

Nutriëntenmaatwerk in de polder

Inrichting en beheer van het watersysteem en
nutriëntenstromen

16 mei 2012, Dorothee van Tol - Leenders

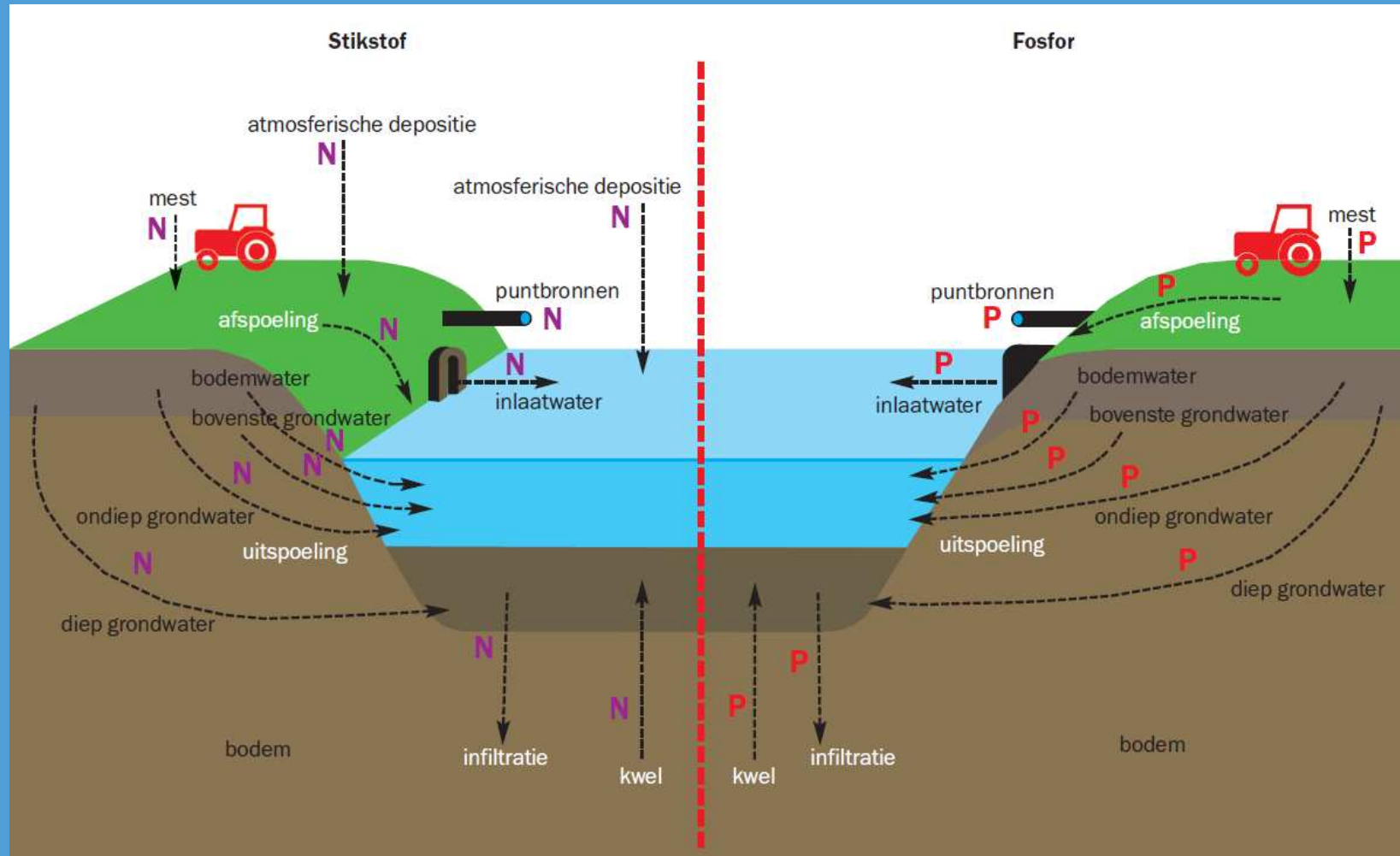


ALTERRA
WAGENINGEN UR

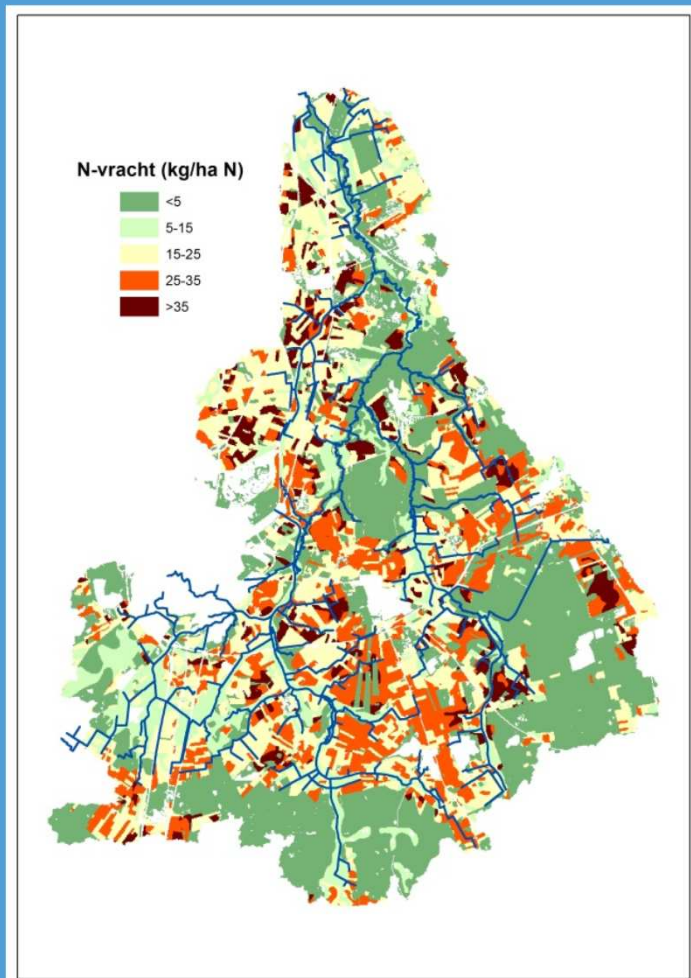
Inrichting van het watersysteem



Bronnen en routes en dan..



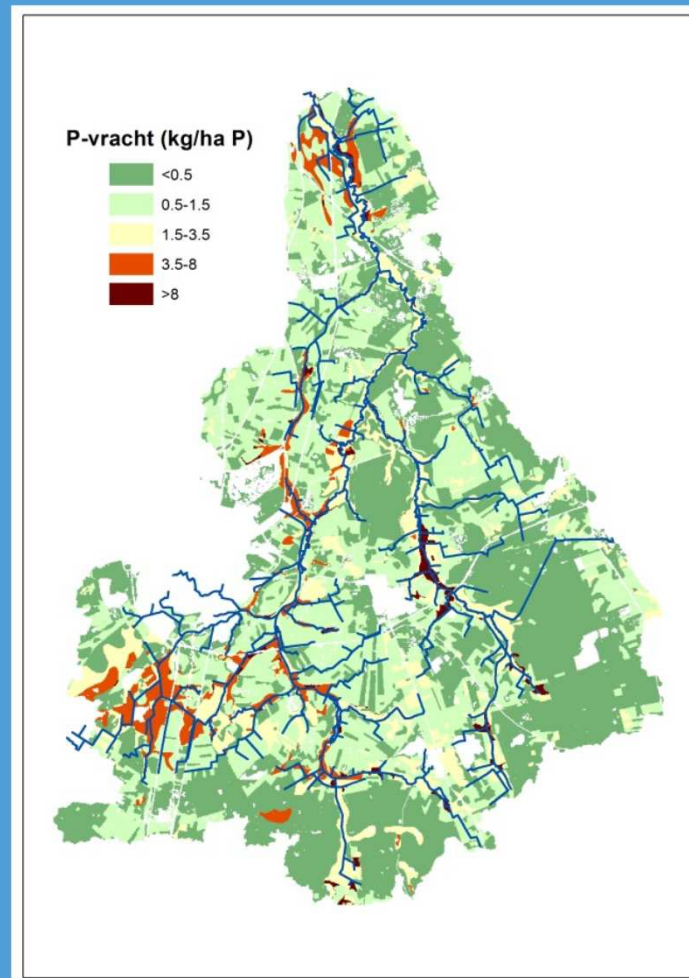
Effectieve inrichting: waar?



Stikstofvracht komt uit
de drogere landbouwgebieden

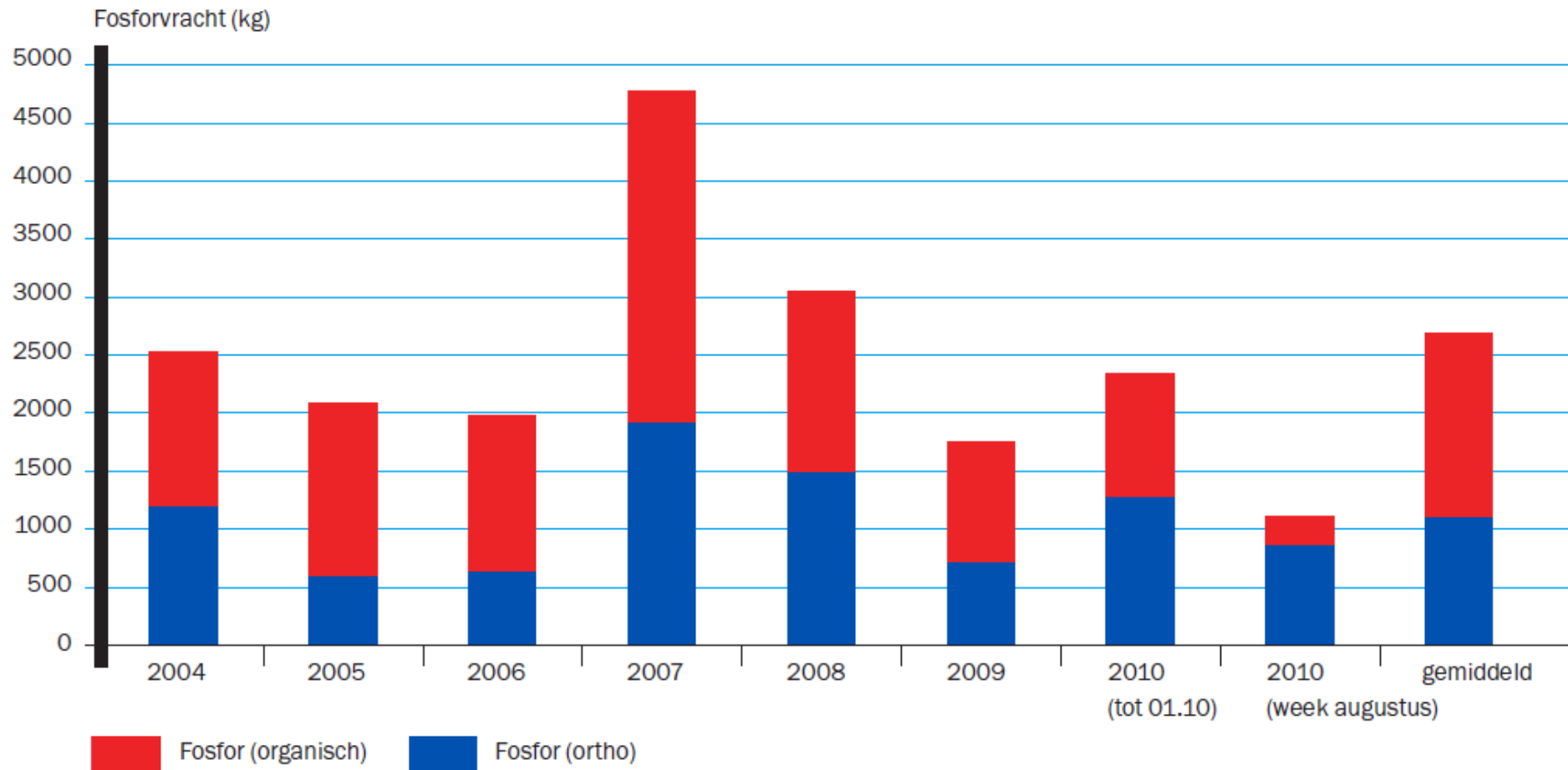


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Fosforvracht komt uit de
(veen) beekdalen met landbouw

Effectieve inrichting: hoe?



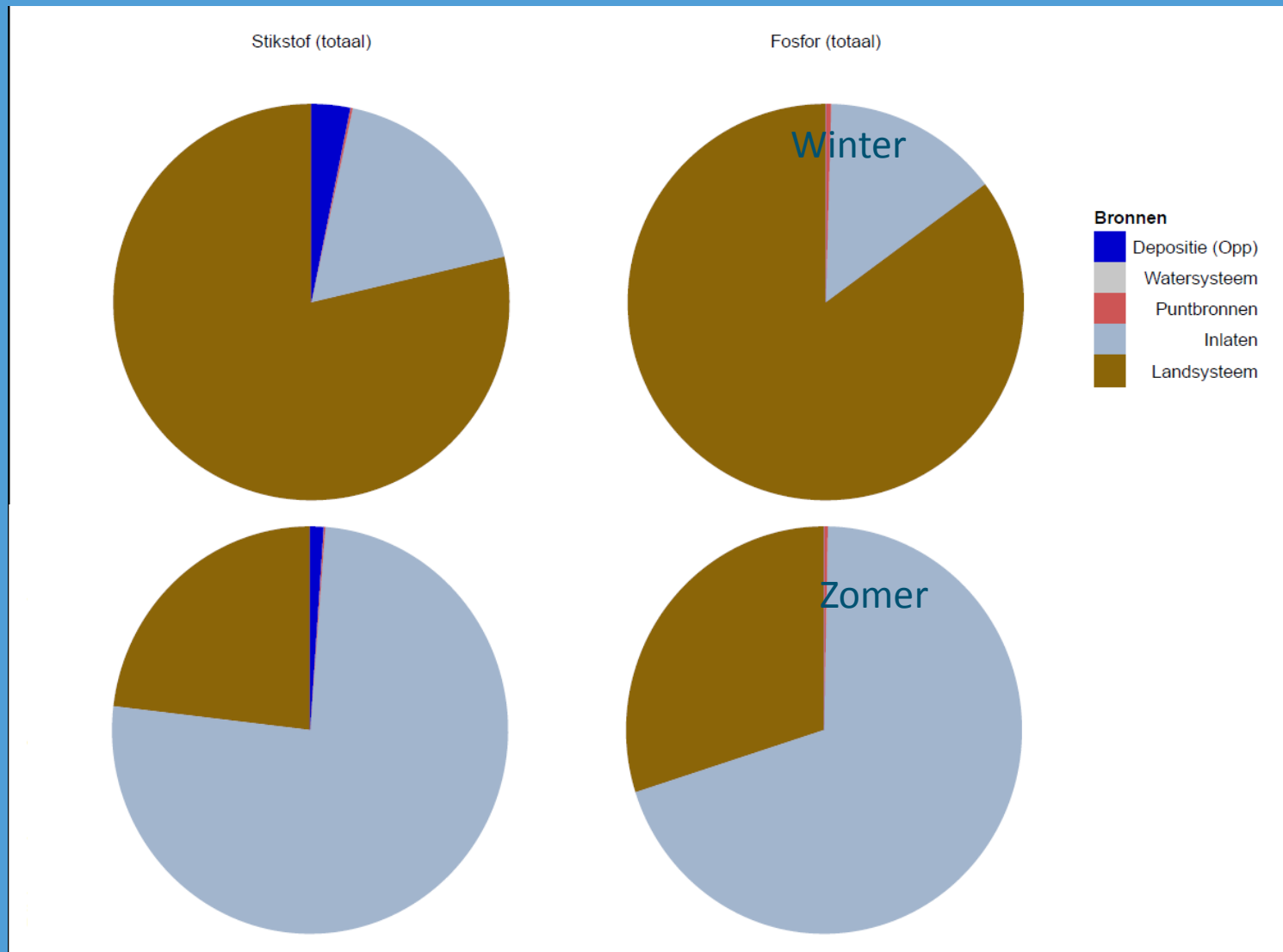
Doorrekenen maatregelen met KRW ECHO

Maatregel	Areaal maatregel		Percentage t.o.v. landbouwareaal		
	ha * 1000	ha * 1000	%	%	%
	Voor optimalisatie	Na optimalisatie	Voor optimalisatie	Na optimalisatie	Verschil
Geen P-kunstmest	1.952	1.077	100	55	45
Voorjaarstoediening	463	390	24	20	4
Mestopslag	974	477	50	24	25
Precisiebemesting	968	570	50	29	20
Bouwplan	746	491	38	25	19
Uitmijnen	1.952	190	100	10	90
DSPD	188	123	10	6	3
Bufferstrook	1.127	492	58	25	33
totaal	8.371	3.813			

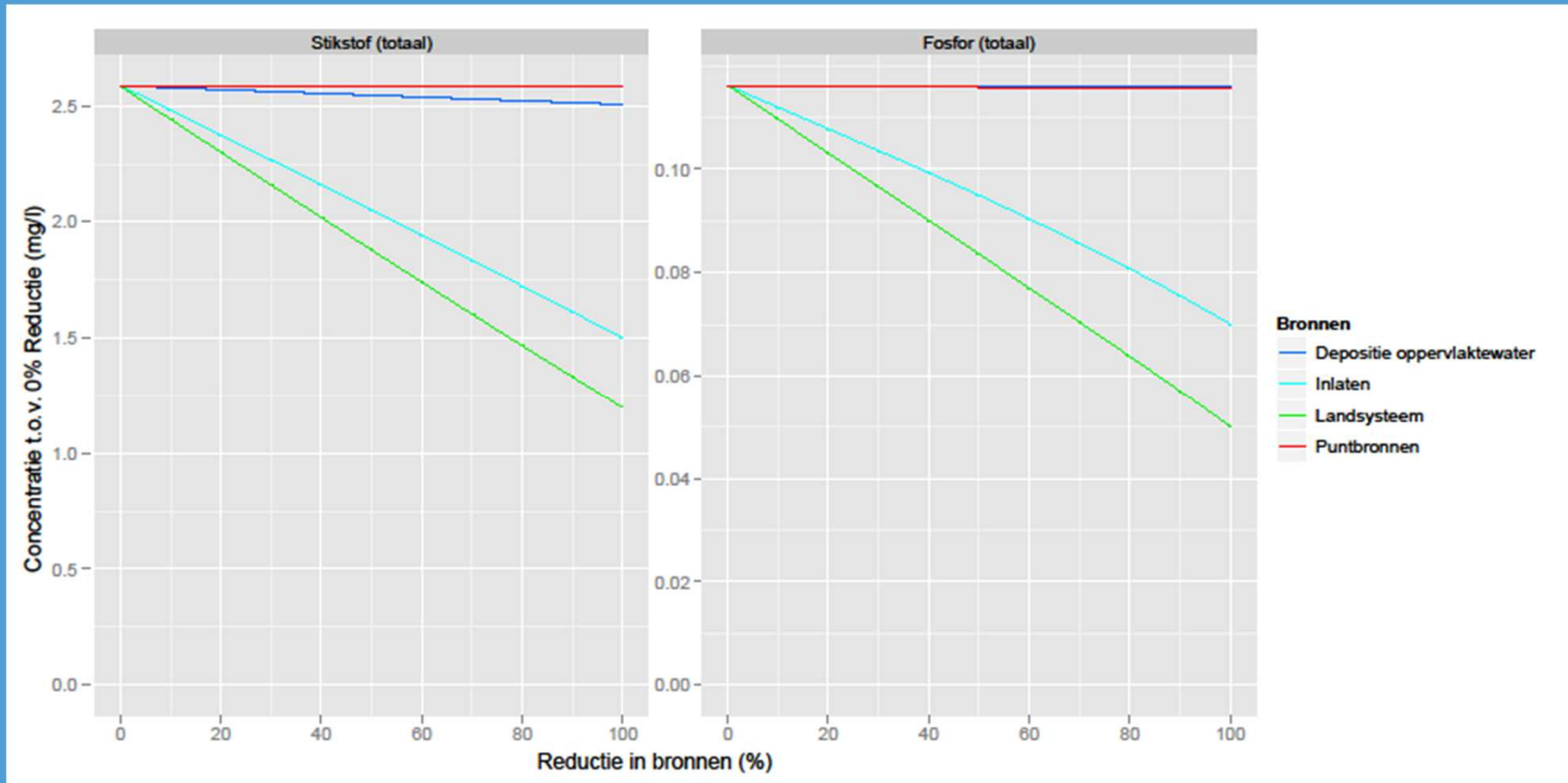
Maatregelen in het watersysteem



Sturen met inlaatwater in de polder



Sturen door veranderen inlaatconcentraties



Hermeanderen, niet altijd gewenste effect



Ecologische effecten in polders en meren

PCDitch

Modelling Ditch Ecosystems

Current Status and Future Prospects

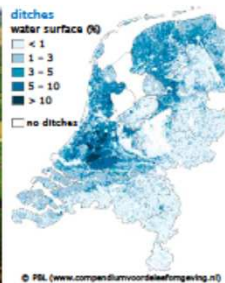
Luuk P.A. van Gerven^{1,2}, Jan H. Janse², Jeroen J.M. de Klein^{1,2}, Wolf M. Mooij^{1,2}

¹ NIOO-KNAW / Department of Aquatic Ecology
² WUR / Aquatic Ecology and Water Quality Management
³ Netherlands Environmental Assessment Agency (PBL)

✉ l.vangerven@nioo.knaw.nl

Ditches

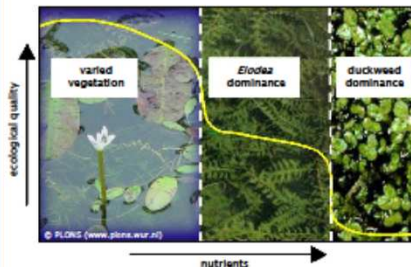
Ditches are man-made small linear waterbodies, designed to regulate water flow in agricultural areas. They are the most common water body in the lowland part of the Netherlands, with a total length of about 300.000 km.



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Ecology of ditches

Besides their hydrological function, ditches provide a habitat for many plant and animal species. The ecological function of ditches is threatened by eutrophication, mainly due to nutrient losses from agriculture. Eutrophication may force a healthy ditch with a varied (submerged) vegetation to get dominated by *Elodea*, or as an endpoint to get dominated by floating (filamentous) algae beds (fab) or floating plants like water fern (*Azolla*) and duckweed (*Lemnaeaceae*). This succession of ecological states goes along with a decline in biodiversity and ecological quality.

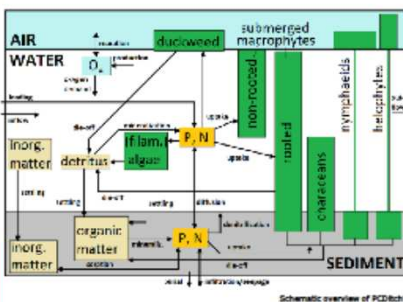


¹ Janse, J. H. (1998). A model of ditch vegetation in relation to eutrophication. *Water Science and Technology* 37(3), 139-149.
² Janse, J. H., and P. J. T. M. Van Paanenroek (1996). Effects of eutrophication in drainage ditches. *Environmental Pollution* 1(2), 547-552.
³ van Lier, L. J. J., Janse, J. H., and C. Aerts (2007). Setting critical nutrient values for ditches using the eutrophication model PCDitch. *Aquatic Ecology* 41(3), 443-449.
⁴ Janse, J. H. (2005). Model studies on the eutrophication of shallow lakes and ditches. Wageningen University, Thesis, Wageningen.

Modelling the ecology of ditches

In the mid '90 the model PCDitch was developed¹ to simulate and predict the ecological state of a ditch. PCDitch describes six different types of macrophytes and one algae group and simulates their competition for nutrients and light, in relation to the oxygen and nutrient cycle in water and sediment.

The model has been used to quantify the critical nutrient loading needed to go from one ecological state to the other² and to quantify how the critical load depends on water depth, hydraulic residence time and sediment type³.



Future prospects

In 2012 a consortium of NIOO-KNAW, WUR, PBL and Witteveen+Bos started a STOWA funded project focusing on improvement and disclosure of PCDitch and the related model PCLake. Part of this project is a four year PhD study on PCDitch. The main goal is to get a better (quantitative) understanding of the ditch ecology and its drivers. This will contribute to the improvement of management strategies to preserve or restore the ecological quality of ditches.

Model updates will possibly focus on:

- Role of sediment in ditch ecology, specific in phosphorus (P) bio-availability in relation to P binding and P release.
- Role of fish and/or macroinvertebrates in ditch ecology
- Connectivity of ditches in relation to ditch ecology

The updated model will be tested, calibrated and validated in case studies, based on field data. The (updated) model can serve as a base for scenario calculations:

- Effect of early spring/winter conditions on summer ditch ecology
- Effect of ditch management (mowing/dredging) on ditch ecology
- Effect of nitrogen loading vs phosphorus loading on ditch ecology
- Effect of climate change on ditch ecology

PCLake

an ecosystem model for shallow lakes: current status & future prospects

Jan J. Kuiper^{1,2}, Jan H. Janse², Jeroen M.M. de Klein^{1,2} & W.M. Mooij^{1,2}

¹NIOO-KNAW, Dept. of Aquatic Ecology ²WUR, Aquatic Ecology and Water Quality Management ³Netherlands Environmental Assessment Agency (PBL)
 ✉ j.kuiper@nioo.knaw.nl

The ecology of shallow lakes
 Typically, shallow lakes are in one of two contrasting (regularen) states¹ (fig. 1):

- a clear state with submerged macrophytes and piscivorous fish
- a turbid state dominated by phytoplankton.

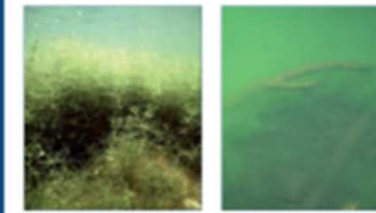


Figure 1. Clear lake (left), turbid lake (right).

A system of interacting ecological processes makes both states stabilize themselves. A switch from one state to the other may be very abrupt and this 'catastrophic regime shift' is largely driven by nutrient loading. If the nutrient loading exceeds a critical value, eutrophication causes a switch from the clear to the turbid state. Recovery of the clear state is difficult as the critical loading for the switch back is often lower - a process of hysteresis² (fig. 2).

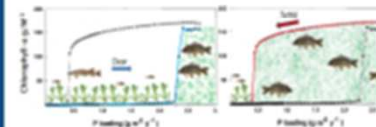


Figure 2. PCLake simulation for an 'average lake' with constant P loading, between averaged (smoothed) after 20 years. Left: start from a clear state, right: starting from a turbid state.

Future prospects

In 2012 a consortium of NIOO-KNAW, WUR, PBL and Witteveen+Bos started a STOWA funded project focusing on improvement and disclosure of PCLake and the related model PCDitch. Part of this project is a four year PhD study on PCLake, for which four research lines have been identified:

- applications of the current model: e.g. linkage to biodiversity, WFD or P becoming a scarce resource
- improvement of modules that are currently underexposed: e.g. better understanding of resuspension³, diagenesis, more emphasis on the fish community or the inclusion of zebra mussels.
- model behavior: what are the principle processes driving hysteresis in this complex model?
- calibration and validation of PCLake based on new datasets from case studies, in collaboration with Witteveen+Bos

PCLake: a complex model

The ecosystem model PCLake, developed from 1990 onwards, simulates the main nutrient and food web dynamics of a non-stratifying lake (fig. 3). PCLake is calibrated against nutrient, transparency, chlorophyll and vegetation data on >40 lakes, and systematic sensitivity and uncertainty analysis have been performed⁴.



Figure 3. Overview of the main biotic and abiotic components in PCLake. Solid arrows represent forcings of matter, dotted arrows represent feedback relationships without transport of matter.

Current status

PCLake is used for system behavior analysis, e.g. to study general relations between lake features and critical nutrient loadings⁵, and how climate warming will impact shallow lake ecosystems⁶.

Furthermore, PCLake is widely applied by water managers to define the critical loadings for specific lakes and to assess the effectiveness of restoration measures⁴ (fig. 4). For this purpose also a meta-model has been developed available online at <http://themaster.pbl.nl/model/en/pclake/>

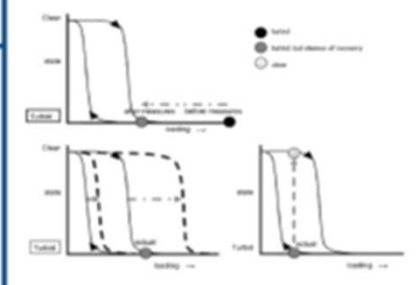


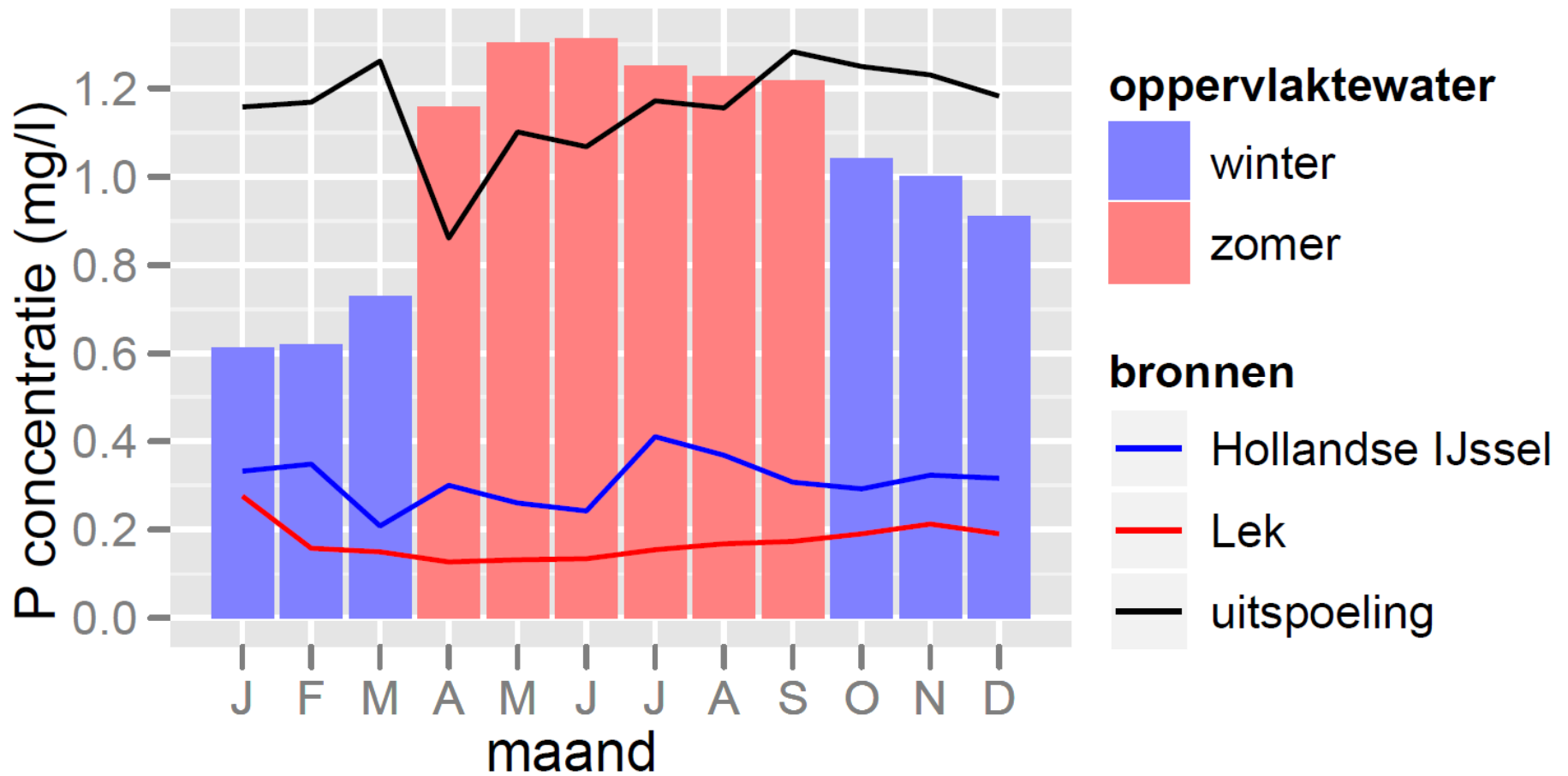
Figure 4. Critical nutrient loadings can be applied in lake management by comparing the critical loadings with the actual loading. Three scenarios can be considered: nutrient reduction (upper left panel), increase of the critical loading, e.g. by hydro-morphological measures (lower left panel) and forcing a switch to a clear food web management (right panel). After Janse et al. (2006).

¹ Scheffer, M. 1990. Alternative equilibria in shallow lakes. *Trends in Ecology & Evolution* 5: 275-279.
² Janse, J. H. 1997. A model of nutrient dynamics in shallow lakes in relation to multiple stable states. *Hydrobiologia* 342: 141-1-8.
³ Janse, J. H. 2000. Model studies on the eutrophication of shallow lakes and ditches. PhD thesis, Wageningen University.
⁴ Kuiper, J. et al., 2004. Critical phosphorus loading of different basins of shallow lakes and the consequences for management estimated with the ecosystem model PCLake. *Limnologica* 34: 209-219.
⁵ Mooij, W.M. et al., 2007. Predicting the effect of climate change on temperate shallow lakes with the ecosystem model PCLake. *Hydrobiologia* 584: 443-454.

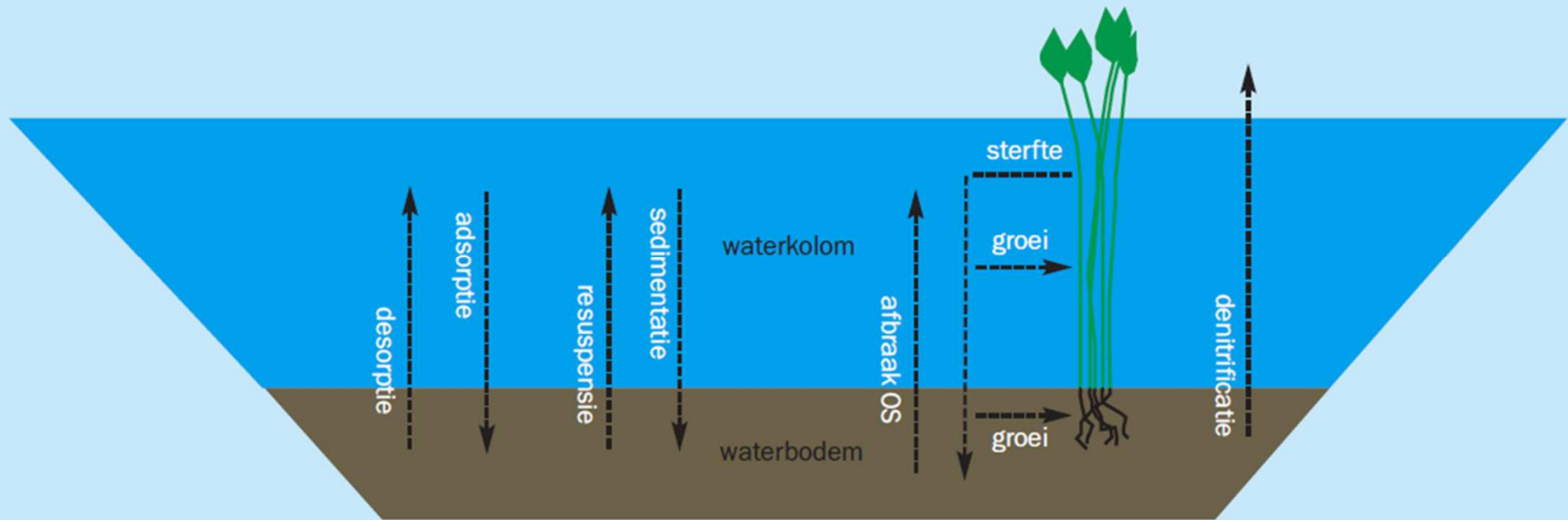
Maatregelen in veenweidegebieden



Inlaten en waterbodem



Waterbodem belangrijk in veenweide



Waterbodem levert fosfor na



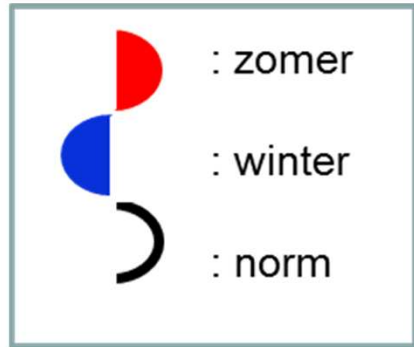
Baggeren als maatregel



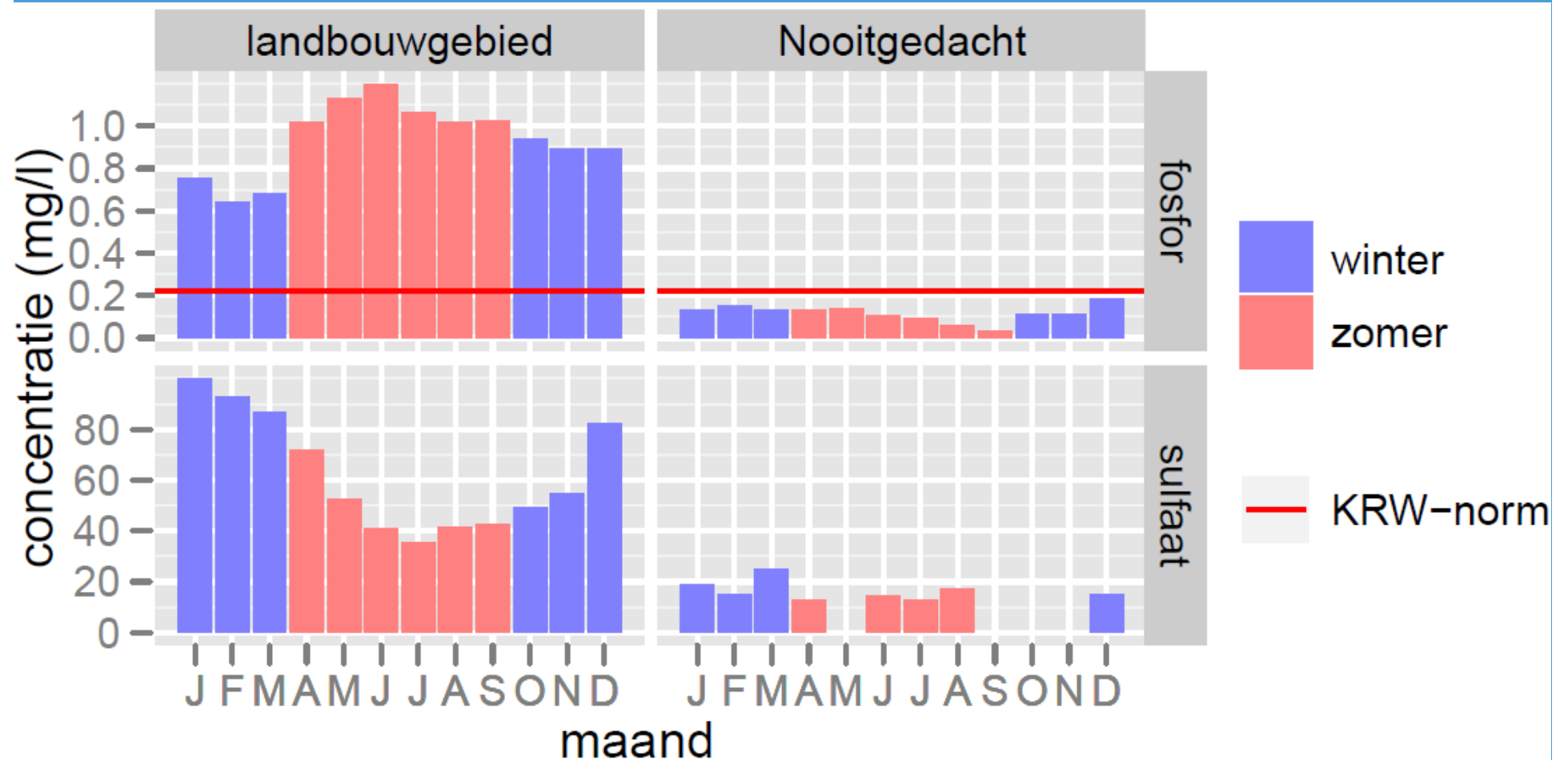
- Weghalen naleverende waterbodem
- Grote kans op nalevering veenbodem



Fosfornormen kunnen worden gehaald!

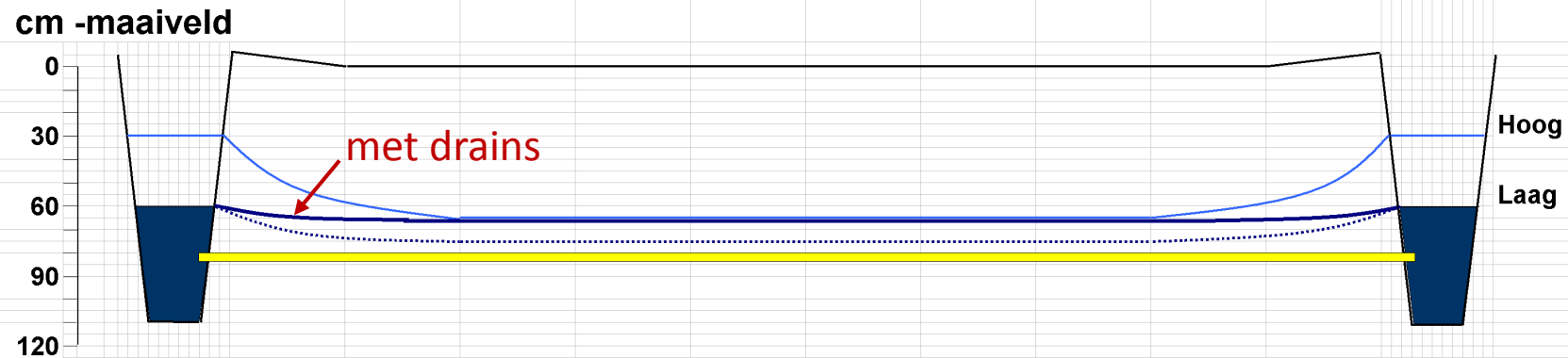


Sulfaat belangrijk!

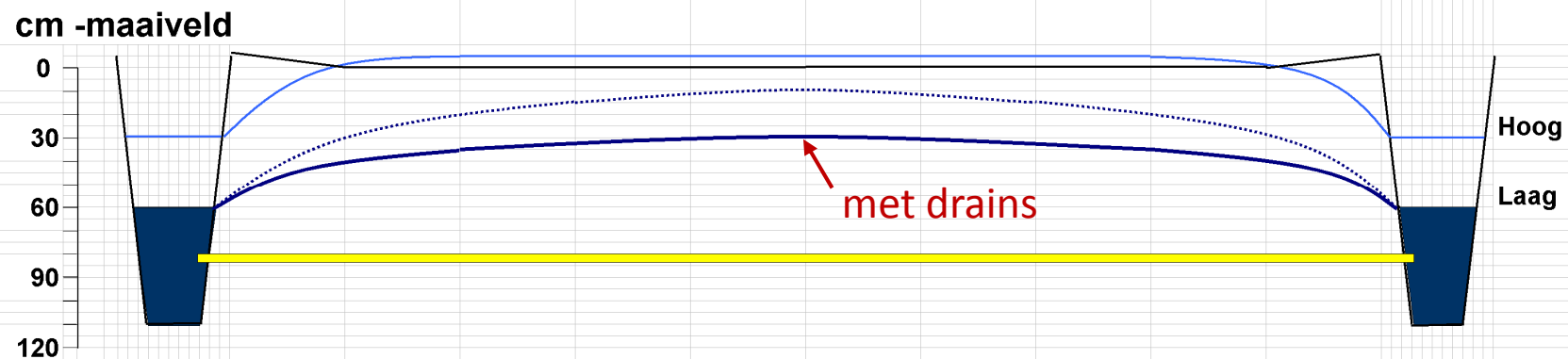


Onderwaterdrains: drains onder slootpeil

a. zomergrondwaterstand



b. wintergrondwaterstand



Primaire doel: nat houden veenprofiel in zomer door vergroten infiltratie

Bijkomend voordeel: drogere bodem in natte tijden --> betere benutting organ. mest

Gevolgen nutriënten: P positief; N meestal positief; SO_4 neutraal/positief bij 50-40 cm

Inbrengen onderwaterdrains



Maatregelen op percelen



Peilgestuurde drainage



INHOUD

INLEIDING
GERELATEERDE ONDERWERPEN
STRATEGIE
SCHEMATISCHE WEERGAVE
WERKING
KOSTEN
RANDVOORWAARDEN EN KANSRIJKE LOCATIES
GOVERNANCE-ASPECTEN
PRAKTIJKERVARINGEN (NATIONAAL EN INTERNATIONAAL)
LOPENDE INITIATIEVEN EN ONDERZOEKEN
KENNISLEEMTES
LITERATUUR/ LINKS
ERVARINGEN
LOPENDE ONDERZOEKEN
DISCLAIMER

Positief:

- Minder beregenen door vasthouden van water in droge periode
- Snelle afvoer van water in natte periode
- Minder perceelstoppen, groter areaal landbouwgrond
- Afname stikstofvracht door hogere denitrificatie
- Afname fosforvracht door betere regulatie freatisch vlak

Negatief:

- mogelijk hogere fosforvrachten bij hoge grondwaterstand



Helofytenfilters

platform



Janjo de Haan, Praktijkonderzoek Plant & Omgeving, Wageningen Universiteit en Research Center
 Jan Rinze van der Schoot, Praktijkonderzoek Plant & Omgeving, Wageningen Universiteit en Research Center
 Abco de Buck, Praktijkonderzoek Plant & Omgeving, Wageningen Universiteit en Research Center
 Franciska Smaal, Alterra

Zuivering van sloot- en drainwater in helofytenfilters is kosteneffectief

Speciaal aangelegde moerassen met rietplanten kunnen bij een gecontroleerde watertoevoer ruim 60 procent van de stikstof of 40 procent verwijderen uit drain- en slootwater. Dat blijkt uit proeven van Wageningen. Aanleg van dit soort zuiveringsmoeras is voor de landbouw een belangrijke maatregel om aan te voldoen. Het is een goedkope methode om stikstof of fosfaat te halen. De kosteneffectiviteit ligt in de orde van vijf tot 41 stikstof, afhankelijk van de keuze van schaalgrootte. De fosfaat is 115 euro per kilo verwijderd fosfor. Nadeel is de koppelen aan andere functies, zoals waterberging, recreatie, kan natuurlijke zuiveringssystemen aantrekkelijk

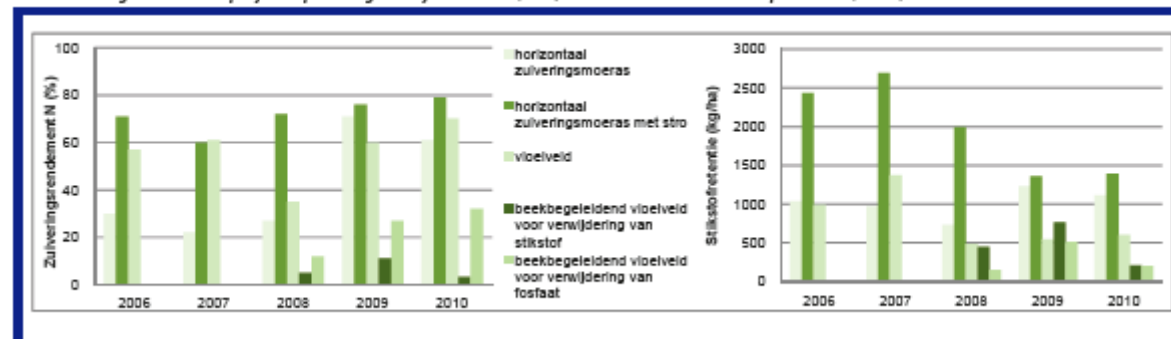
Zuiveringsmoerassen of helofytenfilters zijn in de ex-ante evaluatie van de KRW benoemd als een perspectievolle en kosteneffectieve maatregel om in landbouwgebieden emissies van stikstof en fosfaat te

combineerbaar het landelijke gewas zuiveringsmoeras verwijderen uit l

Onderzocht 1

- Ruim 60 procent van de stikstof of 40 procent van het fosfaat verwijderen uit drain- en slootwater.
- Goedkope maatregel
- Nadeel is de benodigde ruimte.

Abf. 1: Zuiveringsrendementen per jaar in percentage verwijderd stikstof (links) en de retentie in kilo's stikstof per hectare (rechts).



Maaisel van niet-agrarische grond

Het benutten van maaisel van niet-agrarische grond

Verslag deskundigendag maaisel
19 januari 2011 Wageningen

Frans Aarts (PRI, Wageningen-UR)
John Verhoeven (PPO, Wageningen-UR)
Frank de Ruijter (PRI, Wageningen-UR)
Jan Roelmsma (Alterra, Wageningen-UR)



Resultaat:

- Sloopmaaisel is investering in de bodem
- 80% blijft liggen
- Composteren meest gewenst
- Groenblauwe diensten

Bedankt!

