Greenhouse gas emissions of organic dairy farms from six European countries

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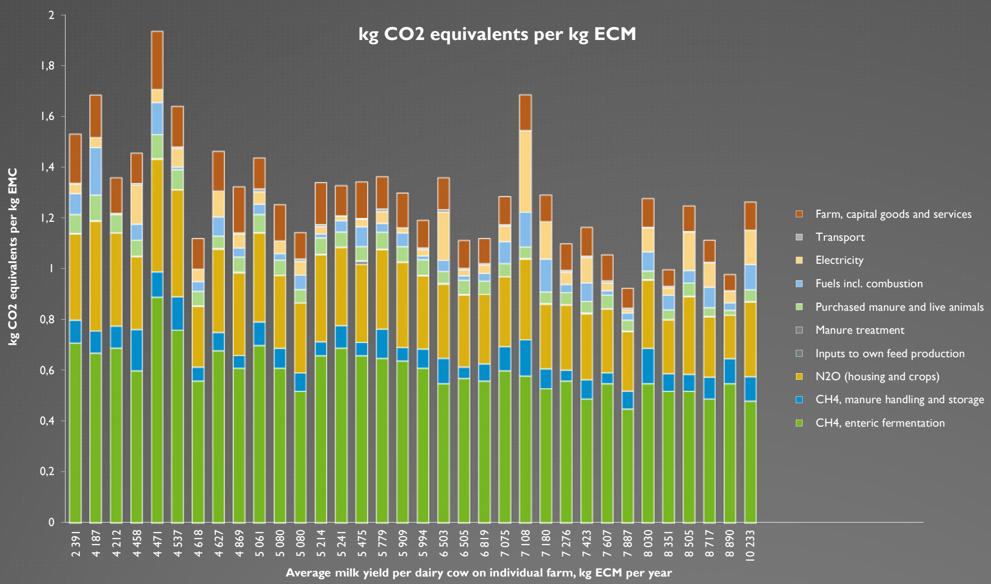
Of all anthropogenic greenhouse gas (GHG) emissions 18 % is estimated to originate in agriculture and the largest agricultural contributor to these emissions is the cattle farming (FAO 2006). According to Gerber et al. (2013) global cattle farming contributes an annual total of 4.6 Gt of CO_2 equivalents, dairy farmings' contribution to this being 2.1 Gt of CO_2 equivalents a year based on Life Cycle Assessment (LCA) approach.

Here, based on data from six European countries, the GHG emissions of a total of 34 organic dairy farms are presented based on LCA approach (as in Hietala et al. 2014a, 2014b). The farm data was collected from a wide variety of farms: 8 from the United Kingdom, 8 from Denmark, 7 from Finland, 2 from Belgium, 4 from Italy and 5 from Austria were assessed. The farm size varied from 9 to 480 dairy cows and from annual production volumes of 41 to 4267 tonnes of Energy Corrected Milk (ECM; Sjaunja et al. 1990) per farm and annual milk yield per dairy cow from 2391 to 10233 kg ECM.



LCA was carried out using system boundaries from cradle to farm gate. GHG emissions were calculated using the LCA method described by Schmidt & Dalgaard (2012a, b). Functional unit used was 1 kg of ECM.

The total GHG emissions of organic dairy farming in Europe averaged 1.32 kg CO_2 equivalents per kg of ECM milk, with a standard deviation of 0.22. Total carbon footprint is ranging from 0.99 to 1.94 kg CO2 equivalents per kg ECM.

The averages per country were, with standard deviation (σ)
1.52, σ 0.33 (AT),
1.17, σ 0.23 (BE),
1.28, σ 0.18 (DK),
1.34, σ 0.19 (FI),
1.31, σ 0.23 (IT) and
1.33, σ 0.17 (UK)
kg CO_2 equivalents per kg of ECM milk.

Of the total average GHG emissions, largest contributors enteric fermentation, N_2O emissions from housing and crop cultivation and farm capital goods account for 76 % and smaller contributors manure management, electricity, fuels, purchased manure and imported feeds contribute together 23 % of total GHG emissions. Remaining 1% resulting from transport and manure treatment. Of these, the main contributor is enteric fermentation, which accounts for nearly half of all GHG emissions in total with 45 % alone.

Here, variations in GHG emissions between organic dairy producing farms and between countries can be seen. Results suggest that even within organic dairy farming, there is potential for reducing GHG emissions. Variations in the tactical management of farms can be viewed as leading to variances in emissions (Henriksson et al. 2011).

In mitigation of GHG emissions from organic dairy sector, especially feed quality and the nutrient efficiency play a large role.

Feed digestibility could be improved, even if it is already considered high in Western Europe (Gerber et al. 2013).

Calculation of methane emissions from enteric fermentation depend on gross energy intake. Therefore GHG emissions from enteric fermentation of farms with less energy intake compared to milk yield are lower. In mitigating N_2O emissions, large impact is in manure/fertilizer and land use efficiency. Lower yielding farms could reduce emissions per kg ECM by aiming to higher milk yields. More details of lower yielding farms would be needed for mitigation design, but generally animal health, efficient nutrition and genetics are the key elements.

Currently, calculation does not take account of carbon sequestration. This would benefit the farms using permanent pastures that are more grass-based and would give more complete view of GHG emissions.

Although enteric fermentation is the largest contributor to GHG emissions, development of more sustainable practices should be in overall tactical management on farm. Life cycle assessment is a valid method in pinpointing inefficiencies of a system and their impacts on environment. More holistic and broader models are needed to understand possible tradeoffs of mitigation of one impact category to another, e.g. eutrophication or biodiversity, and mitigation strategies should be balanced between these.

References

Gerber PJ, Steinfeld H, Henderson B, Mottet A, Opio C, Dijkman J, Falcucci A & Tempio G (2013) Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities. FAO.
Henriksson M, Flysjö A, Cederberg C & Swensson C (2011) Variation in carbon footprint of milk due to management differences between Swedish dairy farms. Animal 5(09): 1474-1484.
Hietala S, Smith L, Knudsen MT, Kurppa S, Padel S, Hermansen JE (2014a) Carbon footprints of organic dairying in six European countries – real farm data analysis. Organic Argiculture (*In Press*)
Hietala S, Kurppa S, Hermansen JE (2014b): The Carbon Footprint Of Organic Dairying In Europe. In: Rahmann G and Aksoy U (Eds.): Building Organic Bridges. Proceedings of the 4th ISOFAR Scientific Conference at the Organic World Congress 2014. 13-15 October 2014 in Istanbul, Turkey. Thuenen Report 20, Braunschweig, Germany, pages: 251-254
Schmidt J & Dalgaard R (2012) National and farm level carbon footprint of milk-Methodology and results for Danish and Swedish milk 2005 at farm gate. Arla Foods, Aarhus, Denmark .
Schmidt J & Dalgaard R (2012) National and farm level carbon footprint of milk-Life cycle inventory for Danish and Swedish milk 2005 at farm gate. Arla Foods, Aarhus, Denmark .
Steinfeld H, Gerber P, Wassenaar T, Castel V, Rosales M & De Haan C (2006) Livestock's long shadow. , FAO Rome.

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