Energy use and energy use efficiency of specialised dairy farms in Flanders

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Introduction Our highly mechanised agriculture largely depends on ever declining stocks of fossil energy and hence contributes to global warming through the emission of greenhouse gases. Therefore, energy use (efficiency) is an important aspect of eco-efficient and sustainable agricultural production systems. In this study, we estimated direct and indirect energy use on a representative set of specialised dairy farms in Flanders (334 farm datasets in 1989-1990 and 147 farm datasets in 2000-2001) and we calculated their energy use efficiency. We studied the observed evolution between 1989-1990 and 2000-2001.

Materials and methods Direct energy used during farm operations was calculated based on the amount of diesel, lubricants, electricity and other energy carriers directly used on the farms. Calculated indirect energy (i.e. energy consumed during the production of farm inputs) included the energy used for the production of mineral fertilisers, seeds, pesticides, concentrates, forages and machines.

Results The results in Table 1 show that the major part of the energy used on dairy farms can be attributed to production of concentrates and mineral fertiliser. In fact, indirect energy use is much higher than direct energy use, where diesel use is the most important factor. Compared to 1989-1990, energy use per ha has decreased significantly in 2000-2001, mainly caused by a large decrease in the use of mineral fertilisers. In Figure 1, we consider energy input vs. milk production for each farm. Some 95% of all farms have an energy productivity between 14 and 40 l milk/ 100 MJ. In 2000-2001, the farms are generally more efficient than in 1989-1990: they have a higher average milk production per unit of energy used (27 l/100MJ and 22 l/100MJ respectively). The most energy-efficient farms have an energy productivity of about 40 l milk/100 MJ. They combine a high milk production (achieved by good livestock management, high milk production from forage or a high livestock density) with a low energy use (mainly achieved by low use of mineral fertiliser and diesel). The least efficient farms have an energy productivity < 14 l milk/100 MJ. They are often extensive farms (± 5000 l milk/ha) with a low livestock density and a relatively high use of concentrates, mineral fertiliser and diesel.

Table 1 Flemish dairy farms: energy use per ha

	1989-1990		2000-2001	
	MJ	%	MJ	%
Diesel	5522	12.9	5771	16.8
Contract work diesel	1503	3.5	2015	5.9
Lubricants	524	1.2	534	1.6
Electricity	2768	6.5	2185	6.4
Other energy sources	0	0.0	24	0.1
Direct energy	**10317**	**24.2**	**10529**	**30.8**
Mineral fertiliser	15245	35.7	8798	25.7
Seeds	150	0.4	150	0.4
Pesticides	189	0.4	219	0.6
Concentrates	13642	31.9	11639	34.0
Forages	950	2.2	506	1.5
Machines	2228	5.2	2426	7.1
Indirect energy	**32404**	**75.8**	**23738**	**69.2**
Total energy use	**42721**		**34267**	

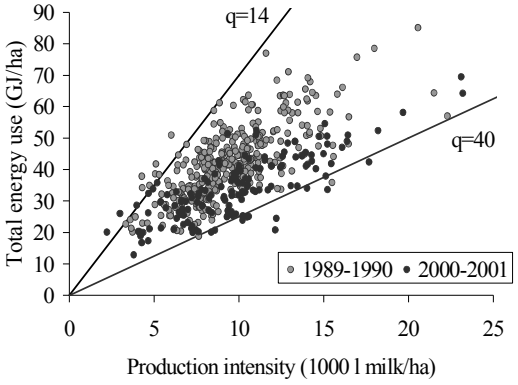

Figure 1 Energy use vs. milk production, q = energy productivity (l milk/100 MJ)

Conclusions Flemish diary farms can save most energy by decreasing the use of mineral fertiliser and diesel. Using less concentrates would also lower the energy use, but this might have a negative impact on milk production (Verbruggen *et al*., 2004). Our results show that an energy productivity of 40 l milk/100 MJ is an achievable eco-efficiency goal. The most efficient farms can reach average to high milk production with a lower than average energy use. The least efficient farms are often extensive farms (low milk production per ha).

Reference

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