Greenhouse Gas Emissions, and Range and Pasture Management

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Greenhouse Gases - Things You Need To Know

Why are Greenhouse Gas Emissions Important?

Over the last century, modern industry and lifestyles have rapidly increased greenhouse gas (GHG) concentrations in the Earth's atmosphere. The majority of scientists studying this issue believe that these increasing concentrations are contributing to global warming. Rapid global warming could result in such problems as more severe weather events, more forest fires, and damage to water resources.

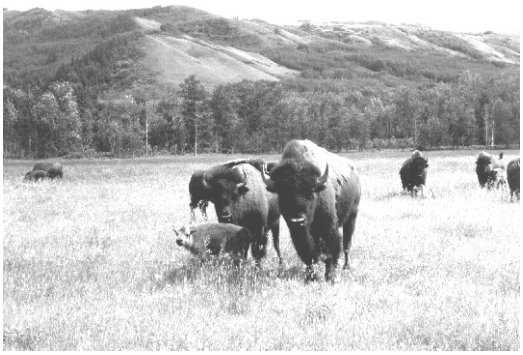
Canada has committed to reduce the nation's GHG emissions to six percent below 1990 levels by 2008 to 2012. All sectors will be expected to reduce their GHG emissions, including agriculture. The livestock industry also has an immediate economic stake in reducing its emissions because these emissions represent a loss of costly feed energy and nutrient inputs.

Emissions from Alberta's Beef Cattle Industry

Alberta's livestock industry contributes about one percent of Canada's total GHG emissions, and a total of nine percent of Canada's agricultural GHG emissions. (For information on the contributions of other industries, see *Greenhouse Gas Emissions of the Agriculture and Agri-Food Industry,* another bulletin in this series.) In Alberta, beef cattle produce more than 90 percent of the GHG emissions from the livestock sector.

The main gases emitted by the livestock industry are methane (CH_4) from animals, and methane and nitrous oxide (N_2O) from manure handling and storage. Methane and N_2O have higher global warming potentials than carbon dioxide (CO_2), the main GHG emitted by most other industries. Methane and N_2O warm the atmosphere 21 and 310 times more than CO_2, respectively.

If the industry's practices remain the same as those used in 1990, annual emissions from Alberta's livestock population are projected to increase by 38 percent from the 1990 level. The projected increase is due to expected increases in feeder cattle, dairy cattle, hogs, poultry, bison, horses, elk and deer numbers. Range and pasture management strategies should be specific for each livestock breed that grazes.



Bison on the range

Reducing Emissions from Alberta's Beef Cattle Industry

Research continues on how to reduce GHG from pastures through improved grazing management. In the meantime, there are a number of common sense approaches that can be used to minimize GHG produced by the beef cattle industry.

Experts say the most effective way to reduce

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GHG emissions is to improve the efficiency per unit land area (for example, increasing the amount of meat produced per acre). This includes:

- Reduce or eliminate cultivation on pasture-land. Soil carbon is lost when a pasture is cultivated. Herbicide removal of the forage and minimum disturbance direct seeding into sod maintains more of the captured carbon. Planting perennials reduces the need for annual cultivation, and are better for pasture maintenance than annuals because they have more root material and litter (i.e. more carbon).
- Plant grass/legume pasture mixes. Legumes provide grasses with nitrogen, creating a more balanced system. Straight legume pastures may produce excess amounts of nitrogen, and under certain conditions, N_2O could be emitted.
- Practice intensive grazing systems. These systems increase yields and pasture profitability, although they do require more time and knowledge to manage properly.
- Add fertilizer nitrogen (using proper rate, source, time and method of application). This will increase pasture productivity, and therefore increase the potential to sequester carbon. However, added fertilizer nitrogen or manure must be balanced with crop utilization. In intensive grazing systems, at least 80 percent of nitrogen consumed will be returned by the animal back to the pasture system, but this does not mean that 80 percent of nitrogen returns to the soil. Volatilization losses of ammonia on average are 25 percent of the total nitrogen in the manure and urine, but can reach 50 percent. Under an actively growing leaf canopy, almost all potential ammonia loss is recaptured and absorbed by the green foliage.

The benefits of switching to an intensive grazing system on grass-legume pastures include increased profit potential that will sequester more carbon in the soil. Although there is no guaranteed percentage increase in pasture productivity, most graziers who move to properly managed intensive grazing increase the carrying capacity of their pastures by 30 to 60 percent in the first five years.

Holsteins grazing

Grazing Systems

Grazing systems can be divided into two broad categories, extensive and intensive. Prairie Farm Rehabilitation Administration (PFRA) defines each system as:

Extensive systems:

- minimal crossfencing and other developments
- land area may be large or small
- livestock densities (number of animals per unit area) are low
- animals are allowed to graze selectively for relatively long periods
- native pastures are often part of an extensive system

Intensive Systems:

- require high levels of management
- manager determines where, when, how much, and what livestock will graze, and controls livestock distribution
- stock density and capital investment are nominally higher
- more grazing units or paddocks are required
- livestock movements based on plant growth rates, forage availability, animal requirements and manager goals
- tame pastures are often part of an intensive

system

Intensive and extensive grazing systems should be managed accordingly. Sufficient residue and litter must be left in order to replenish soil organic carbon lost due to natural processes. Management is site specific and dependent on soil type, rainfall and the general productive capability of soil. Critical amounts are site specific and dependent on soil type, rainfall and the general productive capability of soil.

Usually extensive grazing occurs on land of lower production capability and the stocking rates must match the productivity of the land to be a well managed extensive grazing system. Intensive management systems that pay proper attention to plant growth and long-term stocking rates allow the pasture to improve in productivity while being used. However, production will have an upper limit imposed by site potential and condition or vigor of the forage base.

Reducing Emissions from Range and Pasture Grazing

Nitrous oxide emissions from grazing animals come from their dung and urine. Research shows that more than 80 percent of the nitrogen animals digest is excreted in their manure and urine. As protein content increases, the proportion of nitrogen excreted as urine increases. When protein in the diet is above 20 percent, most of the nitrogen excreted is in the urine. Although it is difficult to get exact measurements, generally the longer dung lays in the field, the more N_2O is lost to the atmosphere and the less nutrients are available to plants.

In grazing situations, most N_2O emission comes from urine spots. It is desirable to

Rotational grazing at Parkland Conservation Farm

manage stock density to avoid overlap of these spots, as they can amount to 600 to 700 lb. of nitrogen over a small area (e.g. 1 sq. ft). To encourage even distribution of manure and urine, move cattle often managing for uniform grazing. Move water, mineral and shade so cattle are not pre-disposed to 'camping' near shade.

Extensive grazing rarely causes excessive soil nitrates to accumulate, which could cause N_2O emissions. However, problems can occur if cattle are allowed to congregate on some areas repeatedly, leaving manure piles and urine patches.

Intensive grazing could result in a buildup of excess soil nitrate and N_2O emissions if stocking density is too high and if excessive amounts of fertilizer nitrogen or manure high in ammonium (hog an dairy slurry) are applied. Fertilizer and swine manure application should be in proportion to crop uptake of nitrogen. Swine manure is an excellent fertilizer for pastures, but livestock should not be allowed back into the pasture for at least 30 days after manure is broadcast. This allows time for the plants to make use of the nutrients, and for potential pathogens in the manure to be killed.

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Determining how much carbon can be stored in soil is difficult due to soil variability and type of management change implemented. Over-grazed pastures or soils with initially very little organic carbon have demonstrated an increase in organic carbon in less than 10 years. However, soils initially high in organic carbon record less change.

Management Strategies to Reduce Emissions from Range and Pastures

- Spread manure evenly around the actively growing pasture to prevent loss of nitrogen.
- 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 nitrate that could become N_2O, and result in higher pasture yield.
- Manage stocking rates so animals have the opportunity to 'eat to fill'. Less CH_4 is emitted per unit consumption if the animal eats to fill compared to consuming only maintenance amounts. This calls for highly productive pastures and astute pasture management.
- Encourage beneficial insects because their presence in the dung will enhance recycling of nitrogen into the soil, reducing the amount lost into the atmosphere. A way of encouraging beneficial insects is to reduce the amount of insecticide used on your herds. More than 450 species of insects can be found in cattle dung in North America. Although a small few of these species are pests to livestock, the vast majority are beneficial members of the plant and soil interface.

Management Strategies to Reduce Emissions from Winter Grazing

- Feed winter rations over a large area to spread out manure. This makes it easier for insects and microbes to incorporate it into the pasture the following spring. This strategy also makes it less likely for manure to run off into waterways or cause nutrient site overloads, which can potentially leach into shallow ground water zones during the spring thaw.
- Extended grazing, standing or swathed stockpiled perennials or bale grazing will reduce winter feeding costs as well as spread manure evenly over pastures. The danger of manure runoff will be reduced and the cost of hauling and spreading the manure from a confined feeding area will be eliminated.

Summary

Governments and consumers are expecting all industries, including the livestock industry, to reduce GHG emissions. Increased adoption of existing practices to improve range and pasture condition and better grazing management could significantly reduce the livestock industry's GHG emissions. As well, promising methods to reduce emissions could be developed through more research. Reducing emissions can improve the industry's production efficiencies, conserve soil and water resources, and contribute to efforts slowing global warming.

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