How does grazing duration per year affect the environmental impacts of dairy farming?

Baumgartner D.U.[1], Bystricky M.[1], Guggenberger T.[2] and Marton S.M.R.R.[1]
[1]Agroscope, Life Cycle Assessment Group, Zurich, Switzerland; [2]AREC Raumberg-Gumpenstein, Irdning-Donnersbachtal, Austria; daniel.u.baumgartner@agroscope.admin.ch

Abstract

In today's Europe, we observe two contradicting tendencies: On the one hand, pasture grazing is declining, on the other hand, consumers call for production systems where animal welfare is increased by allowing dairy cows to express their inherent behaviour. At the same time, environmental issues such as climate change remain a matter of importance. Hence, in a study with twenty-two dairy farms we assessed whether high grazing duration per year had an effect on the environmental performance of milk production. Focusing on the environmental burden per ha farmland, dairy farms with a longer grazing duration performed significantly better than those with shorter ones for all assessed categories, e.g. non-renewable energy demand, global warming potential, and terrestrial ecotoxicity. However, when we turned the attention to the assessment per kg milk, the life cycle assessment results for longer grazing duration showed a diverging picture with benefits for ecotoxicity and the use of P resources and drawbacks for global warming potential. Overall, dairy farming with high grazing duration was better or at least similar for many categories in comparison with low grazing duration farms, with some exceptions as global warming potential when assessing per kg milk. For an even better achievement further efforts should be made to decrease global warming potential from grazing cows (e.g. by improving pasture quality and animal genetics, or using feed supplements) in order to reduce the environmental impacts per kg milk without compromising the results per ha farmland. This would help to promote grazing in European dairy farming.

Keywords: grazing duration, life cycle assessment, environmental benefits, farm management, dairy farming

Introduction

In today's Europe, two contradicting tendencies can be observed: On the one hand, pasture grazing is declining as high lactating cows are fed mainly indoors. On the other hand, consumers' awareness of animal welfare issues is increasing, and numerous stakeholders consider grazing an important part of the inherent behaviour of dairy cows. The same consumer group is often also concerned about the environmental performance of products. The objective of this study was to assess how grazing duration affects the environmental performance of dairy production.

Materials and methods

Twenty-two commercial Austrian dairy farms provided agricultural management data for the year 2014. Grazing duration was calculated from the number of pasture days per year multiplied with the average hours spent on the pasture per day. We formed two classes: (1) a high grazing duration (n=10; average grazing duration per year: 3,880 hours) and (2) a low grazing duration group of farms (n=12; average grazing duration per year: 630 hours). As a threshold, we chose 12 hours grazing during 220 days, i.e. 2,640 hours per year. Being above this means these farms let their cows graze the majority of the vegetation period.

In the high grazing duration group on average grazing supplied 37%, dried or ensiled roughages 58%, and concentrates 5% of the feed intake (in dry matter). For the low grazing duration group the feed

intake was on average split in 8% from grazing, 78% from dried or ensiled roughages, and 14% from concentrates, respectively.

For the environmental assessment we used the FarmLife-methodology (Herndl *et al.*, 2016), a life cycle assessment (LCA) approach at farm level. The spatial system boundary was set at the farm gate. The temporal system boundary is one calendar year for animal husbandry and permanent grassland. For arable crops, it lasts from the harvest of the previous main crop to the harvest of the current main crop, for temporary grassland from the last cut in the previous year to the last cut, or the ploughing, in the main year.

Agricultural systems have two main functions for society: (1) the preservation of natural livelihood for future generations, and (2) the provision of edible products. Therefore we chose two functional units to reflect these two functions,: (1) 1 ha utilised agricultural area in one year and (2) 1 kg of milk. The statistical tests for all comparisons between the two farm groups were performed by using the tool 'R' applying a one-tailed Mann-Whitney U test. The selection of the assessed environmental impacts is based on SALCA (Nemecek *et al.*, 2010).

Results and discussion

Per ha farmland and year, the high grazing group of farms had significantly lower values for cumulative non-renewable energy demand (nrCED), global warming potential (GWP; Figure 1), both aquatic eutrophication N and P, terrestrial ecotoxicity, use of P and K resources, land competition, land use change, and water use. The lower stocking density in the high grazing group was one reason for these positive results. Another important reason was the use of far fewer concentrated feedstuffs (70% less per cow on high grazing farms compared to low grazing farms). In addition, the greater use of purchased concentrates explained the higher land competition for low grazing farms systems, as they needed more agricultural surfaces off-farm for the purchased feedstuffs. In a world with growing human population and increasing demand for food, this is key, as the competition for land will grow further.

Analysing the LCA results per kg milk showed a diverging picture: For several impact categories such as nrCED, aquatic eutrophication N and P, and water use, there was no difference between the dairy farms with high and low grazing duration. For other impacts such as GWP, land competition, and land use change, the impacts of the high grazing farms were significantly higher than of the low grazing ones (Figure 2). Moreover, there were impact categories, such as terrestrial ecotoxicity or resource use of both P and K, where the group of high grazing farms had a significantly lower impact than the low grazing farms.

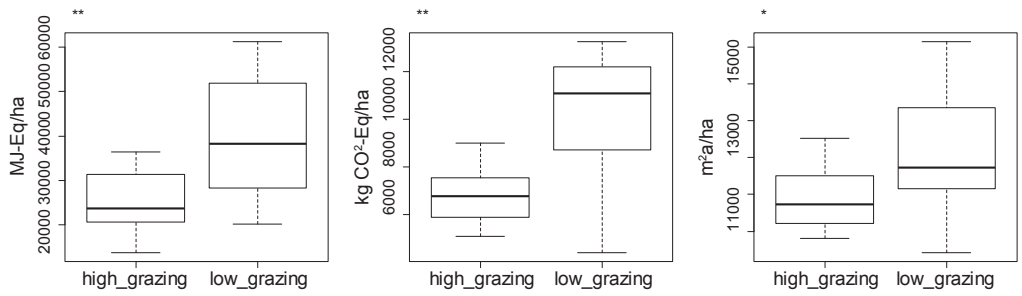

Figure 1. Environmental impacts per ha farmland and year for cumulative non-renewable energy demand, global warming potential, and land competition (from left to right); * = significant different at $P<0.05$; ** = at $P<0.01$; n=22) for the systems high grazing and low grazing duration, respectively.