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THE RENAISSANCE OF MIXED FARMING SYSTEMS: A WAY TOWARDS SUSTAINABLE AGRICULTURE

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Introduction

During the last decades agricultural production systems have developed in North-western Europe that waste inputs and are suboptimal in biotechnical and environmental terms. In the near future this will lead to unacceptable environmental and ecological, but also economical and social effects (Rabbinge, 1992). Therefore, there is a need to develop and test alternative systems, which are acceptable in the long term. One of the possibilities to reduce the negative effects of the increased specialisation and intensification, characterized by too narrow crop rotations and an overuse of external inputs like fertilizers and biocides, is a renaissance of mixed farming systems at farm or regional levels in which products and services are exchanged between the different production branches. The main advantages of mixed farming systems are:

- reduction of use of external inputs and increase their efficiency through (i) use of home-grown concentrates (less purchased concentrates), (ii) more efficient application of animal manure (less waste of nitrogen and minerals), and (iii) broadening the crop rotation (less use of biocides and higher yields due to less problems with soil-borne pests and diseases);
- better utilization of the available labour and spreading of income risks.

Methods

On the Minderhoudhoeve, the experimental farm of Wageningen Agricultural University in Oostelijk Flevoland, two different prototypes of mixed farming systems are developed, optimized and tested: an integrated farm (135 ha; 90 dairy cows, 60 young cattle, 60 sheep) and an ecological farm (90 ha; 55 dairy cows, 60 young cattle and bulls, 40 sheep, 200 laying-hens). Both farms have their own sets of goals and constraints. The production target per ha at the ecological farm is 80% of that on the integrated farm as an average for milk, potatoes and cereals. The location is characterized by a good loam soil with a high nutrient use efficiency and low irrigation needs. Measurements at farm level will start in autumn 1996 when both farms are fully operational. In the foregoing years the two prototypes were designed and the transition to the present farms was initiated. The integrated type is described here according to its targets and constraints. Nitrogen surplus is used as an example for its perspectives.

Main targets and constraints on the integrated mixed farm

1) minimization of the nitrogen (N) surplus per unit product;
2) minimization of the use of biocides per unit product under the fertilization regime resulting from target 1 and with the constraint of a good product quality at harvest;
3) in the system there is a variety of crops more or less corresponding with the 'average' Dutch cattle and arable farms: grassland, maize, seed and ware potatoes, sugar beets, winter and summer cereals, vegetables (onions, peas, green beans, etc.);
4) no bare fields until late autumn to prevent nitrate leaching;

5) cultivation of potatoes and sugar beets on a certain field up to a maximum of only once in every six years to reduce the risks of soil-borne pests and diseases;
6) application of slurry only between late winter and mid-summer to reduce nutrient losses;
7) amount of purchased concentrates less than 0.10 kg per kg milk, i.e. less than about 800 kg cow^{-1} yr^{-1}, to restrict nutrient inputs under the constraint of a milk production of about 8 000 kg cow^{-1} yr^{-1} and about 11 000 kg per ha of forages (grass, clover, maize, wheat);
8) with the exception of 4 ha permanent grassland surrounding the farm buildings, the grass in rotation is ploughed after two or four years to prevent nutrient accumulation in the soil;
9) a stock of 60 ewes is kept to increase pasture utilization and condition (consumption of grass rejected by dairy cows, winter grazing, 'biological' weeding in sown pastures);
10) sufficient phosphorus (P) status of the soil (Pw-value about 25);
11) weeding in principle first through mechanical measures.

Results

The N and P surpluses per unit of acreage and the N surplus per ton of milk are shown in the Table. It illustrates the possibilities of mixed farming to decrease environmental side effects and to increase profit. This was also concluded by De Koeijer et al. (1995) in an environmental-economic analysis of mixed crop-livestock farming. The contribution on a country level is considerable as the dairy sector is responsible for about two-thirds of the N surplus in Dutch agriculture. The negative P balance is due to the aim to achieve a sufficient P status of the soil. Current fertility in most of the fields is far beyond this level.

Table. Calculated nitrogen and phosphorus surpluses excluding deposition on the integrated mixed farm (1996-2000; 50% forage land) compared with the reference year 1993 (56% forage land) and the average of Dutch cattle and arable farms, 1985/1986 (65% forage land).

	Kg N ha^{-1} yr^{-1}	Kg P ha^{-1} yr^{-1}	Kg N ton^{-1} milk
The Netherlands (1985/1986)	217	11	37
Minderhoudhoeve (1993)	124	10	25
Integrated mixed farm (1996-2000)	33	-12	6

Conclusions

The calculated results illustrate that nutrient losses per unit product and per ha may be reduced considerably by a sound integration of the different production branches. It is interesting to note that when the results are translated to the Netherlands as a whole, total milk production is almost the same as the current Dutch production volume (11 million tonnes on 2 million ha agricultural land, i.e. 5 500 kg per ha). On the integrated mixed farm, the milk quotum equals 5 300 kg per ha farmland of which only 50% is used for growing forages. This confirms both the good production situation at this site and the perspectives for mixed farming systems.

References

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