Climate Smart Agriculture in Alberta

Beef Production

Actions that lower greenhouse gas (GHG) emissions are increasingly important to consumers. These bring other "climate smart" benefits of increased productivity and improved adaptation to changing climates to your operations.

Farmers are already taking important steps to lower the footprint of beef production while increasing the efficiency of land use in Alberta. Improved beef production practices from 1981 to 2011 lowered GHG emissions by 15% per kilogram liveweight (Fig. 1). This decline was due to improvements in reproductive efficiency, average daily gain, slaughter weight, and crop yields[2]. Water use intensity per kilogram of boneless beef also decreased by 17% from 1981 to 2011[3]. Continued leadership and demonstrations of progress in these areas are also resulting in new environmental market opportunities.

GHG SOURCES AND SINKS

Figure 1 also shows that most of the GHG from beef production is methane (CH_4) from the digestion of feed in the rumen. Some methane is also emitted by decomposing manure. Methane has 25 more global warming potential (GWP) than carbon dioxide and is affected by feed type, feed quality, additives, and husbandry practices.

About one third of GHG from beef production are nitrous oxide (N_2O) emissions from manure, soils, fertilizers and crop residues. This gas has 298 times more GWP than carbon dioxide and is affected by soil type, moisture, temperature, method of nutrient application and tillage.

Carbon dioxide (CO_2) emissions from fuel use and tillage is impacted by equipment use, tillage, and changes from perennial to annual crops.

Close to 20% of Alberta's agricultural GHG are removed by soil carbon sinks that result from increasing areas of perennial crops and conservation cropping. Increasing soil carbon brings important benefits of improved water infiltration and nutrient cycling, improving the soil's capacity to adapt to changing climates.

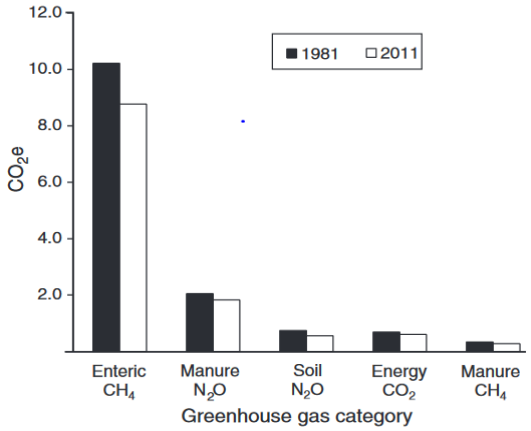


Figure 1. The contribution of different greenhouse gases to total emissions from the production of one kilogram of Canadian beef [1].

Alberta Government

GRAZING MANAGEMENT

Most emissions from beef production result during the long period that cow-calf operations feed on perennial crops. The deeper roots increase efficiency by improving access to moisture and nutrients. Grazing lands support a wide range of ecological services that improve climate adaptation, such as water retention, flood control and biodiversity.

Management improvements have decreased land area requirements by 24% compared with 1981[2]. Improvements you can make for further efficiency, emission reduction and adaptation benefits:

- Convert more marginal crop land to perennials to increase soil carbon
- Reduce or eliminate cultivation to lower soil carbon losses
- Manage stocking rates to avoid nitrous oxides from high concentrations of manure
- Include legumes to reduce amounts of added nitrogen
- Extend grazing seasons with swaths or bales to lower carbon dioxide from fuel use

ANIMAL FEEDING AND HUSBANDRY

Management to increase animal output and reduce emissions[2] will also gain you efficiency and adaptation benefits in all production phases:

- Reduce age to harvest
- Improve forage quality
- Increase digestibility by chopping, grinding or pelleting low-quality feed
- Match diet to nutritional requirements based on sex, age and stage of production
- Supplement with 3 to 6% edible oils
- Improve calf survival and cow fertility
- Select genetics for improved feed use efficiency[4]

MANURE MANAGEMENT

Manure improves efficiency by recycling nutrients that improve soil and crop productivity. Manure also improves benefits of enhanced soil carbon and can generate renewable biogas energy. To lower emissions:

- Test soil and manure before field application to match rates to crop needs
- Avoid application when rain is expected
- Minimize application in fall and winter to avoid nitrogen losses in spring conditions

INCENTIVES FOR IMPROVEMENT

In addition to gains in efficiency and adaptation by reducing emissions, a number of programs are available to help you with improvements. There's also opportunity to learn more about environmental markets by selling offsets in Alberta's carbon market.

For more information, see:
www.agriculture.alberta.ca/climatesmart

Sources

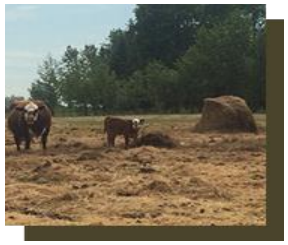
[1]Legesse, G. et al. 2016. Greenhouse gas emissions of Canadian beef production in 1981 as compared with 2011. See: http://www.publish.csiro.au/?paper=AN15386

[2] McAllister, T. et al. 2015. Producing beef with lower GHG emissions and using fewer resources. See: http://www.beefresearch.ca/factsheet.cfm/producing-beef-with-lower-ghg-emissions-and-using-fewer-resources-225

[3]McAllister, T. et al 2017. Producing beef using less water. See: http://www.beefresearch.ca/factsheet.cfm/producing-beef-using-less-water-248

[4]Markus, S. 2016. Residual Feed Intake in Beef Cattle. See: http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/agdex10861

Alberta Government



Ways that you can lower GHGs, while increasing efficiency and improving climate adaptation.

Practice Improvement	Reduce Methane	Reduce Nitrous Oxide	Reduce Carbon Dioxide	Increase Carbon Storage	Challenges	Benefits
Reduce Emissions – Feeding and Husbandry						
Reduce age to harvest	- -	-			Market fluctuations	Feed and yardage savings, offsets*
Improve feed quality, e.g. increase forage quality, use high energy grains, edible oils (up to 6% dry matter)	-	-			Higher costs, more intensive management	Faster marketing
Grazing management, e.g. rotational	-			+	Higher costs, more intensive labour	More efficient weight gain, improved soil quality
Improve cow fertility and calf survival rate	-				More management	Higher production benefits
Genetic selection of feed efficient animals	- -	-			Limited supply of breeding stock	Feed and yardage savings, offsets*
Extend grazing, e.g. swath or bale grazing			-	+	More management, supplemental feed	Fuel savings, manure additions add nutrients and soil carbon
Remove Emissions – Increase Carbon Sequestration						
Land use change from annual to perennial crops		-	-	++	Lower returns	Fuel and fertilizer savings, improve soil quality
Conservation cropping		-	-	+	Seeding equipment, residue management	Fuel savings, improve soil quality, offsets*
Apply manure to previously unmanured soils				+	Transportation costs	Recycle nutrients, fertilizer savings, improve soil quality
Plant windbreaks, woody crops			-	+++	Monitor to manage weeds	Save inputs on marginal lands, stabilize riparian areas
Replace Emissions – Renewable Bioenergy						
Biogas from manure	-				Capital cost recovery	Lowers volume of manure to land apply, offsets*

Symbols: - Emission reductions, + Emission removals. Impact shown by number of symbols varies with site conditions.

* Carbon offsets may be available with verifiable records to document practice improvement.

Alberta Government