The role of life cycle assessment in livestock production improving efficiency and reducing environmental impact

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Life cycle assessment (LCA) is a methodological framework for quantifying environmental impacts across the entire life cycle of a product or system. In dairy production, LCA enables a detailed accounting of resource use and emissions, providing valuable insights into how efficiency can be improved and environmental burdens reduced. This paper draws from recent evidence, particularly two papers by Mazzetto *et al.* (2022) and Mazzetto *et al*. (2023), to examine how LCA supports progress in reducing greenhouse gas (GHG) emissions in the dairy sector.

Dairy systems are significant contributors to global GHG emissions, primarily due to methane (CH_4) from enteric fermentation, manure management feed and fertiliser production. LCA is widely recognised as the most suitable approach for capturing the complexity of emissions in dairy systems, as it includes not only direct emissions from animals but also upstream processes such as feed production and energy use.

Mazzetto *et al.* (2022) identified major disparities in the carbon footprint of milk production among countries, ranging from 0.74 to 5.99kg of carbon dioxide equivalent (CO2e) per kg of fat - and protein-corrected milk (FPCM). Low-emission systems were typically pasture-based and high-yielding, as seen in New Zealand and the United States, whereas higher footprints were found in regions with lower productivity per cow, often due to limitations in feed quality, herd management, and infrastructure.

The study also revealed substantial methodological inconsistencies in published LCA studies, particularly in terms of functional units, allocation procedures between milk and meat, and the global warming potential metrics used. These inconsistencies hinder comparability. By standardising the assumptions - adopting biophysical allocation, using FPCM as the functional unit, and applying the most recent IPCC GWP100 values - the authors recalculated emissions to enable direct comparison. This harmonised approach emphasised the critical role of methodological rigor in LCA applications.

A key insight from the review was the inverse relationship between milk yield per cow and emissions intensity. Higher-yielding cows tend to dilute maintenance emissions over more output, resulting in a lower carbon footprint per unit of milk. Thus, management practices that enhance productivity - such as improved feeding regimes, reproductive performance, and genetic selection - are central to reducing emissions intensity.

While the primary focus of this review was on GHG emissions, it is important to acknowledge that LCA also encompasses other impact categories. These include eutrophication, acidification, land use, and water depletion, all of which are relevant to livestock systems. A comprehensive environmental evaluation must consider these additional burdens to avoid shifting impacts from one category to another.

In summary, LCA provides a robust framework for quantifying and reducing environmental impacts in dairy production. By focusing on emissions intensity, methodological harmonisation, and system-specific mitigation strategies, LCA supports more informed decision-making aimed at minimising the environmental footprint of livestock systems.

References

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