Phopshorus and nitrogen losses from a grassland site on a heavy clay soil in a fluvial plain in the Netherlands

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Transport of dissolved nutrients by water through the soil matrix to groundwater and drains is assumed to be the dominant pathway for nutrient losses to ground- and surface water in flat areas like the Netherlands. Nutrient losses and pathways from a grassland site on a heavy clay soil in the Netherlands were studied from 2003 onwards. The site was located in a fluvial plain and was drained by drains and trenches. Annual N and P surpluses (input by fertilizer and manure minus uptake by grass) were on average 115 kg N $ha^{-1}jr^{-1}$ and 11 kg P ha^{-1} jr^{-1}.

The monitoring site

Figure 1: The monitoring site

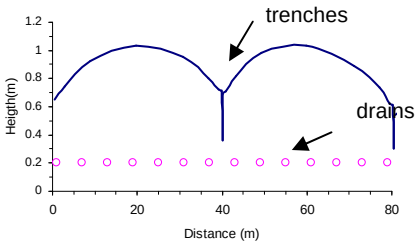

Figure 2: Cross section of the site

Horizon	A	Cg	Cgr	Cr
Depth (m)	0-0.4	0.4-0.8	0.8-1.2	>1.2
OM (%)	5.4	2.3	2.0	2.5
pH	6.7	7.6	7.7	7.8
$CaCO_3$ (%)	0.4	0.7	1.9	7.2
Clay (%)	57	59	53	47
MRP[1] (mg/l)	0.05	<0.01	0.02	0.01
$P_{ox}/(Al+Fe)_{ox}$	6	6	8	11

[1] Concentrations in 1: 2 (s:s) water extract

Figure 3: Major soil properties

Hydrology and pathways

- Trenches are the dominant (60-90%) pathway for water and nutrients
- 10-40% of the discharge is removed by drains
- Contribution of drains depends on the presence of shrinkage cracks (related to precipitation surplus of the previous summer)

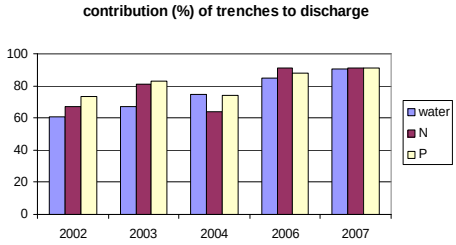

Figure 4: Contribution of trenches to discharge of water and nutrients

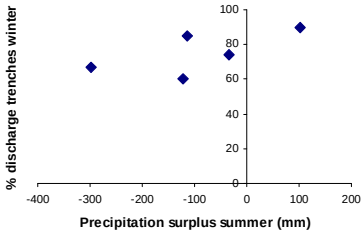

Figure 5 : Contribution of trenches to discharge in winter in relation to precipitation surplus of the previous summer

Nutrient losses

- Average annual losses: 17 kg N ha^{-1} yr^{-1} and 3.5 kg P ha^{-1} yr^{-1}
- Dissolved inorganic N and P < 25%
- 74% the P discharge and 45% of the N discharge is in particulate form
- Average flux weighted concentrations in the drains are 0.4 mg/l P and 5 mg/l N and 1.4 mg/l P and 6 mg/l N in the trenches

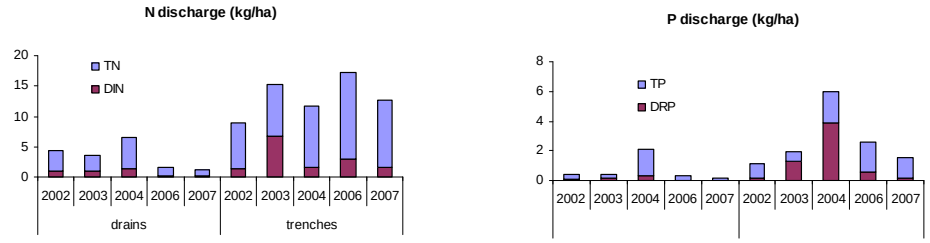

Figure 6: Annual N and P losses by discharge through drains and trenches

Conclusions

The monitoring experiment showed that:

- Rapid discharge of water by trenches and drains are dominant pathways for nutrient losses
- Matrix flow is almost absent despite the level terrain
- The contribution of the drains depends on the presence of shrinkage cracks
- Particulate forms of N and P losses are dominant in both the trenches and the drains
- Average flux weighted concentrations are far above Dutch environmental standards even when particulate N and P forms are assumed to have a limited bio-availability

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