Reducing carbon footprint of milk production systems

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Summary

- Ireland will struggle to simultaneously increase milk production and meet its annual emission reduction targets for the EU effort sharing directive.
- The Teagasc national farm survey shows Ireland's milk carbon footprint is amongst the lowest in the world.
- Most dairy farms can enhance profits and reduce carbon footprint of milk by increasing efficiency e.g., improving soil fertility.
- Low emission technologies and practices that build soil carbon have substantial potential to further reduce farms carbon footprint, but have cost implications.

Introduction

Nationally, we have agreed to reduce carbon emissions by 30% compared to 2005 levels by 2030 for the EU effort sharing directive. The milk sectors emissions are regulated by this directive and account for about 17% of Ireland's non-traded emissions in 2017. The sector's carbon emissions have increased by one million tonnes since the abolition of the milk quota system. They are projected to rise further as the industry expands to meet the dairy requirements of a growing world population. A diverse set of measures have been recommended to reduce milk producers carbon footprints e.g., improving genetic merit, increasing grass utilisation and maintaining hedgerows. This work aimed to quantify the potential of a number of measures to reduce Irish milk production system's carbon footprint.

Carbon reduction strategies

The strategies modelled to reduce carbon emissions were 1) Improve efficiency 2) Adopt low emission technology 3) Build soil carbon. The first strategy's mitigation options were from the carbon navigator and included improve soil fertility, increase economic breeding index (EBI), improve animal health, increase grass yield and utilisation, and increase white clover content. For the second strategy, low emission slurry spreaders and protected fertiliser were tested. The third strategy's mitigation options were plant hedgerows or trees, minimise ploughing and maintain the area of permanent pasture. The effect of the three reduction strategies on the carbon footprint of Irish milk systems were quantified using a life cycle approach. The method was applied using the Teagasc national farm survey 2017 dataset and a Teagasc dairy model certified to comply with the British specification for carbon footprint (PAS 2050). On-farm carbon emissions and off-farm emissions associated with the production of purchased inputs (e.g. concentrate feed) were quantified by the life cycle model. Post-farm emissions were not considered. The model related the annual CO_2 equivalent emission from the farm to milk and meat to determine the carbon footprint of product(s). The share of emissions allocated to milk and meat was based on the proportion of income each product generates over a 3-year period.

Potential carbon footprint

Improving farm efficiency has the largest potential to directly reduce the average Irish milk producer's carbon footprint (Table 1). Applying the measures of this strategy simultaneously, reduces potential carbon and nitrogen emissions by 1) increasing grass

yield and utilisation per hectare, 2) minimising the quantity of concentrate feed and nitrogen fertiliser required, 3) improving lifetime milk solids output and cow fertility. For top performing farms, the efficiency strategy has less mitigation potential, but further footprint improvements are possible by using protected urea fertiliser and low emission slurry spreaders (e.g. trailing shoe).

Table 1. Reduction strategies potential effect on Teagasc 2017 national farm survey average and top milk producer's carbon footprints (kg CO_2e[1]/kg fat and protein corrected milk)

Reduction strategy	Measures	Average farms[2] milk carbon footprint	Top 1/3 milk carbon footprint
None	None	1.14	1.04
Improve efficiency	Improve animal health and EBI + Enhance soil fertility + White clover + Increase grass yield and utilisation	-20%	-13%
Low emission technology	Protected urea + Low emission slurry spreader	-5%	-6%
Build soil carbon	Maintain/Increase permanent pasture + Plant hedgerows and/or trees	-5%	-4%
Combined	All	-30%	-23%

[1]*Equivalent emission* [2]*Average net margin €1,730/ha and top third net margin €2,596/ha*

Dairy farmers can also reduce their footprint by maintaining permanent pasture and by planting trees and hedgerows. These practices reduce emissions by removing carbon from the atmosphere and improve farm's nature value (biodiversity). However, their long-term capacity to accumulate carbon is limited. Fortunately, new low emission technologies are emerging for cattle methane (e.g., 3-NOP and Mootral) and may be available if tests in grass-based systems confirm they maintain production and reduce emissions.

Conclusions

The milk sector can continue to reduce its emissions by adopting a suite of strategies to reduce carbon footprint. The main strategy recommended can be implemented at little or no cost.