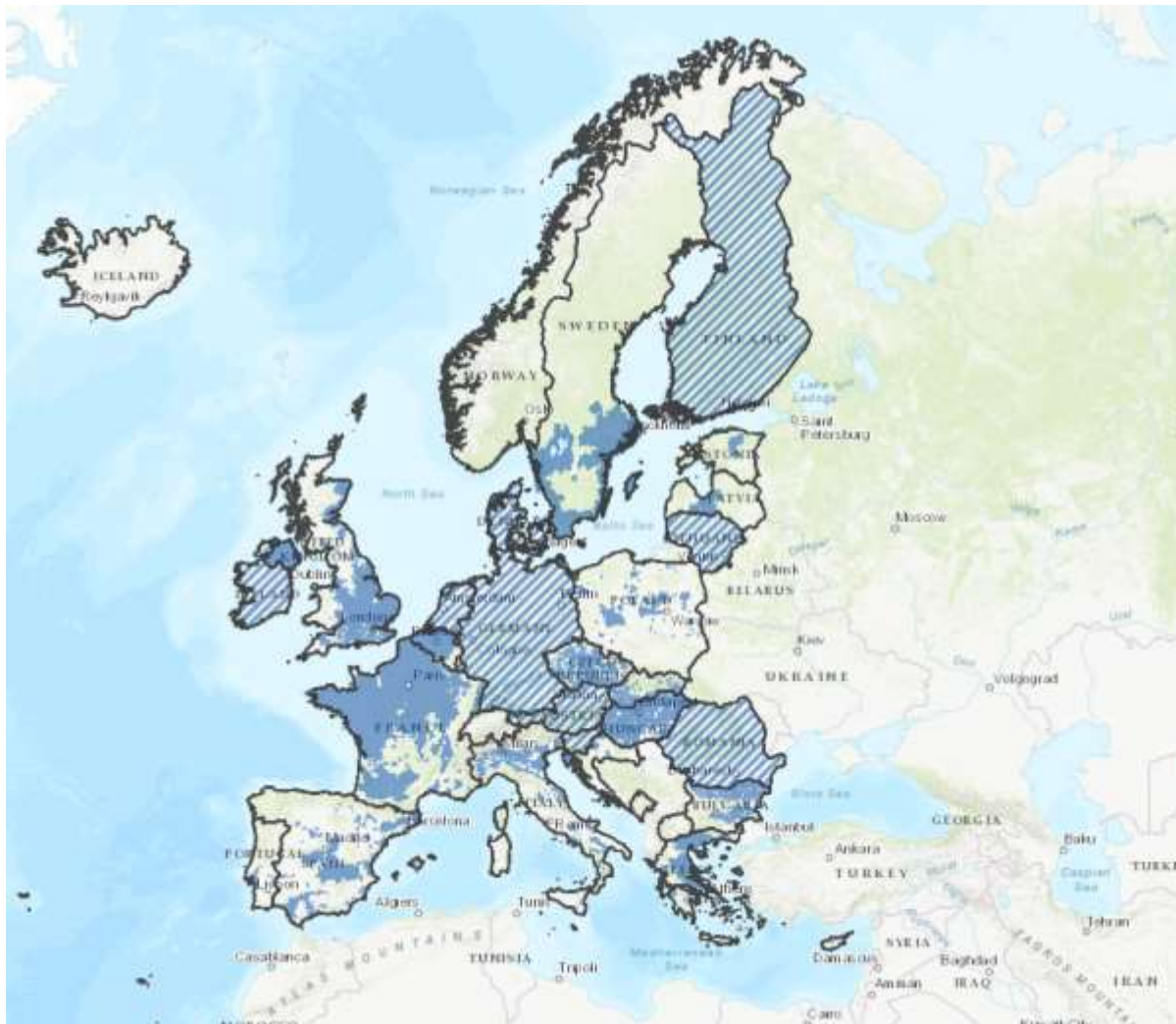
Nitrates directive

- Aim: to protect water quality across Europe by preventing nitrates from agricultural sources polluting ground and surface waters and by promoting the use of good farming practices.
- Integral part of the Water Framework Directive (WFD)

Nitrates directive (91/676/EEC)

1. Identification of water polluted, or at risk of pollution
 - WFD, 50 mg/l, eutrophic waters
2. Designation as "Nitrate Vulnerable Zones"(NVZs)
3. Establishment of Codes of Good Agricultural Practice to be implemented by farmers on a voluntary basis
4. Establishment of action programmes to be implemented by farmers within NVZs on a compulsory basis
5. National monitoring and reporting

Nitrate Vulnerable Zones in the EU



Measures in the Nitrates Directive, examples

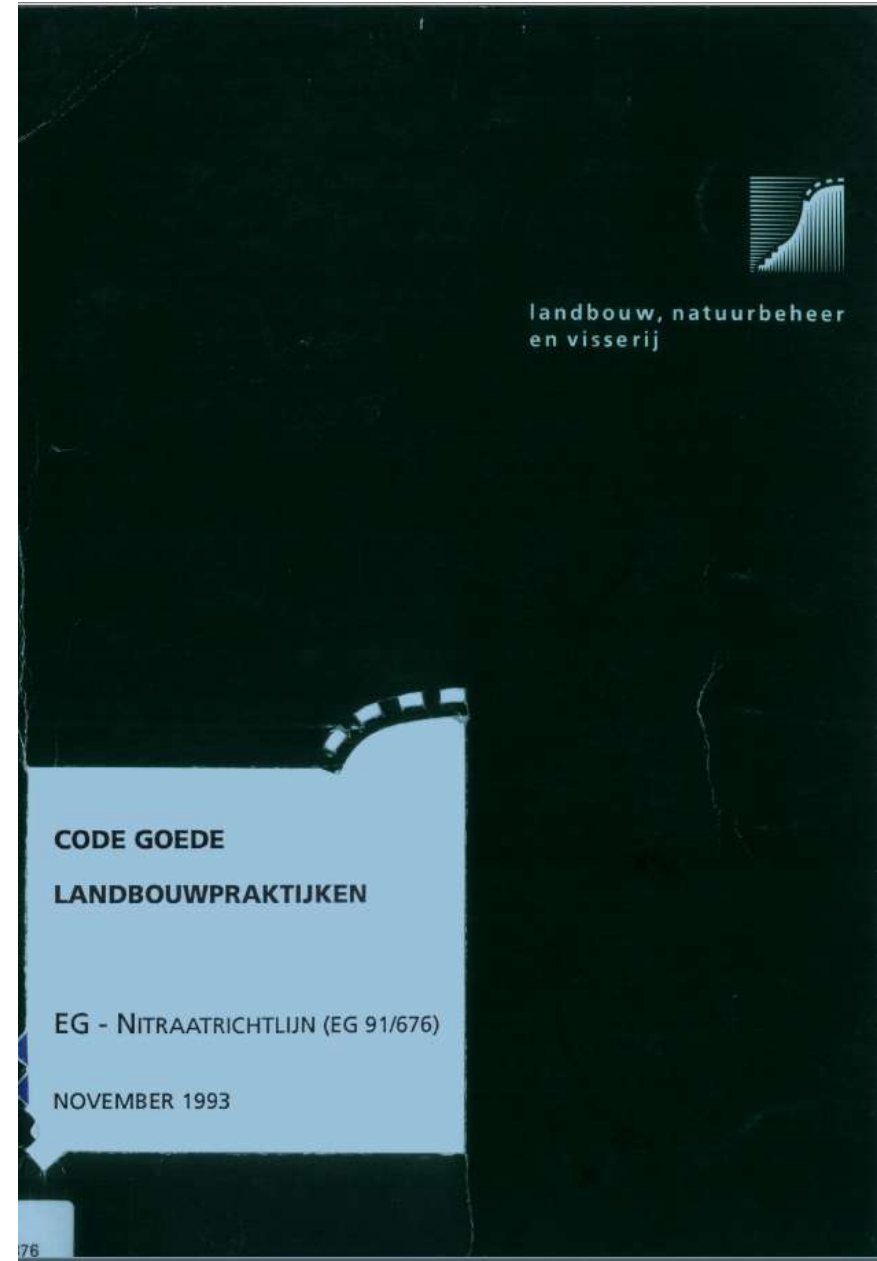
- Periods when nitrogen fertilizers can be applied
 - Conditions for fertilizer application (on steeply sloping ground, frozen or snow covered ground, near water courses, etc.)
 - Minimum storage capacity for livestock manure
 - Crop rotations, soil winter cover, and catch crops
- Good Agricultural Practice
- Limitation of fertilizer application (mineral and organic)
 - Maximum amount of livestock manure to be applied (170 kg nitrogen/hectare/year)
- Action programmes

Discussions on the Nitrates Directive

- Height of standard of 50 mg/l nitrate
- Depth of measurement (upper groundwater or deeper)
- Scale in time and space where 50 mg/l need to be full-filled
 - Every place at every moment
 - Average over years and country

Good Agricultural Practices in NL

- <http://edepot.wur.nl/167208>



History Dutch Manure Policy

- 1988 Prohibition of application in winter (manure storage) and P application standards (125-350 kg/ha)
- 1991: Low emission application of manure
- 1998: MINAS, Mineral Accounting System with standards on N and P losses
- 2006: Application standards for N and P
- Until now: Tightening standards and increase in regulations
 - Balance fertilization P

Dutch Manure Policy: Application standards

- Nitrogen in organic manure: max 170 kg N/ha
 - Derogation for cattle farmers with 80% grassland: 230 – 250 kg/ha
- Available nitrogen
 - Per crop
 - Per soil type and region
- Total phosphate
 - Depending on soil P-status and sector
 - 50% exemption for compost

Application standards available nitrogen (rvo.nl)

Gewas	Klei 2017	Noordelijk ¹⁰ , westelijk ¹¹ en centraal ¹² zand 2017	Zuidelijk ¹³ zand 2017	Löss ⁴ 2017	Veen 2017
Grasland (kg N per ha per jaar)					
Grasland met beweiden	345	250	250	250	265
Grasland met volledig maaien ¹	385	320	320	320	300
Tijdelijk grasland² (kg N per ha per periode)					
van 1 januari tot minstens 15 april	60	50	50	50	50
van 1 januari tot minstens 15 mei ³	110	90	90	90	90
van 1 januari tot minstens 15 augustus ³	250	210	210	210	210
van 1 januari tot minstens 15 september ³	280	235	235	235	235
van 1 januari tot minstens 15 oktober ³	310	250	250	250	265
vanaf 15 april tot minstens 15 oktober	310	250	250	250	265
vanaf 15 mei tot minstens 15 oktober	280	235	235	235	235
vanaf 15 augustus tot minstens 15 oktober	95	80	80	80	80
vanaf 15 september tot minstens 15 oktober	30	25	25	25	25
vanaf 15 oktober	0	0	0	0	0
Akkerbouwgewassen (kg N per ha per teelt)					
Consumptieaardappellassen hoge norm (zie tabel 1a)	275	260	208	204	270
Consumptieaardappellassen overig	250	235	188	184	245
Consumptieaardappellassen lage norm (zie tabel 1a)	225	210	168	164	220
Consumptieaardappel, vroeg (loofvernietiging voor 15 juli)	120	120	96	96	120
Pootaardappellassen hoge norm (zie tabel 1b)	140	140	140	140	140
Pootaardappellassen overig	120	120	120	120	120
Pootaardappellassen lage norm (zie tabel 1b)	100	100	100	100	100

Working coefficients organic manure (rvo.nl)

Soort en herkomst meststof ¹	Toepassing ¹	Werkingscoëfficiënt in procenten
Drijfmest en dunne fractie		
Drijfmest van graasdieren op het eigen bedrijf geproduceerd	Op bedrijf met beweiding ²	45
	Op bedrijf zonder beweiding ³	60
Drijfmest van graasdieren aangevoerd		60
Drijfmest van varkens	Op klei en veen	60
	Op zand en löss	80
Drijfmest van overige diersoorten		60
Dunne fractie na mestbewerking en gier		80
Vaste mest		
Vaste mest van graasdieren op het eigen bedrijf geproduceerd	Op bouwland op klei en veen, van 1 september t/m 31 januari	30
	Overige toepassingen op bedrijf met beweiding ²	45
	Overige toepassingen op bedrijf zonder beweiding ³	60
Vaste mest van graasdieren aangevoerd	Op bouwland op klei en veen, van 1 september t/m 31 januari	30
	Overige toepassingen	40
Vaste mest van varkens, pluimvee en nertsen		55
Vaste mest van overige diersoorten	Op bouwland op klei en veen, van 1 september t/m 31 januari	30
	Overige toepassingen	40
Overig		
Compost		10
Champost		25
Zuiveringsslib		40
Overige organische meststoffen		50
Mengsels van meststoffen ⁴	Voor mengsels geldt de werkingscoëfficiënt van de meststof met de hoogste werkingscoëfficiënt die het mengsel bevat	

Application standards phosphorus (rvo.nl)

Grasland

PAL-waarde	Categorie	2014	2015	2016	2017
<27	Laag	100	100	100	100
27-50	Neutraal	95	90	90	90
>50	Hoog	85	80	80	80

Bouwland

Pw-waarde	Categorie	2014	2015	2016	2017
<36	Laag	80	75	75	75
36-55	Neutraal	65	60	60	60
>55	Hoog	55	50	50	50

- Separate standard phosphate fixing soils 120 kg/ha

Use prescriptions

- Prohibition of application of fertilizers and manure in winter
- Prohibition of grassland destruction in autumn and winter
- Catch crop after maize

Other parts of Dutch Manure Policy

- Manure processing obligation
- Phosphate quota dairy farming
- Animal quota pigs and poultry
- Obligations for transport, manipulation and processing of manure

Fertilization in the Netherlands

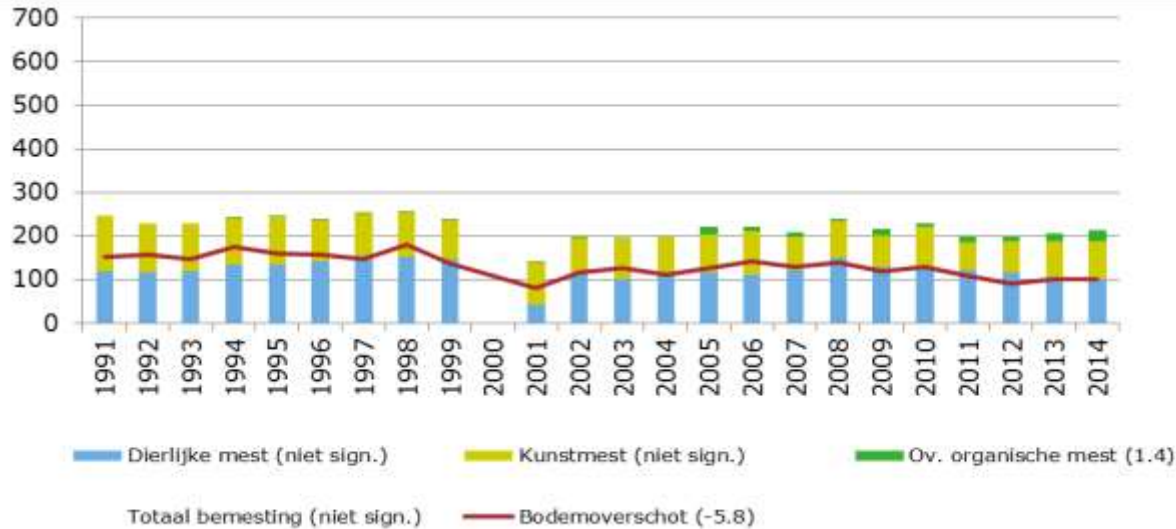
*From Evaluation Manure Policy 2016
(PBL, RIVM, WUR)*

Source Gerard Velthof

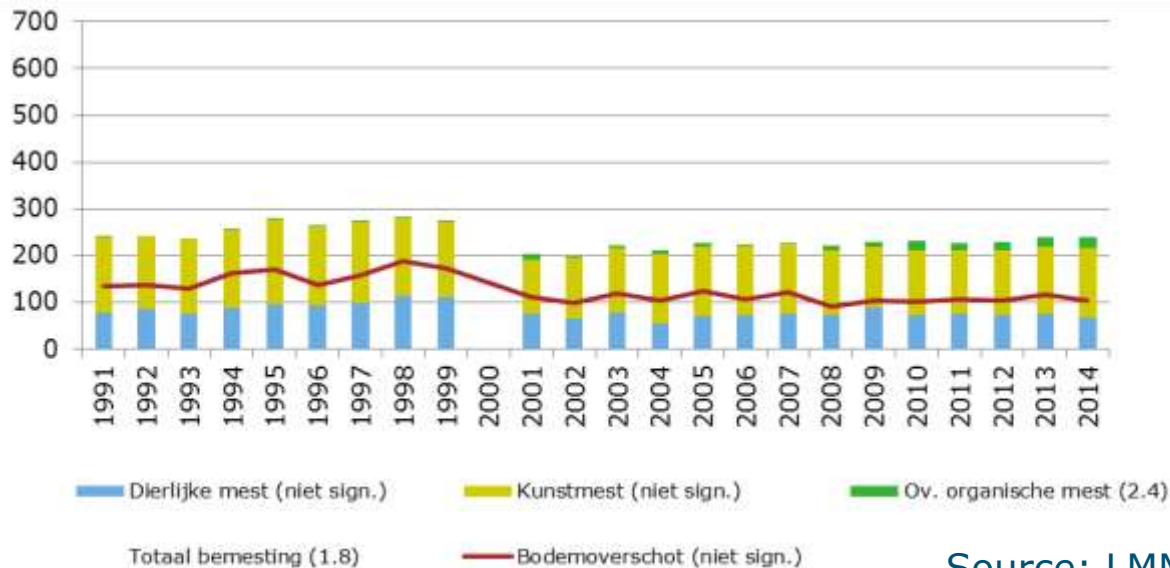


Arable farming nitrogen (kg N/ha)

national measurement network effects manure policy (LMM)

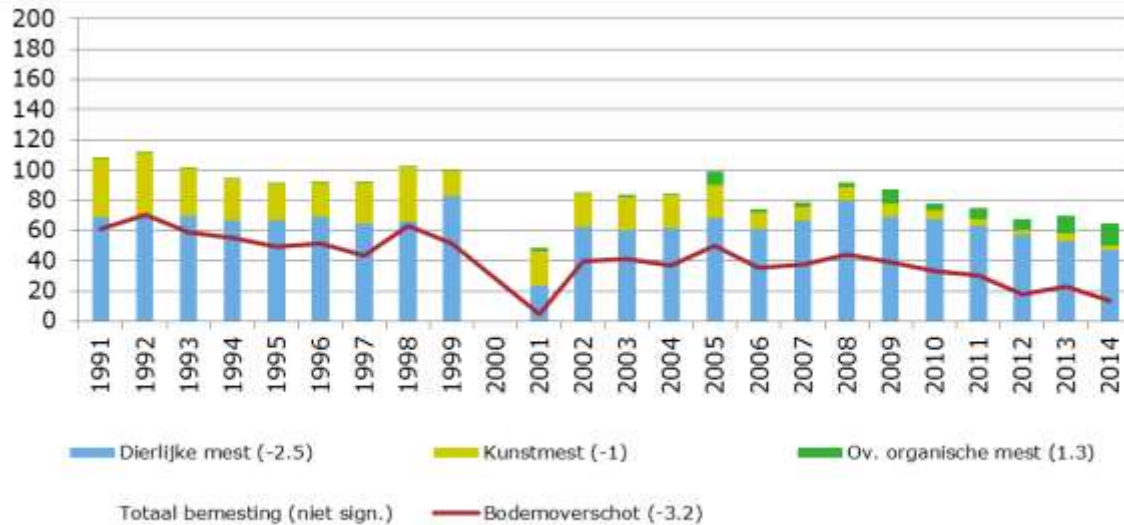


Sandy soils

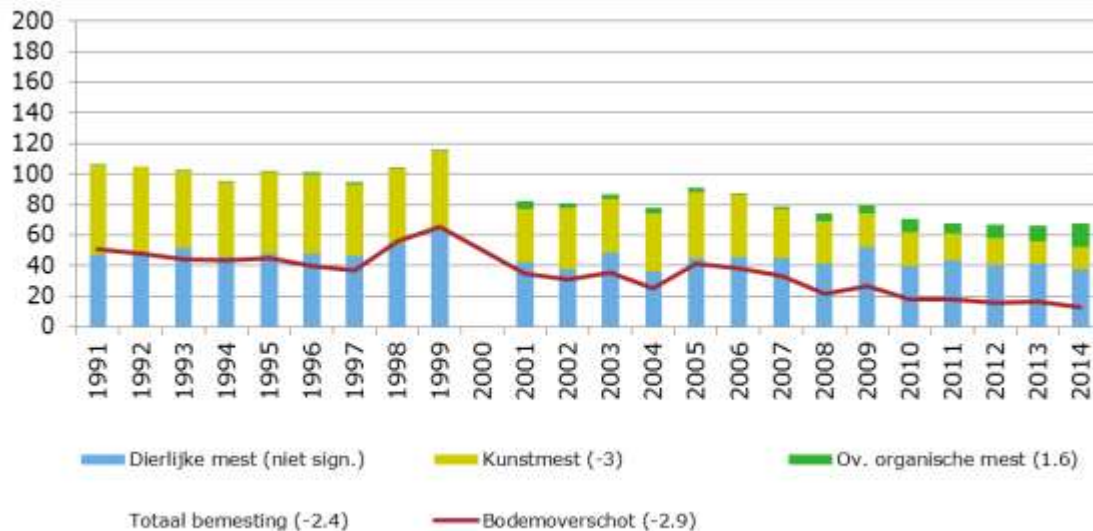


Clay soils

Arable farming phosphate (kg P₂O₅/ha)



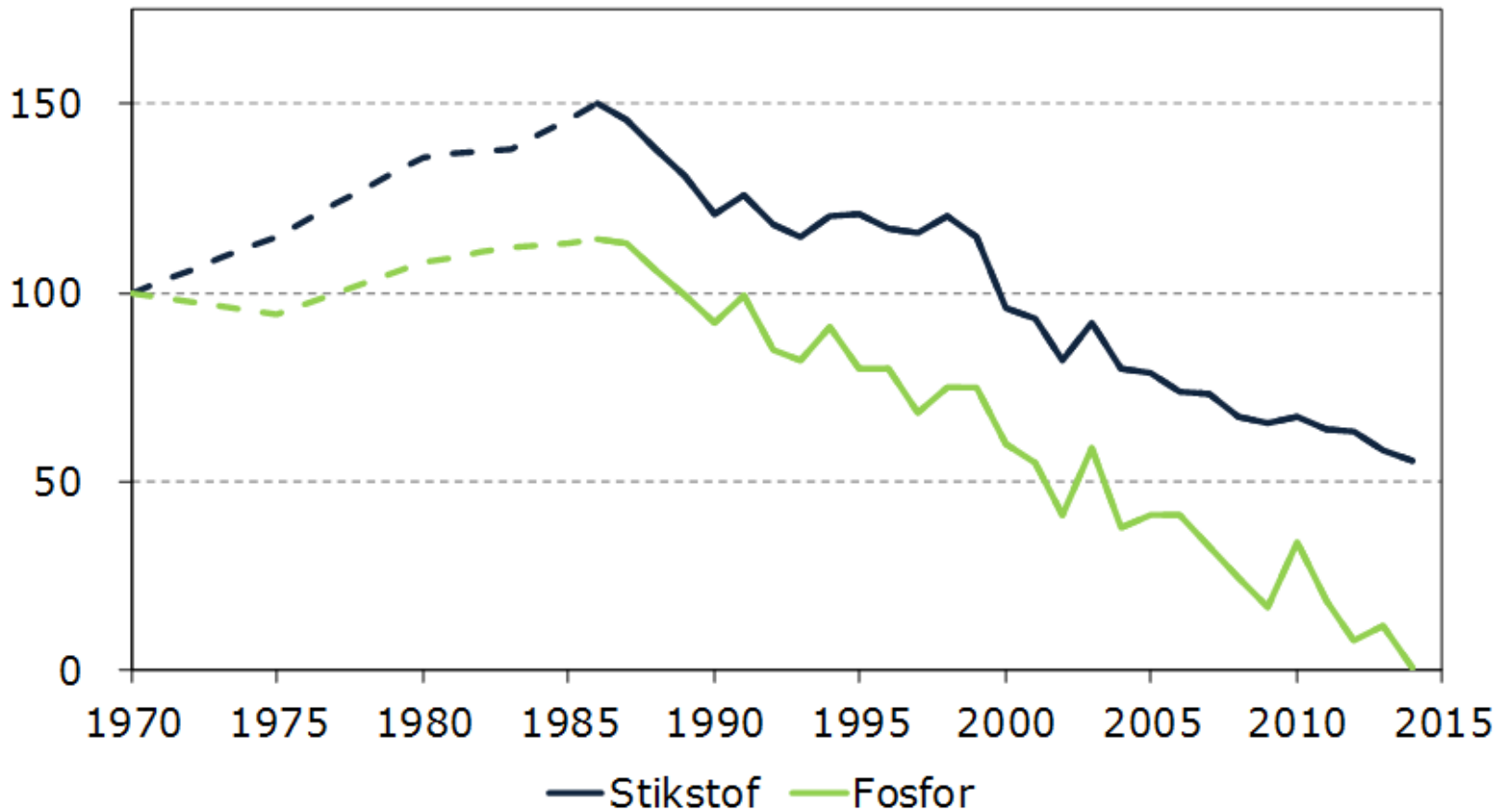
Sandy soils



Clay soils

Nitrogen and phosphorus surpluses

Nutriëntenoverschot (1970 = 100)



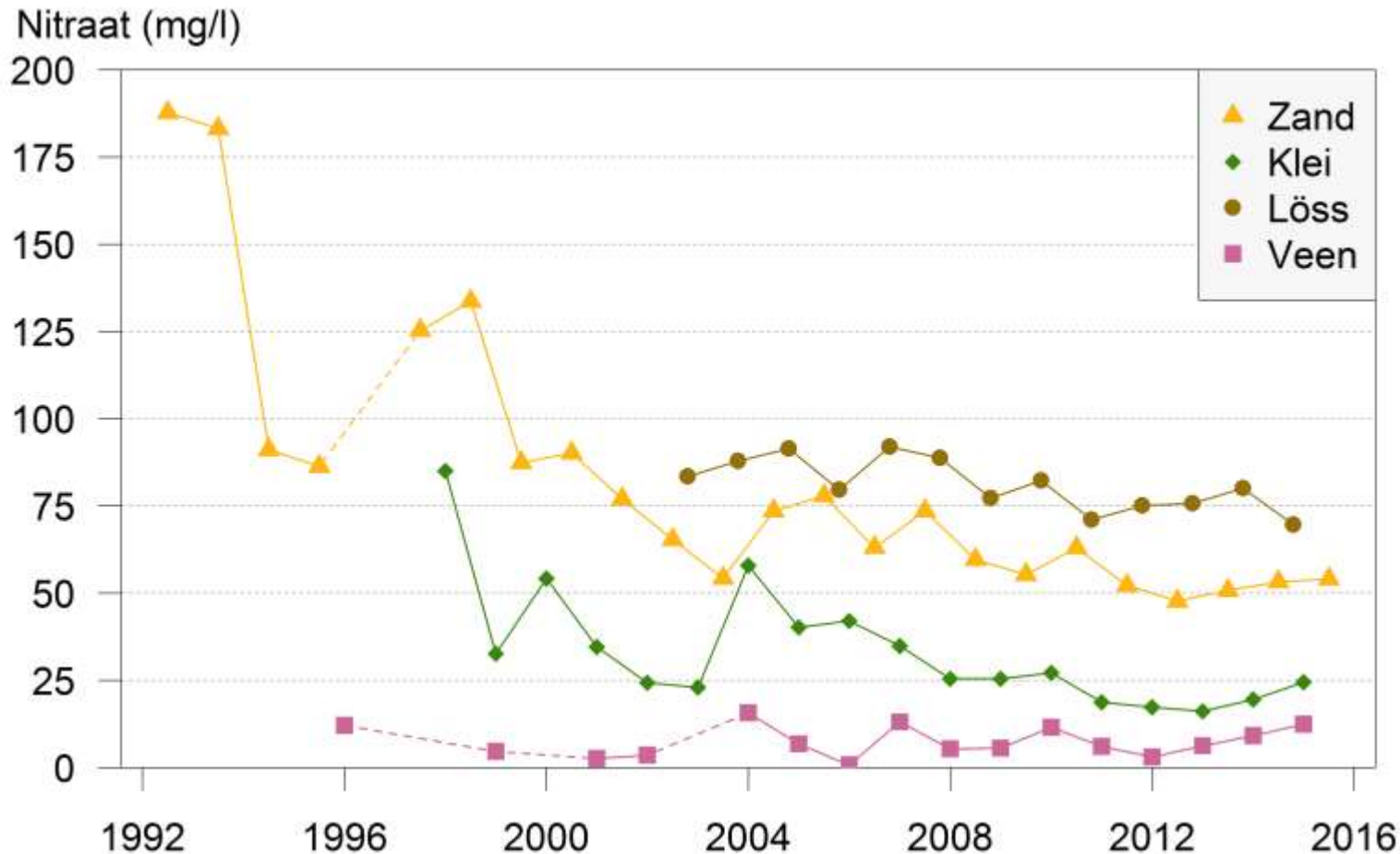
Groundwater Quality

*From Evaluation Manure Policy 2016
(PBL, RIVM, WUR)*

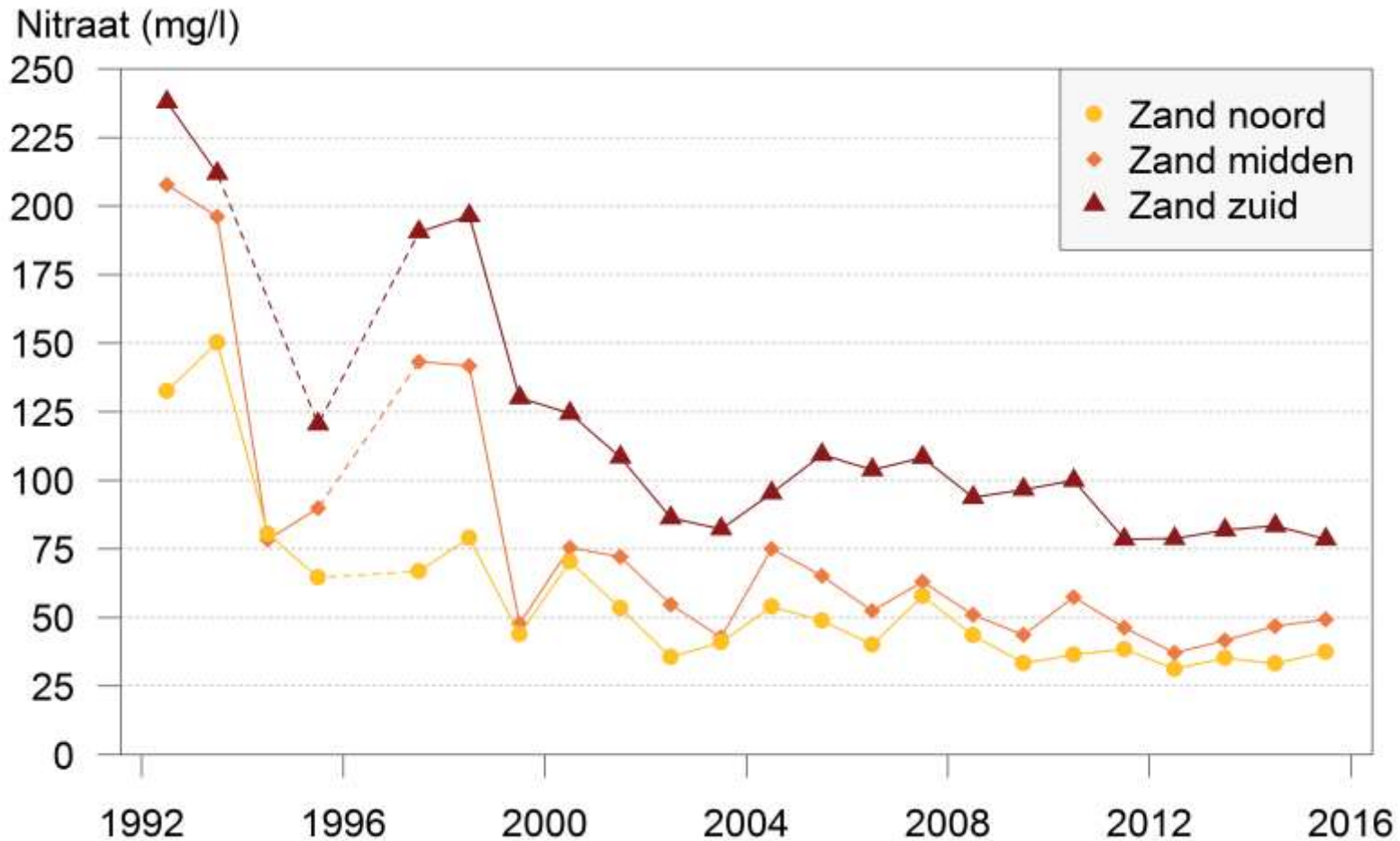
Source Gerard Velthof



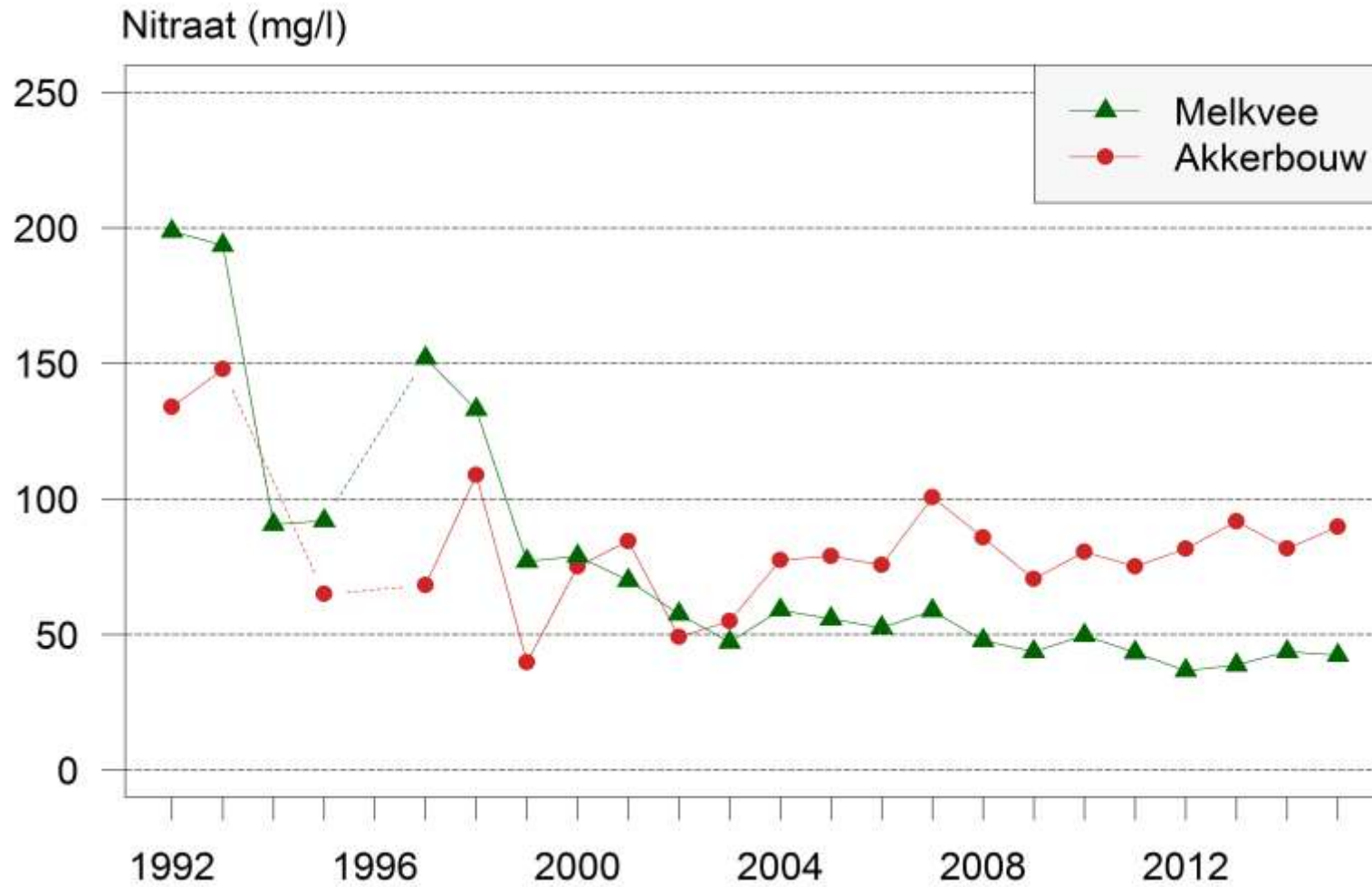
Nitrate in groundwater per soil type (LMM)



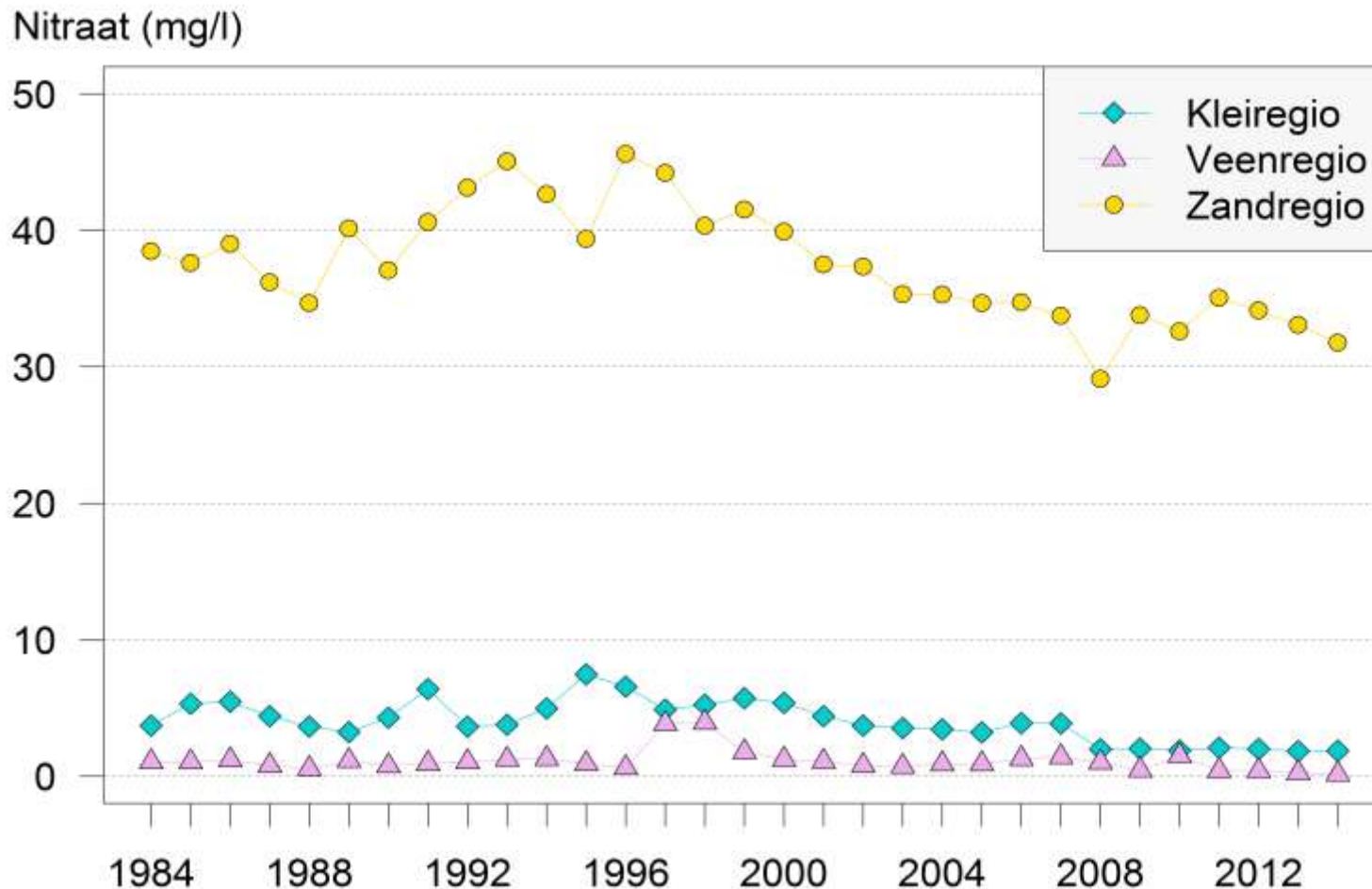
Nitrate in groundwater sandy soils per region (LMM)



Nitrate in groundwater sandy soils for dairy and arable farming (LMM)



Nitrate in groundwater at 5-15 m depth per soil type (LMG)



Surface water quality

*From Evaluation Manure Policy 2016
(PBL, RIVM, WUR)*

Source Gerard Velthof



Emission of nitrogen and phosphorus to surface water

■ Agriculture

- Fertilization, seepage, soil mineralization, deposition
- Courtyard runoff, fertilization of ditches, greenhouse horticulture

■ Nature

- Fertilization, seepage, soil mineralization, deposition

■ Water treatment plants

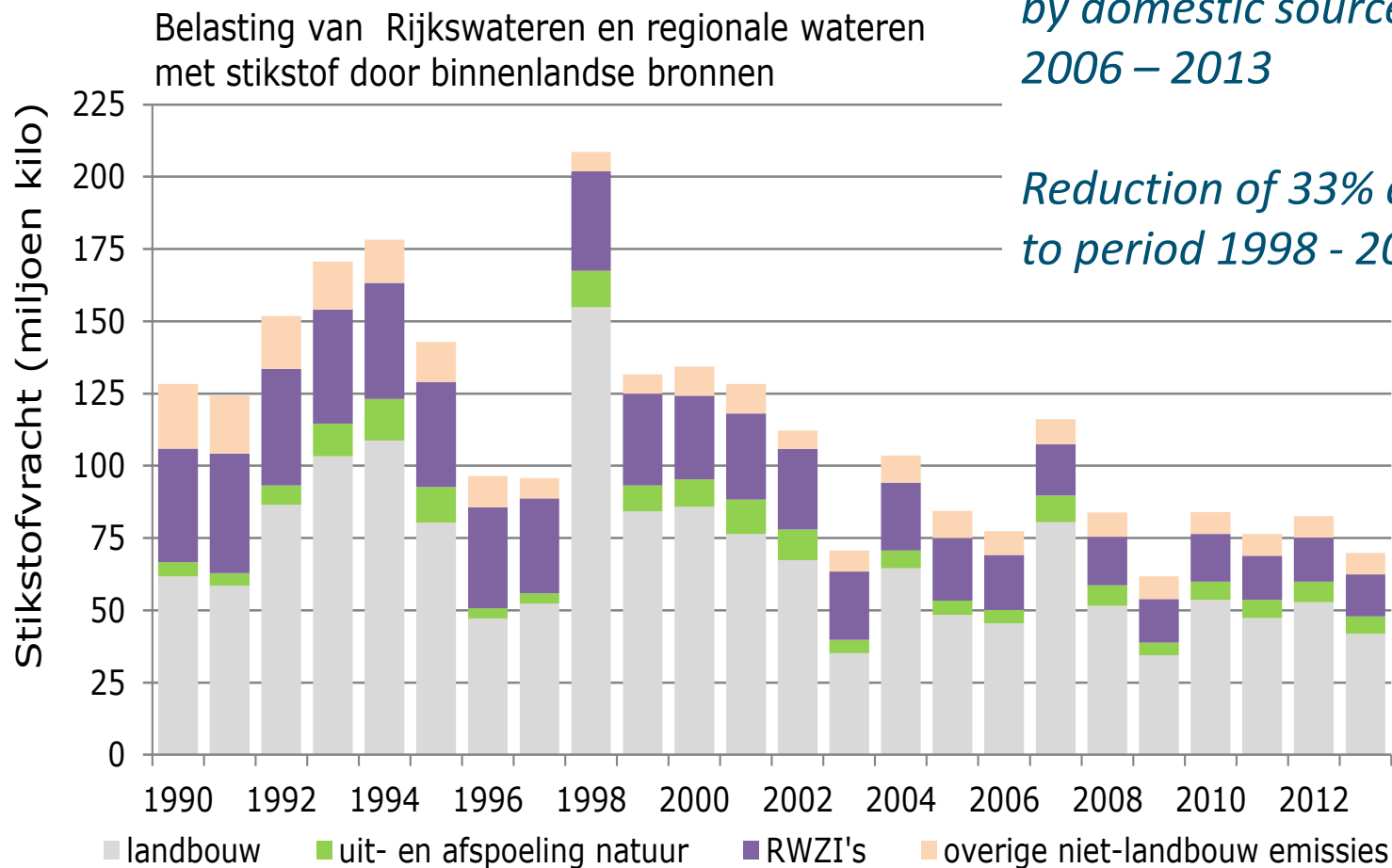
■ Others

- Sewer overflow, traffic, consumers, water birds, etc.

Nitrogen Load

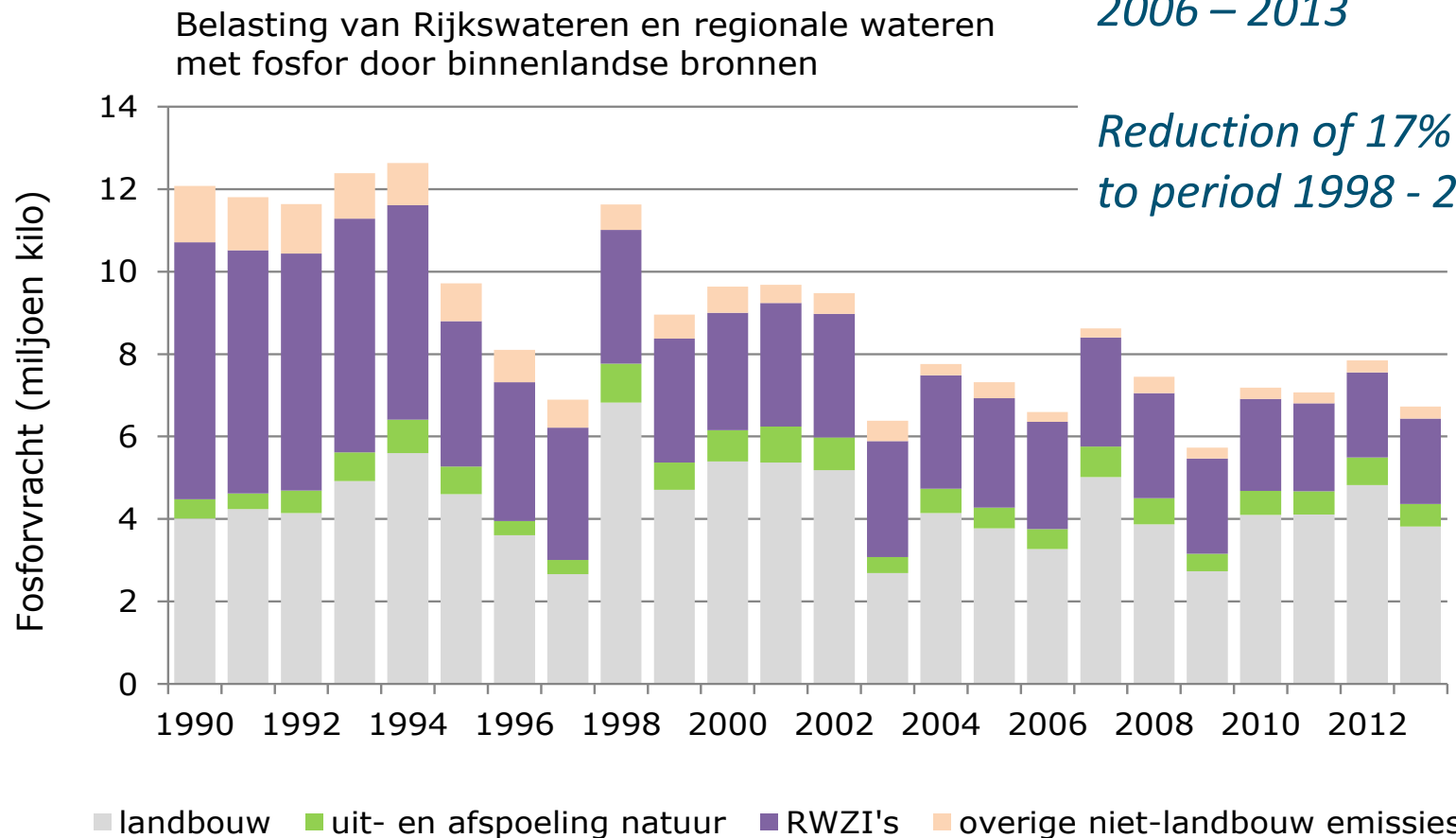
Contribution of agriculture to nitrogen load surface water by domestic sources: 63% in 2006 – 2013

Reduction of 33% compared to period 1998 - 2005



Phosphorus load

Contribution of agriculture to nitrogen load surface water by domestic sources: 55% in 2006 – 2013



Surface water (MNLSO)

Measurement locations in agricultural influenced surface water (MNLSO) which for N-total and P-total fulfil requirements of standards from water boards:

Nitrogen

- Sandy soils 30 – 50%
- Clay soils 40 – 60%

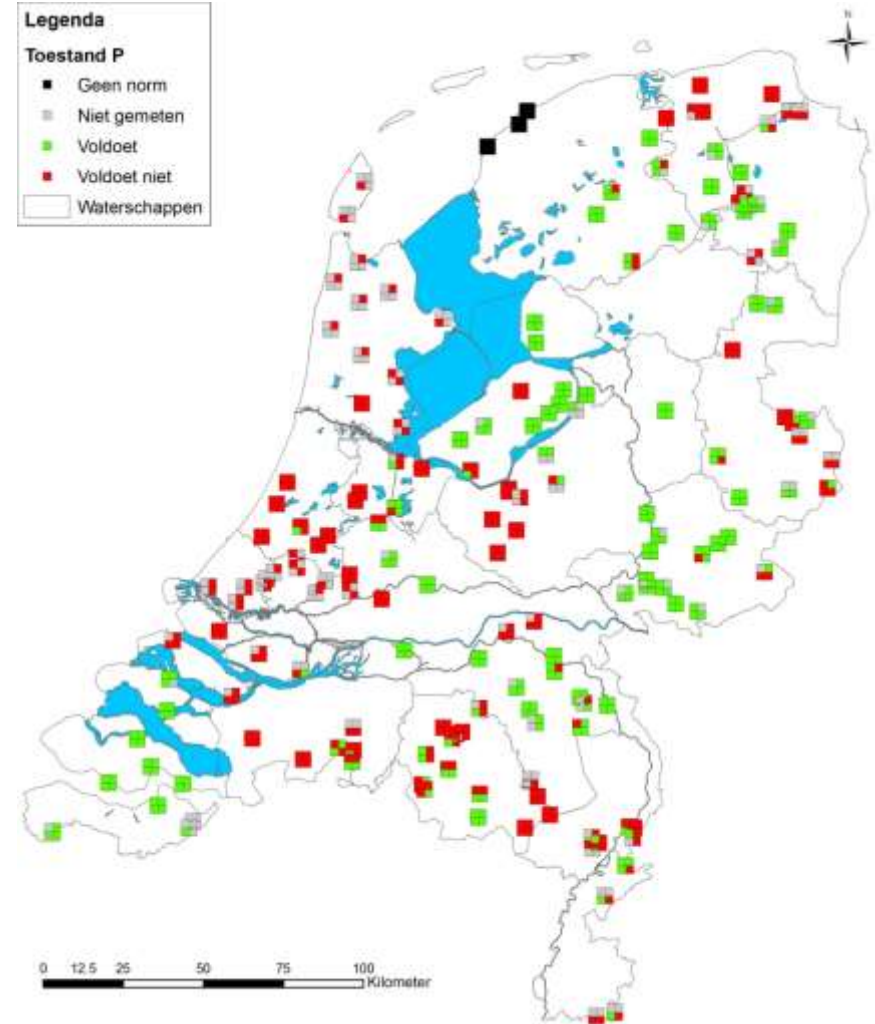
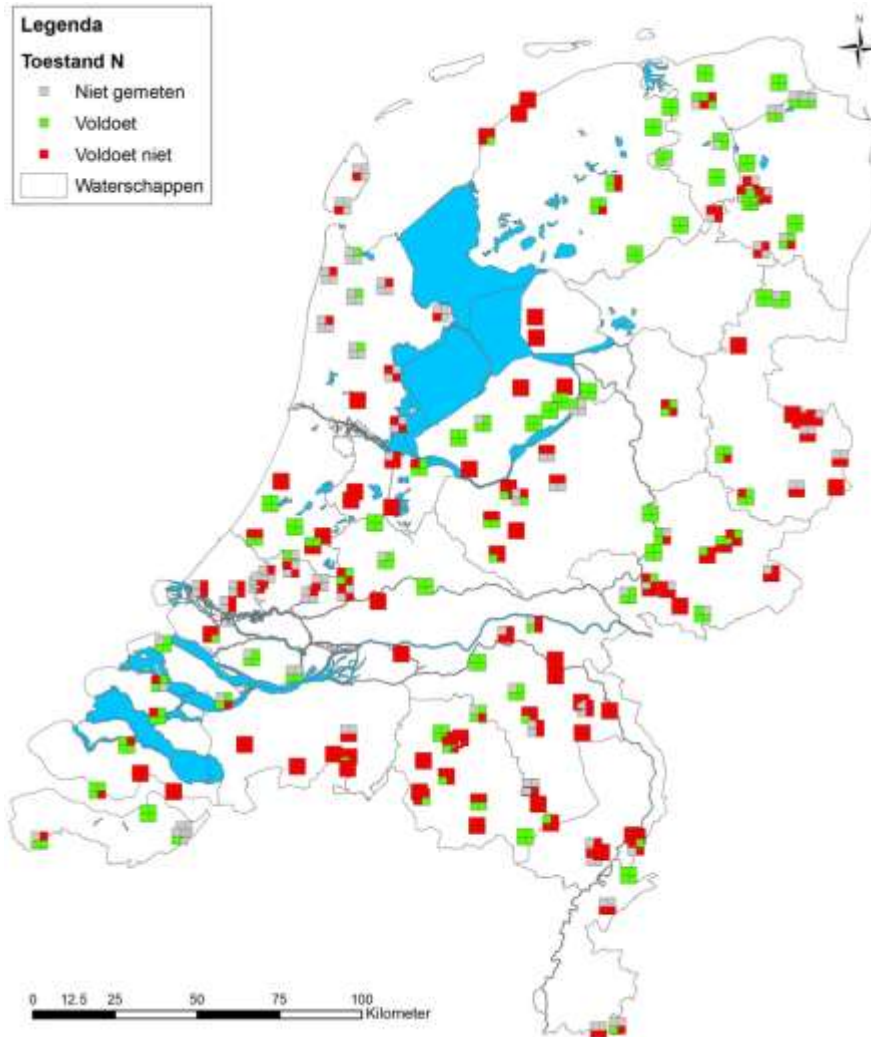
Phosphate

- Sandy soils 50 – 60%
- Clay soils 50 – 65%

Most locations have decreasing trend since '80



Exceeding of standards



Crop yields and soil fertility

*From Evaluation Manure Policy 2016
(PBL, RIVM, WUR)*

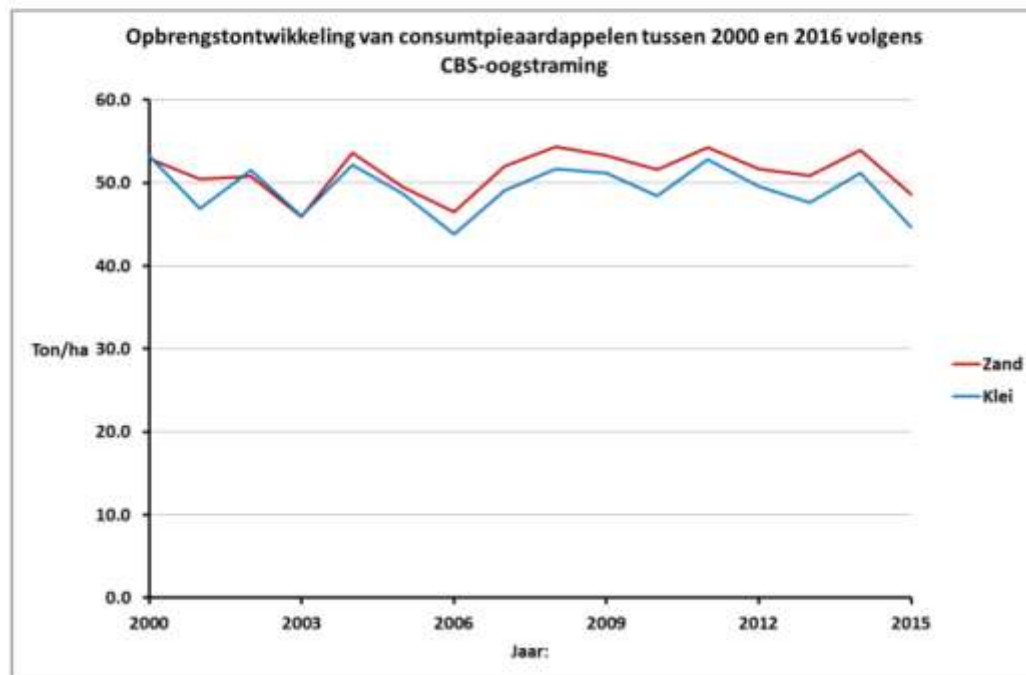
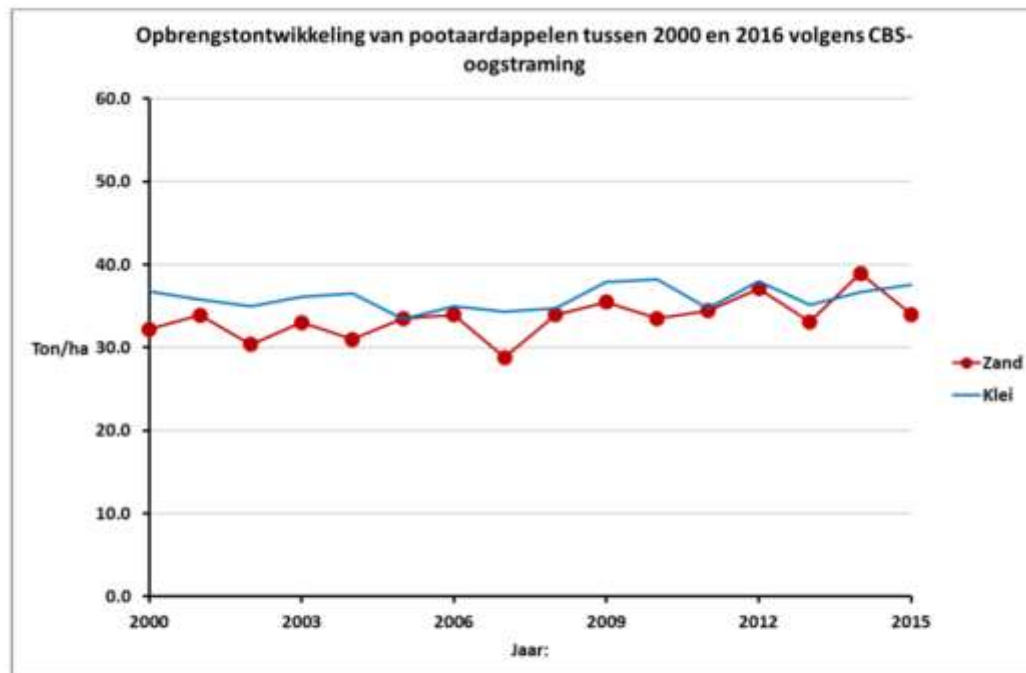
Source Gerard Velthof



Seed potatoes and ware potatoes



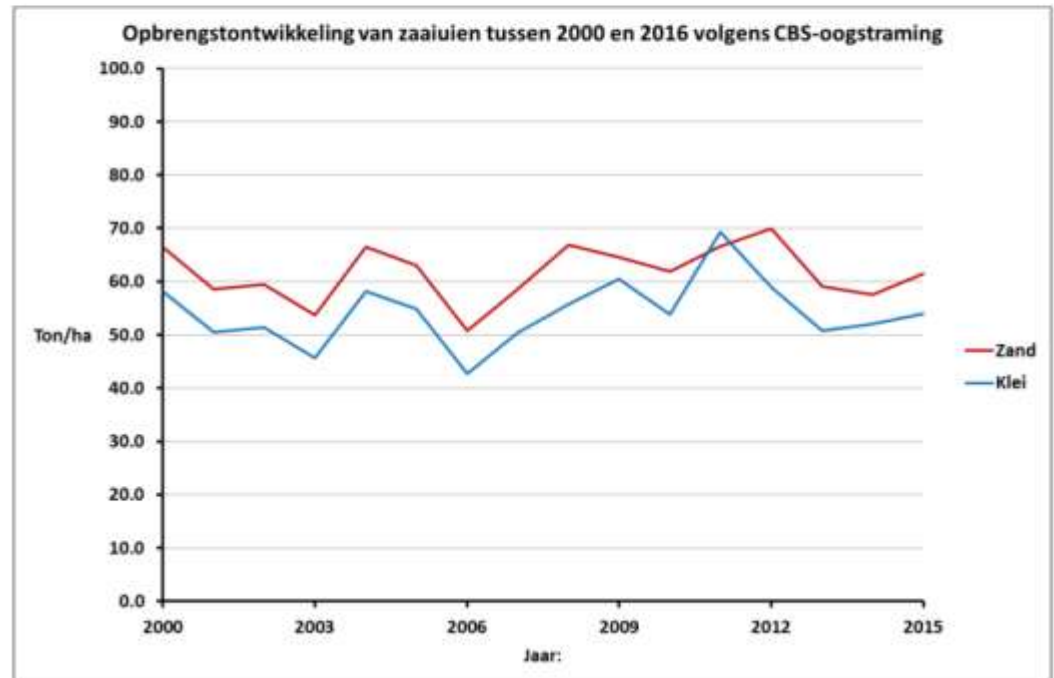
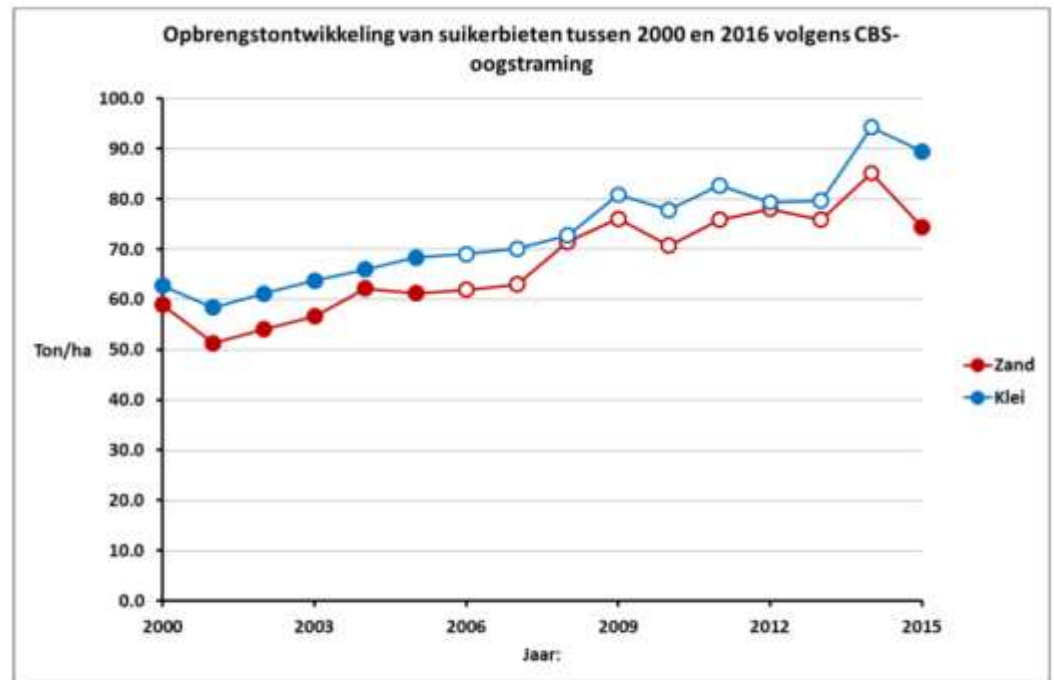
Source: Schröder et al. (2016)
Based on CBS



Sugar beet and onions



Source: Schröder et al. (2016)
Based on CBS



Winter wheat and corn



Source: Schröder et al. (2016)
Based on CBS



Trends CBS yield estimations (2006-2014)

Jaarlijkse opbrengstverandering op zandgrond (inclusief lössgrond) en kleigrond

Gewas	Landelijke areaal in 2015 (x 1.000 ha)	Zandgrond 2006-2014	Kleigrond 2006-2014
		Opbrengstverandering(%)	
Pootaardappel	41	+1,9	+0,6
Consumptieaardappel	72	+0,7	+0,8
Suikerbieten	58	+3,4	+3,1
Zaaiuien	24	+1,0	+1,6
Wintertarwe	127	+1,7	+0,8
Zomertarwe	15	+3,3	+0,7
Korrelmaïs	11	+0,6	+2,8
Wintergerst	8	+1,6	+1,9
Zomergerst	25	+1,5	+2,5
Grasland	1240	+2,1	+1,2
Snijmaïs	224	+0,5	+1,7
Gemiddeld		+1,7	+1,6

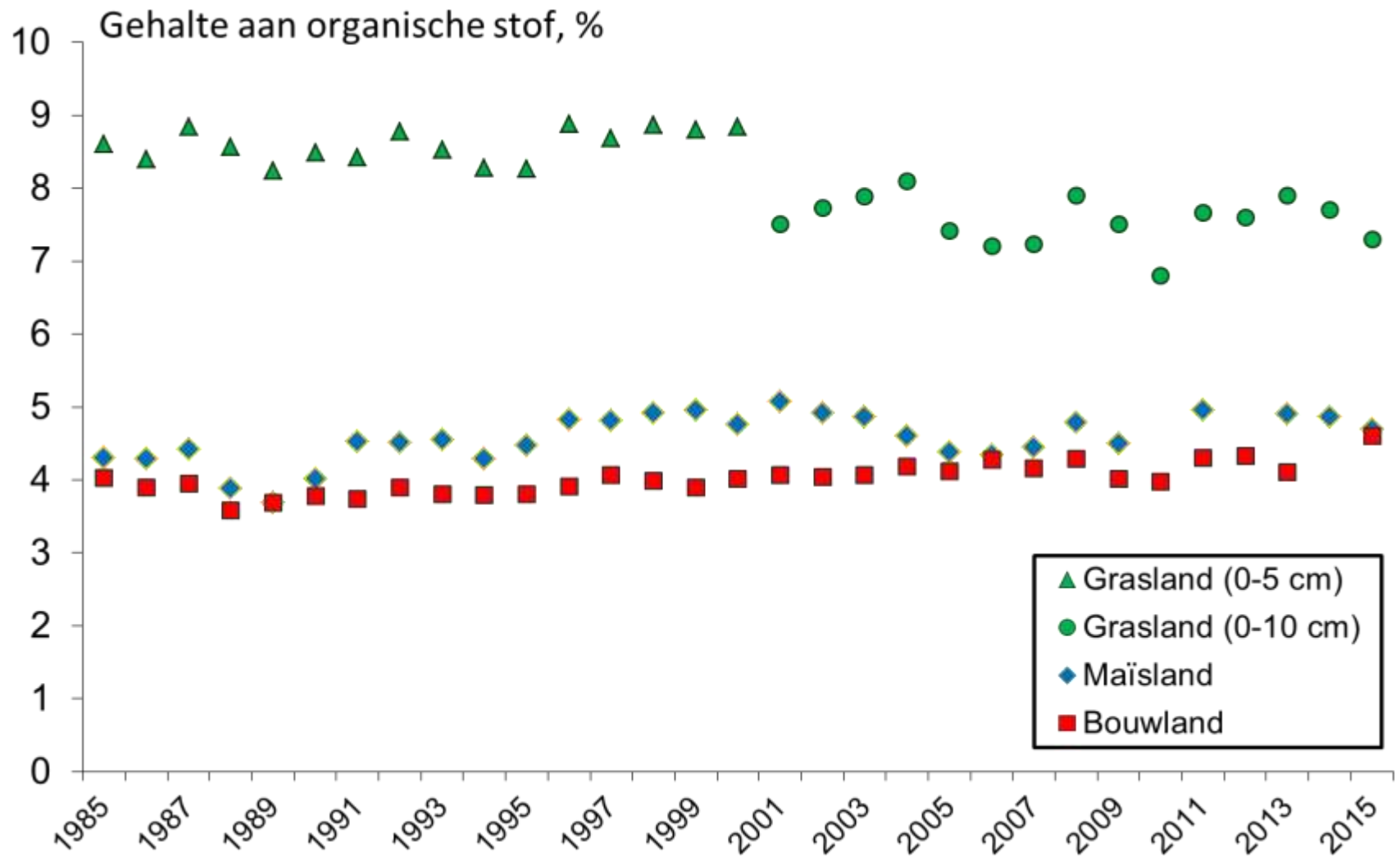
Bron: CBS-opbrengstramingen 2006-2014; Schröder et al. (2016)

Soil fertility

- Data-set Eurofins Agro (Blgg) 2005-2015
 - Arable farming and maize (0-25 cm)
 - Grassland (0-10 cm)
- Selection: minimal 7 years with minimal 75 measuring points
 - Organic matter content
 - Soil P-status (P-AL, Pw, P-CaCl₂)



Trend organic matter content (Eurofins Agro)



Trend organic matter content period 2005-2015

Gewasgroep	Grondsoort	Organische stofgehalte %/jaar
Grasland	Dekzand	n.s.
	Rivierklei	+0,24
	Zeeklei	+0,25
Maisland	Dekzand	+0,07
	Rivierklei	n.s.
	Zeeklei	n.s.
Akkerbouw	Dekzand	+0,11
	Rivierklei	+0,10
	Zeeklei	n.s.

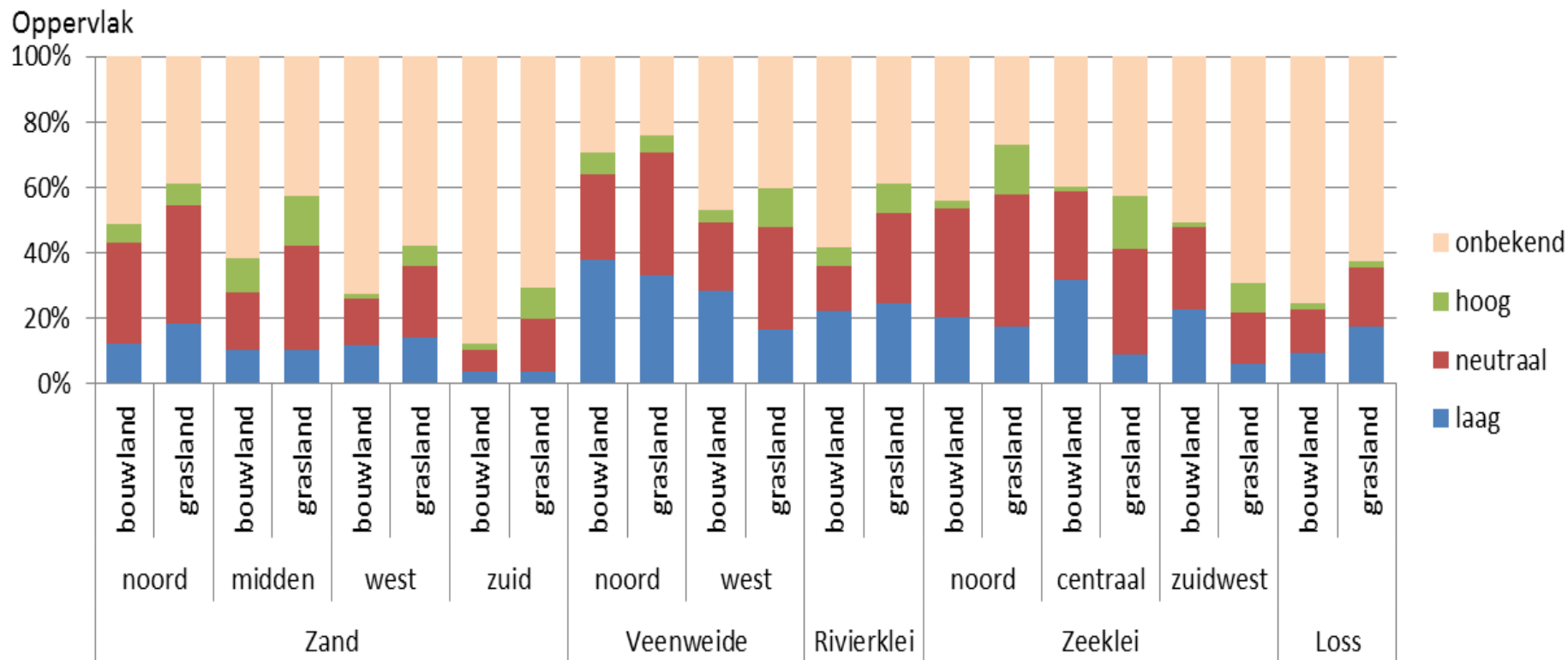
n.s.: niet significant

Trend soil P status in 2005-2015

Gewasgroep	Grondsoort	P-AL mg P ₂ O ₅ /100g/ jaar	Pw-getal mg P ₂ O ₅ /l/ jaar	P-CaCl ₂ mg P/kg/ jaar
Grasland	Dekzand	n.s.	n.s.	-0,11
	Rivierklei	n.s.	n.s.	-0,08
	Zeeklei	n.s.	n.s.	n.s.
Maisland	Dekzand	n.s.	n.s.	n.s.
	Rivierklei	n.s.	n.s.	-0,11
	Zeeklei	n.s.	n.s.	n.s.
Akkerbouw	Dekzand	n.s.	n.s.	n.s.
	Rivierklei	n.s.	n.s.	-0,10
	Zeeklei	n.s.	-0,80	-0,08

n.s.: not significant

Soil P-status in 2015 (RVO.nl)



Farming systems research Vredepeel

How to comply to water quality standards while preserving crop yield

- Since 1989
 - From 2011 in project 'Soil quality on sandy soils'
- Crop rotation
- Strict fertilization plan
- Organic matter input
 - Amount
 - Type of organic matter



Crop rotation

- Arable farming, vegetables and fodder crops
- Extensive crop rotation
 - Alternation of mow and root crops
- Green manure crops
 - Japanese oats after (early) potato and summer barley (and silage maize)
 - Grass-clover after peas (not harvested)
 - Extra nitrogen in the system
 - Example arable-dairy rotation



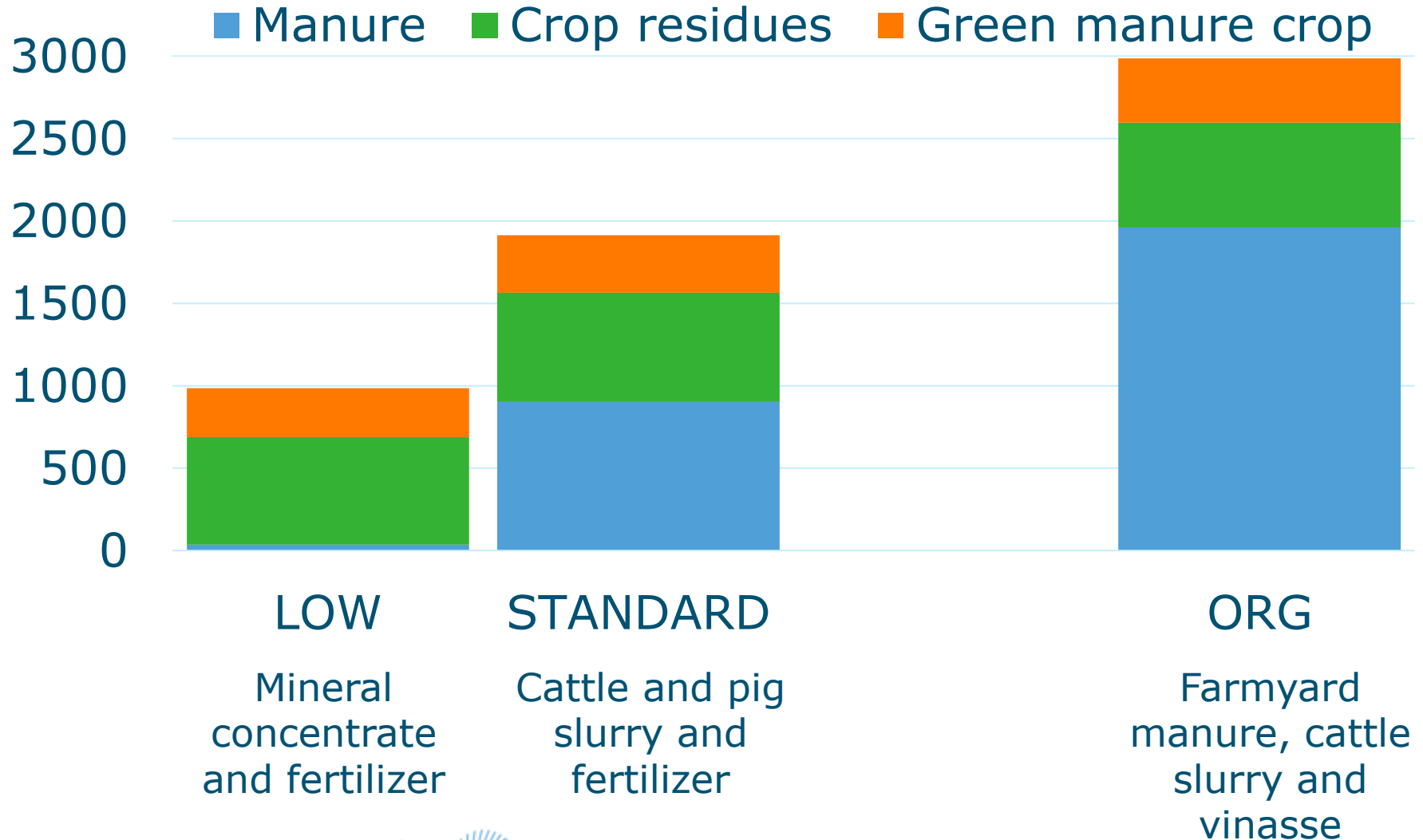
Strict fertilization plan

- Yield dependent balance method
- Accounting form mineralisation from crop residues, green manure crops and organic manure
- Row fertilization organic manure in potato, maize and leek
- Meeting N-standards
 - Part of standard for green manure crop to main crops

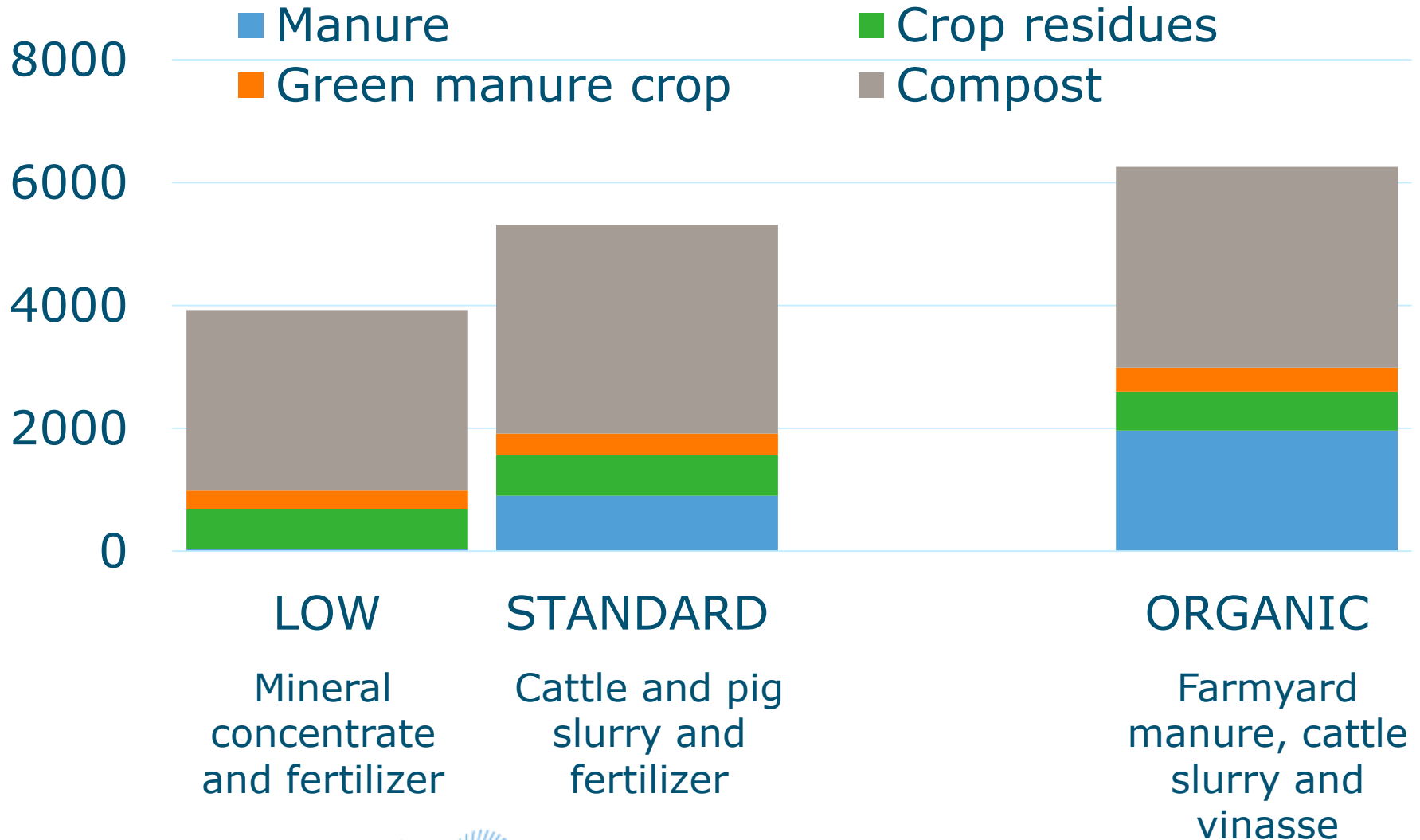
Calculation example fertilization plan silage maize

Target yield	52	ton/ha
N-content crop	3.2	kg/ton
N-uptake	166	kg/ha
N-utilization	75%	
N needed for target	242	kg/ha
Nmin spring	14	kg/ha
N-mineralisation	45	kg/ha
N-deposition	15	kg/ha
N-application	168	kg/ha
Row fertilization 80%	134	kg/ha

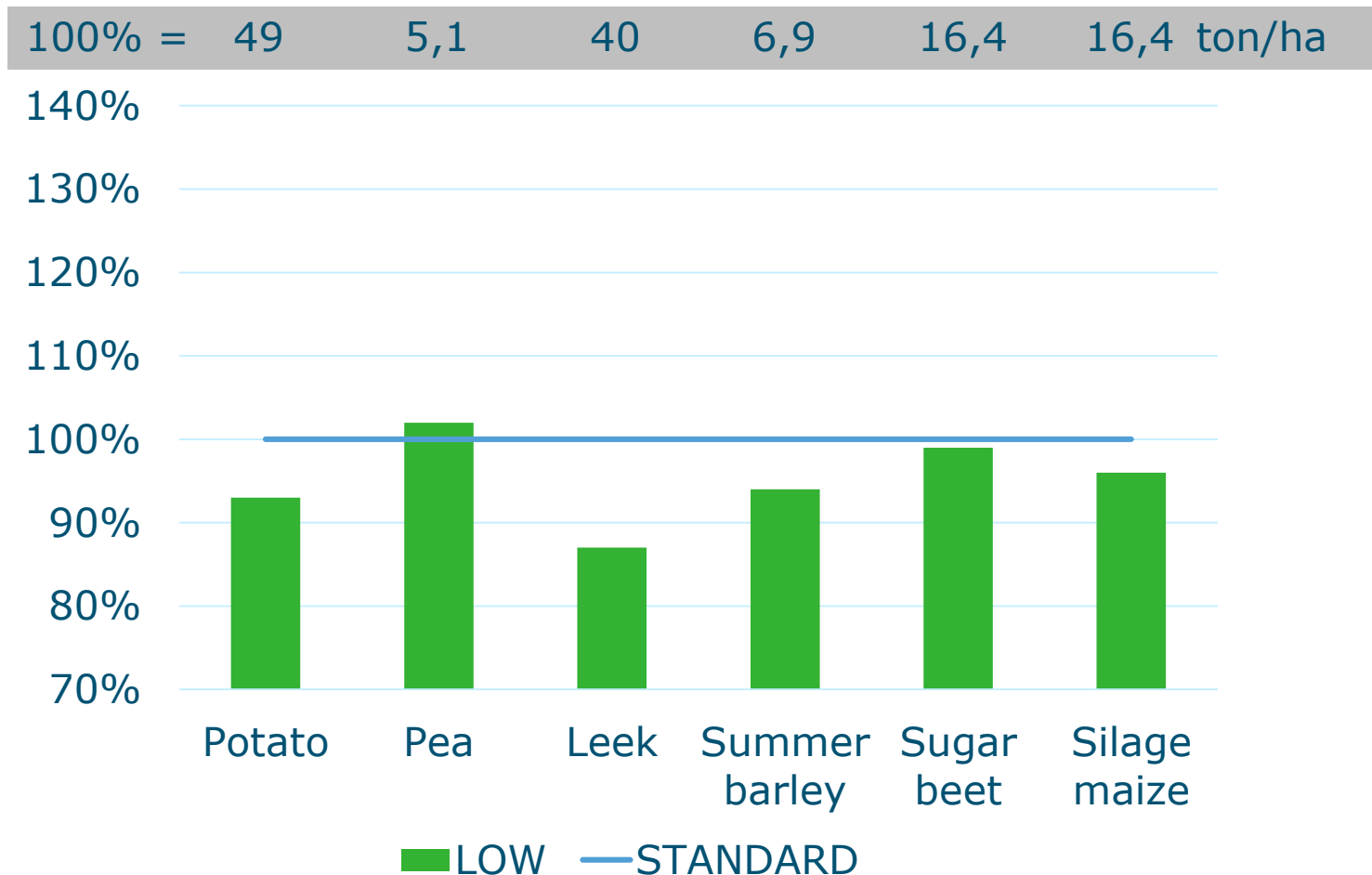
Organic matter inputs per system



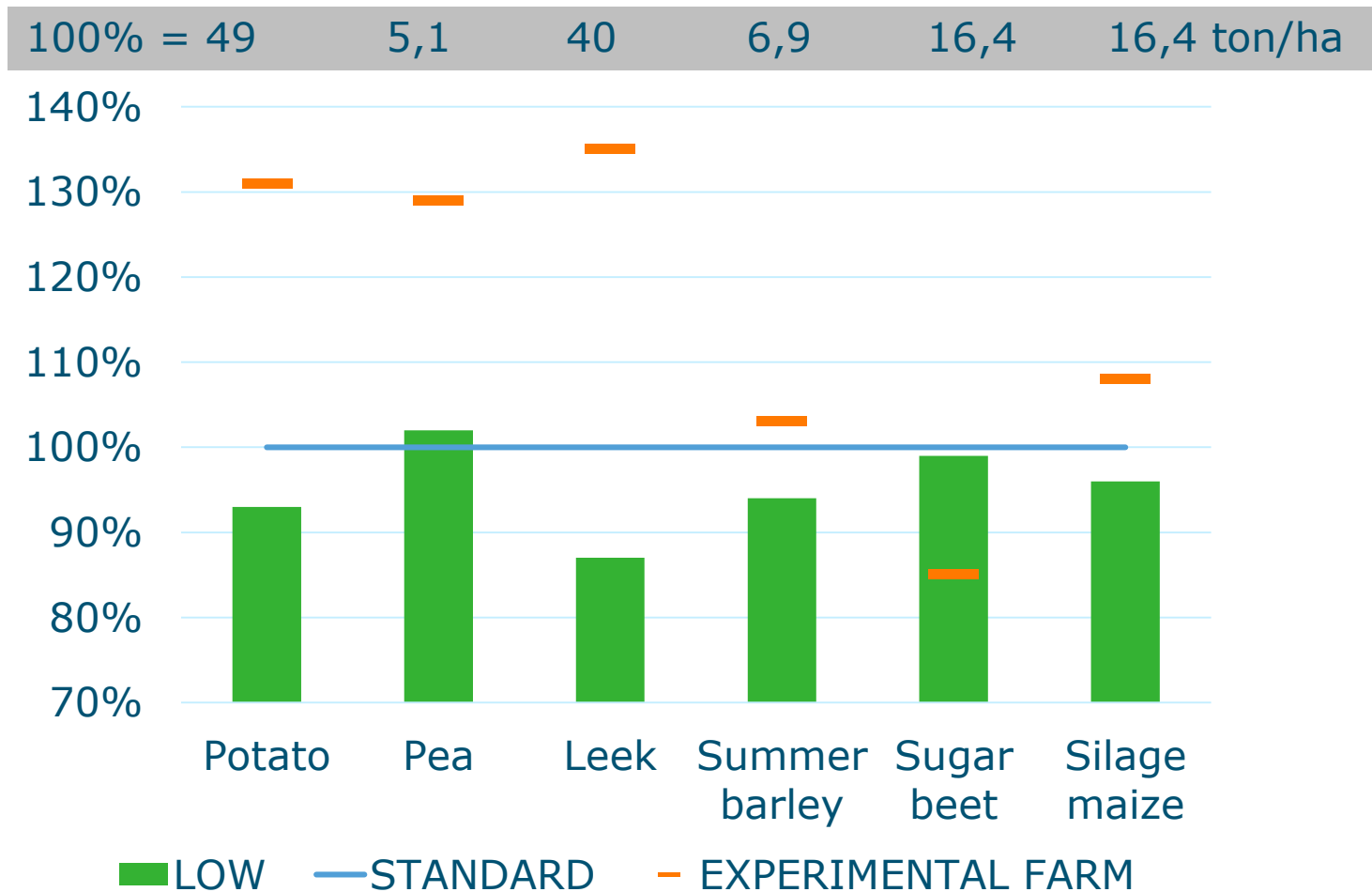
Organic matter inputs including compost



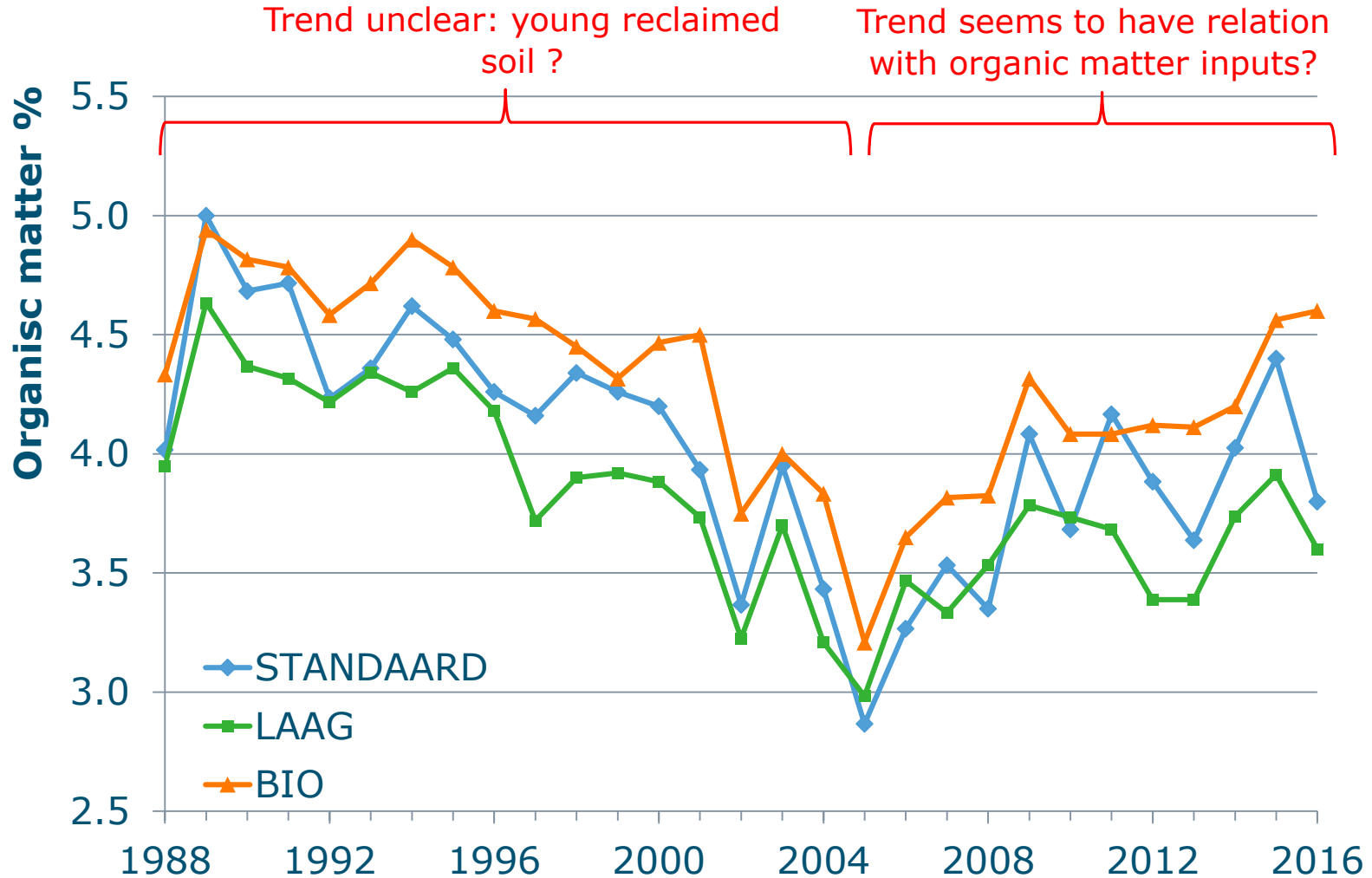
Relative crop yields conventional systems and comparison yields experimental farm



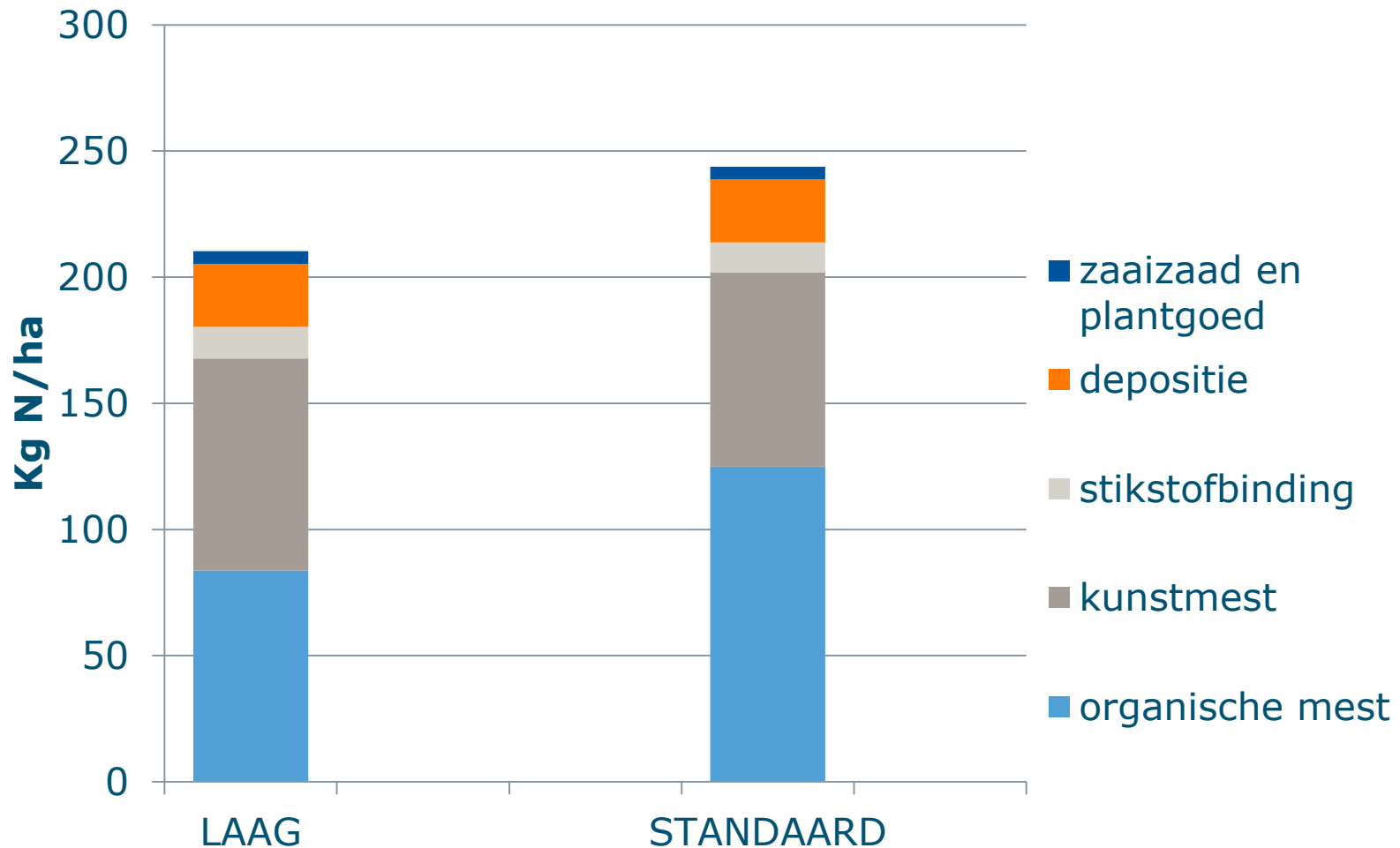
Relative crop yields conventional systems and comparison yields experimental farm



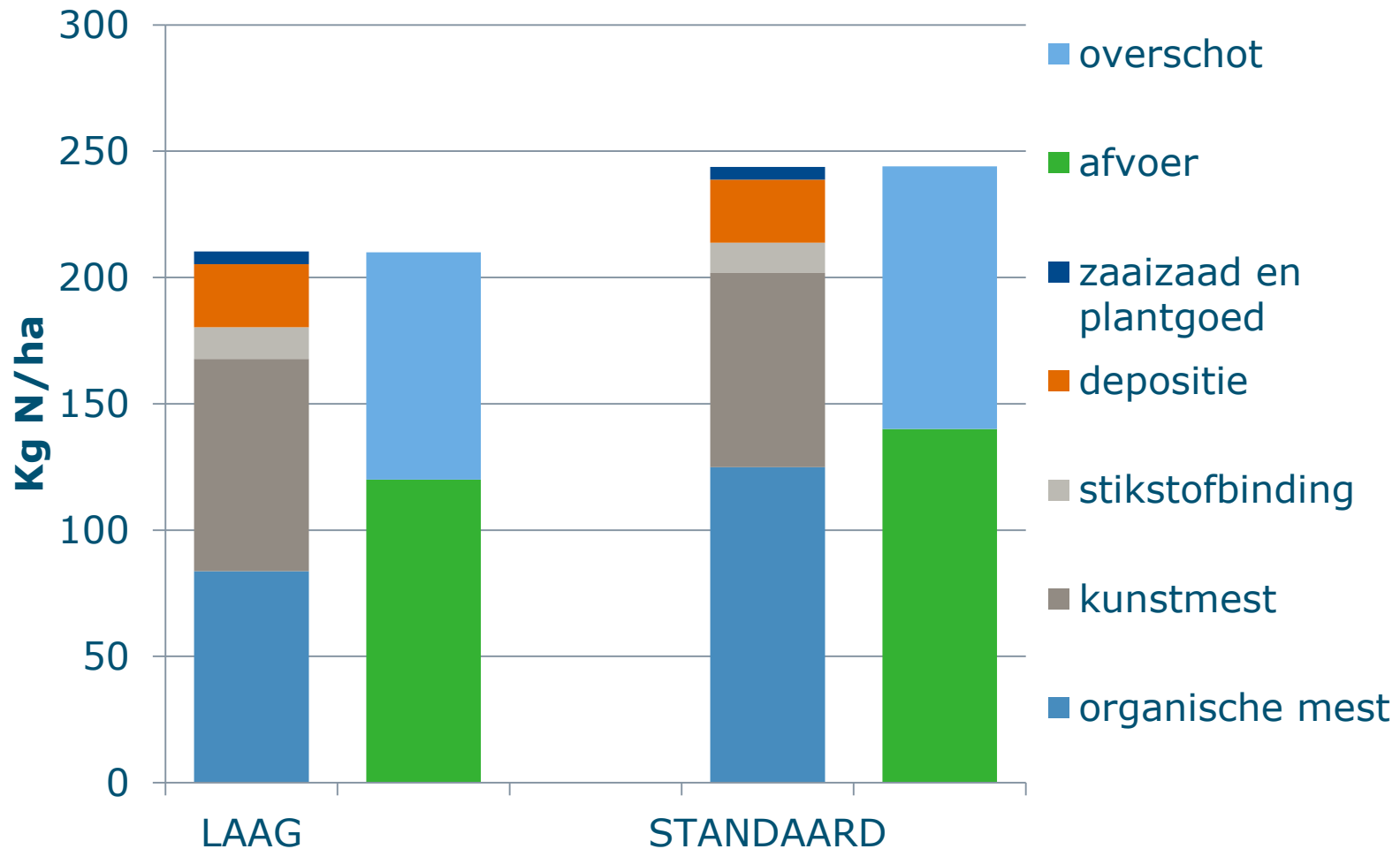
Organic matter content 1988-2016



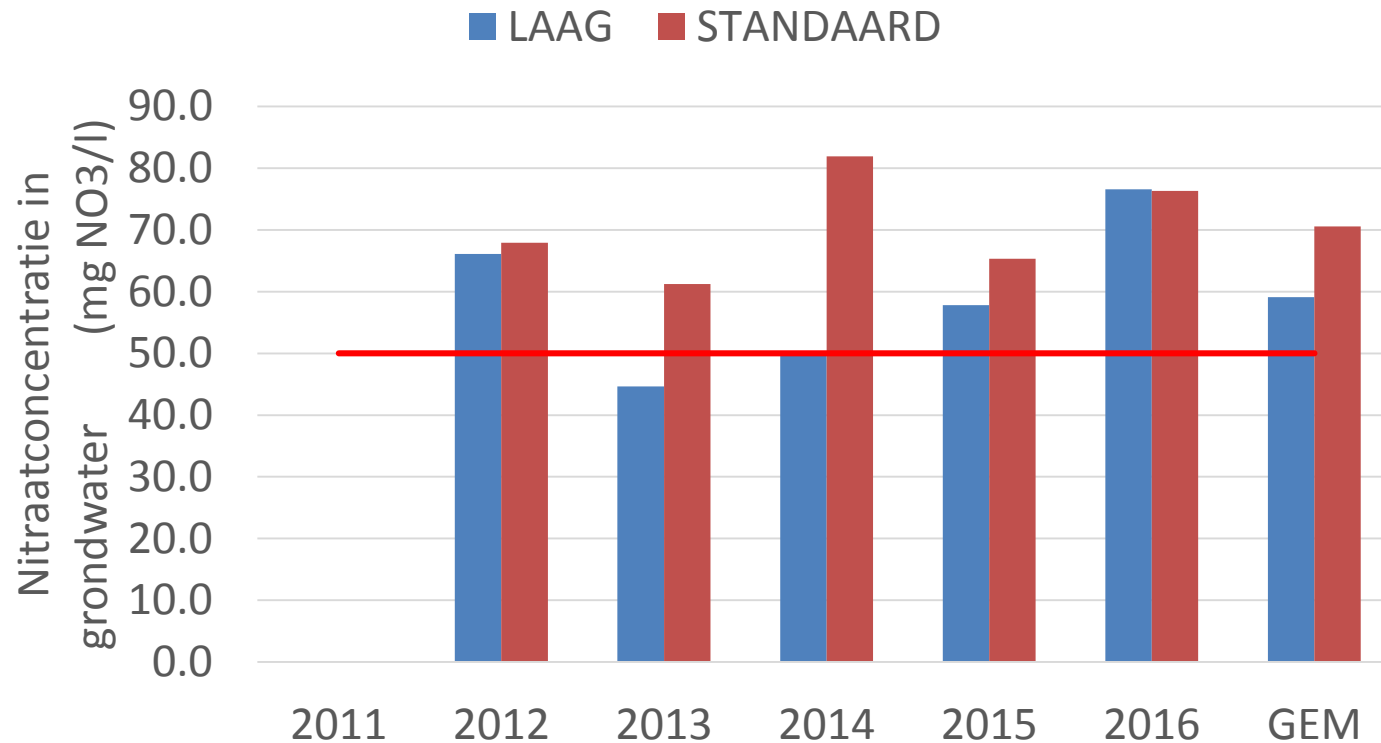
Nitrogen soil balance conventional systems



Nitrogen soil balance conventional systems

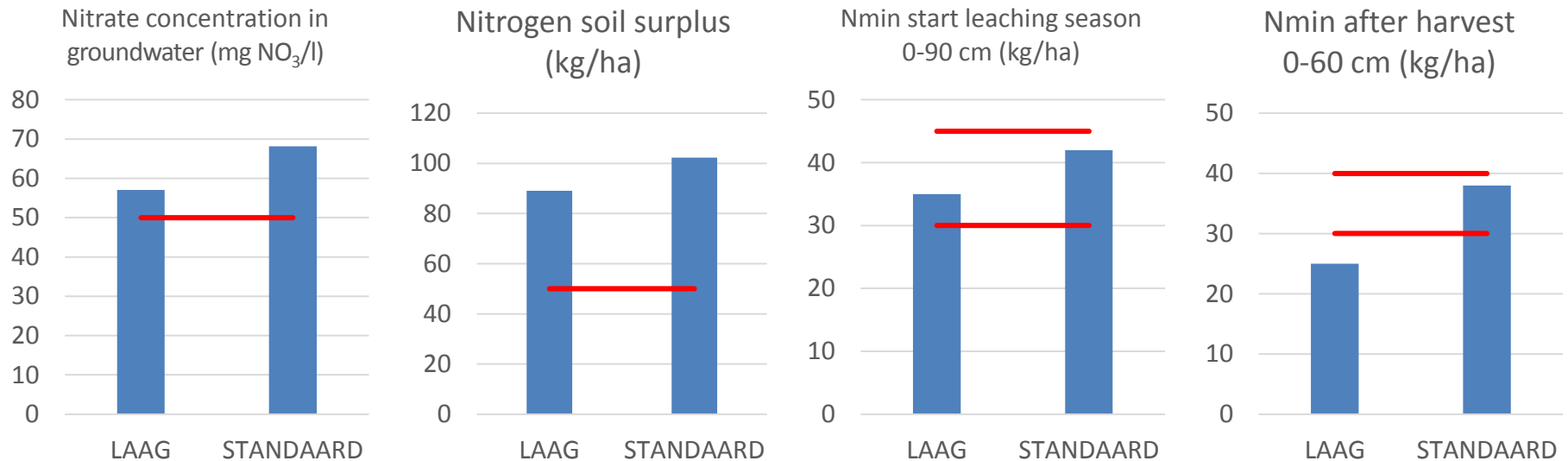


Nitrate concentrations in groundwater conventional systems



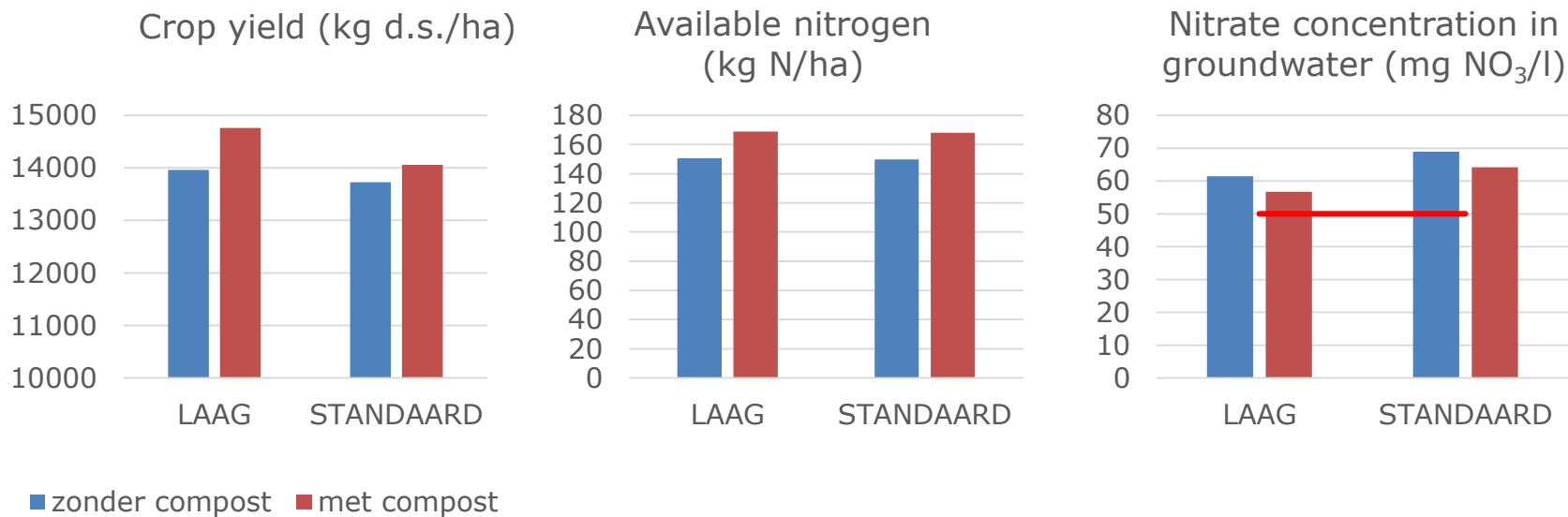
Nitrate concentration in LOW lower than in STANDARD

Leaching risk higher in STANDARD than in LOW



Nitrate concentration in groundwater, nitrogen soil surplus, Nmin at start leaching season and after harvest in STANDARD higher than in LOW

Effect of extra compost input in conventional systems

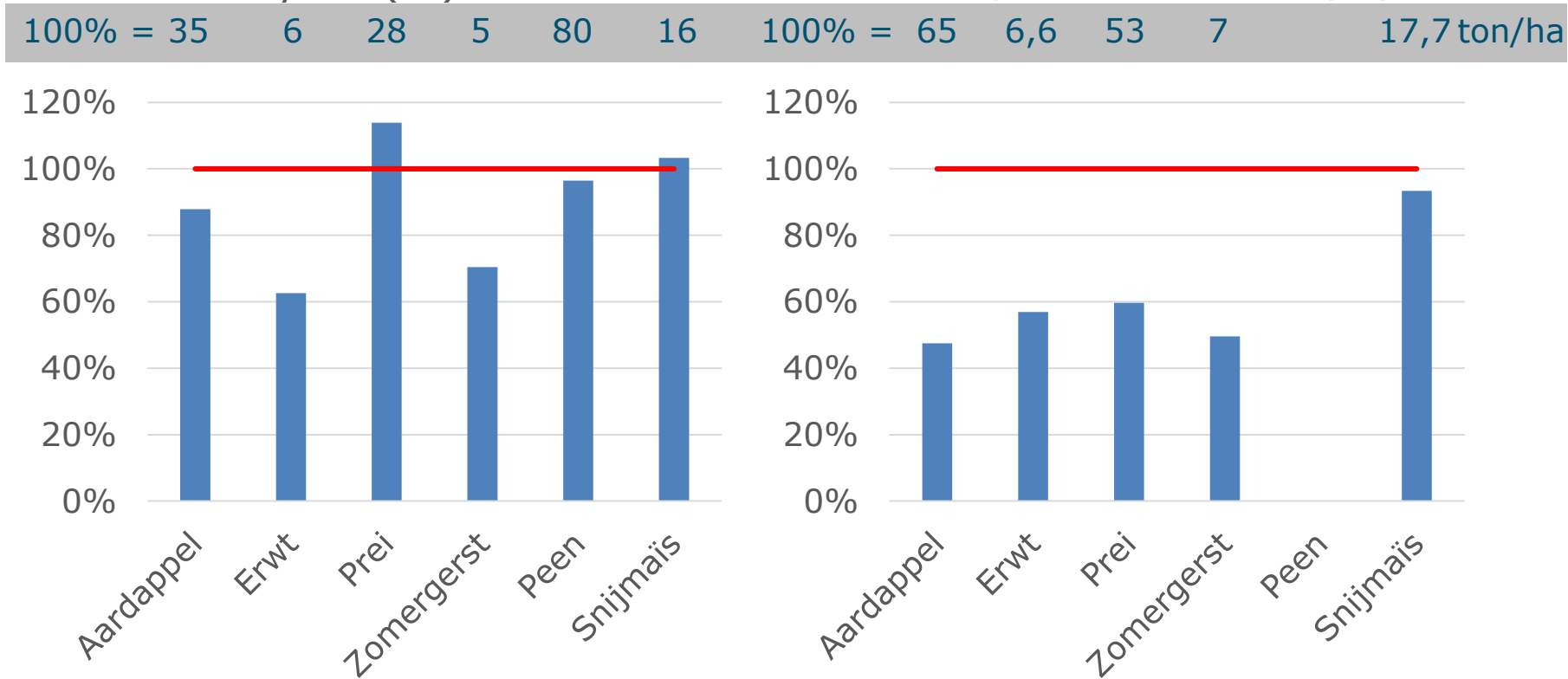


- Compost plots give trend to higher crop yields and lower nitrate leaching
 - Effect on crop yield largest in LOW

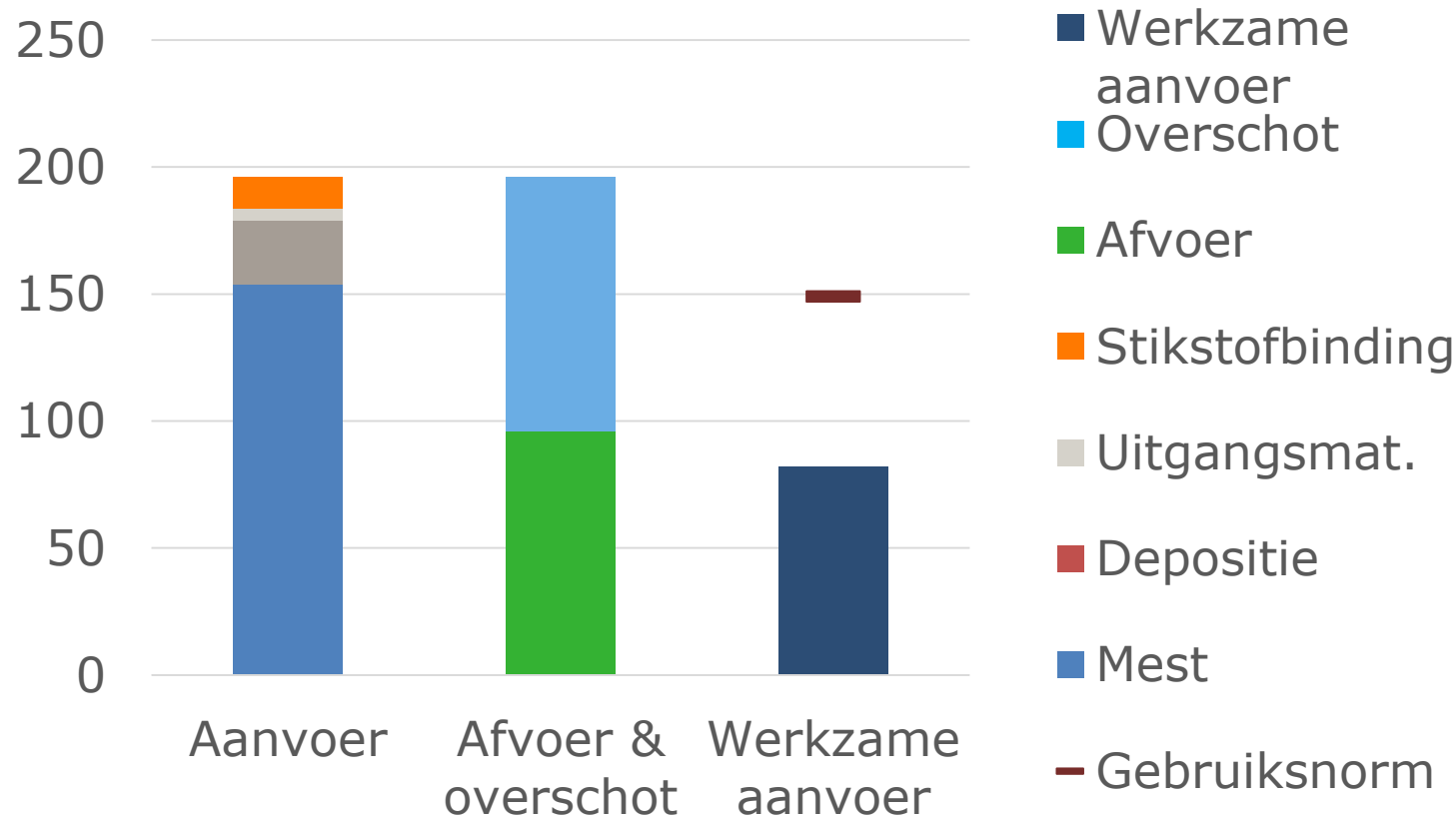
Crop yields Organic systeem '11-'16

Relative crop yield to target
yield (%)

Relatieve crop yield to yields
experimental farm (%)



Nitrogen soil balance & available nitrogen organic system



Nitrate concentrations low, risk on leaching seems high

	measured	target value
■ Nitrate concentration groundwater	35 mg NO ₃ /l	50 mg NO ₃ /l
■ N-min after harvest 0-60 cm	42 kg/ha	30-40 kg/ha
■ N-min at start leaching season 0-90 cm	41 kg/ha	30-45 kg/ha
■ Nitrogen soil surplus	100 kg/ha	50 kg/ha

Conclusions farming systems research Vredepeel

- Lower organic matter input gives
 - lower crop yields but
 - lower leaching as well
 - Use of compost shows trend
 - not to increase leaching
 - increase crop yields
 - Organic system has low leaching despite of high surplus
- How does organic matter influence leaching?
- What strategies give low leaching and high crop yields

6e Action program nitrate

Catch crops

- Reduction of nitrogen application standard for green manure crops with 50% on sandy soils and loess
- Obligation for catch crop after maize at 21/9 or under sowing of grass in maize
- Catch crop after potato before 31/10

Application of manure

- Start and end period application manure two weeks later
 - Start from 1 to 15 Febr., end from 1 to 15 Sept.
- Obligated row fertilization of manure in maize on sandy soils

6e Action program nitrate

Phosphate

- Refine phosphate class system and replacement with other measurements (P-Al and P-CaCl₂)
- Higher standards for lower classes, lower standards for class high
- P-class high: extra room for soil improvers (but with heavy restrictions)

Runoff reduction

- Thresholds in ridge crops (potato)

6e action program nitrate

- Pilot projects
- Deltaplan Agrarisch Waterbeheer
 - Surface water: courtyard emissions, buffer strips
- Management agreement on groundwater protection areas
- Put down equivalent measures
- Derogation
 - Derogation dairy farming on farm level or for grassland?
 - Derogation for wheat?

Outlook: current situation

- Nitrate standard on sandy soils bears no intensive agriculture
- Complex system of legislation drifting away from agricultural practice
 - Low support from agricultural community
 - Standards are partly below fertilization advices
- Reductionist approach only focussed on nitrate leaching
 - Little to no attention to soil quality, crop protection, product quality etc.
- Site specific approach needed based on local conditions and crops grown



Outlook: Legislation

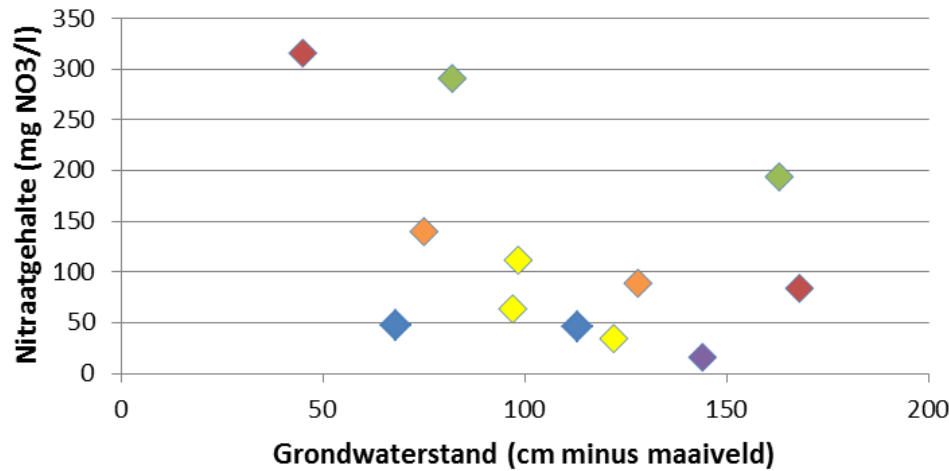
- Evaluation of system of application standards and regulations foreseen in 6e action program
- More attention to knowledge transfer and transfer of needs for legislation
- Less options for customization, site specific approach
 - Abolishment of equivalent measures

Outlook: options for the future

- Give farmers more insight in nitrogen cycles and losses
 - Measurement of nitrogen leaching on farms
 - Applications to model nitrogen cycle (kringloopwijzer)
- Customization on farm level
 - Certification of farmers
 - Farmers have to invest as well
 - Crop rotation, Green manure crops
 - Fertilization techniques
 - Buffer strips
 -

Nitrate concentration in relation to ground water level and nitrogen application

Grondwaterstand - nitraatgehalte

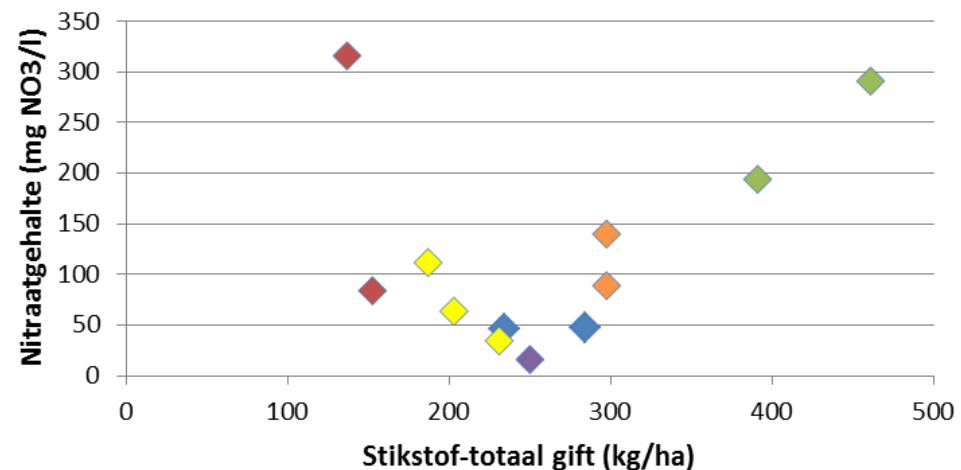


No relation between groundwater level and nitrate concentration



Higher nitrogen application leads to high nitrate concentration in ground water

Stikstofgift - nitraatgehalte



Thank you for
your attention

