## Nitrogen use efficiency of specialized dairy farms in Flanders: evolution and future goals

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**Introduction** Efficient use of nutrients is one of the major aims of eco-efficient and sustainable agricultural production systems. We determined the nitrogen use efficiency of a representative set of specialised dairy farms in Flanders, between 1989-1990 and 2000-2001 and set achievable eco-efficiency targets for sustainability

**Materials and methods** Based on data of the local Farm Accountancy Data Network, we established farm-gate or whole-farm N balances of specialised dairy farms, for 1989-1990 (n=334) and for 2000-2001 (n=148). Nitrogen inputs included purchased concentrates, forages and by-products, straw (or sawdust), animals, mineral fertiliser, manure, biological fixation and deposition. The N output included exported milk, animals, manure and crops. The farm-gate N surplus was calculated as total N input – total N output. The farm N use efficiency was defined as 100 * N output / N input. These results were compared to those of Dutch experimental farms or farm-groups (references available from the authors). Finally, we proposed achievable targets to reach a given low N surplus and eco-efficiency (N-surplus per litre milk).

**Results** The average N surplus of the farms in the study decreased during the study period from 378 kg N/ ha per year in 1989-1990 to 238 kg N/ha per year in 2000-2001 (Table 1). The corresponding N use efficiencies were 15.1 and 22.0 %, respectively. This significant progress was mainly due to a significant decrease in the use of mineral fertiliser and, to a lesser extent, reduced concentrate use. The N output (in milk production) remained unchanged (Table 1). The farms moved from a 1989-1990 eco-efficiency level of 15 to 40 l milk/kg N surplus (Figure 1, zone A) to 20 to 60 l milk/kg N surplus in 2000-2001 (Figure 1, zone B), while a level of 60 to 100 l milk/kg N surplus seems achievable (Figure 1, zone C). Further, an absolute maximum level of 150 kg/ha for N surplus is necessary in order to comply with the European Nitrates Directive (Verbruggen *et al*., 2004). Hence, an optimum zone for sustainable and eco-efficient dairying in Flanders can be delimited (Figure 1, zone C').

**Table 1** Flemish dairy farms: N balance (kg N/ha per year)

| | | 1989 | 2001 |
|---|---|---|---|
| N input | | | |
| Mineral fertiliser | | 238 | 128 |
| Concentrates | | 104 | 76 |
| Manure | | 25 | 29 |
| Straw | | 1 | 1 |
| Forages | | 26 | 17 |
| Deposition | | 50 | 48 |
| Fixation | | 2 | 6 |
| | Total | 446 | 305 |
| N output | | | |
| Milk | | 47 | 49 |
| Animals | | 19 | 16 |
| Crops | | 2 | 2 |
| | Total | 68 | 67 |
| N surplus | | 378 | 238 |
| N use efficiency (%) | | 15.1 | 22.0 |

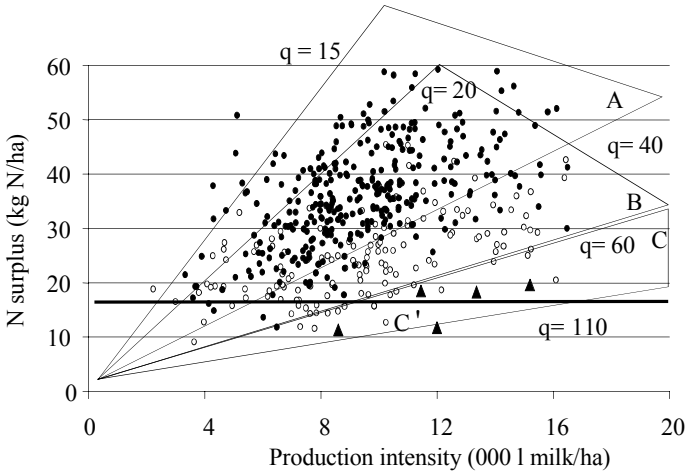


**Figure 1** Farm-gate N surpluses in relation to production intensity: Flemish dairy farms in 1989-1990 (●) and in 2000-2001(○). Dutch experimental farms or farm groups (▲). Isoquants of eco-efficiency (q, l milk/kg N surplus)

**Conclusions** During the past 15 years, Flemish dairy farms have successfully made considerable efforts to increase their N use efficiency with the average farm N surplus showing a significant decrease from 378 kg N/ha per year in 1989-1990 to 238 kg N/ha per year in 2000-2001. Nevertheless, further progress can still be made: an eco-efficiency of 60 to 110 l milk/kg N surplus and a maximum farm gate N surplus of 150 kg N/ha per year seem relevant and achievable targets for a sustainable future for Flemish dairy farming.

**Reference**

Verbruggen, I., F. Nevens, D. Reheul & G. Hofman (2004). Nitrogen use and nitrogen use efficiency on Flemish dairy farms. Flemish Policy Research Centre for Sustainable Agriculture, Publication 6, 58pp.