

An analysis of eco-efficiency scenarios in dairy farming: simulations of cows number



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The study was carried out on the eco-efficiency character of dairy farm which presumes the approach of economic efficiencies and the impact upon environment.

MATERIALS AN METHODS

The study started from a real situation of a dairy farm with 38 cows and 50 hectares of farmland with quantified productions, rations, cost and income and calculated nitrogen (N) balances and value of profit. It was used the equipment belonging to Auto laboratories of Environment and Technologies (NIR, Lactostar) with which there were quantified nutrient inputs and farm's productive outputs and the N-CyCLE software application to perform simulations for maximizing the profit and minimizing the nitrogen.



Figure no 1. Equipments of Auto laboratories of Environment and Technologies

RESULTS AND DISCUSSIONS

By simulating an increase in the number of cows from 39 to 55, two scenarios were performed by using the N-CyCLE software (figure 2): minimization of the N-balances and the maximization of the profit. The two scenarios significantly influence the value of profit – the scenario towards maximizing the annual gross margin generated the highest average profit (617 €/cow), and the scenario towards minimum N balance generated the lowest average profit (193 €/cow). The annual N balance was 136 kg N·ha⁻¹ in the economic scenario and 89 kg N·ha⁻¹ in the ecological scenario. The eco-economic character of the farm was obtained through a mathematical model constructed on barycentric coordinates with equal weights for the two scenarios above. This resulted in a new scenario for the computation of the values of N and the rates of gross margin. The eco-efficient scenario of the farm is described by the following equation, whose graphic representation is given by the surface in graphic no.1:

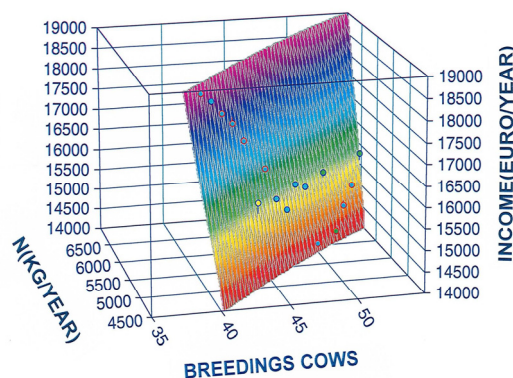
$$z = -315593.47 - 4098.68x + 29.84x^2 + 53041.67\ln y$$

where: $z = \text{Income} \left(\frac{\text{euro}}{\text{year}} \right)$, $x = \text{Breeding cows}$,
 $y = N(\text{kg/year})$

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In our study, the eco-economic character could not be improved by increasing number of cows without land increase - the farm acquires an eco-economic character when the annual N balance is 112 kg N·ha⁻¹ and the profit is 351 €/cow.



Graphic no.1 . Representation of the eco-efficiency function of the farm subjected to simulation

CONCLUSIONS

Increasing the number of the cows is economically not feasible to increase sustainability of dairy farms; in this case the society will support a yearly subsidy of 267 € /cow which is too much in comparison with costs of other management practices as increasing milk or protein productions or optimizing feeding and manure management .

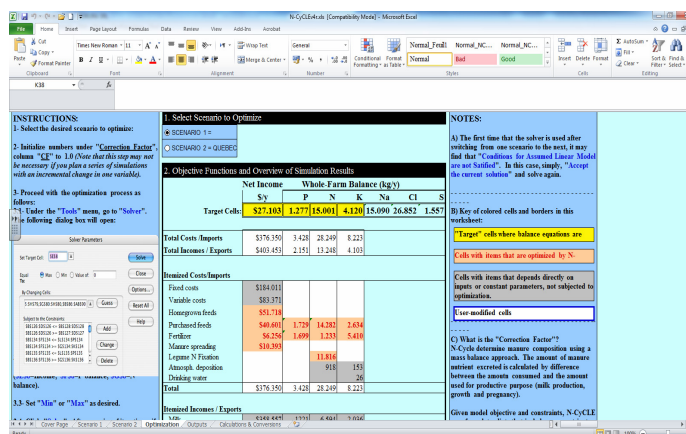


Figure no. 2. Optimization by N-CyCLE software

References

Pellerin, D., Wattiaux, M., Charboneau, E., Moreira, V., Flis, S. (2010). *N-Cycling the Nutrient balance and Optimization spreadsheet. V. 2.5.5. User's Manual and Model Description*, Université Laval, Québec City, Canada, University of Wisconsin, Madison, SUA.