
Researchers have assessed the carbon footprints of dairy farms in 5 European countries.

Farm management practices explained up to 79% of the variation in carbon footprints, which implies potential for lowering emissions.

Life Cycle Assessment (LCA) methodology was used to calculate the environmental impacts of milk production on 71 farms in Ireland, England, Spain, France and Portugal. These farms represent a range of typical dairy farms in Western Europe.

“We found that there is a huge potential for farmers to make changes within their current farming system. It’s realistic and very doable because the study is based on existing feeding strategies, and although the farming, grazing and confinement strategies we researched are based in Europe it is also applicable to other countries,” says Marion Sorley, first author and research assistant at the University of Galway. The paper, that was published in *Journal of Cleaner Production* in January 2024, is a part of her PhD with South East technical university, as well as one of the deliveries in the research project CircAgric-GHG.

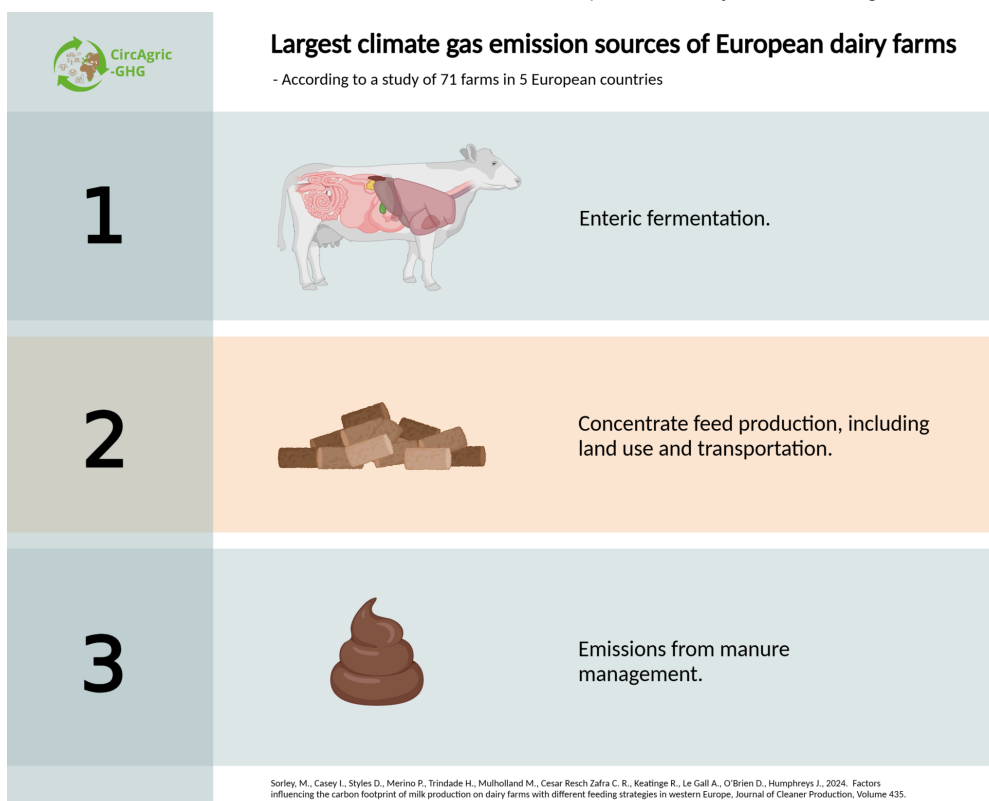
One example of efforts farmers can do is to implement management strategies to lower the cows’ age of first calving.

“If the cows’ can calve at 24 months as opposed to 25 months old, that can be another month’s worth of milk production, and more milk means less CO₂ per kg milk. I think that it’s definitely doable and something the farmers can work on and know that it’s reducing their farm’s carbon footprint,” Says Sorley.

Largest emissions: enteric fermentation, concentrate feed production and manure management

The study divided the researched farms into three groups. On “housed farms” the animals do not graze at all. On “mixed farms” the animals spend less than 220 days a year grazing, and on “grazing farms” the animals graze 220 days or more. Housed farms, had higher carbon footprints compared to mixed and grazing farms.

Emissions from enteric fermentation made up the largest proportion of total emissions across all feeding strategies. Concentrate feed production, including land use and transportation, was the second largest contributor. Methane emissions from manure management were the third largest contributor.



The largest emission sources of 71 European dairy farms. Illustration made in BioRender by Anette Tjomsland Spilling

Suggested efforts to reduce LCA climate footprint from dairy farms

Regardless of feeding strategy, feed efficiency and age at first calving impacted significantly on lowering emissions per tonne fat and protein corrected milk. This highlights the need for improvements in breeding and precision feeding to lower GHG emissions from farms.

Housed farms need higher milk yields per cow to achieve lower carbon footprint per tonne fat and protein corrected milk. Results indicate housed farms should also focus on reducing concentrate feed intake and covering slurry storage.

Grazing and mixed farms on the other hand, should selectively focus on reducing nitrogen surplus, such as efficient slurry application and legume utilisation.



Housed farms had higher carbon footprint but were found to hold the lowest pressure on global agricultural area due to their high intensity milk production system utilising energy- and protein-dense feeds. This picture is from a housed farm close to Bonn in Germany. Photo: Anette Tjomsland Spilling



Grazing and mixed farms should selectively focus on reducing nitrogen surplus, such as efficient slurry application and legume utilisation. Photo: Marion Sorley.

Housed farms: Highest carbon footprint, lowest pressure on global agricultural area

Even though housed farms had higher carbon footprint, the housed farms in the study were found to hold the lowest pressure on global agricultural area due to their high intensity milk production system utilising energy- and protein-dense feeds.

So how does imported feed play out in this calculation, with regards to soy production and land use? Sorley says that land used in other countries is also included in the figure, she explains it like this.

“Grass has less energy and protein than other crops, so we need to grow more of it, and use more land to feed that same number of cows.”

Interestingly, one of the housed farms also had the lowest carbon footprint per tonne fat and protein corrected milk in the present study.

“This farm was above average and focused on a wide range of measures. They had locally produced low intensity concentrate, fantastic management, and higher than average yield per cow, to mention some things. I think this case demonstrates that farmers can reduce their carbon footprint a lot not by excelling at one thing but rather, achieving good results in different areas of management”.

Detailed study including many farms across countries with different feeding strategies

Few studies have compared the carbon footprint of dairy farms with different feeding strategies, and across countries, using a standardised approach to measure carbon footprint. Sorley explains that other LCA-studies within the same field of research often cover either a small, or a very generic and broad range of farms.

“The study is solid because it analysed many real farms across different regions, with a single coherent and detailed approach.”

Next step ahead will be to apply mitigation strategies that can also improve circularity by utilising scenario modelling.

“In this study we concentrated on what the farmers were doing. Now we'd like to calculate to see the effect of the measures proposed to improve circularity in our agri-food systems.”

The researchers hope to develop a suite of circularity indicators tailored for agri-food systems and using the new metrics to evaluate circularity, for instance in beef production. This is a goal both for Sorley's work, and the research project CircAgric-GHG.

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Improved manure management is important for monitoring nitrogen and nutrient run-off. The photo depicts a tractor equipped with modern slurry application machinery in Norway. Photo credit: Erling Fløistad/NIBIO.

By: Anette Tjomsland Spilling

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