

Impact of the application of nitrogen from livestock manure on agricultural parcels on water quality: derogation in Flanders



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Introduction

In the commission decision of 21 December 2007, the Commission of the European Communities approved the Belgian request, with regard to the region of Flanders, to allow a higher application of livestock manure than provided in the EU Nitrates Directive 91/676/EEC. In this derogation decision a number of specific conditions were imposed on individual farmers applying derogation as well as on the competent authorities with regard to monitoring, control and reporting.

Derogation:

- application of > 170 kg N/ha originating from livestock manure
- maximum of 250 kg N/ha from livestock manure
- derogation manure: cattle slurry/cattle manure (solid)
- derogation crops: grass/maize/winter wheat/beets

This monitoring project was carried out under the authority of the Flemish Land Agency (VLM).

Objectives

1. Establishment of a monitoring network of at least 150 farms (target of 180 farms and 225 parcels)
2. Follow-up of this monitoring network during 2009-2011:
 - Nitrate in soil
 - Nitrate in water
 } impact of derogation

Materials & Methods

1. The existing monitoring network for phreatic groundwater:
 - consists of 2,107 multilevel MAP monitoring wells with short well screens at 3 depths
 - for every MAP monitoring well calculation of infiltration area and travel time for water from the root zone to the uppermost well screen.

Selection criteria for the parcels in the monitoring network:

- MAP monitoring wells with infiltration area in a single agricultural parcel and a travel time < 3 years.
- willingness of farmer to participate
- soil type: sand/sandy loam/loam/clay: 50/30/10/10
- derogation/non-derogation: 50/50
- cultivated crop: grassland/maize/winter wheat/beets: 50/30/15/5

→ 117 parcels based on MAP monitoring wells

→ 110 parcels based on no MAP monitoring wells: additional monitoring wells, drains, canals, ditches

Result: 227 parcels, 188 farms

2. Measurements each hydrological year (2009-2011):
 - nitrate soil sample before and after winter (0-90 cm);
 - deep soil sample (90-120 cm) on parcels with water level > 1.5m;
 - water sample from (additional) monitoring wells, drains, canals, ditches.
3. Statistical analysis of the data:
 - general comparison of derogation/non-derogation parcels;
 - detailed comparisons: most common combinations of cultivated crop (grass, maize) and soil type in Flanders (sand and sandy loam);
 - ANOVA test ($p \leq 0.05$).

Results & Discussion

No statistically significant differences between derogation and non-derogation parcels

- for the nitrate soil sample (0-90 cm)
- for the concentration of nitrate in the pore water of the soil (90-120 cm);
- for the concentrations of nitrate in drains, canals and ditches, in the (additional) monitoring wells.
 - at none of the sampling moments;
- for none of the cultivated crops;
- for none of the soil types.

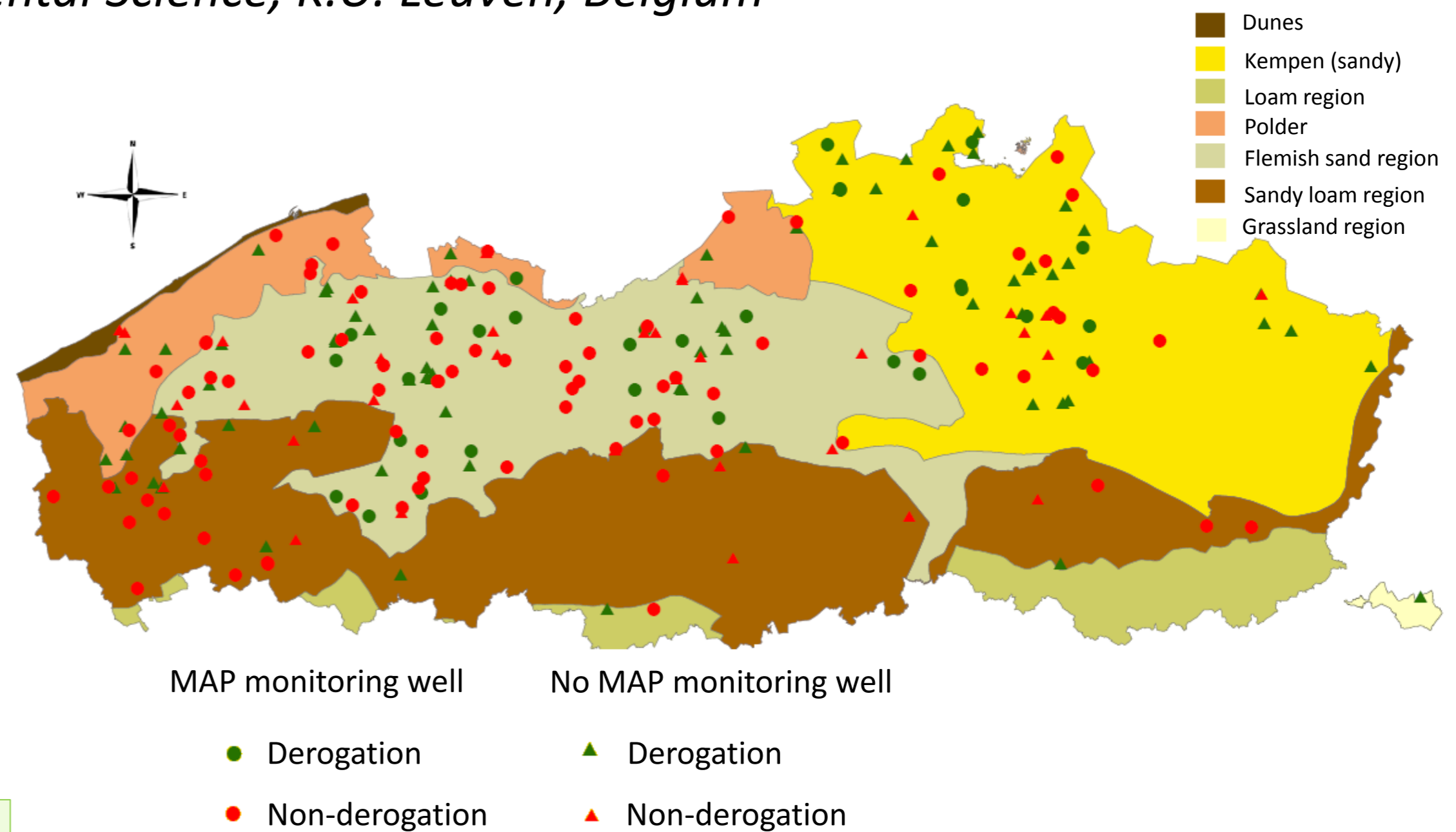


Figure 1: Location of the 227 parcels in the monitoring network in Flanders, Belgium

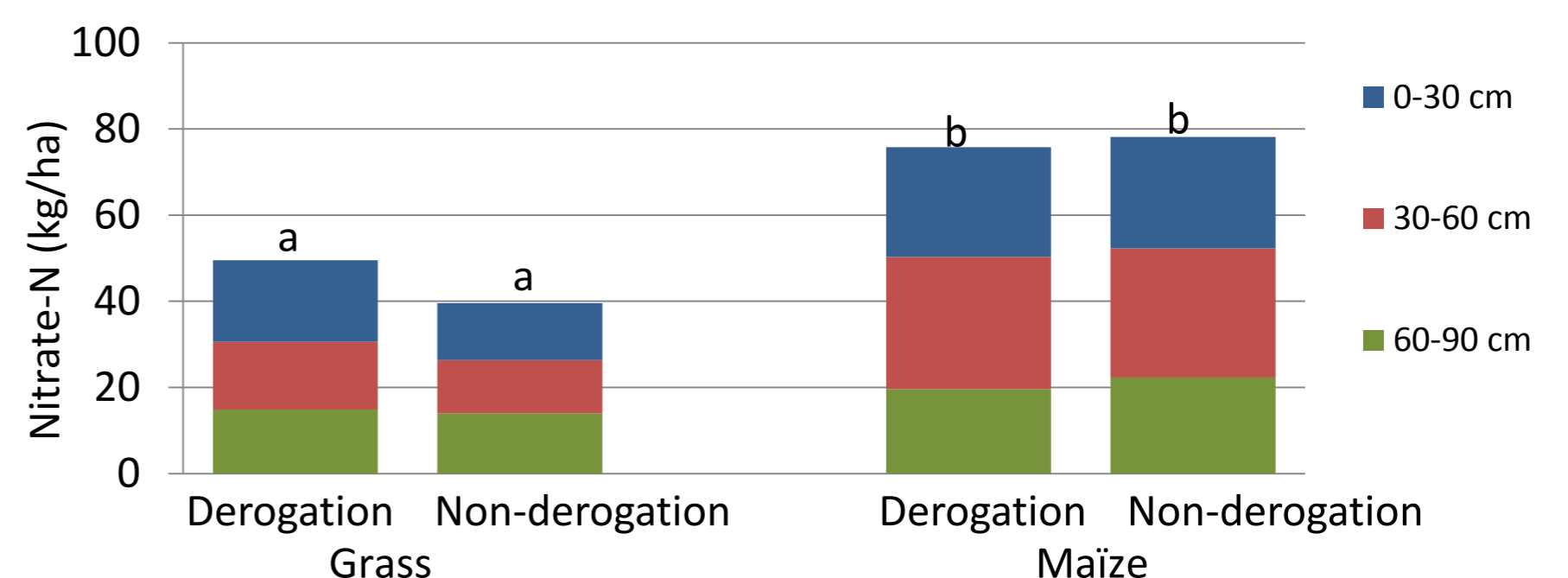


Figure 2: Average nitrate-N (kg/ha) in the soil profile (0-90 cm) of sandy soils cultivated with grass or maize, before winter 2010

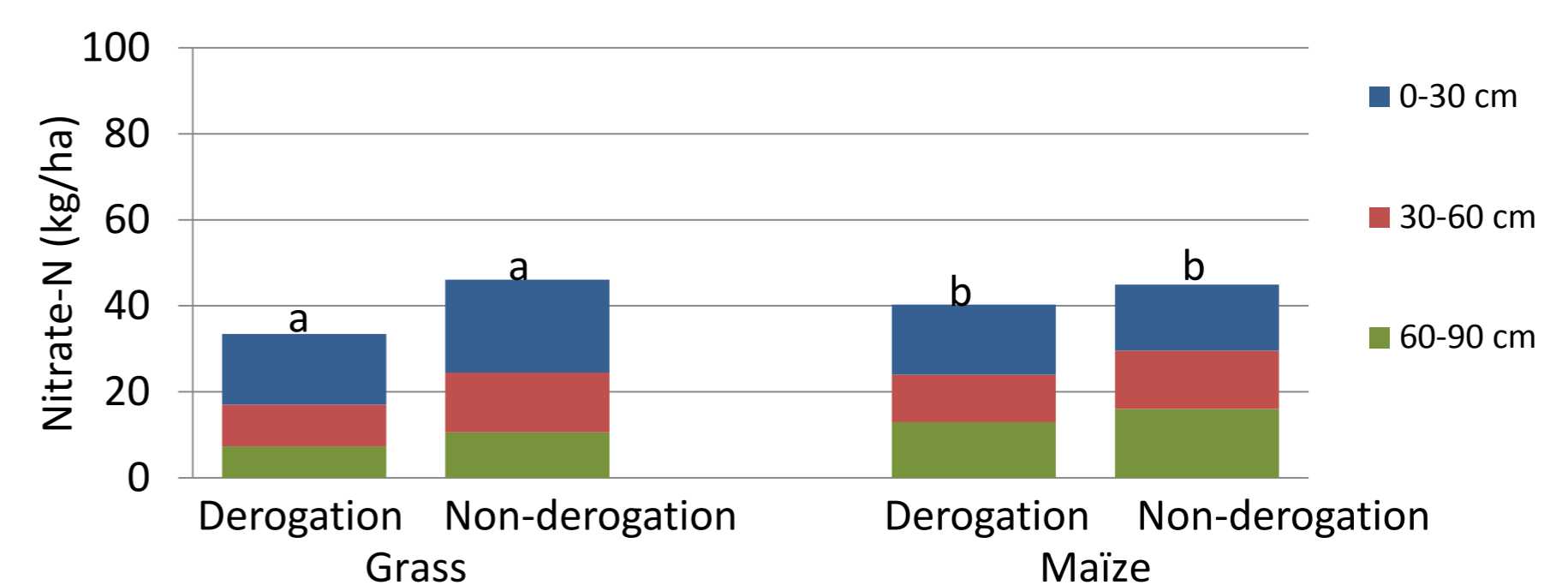


Figure 3: Average nitrate-N (kg/ha) in the soil profile (0-90 cm) of sandy soils cultivated with grass or maize, after winter 2010

Table 1: Average nitrate ($\text{mg NO}_3 \text{ L}^{-1}$) in pore water of the soil 90-120 cm, all crops and soil types

Date	Derogation	Non-derogation	Significance*
November 2009	77 (± 58)	95 (± 101)	n.s.
February 2010	64 (± 56)	92 (± 77)	n.s.
November 2010	64 (± 63)	77 (± 113)	n.s.
February 2011	48 (± 37)	76 (± 72)	n.s.

*n.s. indicates no statistically significant difference according to the ANOVA test ($p \leq 0.05$).

Table 2: Average nitrate ($\text{mg NO}_3 \text{ L}^{-1}$) in MAP monitoring wells, grass parcels and all soil types

Date	n	Derogation	n	Non-derogation	Significance*
November 2009	11	9	15	7	n.s.
February 2010	13	9	17	14	n.s.
November 2010	13	15	13	12	n.s.

*n.s. indicates no statistically significant difference according to the ANOVA test ($p \leq 0.05$).

Conclusion

Based on the extensive information of the monitoring network it is possible to conclude that application under specific derogation conditions of more nitrogen originating from livestock manure than described in Nitrogen Directive 91/676/EEC has no significant negative impact on water quality in Flanders, regarding nitrate concentration.

Acknowledgements

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