In: Proceedings of the SETAC Europe 17th LCA Case Study Symposium "Sustainable Lifestyles", Budapest, 28 February – 1 March 2011

Variability of the global warming potential and energy demand of Swiss cheese

Thomas Nemecek[1], Adrian Schmid[2], Martina Alig[1], Kurt Schnebli[3], Markus Vaihinger[2]

[1]Agroscope Reckenholz-Tänikon Research Station ART, CH-8046 Zurich, Switzerland
[2]Swiss College of Agriculture, CH-3052 Zollikofen, Switzerland
[3]Fromarte, CH-3001 Bern, Switzerland
E-mail contact: thomas.nemecek@art.admin.ch

1. Introduction

Milk production contributes 22% to the economic output of Swiss agriculture. 42% of Swiss milk is transformed to cheese, mainly in artisanal dairies. Due to this large share, the environmental impact of cheese is of high relevance, but was so far not assessed in detail. In the present study, the energy demand and the global warming potential of milk and cheese production have been analysed by life cycle assessment.

2. Materials and methods

Data were collected on more than 100 farms during three years in the frame of the LCA-FADN project [1]. Averages of the years 2007 and 2008 were used from 66 dairy farms in this analysis. The environmental impacts of milk production on farms were calculated with the Swiss Agricultural Life Cycle Assessment [SALCA, 2]. Direct energy use was recorded in about 250 dairies. These data were complemented with surveys on the use of water, detergents, rennet, salt and buildings and equipment[3], and calculated with inventory data from the ecoinvent database [4].

3. Results and discussion

The average global warming potential (GWP) per kg milk at the farm gate was 1.4 kg CO_{2eq} with a coefficient of variation of 20%. The GWP at the farm was dominated by methane from enteric fermentation, emissions from manure management and fertiliser applications, followed by use of fossil energy, and the purchase of feedstuffs and animals. Factors such as production region, type of farm or farming system (integrated, organic) did not explain the variation observed. However, a slight correlation was found between the milk production volume per farm and year and the GWP (Figure 1). Farms with a small production volume can have high or low values for global warming. Farms with larger production volumes have average or lower results. This shows that a small farm can be equally efficient as a large farm. A similar relationship was found for the non-renewable energy demand (mean 5.6 MJ/kg, coefficient of variation 35%).

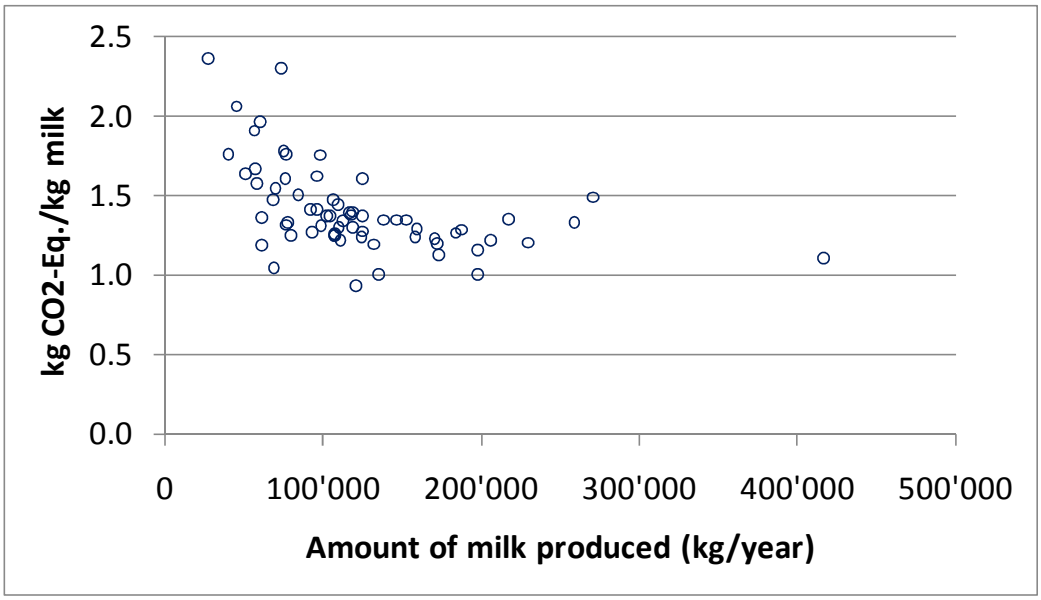

Figure 1: Global warming potential per kg of milk produced at the farm gate in function of the amount of milk produced.

For the processing in the dairy, including transports, auxiliary materials and infrastructure, 0.06 kg CO_{2eq} were calculated per kg of processed milk average (only 4% of the total GWP of cheese production). The coefficient of variation was 35% and thus higher than for the agricultural phase. The dominating factor at the dairy was the use of energy (76%, mainly heating oil and electricity), followed by transport and infrastructure. Auxiliaries and water use had only a minor effect. For the dairies, the use of energy and the GWP decreased with increasing processing volumes (scale effect, Figure 2). Small dairies can have high or low values, while large dairies tend to have a carbon footprint below the average. Since the Swiss electricity mix is mainly based on hydropower and nuclear power, its GWP is comparatively low. The contribution of the dairy thus could be higher in other countries. Milk transport and dairy processing used 1.3 MJ-eq/kg milk (coefficient of variation 41%). The high variability both in the agricultural production and in the processing step indicates that there is a high potential for environmental optimisation.

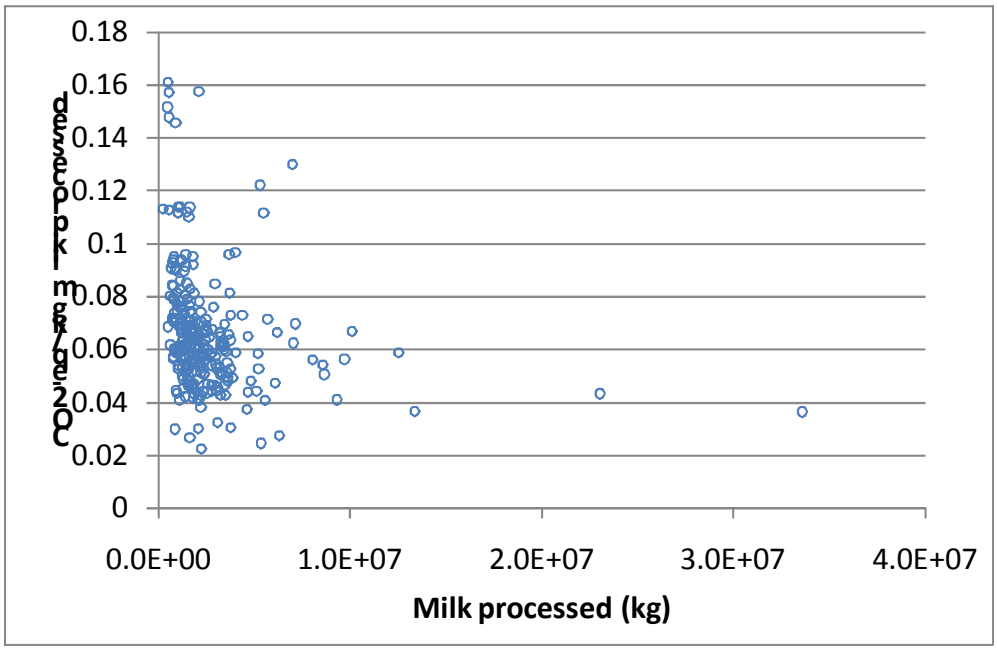

Figure 2: Global warming potential per kg of milk processed per year in a dairy, including milk transport, water use, detergents, rennet, and salt, but without agricultural milk production.

4. Conclusions

Milk production on Swiss farms showed highly variable global warming potentials. Milk processing in dairies led to even more variable results. A trend was observed in both analyses that the environmental impact decrased with increasing production volumes. However, some of the small production units had also favourable results, which shows that there is also an improvement potential independent on the production volume.

5. References

1. Gaillard, G., M. Alig, D.U. Baumgartner, S. Blaser, T. Nemecek and G. Müller. *Farm LCA for an efficient environmental management*. in *Proc. of the 8th Int. Ecobalance Conference*. 2008. Tokyo, Japan.
2. Nemecek, T., R.F. Knuchel, M. Alig and G. Gaillard. *The advantages of generic LCA tools for agriculture: examples SALCAcrop and SALCAfarm*. in *7th Int. Conf. on LCA in the Agri-Food Sector*. 2010. Bari, Italy.
3. Schmid, A., *Carbon Footprint von Schweizer Käse*, in *Bachelor Thesis*. 2010, Swiss College of Agriculture, Zollikofen. 72 p.
4. ecoinvent Centre, *ecoinvent Data - The Life Cycle Inventory Data*. 2007, Swiss Centre for Life Cycle Inventories: Dübendorf.