

Targeting Greenhouse Gas Research for Agriculture

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Greenhouse Gases - Things You Need To Know

For Alberta's agricultural industry, reducing greenhouse gas (GHG) emissions offers both challenges and opportunities. Agricultural producers can meet the challenges and take advantage of the opportunities with the help of results from targeted, practical research.

Based on input from scientists, producers, funding agencies and policy makers from across Canada, 10 GHG research areas have been identified as top priority for agriculture in Alberta. Research in each of these areas has the potential to result in significant progress in reducing GHG emissions while providing economic benefits for producers.

GHG Emissions & Agriculture

Over the last century, modern industry, land use and lifestyles have rapidly increased GHG concentrations in the Earth's atmosphere. The majority of scientific evidence points to increasing GHG concentrations contributing to changes in temperature, precipitation and weather patterns. These changes can cause many serious effects, such as more severe and extreme weather events, more forest fires, and damage to water resources. And those effects could have important consequences for local and global economies as well as ecosystem health.

For agriculture in Alberta, the impacts of climate change may include movement of insect pests and diseases into new areas, increased risks of drought and flooding, and the need to adjust management practices to cope with changing conditions.

Canadian agriculture contributes nine percent of the nation's total GHG emissions. The main GHGs from agriculture are nitrous oxide (N₂O) from fertilizer and manure application,

methane (CH₄) from livestock and manure, and carbon dioxide (CO₂) from fossil fuel use and decay of soil organic matter.

Lowering GHG emissions would benefit agriculture in various ways. These emissions represent nutrient losses from agriculture, so minimizing emissions will increase production efficiencies and lower input costs. Many practices that reduce net emissions also help protect soil, water and air quality needed for sustaining agricultural production. Lowering emissions is also one way to demonstrate that producers are good stewards of the environment. As well, reducing net emissions could enable producers to participate in a short-term opportunity of selling GHG offset credits (or 'carbon credits').

Targeting Process for GHG Research

GHG emissions in agricultural systems involve complex interactions that are influenced by diverse factors. There are many gaps in our knowledge. Those gaps need to be filled so researchers can develop cost-effective practices to reduce emissions and so producers can select options that will provide the most economic and environmental benefits for their own operations.

However, funds for research are limited. So researchers and research funding agencies must focus on areas that will generate the greatest benefits. But what exactly are those areas? To answer that crucial question, Alberta specialists and others embarked on a three-step process to hone in on the most urgent and important research gaps.

First, specialists and researchers from Alberta Agriculture, Food and Rural Development and



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the University of Alberta conducted a comprehensive review of over 2,600 scientific papers and reports on GHG emissions related to prairie agriculture. They identified over 50 gaps.

Then, in June 2003, those specialists and researchers met with GHG researchers from across Canada. Together they prioritized the gaps, based on how urgently the research is needed and how great an impact the research would have. Their input was used to prepare the *Alberta Agricultural Greenhouse Gas Assessment Science Plan*.

The *Science Plan* was the springboard for the final step in the process -- creation of a more specific 'roadmap' to guide research funding agencies. At a June 2004 workshop, researchers, policy specialists, producers and research funders developed a list of agricultural practices with the greatest potential to reduce GHG emissions. For each practice, they identified gaps that needed to be addressed to move the practice toward widespread adoption by Alberta's agricultural industry. Using the workshop results, a team of specialists and researchers developed *Strategic Research Roadmap for Greenhouse Gas Management in Agricultural Systems*. It identifies 10 priority areas for GHG research needed by Alberta's agricultural industry.

10 Priority Research Areas

The *Research Roadmap's* 10 areas, listed below, have the potential to lead to significant reductions in GHG emissions from prairie agriculture while also providing economic benefits for producers. All 10 areas can be addressed through the expertise at research agencies in the Prairie Provinces.

1. Feeding edible oils to feedlot cattle:

Testing is needed to assess the effects of various edible oils on reducing methane emissions, increasing the meat's health benefits and improving feed efficiency.

Possible benefits to Alberta's agricultural industry include:

- reduced methane emissions from feedlot cattle by 20 percent.
- practical feeding protocols that improve feed efficiency
- new branded products that may be able to command a higher price
- identification of other Alberta-grown edible oil crops that provide similar benefits

2. Feeding edible oils in cow-calf operations:

Research is needed to develop cost-effective, practical methods for feeding edible oils to wintering and grazing cows, and to quantify the effects on reducing methane emissions and enhancing meat quality.

Possible benefits to Alberta's agricultural industry include:

- reduced methane emissions from cow-calf operations by 20 percent
- identification of practical feeding protocols that increase feed efficiency and reduce production costs
- new branded products that may be able to command a higher price

3. Improving net feed efficiency in cattle:

Research is needed to refine the methods for selecting feed-efficient cattle, and technology transfer is needed to demonstrate cost-effectiveness of feed-efficient cattle.

Possible benefits to Alberta's agricultural industry include:

- reduced methane emissions by 2.5 percent per year for feed-efficient cattle
- identification of breeding stock with better net feed efficiency
- significantly reduced feed costs. With just 10 percent adoption, the potential saving in feed costs is about \$5 million per year for Alberta's feeding industry and at least this much for the cow-calf sector.

4. Optimizing manure composting:

Research is needed to assess composting



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methods for GHG emissions, cost-effectiveness and practicality under Alberta conditions.

Possible benefits to Alberta's agricultural industry include:

- reduced methane and nitrous oxide emissions
- improved retention of nitrogen, reduced fertilizer costs
- a drier, less odorous product that costs less to transport than raw manure
- opportunities to market bagged compost

5. Optimizing systems for land application of manure:

Research is needed to find which manure treatment and application methods are most effective at reducing GHG emissions on Alberta soils while also being cost-effective and practical.

Possible benefits to Alberta's agricultural industry include:

- reduced nitrous oxide and methane emissions
- improved retention of nitrogen
- reduced commercial fertilizer inputs and/or less odour with some practices

6. Covering and collecting biogas from earthen manure storage facilities:

Research is needed to evaluate cover/gas collection systems for earthen manure storage facilities in terms of cost, performance, maintenance and emissions under prairie conditions.

Possible benefits to Alberta's agricultural industry include:

- reduced methane emissions
- practical information on various cover/gas collection systems under Alberta conditions

- opportunities to use the collected methane for energy
- reduced odour

7. Developing low-cost biodigester technology:

Biodigestion converts manure into a biofertilizer and generates biogas for energy. Research is needed to develop and test this technology for use on small and medium-sized Alberta farms, in terms of cost, performance, operation, and quality and quantity of biogas and biofertilizer.

Possible benefits to Alberta's agricultural industry include:

- reduced methane and nitrous oxide emissions
- opportunities to use the collected methane for energy
- opportunities to sell the nutrient-rich, odour-free biofertilizer

8. Using controlled release urea fertilizer products:

Research is needed to examine the use of these products to maximize nitrogen use efficiency by the crop and reduce nitrous oxide emissions for agronomic, economic and GHG benefits under prairie conditions.

Possible benefits to Alberta's agricultural industry include:

- reduced nitrous oxide emissions by 10 to 20 percent
- identification of soil/fertilizer/crop management strategies that improve nitrogen fertilizer use efficiency
- reduced fertilizer rates and costs for crop production from improved nutrient use efficiency (potentially \$5 to \$10/acre/yr)
- increased crop productivity and revenue from improved nutrient use efficiency (po-



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tentially \$15 to \$45/acre/year)

9. Assessing legumes/cereal/oilseed rotations and soil/nutrient management strategies:

Research is needed to assess GHG emissions and carbon sequestration from various crop management systems in order to develop and select practices that maximize economic and environmental benefits.

Possible benefits to Alberta's agricultural industry include:

- reduced GHG emissions and improved carbon storage
- reduced fertilizer costs from improved nutrient management
- identification of crop management strategies with multiple benefits for reducing GHG emissions, carbon sequestration and improved nutrient management

10. Quantifying GHG emissions for various pasture and rangeland management systems:

GHG data for Alberta grazing management systems are needed to help in developing and selecting cost-effective practices that also reduce emissions.

Possible benefits to Alberta's agricultural industry include:

- reduced net GHG emissions
- improved long-term pasture productivity, increased livestock weight gain, and more efficient nutrient management
- reduced production costs for cow-calf operations by 20 percent
- potential for branded products that may command a higher price

Summary

Research is needed to help Alberta producers take advantage of the many economic and environmental benefits possible from reducing GHG emissions. To speed progress in this area, researchers and research funding agencies need to focus on the most urgent and

important research topics.

Ten priority GHG research areas have been identified through input from researchers, producers, policy specialists and research funding agencies from across Canada. Research in those areas has the greatest potential to make significant strides forward in managing GHG emissions from agriculture while improving production economics for Alberta producers.

For More Information

The following reports provide details on the process used to identify the priority research areas:

- *Development of a Farm-Level Greenhouse Gas Assessment: Identification of Knowledge Gaps and Development of a Science Plan*
- *Alberta Agricultural Greenhouse Gas Assessment Science Plan*
- *Workshop Summary Report: Farm Level Greenhouse Gas Assessment Research Priorities Workshop, June 2 and 3, 2004*
- *Strategic Research Roadmap for Greenhouse Gas Management in Agricultural Systems*

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