Technical Note

ANIMAL HEALTH AND SUSTAINABILITY

KEY MESSAGES

- **Sustainability encompasses environmental, economic, and social aspects, all of which benefit from improved animal health.**
- **Healthier cows have lower emissions intensity (greenhouse gas emissions per unit of milk) due to better efficiency in feed use, digestion, and productivity.**
- **Conditions like lameness, mastitis, and ketosis increase emissions by reducing milk yield and requiring more resources for treatment.**
- **Longer cow lifespans reduce the need for resource-intensive replacements, but improving cow health more holistically should be the primary focus.**
- **Veterinarians and advisors can help improve cow health through disease prevention, early detection, and better management practices, enhancing farm sustainability and profitability.**

INTRODUCTION

Sustainability is a broad term encompassing environmental, economic, and social factors (Purvis et al., 2019). Approaching sustainability from an animal health perspective, there are benefits to improving animal health extending into each of the three supporting pillars of sustainability:

> **Environmental:** Healthier cows contribute to the environmental sustainability of the dairy industry by using less feed, water, and energy to produce the same amount of milk.
>
> **Economic:** Improving animal health lowers treatment costs, improves productivity, and maximizes the lifetime performance of cows.
>
> **Social:** Ensuring the health and welfare of dairy cattle demonstrates farmers' dedication to responsible farming practices, which is important to consumers who are increasingly concerned about the ethical impacts of their food choices.

While sustainability may seem disconnected from individual conditions like lameness, the broader picture shows that managing cow health leads to more efficient, resource-conserving practices, benefiting the farm, the environment, and society.

HOW DO WE TALK ABOUT ENVIRONMENTAL IMPACT?

Discussions around sustainability often focus on environmental impact, making it important to clarify some of the terms and concepts used to discuss environmental impacts. First, when we talk about greenhouse gas emissions there are several key terms to understand:

Greenhouse Gas Emissions: The release of greenhouse gases, such as carbon dioxide, methane, and nitrous oxide, into the atmosphere (UNFCCC, 1992). Greenhouse gases are gases that trap heat in the atmosphere, warming the planet.

CO_2e: CO_2e or CO_2eq refers to carbon dioxide equivalent, a metric used to illustrate the climate effects of different non-CO_2 greenhouse gas emissions, such as methane (CH_4) or nitrous oxide (N_2O), relative to their equivalent impact in terms of CO_2 (IPCC, 2021). This allows for the different greenhouse gas emissions associated with a process or product to be tallied and expressed in one unit for easier comparison.

With respect to how we quantify and describe emissions, two additional key terms to understand are:

Absolute emissions: Absolute emissions or cumulative emissions refer to the total amount of greenhouse gases (GHGs) produced over a specific period. It is usually measured in tons of CO_2e per year. (IPCC, 2021). For example a dairy farm might produce 100 tons of CO_2e per year, which represents its absolute emissions. This total would include all GHGs emitted from activities such as enteric fermentation, manure management, feed production, and energy use on the farm.

Emissions intensity: Emissions intensity refers to the amount of GHGs produced per unit of product, serving as a measure of efficiency (IPCC, 2021). In the dairy industry, this is often measured as GHGs per unit of milk produced. For example, if a farm produces 100,000 litres of milk and generates 100 tonnes of CO_2-equivalent, emissions intensity is 100 tonnes of CO_2e /100,000 litres or 1 kg of CO_2-equivalent per litre of milk.

The relationship between the two: While **absolute emissions** measure the total environmental impact, **emissions intensity** reflects the environmental efficiency of the dairy farm, with both being heavily influenced by animal health, management practices, energy use, and other factors such as weather.

In some cases, references will be made to the overall environmental impact of a product or process. This is where other tools come in:

Life Cycle Assessment (LCA): An LCA is a tool used to evaluate the total environmental impact of a product or process, from start to finish. For dairy farms, an LCA may look at the entire process of producing milk — from the raising of cattle to the final product on the shelf at a grocery store. The total environmental impact of a product is not limited to greenhouse gases and may encompass other measures of impact like land, energy, and water use. An LCA from the Dairy Farmers of Canada (2025) looked at the carbon footprint, water consumption, and land use for one kilogram of milk produced at a Canadian farm and transported to a processing facility.

Carbon footprint: Carbon footprint is used to measure or quantify the greenhouse gas emissions associated with a process or product. For example, an LCA done by the Dairy Farmers of Canada found that the carbon footprint of a litre of milk produced in Canada in 2021 was 0.94 kg CO_2eq (Dairy Farmers of Canada, 2025). For more information on this topic please visit https://dairyfarmersofcanada.ca/en/dairy-in-canada/dairy-excellence/strengthening-our-commitment-canadians

What does Canada's dairy picture look like? Dairy Farmers of Canada has used LCAs to look at the land use, water consumption, and emissions related to the production and transport of Canadian milk to processors. They have also compared the LCA results between years. Most recently they found that between 2011 and 2021 the carbon footprint and land use associated with milk production have decreased by 9% and 21%, respectively. Increased productivity is a key driver to the improvements in environmental impact. With more milk produced per cow, the amount of emissions per unit of milk (emissions intensity) decreased.

WHAT IS THE RELATIONSHIP BETWEEN DAIRY COW HEALTH AND GREENHOUSE GAS EMISSIONS?

The health of dairy cows is closely linked to emissions and overall farm sustainability. Cows with illnesses can contribute to higher emissions due to inefficient digestion, decreased conception rates, poor feed conversion, and production losses. The resources used for treating illness or managing disease also add to the environmental footprint of milk. Therefore, improving animal health is a key strategy for reducing emissions and enhancing resource efficiency.

Ruminant animals rely on anaerobic fermentation and their gut microbes to extract nutrients and energy from plant matter. Due to this fermentation digestion process, ruminants emit enteric methane (CH_4), a greenhouse gas, by burping. The amount of methane released is influenced by internal factors like genetics and health, and external factors like feed types and rations (Min et al., 2022). Importantly, many of these factors are modifiable and research is ongoing on how we can reduce emissions through multiple channels. Of particular interest is the opportunity to lessen emissions through improvements in health and reproduction throughout dairy cattle lifestages.

YOUNGSTOCK MANAGEMENT

The care and management of calves plays a crucial role in productivity and health throughout their lifetime. Proper nutrition and disease prevention during the first months of a calf's life are essential for developing strong immune systems, optimal growth rates, and efficient production later in life (Crannell & Abuelo, 2023; Wolfe et al., 2023). Colostrum management plays a key role in this process. Effective colostrum programs that achieve good or excellent transfer of passive immunity achieve better health and growth outcomes (Sutter et al., 2023; Crannell & Abuelo, 2023; Lombard et al., 2020). Calves and heifers that are well-managed are more likely to grow into healthy and productive cows, reducing the need for costly interventions and lowering the environmental impact associated with disease outbreaks and inefficient production. By prioritizing the health and management of calves and heifers, farmers lay the foundations for improved herd health, milk yield, and ecological footprint of the dairy operation, contributing to a more sustainable and economically viable farming system in the long run.

REPRODUCTIVE MANAGEMENT

Improvements in reproductive management help enhance herd productivity and can reduce environmental impacts of a farm. Studies in the UK showed that improvements in reproduction, like an increase in pregnancy rate or the adoption of estrus synchronization techniques, can reduce greenhouse gas emissions for the herd via increased productivity (Garnsworthy, 2004; Archer et al., 2015). By optimizing reproduction, farmers can ensure more efficient herd turnover, leading to more consistent production over time. This reduces the need for excess resources, such as feed and water, and lessens the environmental burden associated with prolonged calving intervals or inefficient breeding.

KEY HEALTH CONDITIONS IMPACTING EMISSIONS

The table below is a summary of literature on key health conditions impacting greenhouse gas emissions on dairy farms. Researchers in these studies have tried to quantify emissions related to specific conditions and model the environmental impact of improving animal health in clearer terms per condition. This is a relatively new area of study and current studies are limited in the data they have used for their models, often using data specific to a single farm or breed of cow.

Summary of research on the greenhouse gas emission impacts of key health conditions

Condition	Summary of Results	Study Description	Reference
Lameness	GHG emissions increased by 1.5% per case of foot lesions	• This is an average of the impact of digital dermatitis, white line disease, and sole ulcers • Model was applied to a Dutch dairy farm • Used a dynamic stochastic model to estimate production losses and an LCA to quantify GHG impacts	Mostert et al., 2018b
	Lameness increased emissions per kg of milk produced by 0.7% to 7.8%	• Used UK averages and Holstein cows for model scenario • Used an LCA to assess environmental impact	Chen et al., 2016
Mastitis	Preventing a case of clinical mastitis can reduce GHG emissions of a cow by 6.2%	• Model simulated random removal of cows from the herd and did not model culling decisions based on milk production or severity of clinical mastitis • Modeled on a Dutch dairy farm • Used a dynamic stochastic model to estimate production losses and an LCA to quantify GHG impacts	Mostert et al., 2019
Subclinical Mastitis	Total farm emissions reduced by 3.7% if SCC was reduced from 800,000 cells/mL to 50,000 cells/mL	• Modeled on an average Norwegian dairy farm • Combined a dynamic programming model focused on maximizing profit per cow when making replacement decisions and a GHG model (HolosNor)	Özkan Gülzari et al., 2018
	Subclinical mastitis cases increased the GHG emissions by 2% per kg of milk produced	• Modeled on a Norwegian dairy farm • Breakdown of GHG emissions for the output values is unclear, only soil carbon changes are mentioned • Combined a dynamic programming model and a GHG model (HolosNor)	Özkan et al., 2015

Summary of research on the greenhouse gas emission impacts of key health conditions			
Condition	**Summary of Results**	**Study Description**	**Reference**
Ketosis	Average GHG emissions increase of 2.3% per case of subclinical ketosis	• Modeled on a European dairy farm • Used a dynamic stochastic model to estimate production losses and an LCA to quantify GHG impacts	Mostert et al., 2018a

LONGEVITY

There is growing interest in how dairy cow longevity relates to sustainability. Increasing dairy cow longevity can reduce the number of replacements needed, which can significantly decrease the overall carbon footprint of dairy farming. Raising replacement animals is resource intensive, contributing 20-33% of the enteric methane emissions for the entire herd (Knapp et al., 2014). In Canada, the median age at first calving in 2024 was 24.7 months, based on herd averages (Lactanet, 2025). Lowering the age at first calving for properly developed heifers reduces energy demands during their growth phase, which is not directly productive for milk (Knapp et al., 2014). Additionally, reducing mortality and morbidity rates helps minimize energy and resource waste, as animals that die or are culled before their first lactation contribute to unused energy without producing food (Knapp et al., 2014). Higher lifetime milk production also spreads the emissions associated with early non-productive lifestages over a longer period. However, it is important to balance fertility and longevity, as reduced fertility is one of the most common reasons for culling (De Vries & Marcondes, 2020). Ensuring reproductive management is optimized can help to minimize the culling of productive older cows, which can result in lower emissions (Clasen et al., 2024). Culling decisions are multifactorial, but farms can achieve a balance between economic and environmental sustainability (Adamie et al., 2023; Grandl et al., 2019). That said, longevity alone is not a measure of sustainability. Focusing solely on longevity could overlook other important welfare and health factors that impact sustainability. Optimizing cow health offers a route to improved sustainability, with longevity as an added benefit. Ultimately, sustainability in dairy farming requires a holistic approach that considers multiple factors, not just the longevity of the animals.

WHAT CAN ADVISORS DO?

Sustainability in dairy farming extends beyond reducing emissions; it encompasses a broader picture that includes environmental, economic, and social factors. Advisors and veterinarians play a key role in helping farms understand both the immediate and long-term costs and benefits of adopting sustainable practices across all these areas. By guiding farms toward strategies that improve cow health at all stages of life, such as enhancing colostrum programs, implementing early disease detection, and ensuring good housing, advisors can help reduce the negative impacts of disease — an achievable goal for any farm. Focusing on cow health not only reduces treatment costs and inefficiencies associated with illness, it also positions the farm to meet the growing consumer demand for sustainable dairy products. Ultimately, improving cow health supports a more sustainable and efficient dairy operation, benefiting the environment, the farm's financial performance, and the broader community.

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