NITROGEN-USE EFFICIENCY OF DIFFERENT FORAGE-BASED DAIRY PRODUCTION SYSTEMS

H. Menzi[1], R. Ziegler[1], P. Sperling[2], B. Reidy[2], T. Kupper[2], P. Hofstetter[3]

[1] Agroscope, Institute for Livestock Sciences ILS, 1725 Posieux, Switzerland;
[2] Bern University of Applied Sciences; School of Agricultural, Forest and Food Sciences HAFL; Zollikofen, Switzerland
[3] Vocational Education and Training Centre for Nature and Nutrition BBZN, Schuepfheim, Switzerland

harald.menzi@agroscope.admin.ch

Objectives

Fresh grass is the most important forage in Switzerland. In dairy farming, previous projects have compared full grazing systems (during summer) with the maize-based high yield strategy. As most Swiss farms combine indoor feeding of fresh grass with partial grazing, the new project "System Comparison Hohenrain 2" aims at comparing the full grazing system with indoor feeding of fresh grass combined with partial grazing at two different levels of concentrate supplementation IFC). The performance and effects of the three production systems on sustainability are studied and compared in a system comparison with three herds on a demonstration farm and on 38 pilot farms in different regions of Switzerland. This contribution focuses on Nitrogen (N) flows and N use efficiency (NUE) of the pilot farms. The aim is to identify structural and management parameters with respect to the NUE of the different production systems and to develop practice orientated optimization options.

Material and Methods

Together with Cantonal extension services 38 interested dairy farms from different regions of the Swiss lowlands were recruited, approx. 12 for each of the three strategies: 1) full grazing plus <300 kg concentrate (FG), 2) indoor feeding/partial grazing plus <500 kg (IFC1), indoor feeding/partial grazing plus 800-1200 kg concentrate (IFC2). The conditions for the participating farms were clearly defined. A detailed list of management and structural parameters were either regularly recorded by the farmers, surveyed in detail during regular visits or collected through a questionnaire in spring 2015. The questionnaire covered all aspects of livestock and manure management that are relevant for N flows and ammonia (NH_3) emissions. Based on this information and structural data, N flows and NUE (N in sold products in percent of N inputs) are calculated for each farm (35 farms with complete data). Ammonia (emissions were also calculated for each farm using the model AGRAMMON (Kupper et al. 2010, 2015). The results are compared to different structural and management parameters to identify the most important influencing factors and promising actions to improve the NUE.

Results

For all three groups the average farm size surpassed the Swiss average of about 18 ha agricultural surface. On average the IFC2 farms (23.8 ha) were clearly smaller than the IFC1 (34.6 ha) and the FG (32.4 ha) farms. The FG farms had less arable crops (9% of agricultural surface) than the IFC1 (24%) and IFC2 (28%) farms. The average annual milk yield was 8016 kg for the IFC2 farms, 6378 kg for IFC1 and 5734 for FG. As expected, the average amount of concentrate supplementation per cow per year decreased from 1073 kg for IFC2 farms to 366 kg for IFC1 and 100 kg for FG farms. Seven of the 12 FG farms did not feed any concentrate at all.

Detailed results on N-flows and NUE were not yet available at the time when this abstract was written. They will be exclusively shown for the first time at the N workshop. A primary focus will be the question of the ranking of the different strategies with respect to NUE, e.g. does the higher milk yield achieved primarily through higher concentrate supplementation improve or reduce the NUE. Most important for the participating farms and the wider applicability of the project results in farming practice will be the analysis of which are the key factors influencing the NUE of dairy farms and the most promising strategies to improve the NUE. A promising step in this direction will be the comparison of the results of this project with 1) our parallel analyses of data from a representative national survey on farming practice (approx. 3000 farms, of which about 1050 with strong focus on dairy production) and 2) our parallel assessment of the NUE of pilot farm groups that have deliberately tried to improve their manure management.

From earlier studies we know that it is difficult to compare the NUE of different farms as soon as there are structural differences, e.g. the proportion of agricultural land used for crop production (Menzi et al. 2013) or the different types of livestock categories present on the farm. For our study special challenges will be questions like how to deal with farm specific specialties such as the milk use rearing fo fattening calves or the outplacement of heifers to other farms.

Conclusions

The project aims at ranking the efficiency of the different dairy production strategies and to assess their sustainability. However, it will also have to consider that farm structure, market potential and personal considerations of the farmer family often limit the choice of the best production strategy. For example, the full grazing strategy is often impeded by a limited consolidation of the grazing plots around the farm facilities or the lower demand for milk during summer months. The discussion of the results will therefore have to be placed in a holistic perception that takes into account a wide variety of issues.

Hopefully the project will provide detailed recommendations and aids for the assessment and optimization of the efficiency of dairy farms which are easily implementable under practical conditions. Support for success in this direction will be the pioneer and demonstration effect that the pilot farms of the "System Comparison Hohenrain 2" project will have thanks to on farm events and other knowledge transfer activities planned towards the end of the project.

References

Kupper T., Achermann B., Bonjour C., Zauker F., Menzi H., 2010. Agrammon: An internet based model for the estimation of ammonia emissions (Poster), C.S.C. Marques dos Santos Cordovil and L. Ferreira (Eds.), Proc. 14th Conference "Recycling Agricultural, Municipal and Industrial Residues in Agriculture Network (RAMIRAN)", 0167, http://www.ramiran.net/ramiran2010/docs/Ramiran2010_0167_final.pdf

Kupper T., Bonjour C., Menzi H., 2015. Evolution of farm and manure management and their influence on ammonia emissions from agriculture in Switzerland between 1990 and 2010. Atmospheric Environment 103, 215-221

Menzi H., Gregis B., Mahrer D., Kupper T., 2013. Assessment of the nitrogen use efficiency of Swiss farms based on a representative farm management survey. Proc. 15th RAMIRAN Conference, Versailles June 3-5 2013, S5.03, http://www.ramiran.net/doc13/Proceeding_2013/documents/S5.03..pdf