Greenhouse Gas Emissions and Alberta's Livestock Industry

Why are Greenhouse Gas Emissions Important?

Over the last century, modern industry and lifestyles have rapidly increased amounts of greenhouse gas (GHG) in the earth's atmosphere. Most scientists who study this topic believe that increased GHG are causing the climate to change. Changes in climate are expected to result in more severe weather events, such as prolonged droughts and flooding, with associated impacts that may include reduced availability of quality water supplies.

Canada has committed to reducing GHG emissions to 17% below 2005 levels by 2020 and 30% below 2005 levels by 2030. Alberta has also made its own commitments to reduce emissions and was the first province to design rules for cutting GHGs. Provinces and territories have been taking steps to address climate change according to their specific circumstances. Businesses and individuals are also reducing emissions by using resources more efficiently and adopting new, cleaner technologies.

Alberta's livestock industry already has many beneficial management practices that can reduce GHG emissions and capture and store carbon. By showing leadership and taking initiative, Canadian farmers can increase efficiencies, remain competitive, adapt to climate change and may be able to capture new opportunities in emerging environmental markets.

In 2013, about 8 % of Canada's total GHG emissions came from the agricultural industry[1]. Of these agricultural emissions, 56% were from livestock sources[1]. The types of GHG emitted by the livestock industry are methane, nitrous oxide and carbon dioxide. Methane has close to 25 times the global warming potential of carbon dioxide and nitrous oxide has close to 298 times more warming potential than carbon dioxide. All GHG are compared on the basis of their carbon dioxide equivalents (CO_2e).

Cattle emit methane primarily from enteric fermentation during digestion. Amounts are influenced by factors including feed type, feed quality, ration additives, husbandry practices and the lifespan of an animal. Methane is also emitted from manure under low oxygen conditions, such as when stored as a liquid or in poorly aerated stockpiles. Nitrous oxide is also emitted by manure, with amounts depending on feed quality, moisture conditions when stored, land application (methods, timing and rate), as well as type of manure and soil conditions. Carbon dioxide emissions occur from fuel and energy use in agricultural operations, from tillage of soils and from land use change. Unique to agricultural management, carbon dioxide can also be sequestered in soils by management practices like seeding annually cropped land to perennials or manure additions to soils with low carbon levels.

In Alberta, GHG emissions from all agricultural sources totaled 22 million tonnes (MT) CO_2e in 2013[1]. Figure 1 shows that of this total, 44% came from enteric fermentation, 10% from manure, 32% from soils and 14% from off-road fuel use[1]. Beef cattle accounted for 92 % of enteric and manure emissions from Alberta's livestock industry[1].

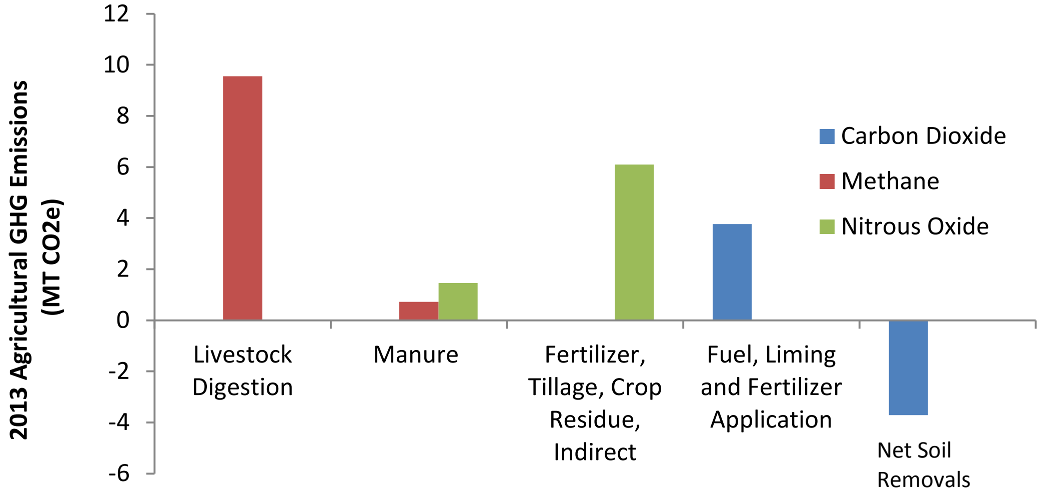

Figure 1. Alberta's GHG emissions from agriculture for 2013 by source in millions of tonnes (MT) of carbon dioxide equivalents (CO2e). *Data from: Environment Canada 2015.*

Scientists in Lethbridge, Alberta simulated GHG emissions from beef production systems over an 8 year production cycle in western Canada[2]. Over the 8 year cycle, methane from enteric fermentation was the largest source of emissions, followed by nitrous oxides from manure, nitrous oxides from cropping, carbon dioxide from energy use and lastly methane from manure. Figure 2 illustrates amounts of emissions by component over the simulated 8 year beef production cycle, indicating that 80% of emissions came from cow-calf system and 20% from the feedlot system[2].

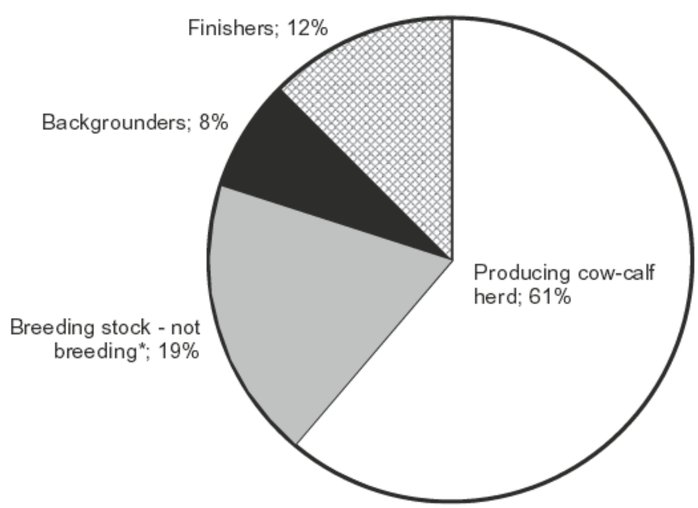

Figure 2. Breakdown of total GHG emissions in carbon dioxide equivalents by component of a western Canadian beef farm simulated over an 8-year production cycle[2].

Reducing GHG Emissions from the Livestock Industry

Many livestock producers and feeders in Alberta have improved their production efficiencies and adopted beneficial management practices. Between 1981 and 2006, Canadian livestock producers lowered GHG emissions by close to 35%[3]. The main reasons for these declines were dramatic increases in productivity, including a doubling of crop productivity in the last 50 years. Better genetics, better feed formulation, better animal housing, and better animal health have also contributed to these improvements. Producers are encouraged to assess operations and management systems often to help the industry to continue to improve. Continuous improvement will further increase production efficiency, reduce the amount of GHG emissions produced by livestock, and reduce costs in both the short and long terms.

A continuation of the simulation study of an 8 year western Canadian production cycle assessed the effectiveness of a number of management options to reduce emissions [4]. Results showed that management strategies relating to the cow calf herd could reduce total GHG intensities by up to 8% and that combining strategies could reduce emissions by up to 17%. Strategies related to the feedlot only had a smaller impact on total GHG emissions over the 8 year production cycle.

Animal Husbandry

Management changes that increase animal output will reduce GHG emissions. Increasing the number of calves weaned per cycle by improving the calving rate of cows will decrease amounts of GHG per kilogram of beef produced. Reducing the age to harvest as soon as animals have reached market weight also reduces emissions. Increasing the longevity of breeding animals has minimal impact on emissions.

Reducing Emissions from Range and Pasture Grazing

In addition to methane emissions from grazing animals, nitrous oxides are emitted from manure and urine. Managing stock density to avoid concentrations of manure and urine will help to reduce emissions. Sources of water, mineral and shade can be moved on a regular basis so cattle activity is distributed. Grazing can result in a build-up of excess soil nitrates and nitrous oxide emissions if stocking density is too high or if excessive amount of nitrogen fertilizer or manure is applied. Fertilizer and manure application should be in proportion to crop uptake of nitrogen. Over-grazed pastures or soils with initially low levels of organic carbon have shown an increase in soil carbon levels in less than 10 years when grazing strategies improved. However, increases were not as great in soils that were initially high in organic carbon.

Range and pasture management improvements to reduce GHG emissions include:

- Match stocking rates to land productivity. A well managed intensive grazing system can increase the carrying capacity of pastures by 30 to 60% in the first five years
- Manage stocking rates so animals have the opportunity to ‘eat to fill’. Less methane is emitted per unit consumption if the animal eats to fill compared to consuming only maintenance amounts. This calls for highly productive pasture and well-planned pasture management.
- Reduce or eliminate cultivation on pasture lands to reduce loss of soil carbon from cultivation. Herbicide removal of the forage and direct seeding into sod maintains more of the captured carbon
- Plant grass/legume pasture mixes. Legumes provide grasses with nitrogen and reduce need for synthetic sources of nitrogen. Straight legume pastures may produce excess amounts of nitrogen, and under certain conditions N_2O could be emitted.
- Encourage healthy populations of beneficial insects that breakdown manure by reducing the amount of insecticide used on your herds.
- Extend the grazing season. Standing or swathed stockpiled perennials or bale grazing will reduce feeding costs, as well as spread manure evenly over pastures. Chances of manure runoff will be reduced and the time and cost of hauling and spreading from a confined feeding area will be eliminated.
- Carefully manage riparian areas by controlling access, choosing alternative watering systems, using fencing, and using distribution tools like salt and minerals.

- Keep pastures in excellent condition. Intensive grazing accompanied by high levels of management that give plants adequate rest for recovery between grazing will help the pasture crop take up excess soil nitrates that could be transformed to nitrous oxides, and result in higher pasture yield.
- Add nitrogen fertilizer (using proper rate, source, time and method of application) to increase pasture productivity, and potential to sequester carbon. However, added nitrogen fertilizer or manure must be balanced with crop needs.

Feed Management

Since methane from enteric fermentation accounts for the largest source of emissions from cattle, feed management is an important aspect of reducing emissions. Improvements that target the feed quality increase digestion efficiencies. Advances in genetics to identify cattle that gain weight more efficiently means backgrounding and finishing cattle will require less feed and produce less manure[5].

Improved feed management can be accomplished by:

- genetic selection to increase feed efficiency
- adding grain to the diet resulting in lower methane yield relative to forages promotes more rapid growth, reduced days to market and less manure is excreted
- improving quality of forage
- matching diet to nutritional requirements based on sex, age and stage of production
- increasing digestibility in the rumen by chopping, grinding or pelleting low-quality feed
- feeding silage rather than dry feed (although silage is typically a less cost effective way of putting up feed, due to higher requirements for labour and machinery it does have prolonged storage to offset these costs.)
- supplement diets with 3 to 6% edible oils, such as canola oil
- feeding cattle additives, such as ionophores that inhibit methane production by rumen bacteria
- optimizing protein and balancing amino acids in the diet to minimize excess amounts of nitrogen excreted, particularly in urine

Reducing Emissions from Manure

Livestock manure is a valuable resource for nutrients and an excellent soil amendment to improve soil quality and productivity. There is also potential to increase the capacity of soils to act as a carbon sink when manure is applied to lands with low levels of soil carbon.

If sufficient volumes of manure can be collected it may be effective to process manure in a digester under anaerobic conditions to produce methane gas (biogas). However, very high capital costs are associated with the constructionof biogas digestors and feasibilities must be carefully assessed. The biogas can be used as an alternative energy source and the digested manure retains nutrients that can be land applied as fertilizer.

Manure management can be improved to reduce GHG emissions by:

- Testing both the soil and the manure before field application to match rates to crop needs
- Avoiding land application when the weather is hot and windy, or rain is expected, since these conditions can increase N_2O emissions
- Avoiding land application in the late fall and winter to avoid nitrogen loss in moist spring conditions

Composting solid manure produces a stabilized product that can be stored or spread on agricultural land with minimal odour, pathogens and weed seeds, although GHG emissions occur during the composting process.

Incentives for Management Improvements

Many livestock management improvements to reduce GHG emissions also increase production efficiencies. In Alberta, carbon credits can also be created from voluntary farm practice improvements that have a sound science basis for lower greenhouse gas emissions, are above and beyond business as usual, and can be verified by independent third parties. Companies who are regulated under Alberta's Specified Gas Emitters Regulation (2002) can use carbon credits as way to meet their requirement to reduce greenhouse gas emission intensities each year.

There are a number of carbon offset protocols that provide incentives to reduce emissions from livestock. All of the protocols outline the science, policy and verification basis for management improvements that are eligible to create carbon credits for sale to regulated companies. More information about agricultural carbon offsets is available at: www.agricuture.alberta.ca/agcarbonoffsets.

Summary

There is an increasing expectation for all industries, including the livestock industry, to reduce GHG emissions and help slow global warming. Current research and innovation in livestock management are leading to new methods for lowering emissions. Lower emissions are expected to lead to gains for the industry including: improved efficiency, soil and water conservation, and increased access to emerging market opportunities, such as Alberta's carbon offset market.

References

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