Livestock and Greenhouse Gases

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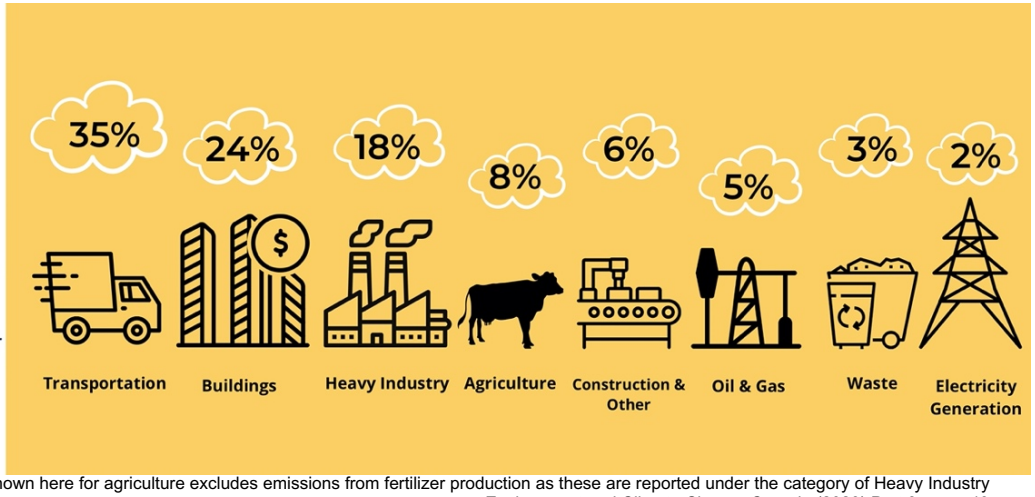
Climate Change & Global Warming

Climate change is an accepted fact for the world today. The Greenhouse effect naturally maintains Earth's temperature at a stable average of 15°C rather than -18°C without the greenhouse effect (NASA, 2021). The concern with increased greenhouse gases from anthropogenic sources is that it enhances the greenhouse effect and allows additional warming. Greenhouse Gas (GHG) emissions from a variety of sources trap heat close to the Earth's surface creating a global warming effect. Targeted reductions in GHG emissions may change the future of farming, how food is eaten, how we waste, and how we manage the Earth's natural resources. In Ontario there is an expected increase in risk of droughts, flooding, extreme weather events and direct impacts on the livestock sector with warming of 1.5°C or more (IPCC, 2019). Higher temperatures risk increased heat stress on livestock and can affect crop yields as well as number of days of rain (IPCC, 2019). For Ontario livestock farmers, it is important to keep climate change in mind as innovative new technology becomes available. Industry will need to adapt production systems to reduce impact and to respond to the expected risks. Canada has signed on to the Paris Climate Agreement and agreed to the United Nation's 2030 agenda for sustainable development, thus committing industry to meet specific goals.

Total Ontario Greenhouse Gas Emissions by Economic Sector in 2018



* Note that the value shown here for agriculture excludes emissions from fertilizer production as these are reported under the category of Heavy Industry
Environment and Climate Change Canada (2020) Part 3, page 49

Why it matters to the Ontario livestock industry:

Ontario has one of the highest per capita emissions of GHG's in the world (Coad, 2011). This is generally attributed to our needs for heating, cooling, transportation and a reliance on imports. According to the National Inventory Report 165.0 Megatonnes of CO_2 equivalent ($MtCO_2eq$) of GHG were emitted in 2018 from Ontario's economic sectors while Canada, as a whole, emitted 729.0 $MtCO_2eq$ (Environment and Climate Change Canada, 2020). The economic sectors contributing to GHG emissions are shown in the figure above. Emissions from fertilizer production is accounted for in the Heavy Industry sector. The breakdown of agricultural GHG sources is farm fuel use, crop production, and livestock production.

The National Inventory Report data indicates that Ontario agriculture represents 8% of the total GHG emitted in the province, whereas agriculture accounts for 10% of the total emissions in Canada (Environment and Climate Change Canada, 2020). Livestock contributes direct GHG emissions from enteric fermentation and due to manure management, which account for about 50% of emissions from the agriculture sector in Ontario. Thus, the livestock sector accounts for approximately 4% of total emissions. Livestock feed production contributes emissions due to synthetic fertilizer and manure applications to soil and are accounted for under crop production (Jayasundara and Wagner-Riddle, 2014). The livestock industry is constantly looking to lower their GHG emissions and improve production efficiencies. The livestock industry also has an opportunity, through measures that contribute to regenerative agriculture, to become a key part of the solution through soil carbon capture (Liang et al., 2020).

The Importance of Context:

Ruminant animals are able to digest feed that cannot be eaten by other animals, creating nutritious products such as meat and milk. The trade-off with such productive conversion is that the resulting methane released contributes to the GHG effect.

Estimates of livestock's contribution to global greenhouse gas emissions vary based on the way they are measured and compared. The world view is very different from the North American view when looking at percentages of GHG emissions by source, due to the very different production practices found in each country. Depending on the purpose of the analysis the emissions may be expressed by sector as explained above, or a life-cycle approach may be taken considering upstream

production of inputs, farm-level and downstream consumption of products. Analysis 'up to farm gate' is often of most interest to farmers as results reflect processes that can be managed at the farm-level. Productivity is considered in this analysis by scaling the GHG emissions per unit of product (e.g. litre of milk) also referred to as the carbon footprint. Where livestock production occurs affects the carbon footprint, due to different animal and feed production practices. For example, if feed production involves deforestation and practices that lead to soil degradation, then this increases the carbon footprint of the livestock product. Changes implemented to improve production efficiencies decrease the carbon footprint. The United Nation's Food and Agriculture Organization (FAO) found that producing one kilogram of beef in North America, Europe, or Australia, emits half the methane of the same production in Latin America, India or China (Gerber et al., 2013). Continuous improvements will be needed to mitigate the increased emissions associated with the expected increase in consumption of livestock products world-wide and ensure the sustainability of the livestock sector.

Advancements in the livestock industry and impact of greenhouse gas emissions:

The last few decades have seen continuous improvements in livestock production and efficiency with advances in precision nutrition, genetics and animal welfare. On a per kg of beef produced basis, Canadian beef production uses 17% less water and produces 15% less GHG emissions compared to 1981 (McAllister, 2019 and Legesse et al., 2015). Jayasundara and Wagner-Riddle (2014), found that the GHG intensity of Ontario milk production in 2011 was about 22% less than that in 1991, the result of increased milk production per cow and the reduction of maintenance energy costs. Wagner-Riddle et al. (2017) stated that a decrease in GHG intensity can be observed from improved production efficiency of ruminant livestock on farms due to more production and decreased manure volumes with less animals. Further, lower carbon footprint of milk production was associated with more profitable dairy farms (Jayasundara et al., 2019).

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What can livestock farmers do?

Implementation of regenerative soil practices alongside better animal nutrition and increased production efficiency can mitigate GHG emissions. Reduced GHG emissions per unit of production can go hand in hand with increased profitability.

Below are management options for mitigating GHG emissions on livestock farms, many of which also create cost savings for farmers or are cost neutral (Ahmed et al., 2020).

Management Options

- Healthy Animals
    - Improved health of animals increases production efficiency which is closely tied with GHG emissions per unit of production.
- Optimum Rations
    - Feed processing for improved digestibility, feed additives, and ration ingredients can all contribute to the optimum ration and reduced GHG emissions. For example, adding supplementary lipids to the diets of rumen improves digestion of fibre while suppressing methane by reducing fermentation (Ahmed et al., 2020). This may be achieved by use of by-products from oil seed crops. Some animal feed additives have shown success at inhibiting enteric fermentation in rumen, and therefore, reducing GHG emissions (Robinson et al., 2011).
- Genetic selection
    - Historically, genetic selection in livestock has focused on increasing production. Recent changes in determining genetic merit of animals in the dairy sector include additional factors aimed at improving sustainability of production (Wagner-Riddle et al., 2017).
- Manure management
    - Proper manure storage and management including, where feasible, anaerobic digestors reduces GHG emissions. Digestors are also helpful for controlling odour and reducing pathogens in the farm environment (Wagner-Riddle et al., 2017).
- Precision agriculture
    - Automated data capture will transform the livestock sector and provide new knowledge that will allow further improvements in livestock productivity and reductions in GHG emissions per unit of product.

- No till cropping
    - Conservation tillage practices such as no tillage or minimum tillage can improve soil health and sustainability of feed production systems, including a decrease in GHG emissions (Liang et al., 2020).
- Grazing Management
    - Regenerative agriculture (see related LRIC White Paper) and farm practices that integrate mixed crop–livestock systems and rotational grazing can improve soil organic carbon stocks and decrease the impact of GHG emissions from livestock (Liang et al., 2020).

Research Gaps

- We need to better understand the relationship between measures of feed efficiency at different stages of production (e.g., breeding animals versus finishing animals)
- Best management practices for grazing management, including data on the carbon sequestration potential
- Feed additives to optimize the gut/rumen microbiome and reduce methane production
- Development of automated data capture sensors, particularly for grazing livestock

Innovation Gaps

- Increased efficiencies and lower price point for new technologies such as bio-digesters
- Improving data-capture sensors to be rugged, cost effective and reliable
- Effective, secure data sharing that ensures value to data owners
- Artificial intelligence that will deliver practical recommendations to producers
- Continued work in the area of genomics, genetic selection and sustainable production

For more information

1. Claudia Wagner-Riddle, Professor, School of Environmental Sciences, University of Guelph
2. Frank Mitloehner's blog, available at: https://clear.ucdavis.edu/blog

3. Please contact LRIC at info@livestockresearch.ca or 519-766-5464.

Additional resources

- LRIC's First White Paper in the Horizon Series on Regenerative Agriculture
- Podcast episode: *Soil: The Dirty Climate Solution* by How to Save a Planet https://gimletmedia.com/shows/howtosaveaplanet/39h6wn7/soil-the-dirty-climate-solution
- The United Nation's Sustainable Development Goals https://sdgs.un.org/goals

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