ASSESSMENT OF THE POTENTIAL TO MODIFY THE ENVIRONMENTAL IMPACT OF SLURRY THROUGH DIETARY CHANGES IN DAIRY CATTLE FARMS

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INTRODUCTION

→ **Nitrogen (N)** is an essential element in animal production.

→ The problem of the cycle of N in dairy farms is that **significant losses** normally occur that contribute to the degradation of our environment.

→ The current concern focuses on **N emissions to the atmosphere**: ammonia, nitrous oxide and nitric oxide.

→ Conservation of N in dairy farms must begin by **improving N use efficiency** in the animals.

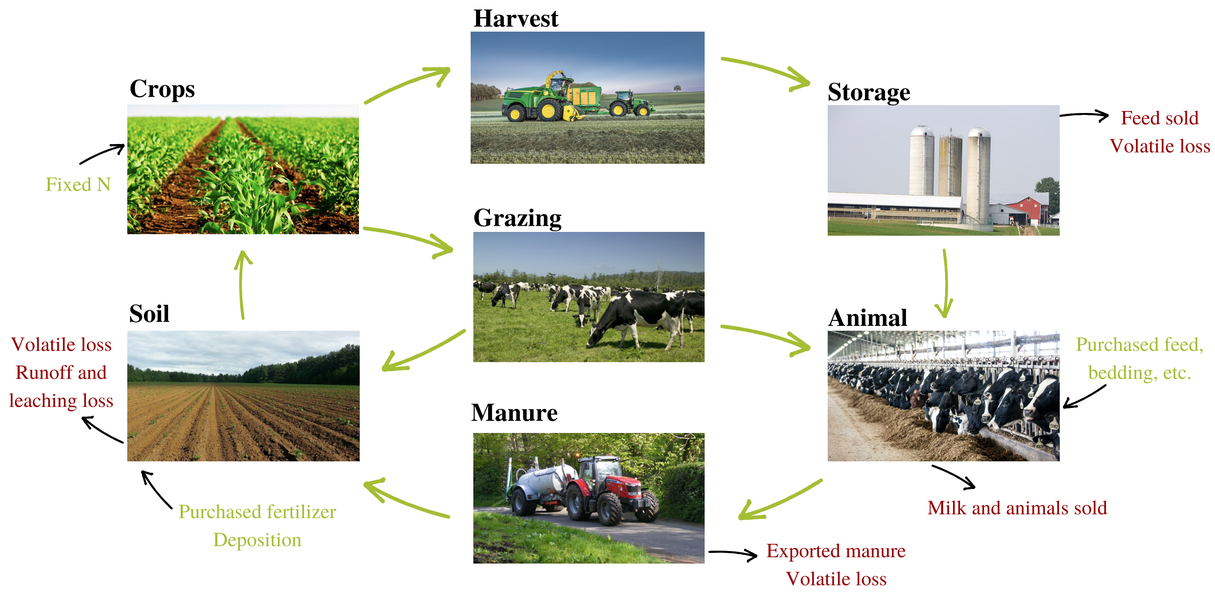

Figure 1. Major nitrogen flows in a dairy farm (Rotz 2004).

OBJECTIVES

To assess the potential to modify the environmental impact of slurry through dietary changes in dairy cattle farms:

1. To assess the impact of formulating diets for small groups of animals on N and phosphorus (P) excretion and the final cost of the ration.
2. To study the effect of modifying the protein content of the ration on total nitrogen excretion in lactating cows.
3. To seek a method to modify lactating cow rations to improve nitrogen utilization efficiency, meet nutrient requirements and maintain or increase milk production.

MATERIAL AND METHODS

→ Data were collected from a total of **5 typical Holstein dairy farms**, that were selected to represent different milk yields and feeding systems.

Table 1. Characteristics of the dairy farms studied.

Parameters	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5
Herd characteristics					
Number of lactating cows	100	100	100	100	100
Days in lactation (days)	150	150	150	150	120
Body weight (kg)	703	703	703	677	624
Body condition (1-5)	3,00	3,00	3,00	3,00	2,75
Production characteristics					
Milk production (kg/cow/day)	30,0	30,0	40,0	40,0	40,0
Milk fat (%)	3,80	3,70	3,80	3,70	3,70
Milk protein (%)	3,20	3,10	3,20	2,98	3,20
Diet composition and intake					
Dry matter intake (kg/cow/day)	22,90	23,11	25,47	26,61	25,06
% concentrates	52,40	47,20	44,90	51,90	52,90
% forages	47,60	52,80	55,10	48,10	47,10

→ Nitrogen and phosphorus emissions associated with each ration and dairy farm studied were simulated using the **Spartan Dairy 3 program** *(https://www.canr.msu.edu/spartandairy/)*.

→ Nitrogen and phosphorus **mitigation scenarios simulation**:

Two new diets (50 cows/diet) were formulated for each farm:

30 kg of milk/cow/day
↓
40 and **25 kg/cow/day**

40 kg of milk/cow/day
↓
50 and **35 kg/cow/day**

The **same ingredients** as in the original diets were used.

The **introduced quantities** of each ingredient **were changed** to meet the requirements needed for the new established productions.

RESULTS AND DISCUSSION

Table 2. Nutrient management (N and P) according to the diets studied.

Nutrient management (N and P)	Farm 1		Farm 2		Farm 3		Farm 4		Farm 5	
	Original diet	New diet	Original diet	New diet	Original diet	New diet	Original diet	New diet	Original diet	New diet
Faecal dry matter (kg/d)	824	840	750	778	951	1005	917	970	834	897
Nitrogen										
Captured N (%)	22,70	26,05	24,20	28,00	30,70	30,95	28,40	29,75	33,90	34,60
Total N excreted (kg/d)	57,30	51,40	51,10	44,60	50,30	52,75	52,50	51,95	43,90	44,85
N excretion reduction (%)	-10,30		-12,72		+4,87		-1,05		+2,16	
Phosphorus										
Captured P (%)	20,20	21,95	30,10	33,10	29,60	29,45	42,60	43,90	51,00	51,15
Total P excreted (kg/d)	11,60	11,00	6,80	6,30	9,10	9,60	5,10	5,15	3,80	3,90
P excretion reduction (%)	-5,17		-7,35		+5,49		+0,98		+2,63	

→ N use efficiency of the animals can be improved by formulating diets more adjusted to their requirements. Another strategy to reduce N excretion is to improve animal productivity.

→ As dietary crude protein increases, nitrogen excretion increases.

→ N use efficiency improvement might contribute to the optimization of P use efficiency.

Table 3. Costs according to the diets studied.

Costs	Farm 1		Farm 2		Farm 3		Farm 4		Farm 5	
	Original diet	New diet	Original diet	New diet	Original diet	New diet	Original diet	New diet	Original diet	New diet
Purchased feed costs										
(€/cow/day)	6,40	6,27	5,44	5,37	5,81	6,07	5,63	5,82	5,30	5,60
(€/day)	640	627	544	537	581	607	563	582	530	560
Final comparison (€/d)	-13,00		-7,00		+26,00		+19,00		+30,00	
Cost per litre of milk										
(€/L)	0,21	0,20	0,18	0,17	0,15	0,14	0,14	0,14	0,13	0,14
Final comparison (€/L)	-0,01		-0,01		-0,01		0,00		+0,01	
Income over feed costs										
(€/cow/day)	3,20	4,14	4,16	5,04	6,99	7,54	7,17	7,78	7,50	8,00
(€/day)	320	414	416	504	699	754	717	778	750	800
Final comparison (€/d)	+94,00		+88,00		+55,00		+61,00		+50,00	

→ The formulation of diets that are more adjusted to the animals' requirements is not sufficient to reduce the purchased feed costs in the rations for high producing cows.

→ More productive farms have a lower milk production cost.

→ Income over feed costs (IOFC) increase as milk production increases. More productive farms have a lower increase in IOFC.

CONCLUSIONS

The **reduction** and the **correct match** between dietary crude protein fed and that required by lactating cows is a valid option to reduce N excretion. When adjusting the protein content, it is also necessary to **balance the energy content** of the rations. Rations that improve N use efficiency may **reduce cow P excretion** if dietary requirements are not very high. Evaluation of diets through simulation programs can provide **useful information to mitigate the environmental impact of slurry**.

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