



Nitrogen leaching from upper groundwater to ditchwater in agricultural regions of the Netherlands

Introduction

The agricultural sector in the Netherlands is intensive and causes nitrogen losses to the environment. In the artificially drained parts of the sandy regions nitrogen concentrations in the upper groundwater regularly exceed the European target value of 50 mg NO₃/l (Figure 1). These concentrations are related to farm management (a.o. Boumans et al., 2005¹). In this paper we focus on the total nitrogen pathway from upper groundwater towards ditchwater, thereby providing a basis for exploring the potential risks of nitrogen in the upper groundwater of farms for larger surface water bodies.



Material and methods

Selected farms

- 59 farms are selected which participate in the Minerals Policy Monitoring Programme of the Netherlands. This monitoring programme was set up to study the effect of management regulations on water quality at farms.
- All selected farms are situated in the wet parts of sandy regions and are drained with tile drainage and ditches.

Data collection

- Groundwater is sampled on whole farm area, 1x per winter period.
- Tile drain water and ditchwater are sampled on drained parts of the farm, 4x per winter period. In this study we focus on ditches originating at the farm.
- Water samples are analysed for, among others, total nitrogen.

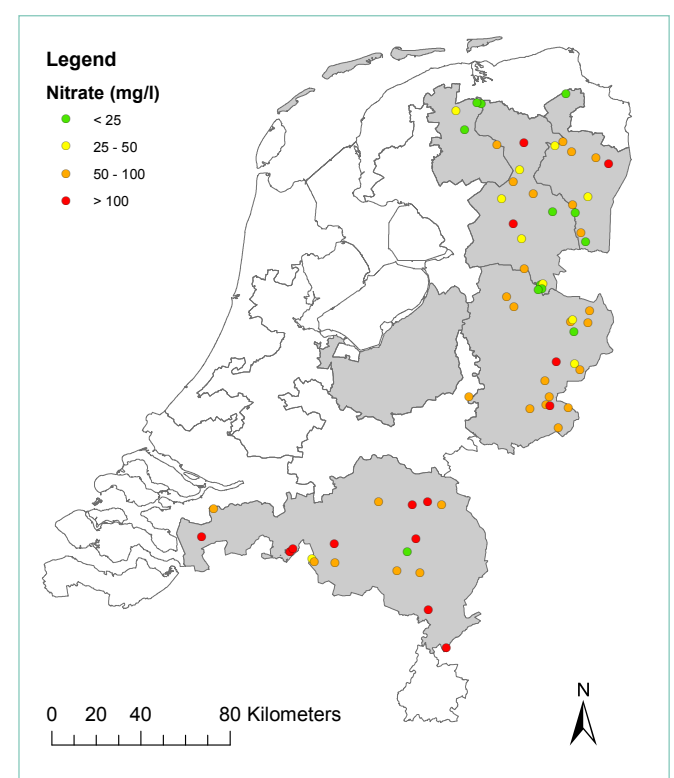
Data analyses

- Data is averaged per farm per water type for period 2004–2009.
- Correlations between water types are made.

Results and discussion

- There are strong significant ($p < 0.0001$) and positive relationships between:
 - upper groundwater and tile drain water (Figure 2), and
 - nitrogen concentrations in tile drain water and ditchwater (Figure 3).
- There also is a correlation between upper groundwater and ditchwater, which is slightly less strong (Figure 4).
- The nitrogen concentrations of all water types are related: a higher nitrogen concentration in groundwater is reflected in higher nitrogen concentration in tile drain water and in ditchwater. The correlation between upper groundwater and

Figure 1: Average nitrate concentrations in upper groundwater on drained farms in the sandy region (grey area) between 2004 - 2009.



tile drain water on the one hand and between tile drain water and ditchwater on the other hand, are both stronger than the correlation between upper groundwater and ditchwater. Therefore, we postulate that nitrogen is mainly transported from upper groundwater through tile drains into ditches.

Figure 2. Total nitrogen concentration (mg N/l) in groundwater in relation to concentration in tile drainwater per farm for period 2004-2009.

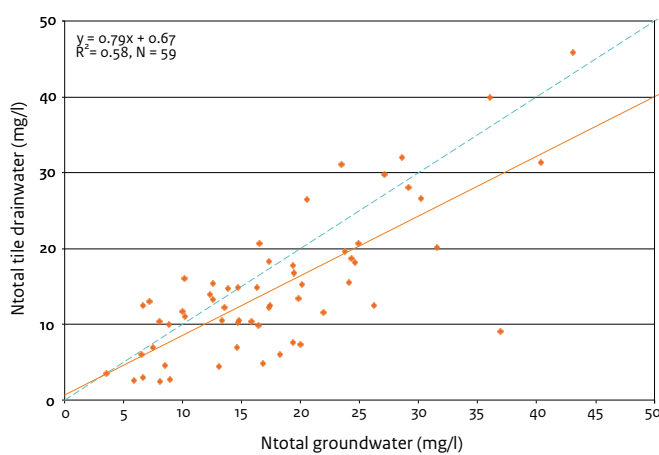


Figure 3. Total nitrogen concentration (mg N/l) in tile drainwater in relation to concentration in ditchwater per farm for period 2004-2009.

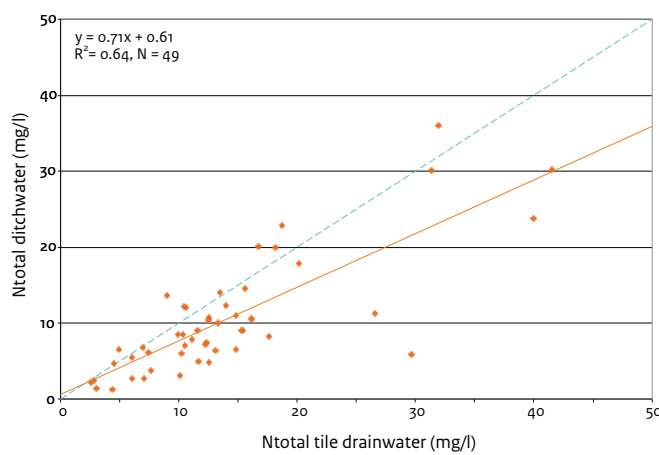
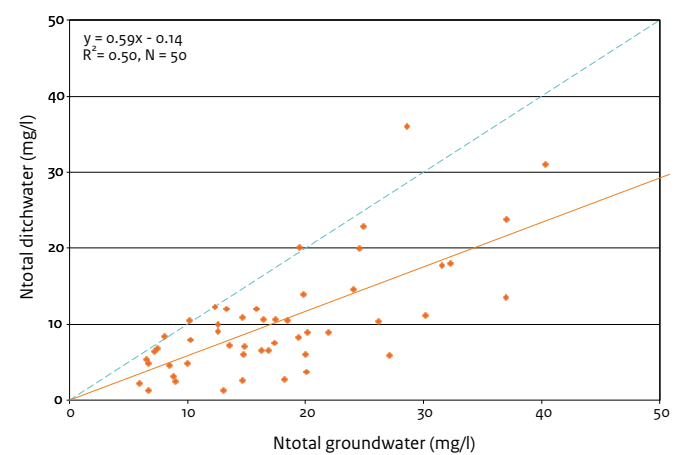


Figure 4. Total nitrogen concentration (mg N/l) in groundwater in relation to concentration in ditchwater averaged per farm for period 2004-2009.



¹ Boumans, L. J. M., D. Fraters, G. van Drecht, 2005. Nitrate leaching in agriculture to upper groundwater in the sandy regions of the Netherlands during the 1992-1995 period. Environmental Monitoring and Assessment, 102 (1-3): 225-241.

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Published by:
**National Institute of Public Health
and the Environment**
P.O. Box 1 | 3720 BA Bilthoven
www.rivm.com

Conclusion

Our results show that nitrogen concentrations in the upper groundwater will influence nitrogen levels in ditchwater. As ditchwater will eventually drain into larger surface water bodies, nitrogen from the upper groundwater of farms may cause eutrophication of larger surface waters. Farm management is therefore an important factor for environmental quality of these waters.