

Sustainability evaluation of raw sheep milk production: an LCA and animal welfare perspective from Tuscany

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The environmental impact and animal welfare were evaluated in a sample of sheep farms in the Tuscan region, focusing on the sustainability of raw sheep milk production. The study applied a Life Cycle Assessment (LCA) method, using 1 kg of Fat and Protein Corrected Milk (FPCM) as the functional unit, with the upstream phase of milk production as the main focus. The analysis followed ISO 14040-44 standards, covering key areas such as energy consumption, water use, feed management, and methane emissions from enteric fermentation, which accounted for over 52% of total milk production emissions.

A sample of 14 farms for LCA was selected to represent different farm sizes and management practices typical of the region. Additionally, animal welfare was assessed on 116 farms using the CLASSYFARM system, which categorized farms based on the level of risk for animal welfare issues, evaluating conditions related to housing, nutrition, and overall management.

The results showed that larger farms were more productive and had lower environmental impacts per liter of milk produced. Conversely, smaller farms, although producing less milk overall, had a higher environmental impact per unit of milk. On average, the Global Warming Potential (GWP) of sheep milk in southern Tuscany was 3.96 kg CO₂-equivalent per kg of FPCM. Additionally, farms with milk production exceeding 1.5 liters per head per day consistently achieved CLASSYFARM animal welfare scores above 65, suggesting a link between higher milk yields and improved animal welfare conditions. The multivariate statistical analysis highlighted key factors influencing environmental performance, emphasizing the need to improve feed quality and reduce reliance on external concentrate feeds to lower greenhouse gas emissions.

In summary, the LCA results suggest that sheep milk production in this region aligns with average environmental impacts reported in other studies and the assessment of animal welfare also provided valuable insights, showing how management practices and productivity levels can directly influence both environmental sustainability and the well-being of livestock. The study highlights the importance of continued improvements to achieve environmental certification and ensure sustainable farming practices.