NIMF, an N-reduction project in the province of Gelderland, the Netherlands

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Abstract

Fifty four dairy farms in the province Gelderland participated in the NIMF project. Every year the surplus on the farm N balance (MINAS) was calculated, mineral N content of the soils was measured and on some farms also the nitrate concentration of the upper groundwater was sampled. Despite farmers reducing the MINAS surplus and 80% of them achieving the 2003-norm in 2002 already, the nitrate concentration did not significantly decrease and remained about twice the target of 50 mg l^{-1}.

Background and objectives

From 1999-2003 several 'Nitrate-projects' were carried out in the Netherlands. Besides a broad variety of farm level projects, also a number of regional projects were started. In the province of Gelderland the goals of the NIMF-project were:

- to stimulate farms on dry sandy soils to achieve the targets of the Dutch MINeral Accounting System (MINAS) at least one year earlier than the statutory regulations;
- to reduce the nitrate concentration of groundwater.

NIMF was an initiative of the province to stimulate the development and transfer of knowledge about nutrient management in the eastern part of Gelderland. The project was set up with the regional farmer's organization (GLTO) and the drinking water company (Vitens).

Table 1. Farm data and mineral balance for three regions (Nieuwenhuis, 2003).

Group	Hengelo ('t Klooster)		Neede Borculo		Varsseveld-Veluwe	
Number of farms	11		23		20	
Year	1999	2002	1999	2002	2001	2002
Grassland ha	23.9	24.2	25.4	30.6	26.0	29.8
Maize land ha	6.9	9.4	8.5	9.2	9.0	10.5
N application grassland kg ha^{-1}	377	303	402	292	318	296
Number of dairy cows	53	54	59	68		64
Milk kg cow^{-1}	7,418	7,652	7,8555	7,973	7,791	7,866
N input kg ha^{-1}	**438**	**314**	**489**	**338**	**315**	**292**
- concentrates	216	160	235	203	138	154
- fertilizers	199	138	216	113	156	123
N output kg ha^{-1}	**170**	**142**	**191**	**161**	**99**	**125**
- cattle	56	37	64	48	19	
- milk	70	68	77	77	75	
- manure	42	26	50	32	4	11
N surplus	**268**	**172**	**298**	**177**	**216**	**167**
Correction for inevitable NH_3 losses from animal houses'	51	39	52	45	37	34
MINAS surplus kg N ha^{-1}	**217**	**134**	**246**	**132**	**179**	**133**
2003-norm calculated including dry sandy soils		**152**		**158**		**153**

NIMF consisted of seven sub-projects stimulating adaptations in farm management, monitoring the N and P utilization, the financial results of the farms and the reduction of nitrate leaching to the groundwater. Also the effects of the use of slurry additives were monitored and the impact was studied of far-going adaptations in water catchment areas to extensify dairy farms.

Material and methods

Thirty four farms participated in the project during 3 years (2000-2002). An extra 20 farms participated in the final year 2002. Average farm size was 39 ha (approx. 29 ha grassland and 10 ha silage maize) with 64 dairy cows. Average milk production per cow was 7900 kg $year^{-1}$. For every farm the MINAS surplus (Neeteson *et al.*, 2001) was calculated every year. In October 2002 about 400 soil samples were taken at the farms and on a group of comparable farms in the province Overijssel to analyze the mineral N content in the upper 60 cm of the soil. Nitrate concentration in the upper groundwater of 50 fields from 11 farms in Hengelo ('t Klooster) was measured in the autumns of 2000-2003. Eight bore holes per field were sampled and 20 permanent wells in a neighboring pine forest as a reference.

Table 2. *Mineral N content in soils under grassland, grass-clover, silage maize and other crops, autumn 2002 (Brouwer, 2003).*

Crop	Number of samples	Mineral N kg ha^{-1}		
		25% lowest	average	25% highest
Grassland	227	18	45	87
Grass-clover	34	14	36	65
Silage maize	110	35	71	119
Other	13	20	108	224

Remarks: grass-clover swards contain at least 20% clover.

Results and discussion

The MINAS-surplus at the 34 farms in Hengelo and Neede Borculo decreased from 237 kg N in 1999 to 133 kg N ha^{-1} in 2002 (Table 1). It coincided with a decrease in N application rate on grassland (fertilizer N and effective N from slurry) from 394 to 296 kg ha^{-1}. There was also a reduction in the use of N in concentrates. Under intensive coaching the 20 farms in Varsseveld-Veluwe in 2002 reduced their MINAS surplus in one year from 179 to 133 kg N ha^{-1}. In 2002 the average MINAS surplus in every group was lower than the norm for 2003 on dry sandy soils and 80% of the farmers achieved the 2003-norm (Nieuwenhuis, 2003).

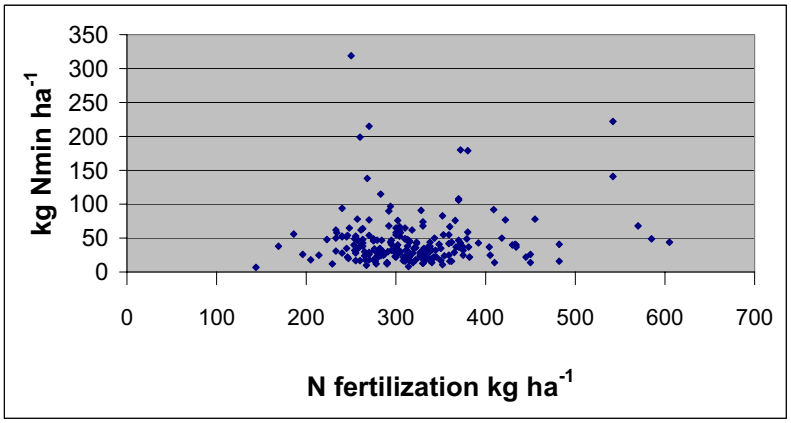

Figure 1. *Relation of N fertilization and mineral N in autumn (Brouwer, 2003).*

Autumn 2002, the mineral N content in the soil on maize land was higher than on grassland and grass-clover fields (Table 2). Highest mineral N content on grassland was measured under fields which were reseeded in autumn 2002. Other crops were mostly grain. Some of these fields got a slurry application in August or September prior to the sampling; this causes the highest mineral N values.
N-fertilization level did not relate to Nmin in autumn (Figure 1), neither with grazing pressure, but there was a positive relation between Nmin and organic matter content of the soil (Brouwer, 2003).
The nitrate concentration in the upper groundwater of 50 fields was measured in autumns of 2000-2003). The variation between years on the same field was large and showed no pattern (Van Beek *et al.*, 2004).

Table 3. Nitrate in upper groundwater in 't Klooster in 2000-2003 under farmland and pine forest, with additional data for 1989 and 1993 (Van Beek, 2003; 2004b).

Year	1989	1993	2000	2001	2002	2003
Farmland						
Number of fields	25	24	50	49	51	49
NO_3 mg l^{-1}	155.3	165.2	99.5	103.5	93.4	102.3
Nature (forest, mostly pine trees)						
Number of wells			17	16	14	
NO_3 mg l^{-1}			24.4	36.5	37.7	

The average nitrate concentration under farmland varied between 93.4 and 109.3 mg NO_3 l^{-1}, the concentration showed no significant decrease despite the reduction of the MINAS-surplus in this period (Table 3). The difference in nitrate concentration under grassland and arable fields in 2003 was 96.4 versus 120.6 mg NO_3 l^{-1} (Van Beek, 2004a).

Conclusions

Despite their efforts to reduce the MINAS surplus and although 80% of the farmers in 2002 achieved the 2003-norm, the nitrate concentration showed during these years no significant decrease. The nitrate concentration under farmland is still about twice the target of 50 mg l^{-1}.

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Multifunctional land use and its impact on the nitrate concentration in groundwater under grassland

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Abstract

During three years data of six grassland types were collected on 14 farms. Grass production, number of plant species, N fertilization, Nmin in autumn and nitrate leaching in following spring showed a large variation. There was no relation between N-fertilization level and Nmin, neither between Nmin in autumn and nitrate concentration in the following spring.
Multifunctional land use, including diversification and extensification of grassland, can help to meet the target of 50 mg nitrate per l in groundwater.

Keywords: DM production, fertilizer, grassland, leaching, nitrate, nitrogen

Background and objectives

The objective of multifunctional land use is to combine different functions (e.g. food production, nature conservation, environmental protection and recreation) within one area. Multifunctional land use is considered as an option to enlarge the economical and environmental sustainability of an area. In 1998 a large program on sustainable land use started in the Winterswijk area. The area consists of a small-scale landscape with a dominant role for agriculture. Substantial parts of the area are covered by nature, forests, recreation areas and campsites. The focus of the program is:

- to create more variation in grasslands and arable crops, than only perennial ryegrass swards and silage maize
- to enlarge the ecological values of farmland
- to make the area more attractive for recreation and tourism
- to reduce environmental losses like nitrate leaching.

Material and methods

From 2002 till 2004 an intensive monitoring programme was carried out on 14 farms covering a broad range in farming types. Relations between fertilization, production, farm income, biodiversity and environmental issues were analysed thoroughly.
In this paper we present results of different grassland management types on dry matter production, number of plant species, N-fertilization (fertilizer N and effective N from slurry), N harvested in the crop, residual Nmin in autumn and nitrate in upper groundwater in the following spring.

Results and conclusions

The grasslands were grouped into the six types (Table 1). Total N-fertilization (mainly cattle slurry) on grass-clover swards was less than half the amount of fertilized ryegrass swards (which were regarded as a kind of control for the ordinary farming system in that region), but the average dry matter production, N-uptake and nitrate concentration on grass-clover swards were similar. The average clover content (expressed as ground cover by clover leaves) on the grass-clover fields was 33%.