



Effects of dairy farms livestock outdoor grazing on leaching in the sandy region of the Netherlands

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Background

In the Minerals Policy Monitoring Programme (LMM) more than 300 dairy farms have been sampled during the 1992-2013 period. In total about 1600 farms visits have been made to take 16 groundwater samples while farm management was registered in the forgoing year.

Since 1992, nitrate concentrations have decreased more than nitrogen surpluses. During the same period, livestock outdoor grazing declined in favour of a growth in the number of factory dairy farms.

Objective

Examine whether the decline in outdoor grazing can explain that nitrogen leaching has decreased more than nitrogen surpluses.

Introduction

LMM databases show that nitrogen concentrations decreased from 140 mg/l on average in the 1991-1995 period to 42 mg/l on average in 2009-2013 (figure 1). This decrease amounts 70 percent. In the same time the average nitrogen surplus on the soil balance showed a decline of 48 percent (313 kg N per ha in 1991-1995 to 164 kg N/ha in 2009-2013). The decline in outdoor grazing by milk cows was comparable to nitrate leaching. As a consequence, the cutting percentage of grassland increased (figure 2).

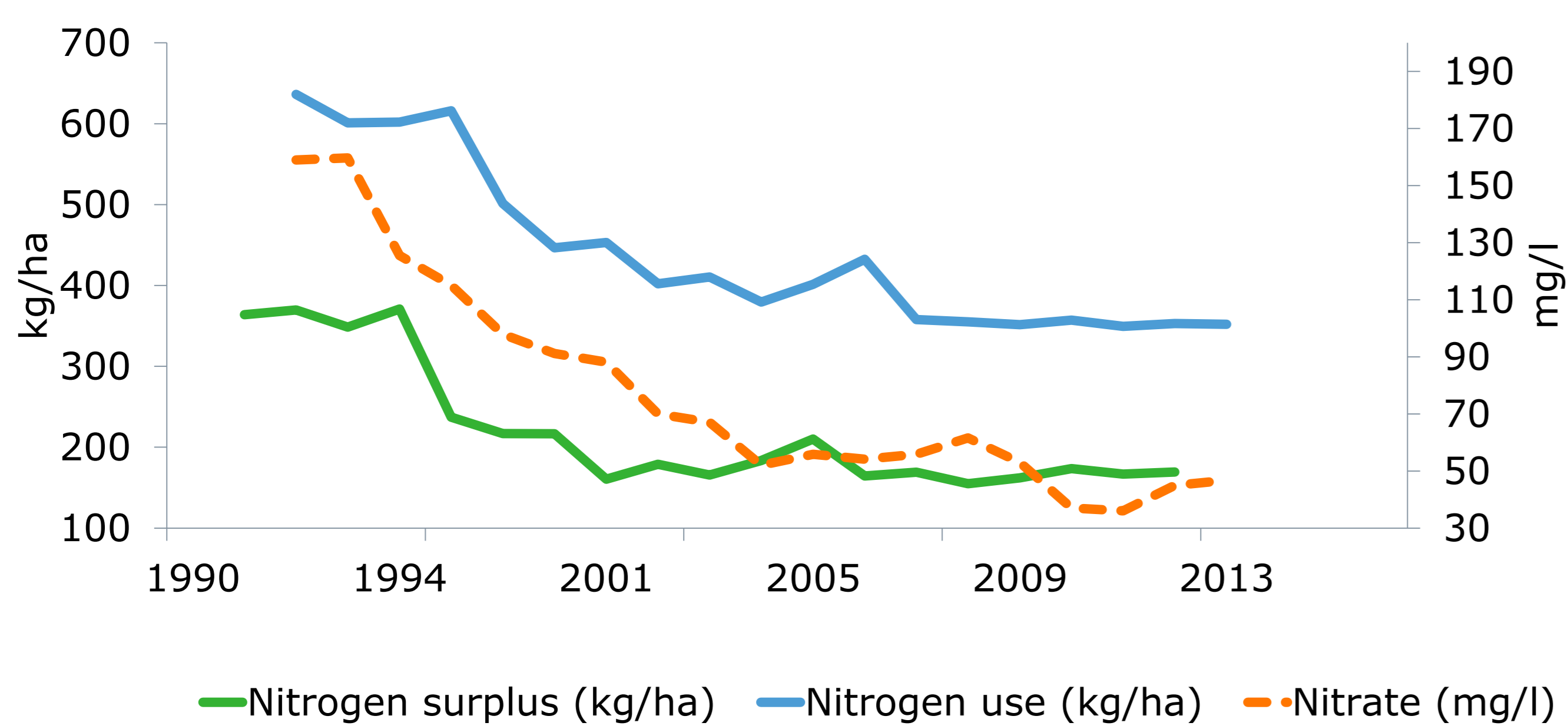


Figure 1. Nitrogen leaching (mg/L) nitrogen use and nitrogen surpluses (kg N per ha) on dairy farms in the sandy region, 1991-2013.

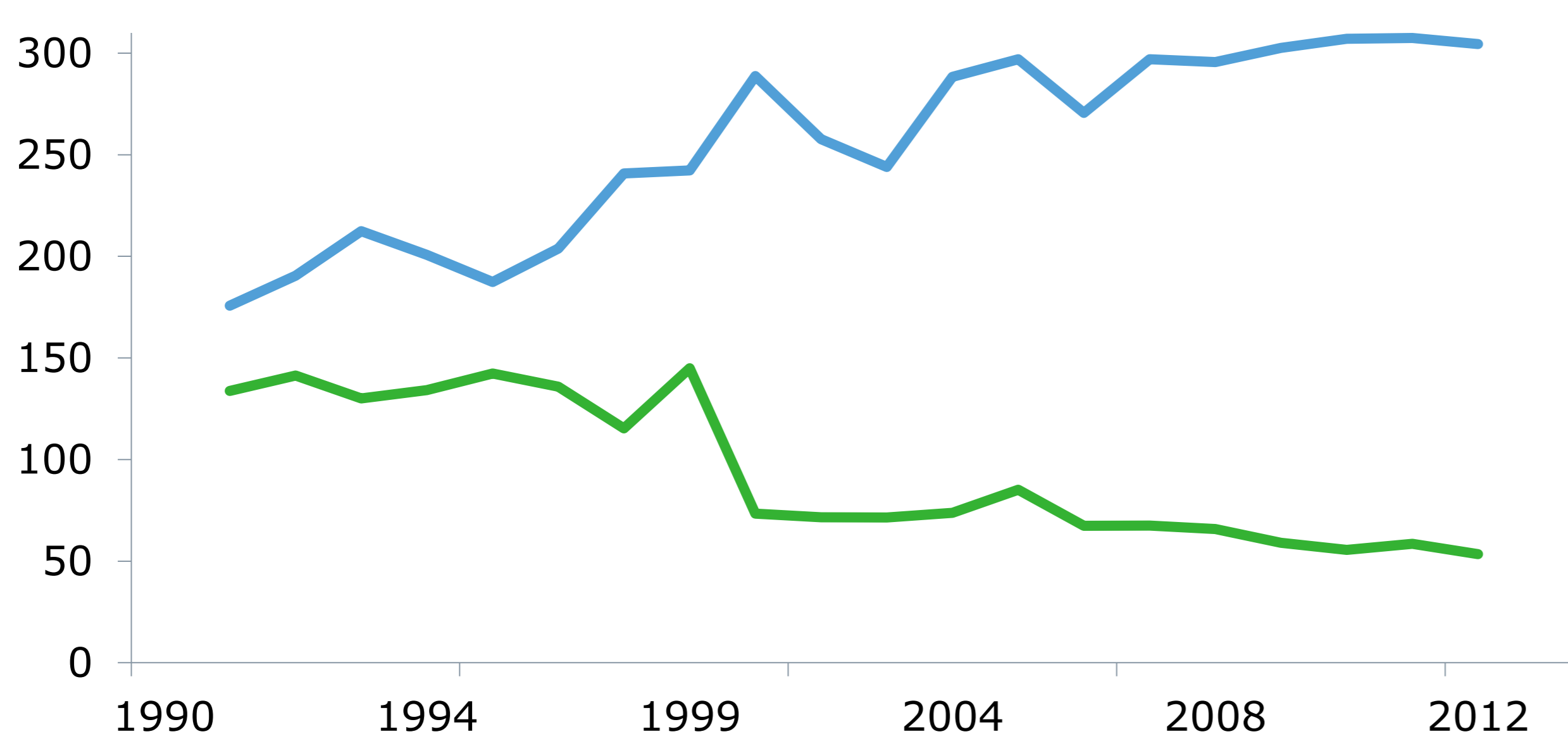


Figure 2. Nitrogen production in pasture (kg N per ha grassland), and grass cutting percentage (% of hectares of grassland) on dairy farms in the sandy region, 1991-2012.

Effects of grazing

It is well known that the application of nitrogen by outdoor grazing is less efficient for plant production than applying either artificial or organic fertilizers. Therefore, a decline in outdoor grazing can result in lower nitrogen surpluses. However, in practice farmers are not always able to harvest all grass during the grass growing season - in particular autumn grass.

Furthermore, outdoor grazing may have positive effects on denitrification in the soil caused by cows compacting it during grazing.

Method

As LMM is an unbalanced panel, a mixed modelling technique is used. The mean of sampled nitrate concentrations was related to the amount of grazing (expressed in several variables).

As covariables also the nitrogen surplus, the precipitation surplus (FLUX), the drainage (poor, well), the percentage of maize (CROP) and the sampling month (AGE) are added to the model as fixed effects. The year and farm of sampling are added to the mixed model as random effects.

Results

Results of the analyses show that the tested covariables have a clear influence on nitrate concentrations, which are in line with their expected influence, in all models whether or not the year of sampling is in the model or some periods are investigated separately. This is not the case for tested outdoor grazing parameters.

Only when the year of sampling is left out of the model and the whole period is considered, it is found that less grazing gives less nitrate leaching. So there is no clear influence of the tested outdoor grazing parameters to nitrate leaching.

	No year effect				Random year effect			
	Rc	se	F	F-COVARS	RC	se	F	F-COVARS
N production in pasture								
N use	0.15	0.06	+	++++++	-0.09	0.06	.	++++++
N surplus	0.28	0.06	+	++++++	-0.08	0.06	.	++++++
-	0.37	0.06	+	++++++	-0.02	0.06	.	++++++
Grass cutting percentage								
N use	-0.04	0.01	+	++++++	-0.00	0.00	.	++++++
N surplus	-0.04	0.01	+	++++++	0.00	0.00	.	++++++

■ F_{prob} < 0.001 ; ■ F_{prob} 0.001-0.01; + F_{prob} = 0.01-0.05; . F_{prob} > 0.05 COVARS: Npar, Drainage-poor, Drainage-well, AGE, FLUX, CROP

Table 1. Models to explain nitrate concentrations

Discussion

Other possible explanations for increasing N-leaching:

- after-effects of high(er) nitrogen soil surpluses in the past.
- decrease in nitrogen leaching fractions while surpluses declined, as a result of fixed, limited denitrification capacities during time.

Conclusion

There is no evidence that the decline in outdoor grazing can explain that nitrogen leaching has decreased more than nitrogen surpluses.

