



ENVIRONMENT IN THE COURTROOM II

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Reducing Greenhouse Gas Emissions from Canadian Agriculture

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Introduction: Agriculture and Global Climate Law

“To ensure that food production is not threatened” would not be widely recognized as one of three explicit considerations applicable to the *United Nations Framework Convention on Climate Change* (UNFCCC)’s over-arching climate objective of “stabilization of greenhouse gas concentrations . . .”² Equally noteworthy is recognition in the 2015 *Paris Agreement* of “the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to . . . climate change.” Combining concerns for mitigation and adaptation, the *Paris Agreement* refers specifically to “[i]ncreasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production.”³

More generally, policymakers have been advised of three global limits: “the quantity of food that can be produced under a given climate; the quantity needed by a growing and changing population; and the effect of food production on the climate.”⁴ While we can, therefore, assume that global climate law encompasses agriculture, it is noteworthy that the activity mentioned is food production rather than agriculture. Noting the tendency to focus on adaptation and resilience, this chapter seeks to highlight opportunities and challenges associated with mitigation.⁵

Delineating the Scope of the Agriculture Sector for Climate Change

On the assumption that you cannot confidently regulate what you cannot define, it is worth asking about the relative scope of food production and agriculture. A recent analysis explains that greenhouse gas (GHG) emissions attributed to agriculture for purposes of the *UNFCCC* instruments originate from a range of sources—some but not all involving land-use, and some involving CO₂ as well as other gases, notably methane and nitrous oxide. These sources were not being treated in “an integrated, sector-specific way,” with the consequence that the Intergovernmental Panel on Climate Change (IPCC) eventually formulated the AFOLU (agriculture, forestry and other land uses) category to address inconsistencies and double counting.⁶

Challenges of categorization also arise within domestic frameworks. Agriculture and Agri-Food Canada (AAFC), for example, notes that its agricultural GHG indicator: “does not attempt to capture carbon dioxide emissions from fossil fuel consumption by farm machinery, as these emissions are typically reported by the manufacturing and transportation sectors.”⁷ For its part, the House of Commons Standing Committee on Environment and Sustainable Development advances a wide-ranging recommendation for the reduction of GHG emissions from “Canada’s forestry, agricultural, and waste sectors.”⁸ For the purposes of the federal *Greenhouse Gas Pollution Pricing Act* (GGPPA), agriculture is equated with “farming,” the latter defined to include “tillage of the soil, livestock raising or exhibiting, maintaining of horses for racing, raising of poultry, fur farming, dairy farming, fruit growing and the keeping of bees, but does not include an office or employment under a person engaged in the business of farming.”⁹

A description of agricultural processes, to inventory highlights, may involve land preparation, seed planting, nutrient application, pest management, irrigation, harvesting or collection, storage and delivery. If delivered for processing or as an ingredient, agricultural produce will then be processed, packaged, and distributed to retail, commercial, or industrial consumers. The continuing storyline at the household level includes purchase, transport, preparation, consumption, and waste. Appropriate modifications would produce a livestock narrative.

This approach to agriculture extends its scope significantly beyond activities on the farm. The Food and Agricultural Organization (FAO) adopted

this broader approach in its formulation of climate smart agriculture. Climate smart agriculture might involve on-farm activity, including land-management practices, food-processing arrangements, retail distribution processes, and consumption.¹⁰ The agriculture and agri-food system, as understood by AAFC is also multi-dimensional: “a complex and integrated supply chain that includes input and service suppliers, primary producers, food and beverage processors, food retailers and wholesalers, and foodservice providers.”¹¹

Climate smart agriculture has gained some traction in Canada and is of interest in achieving “agriculture that sustainably increases productivity, resilience (adaptation), reduces/ removes GHGs (mitigation), and enhances achievement of national food security and development goals.”¹²

The extent to which mitigation initiatives in agriculture merit attention depends ultimately on their potential to make a difference. With 36 million hectares of active cropland, Canada was ranked seventh by arable land surface in the years 1961–2019 after the USSR, the United States, India, Russia, Mainland China, and Brazil.¹³ The size of Canadian farming operations varies, but if a successful initiative to reduce GHG emissions on one not-necessarily-large farm might be replicated across 200,000 other Canadian farms of similar size, a difference could be made. Regrettably, it is not quite so straightforward.

Scale and its relation to adaptation was addressed in the Working Group II (WGII) contribution to the Fifth IPCC Assessment Report: “adaptations can occur at a range of scales from field to policy.”¹⁴ WGII further observed: “effective adaptation will often require changes in institutional arrangements and policies to strengthen the conditions favorable for effective adaptation including investment in new technologies, infrastructure, information and engagement processes.”¹⁵ Also noteworthy is a reference to “the sector-specific nature of many adaptations.” Similar considerations apply to mitigation.

Greenhouse Gas Emissions from Agriculture

As much as 29 percent of global GHG emissions can be attributed to “food systems.”¹⁶ Setting aside divergent understandings of food systems and agricultural sectors, let alone the challenge of orderly reconciliation, it is possible to report Canadian data. Prominent conventional assessments have attributed as much as 10 percent of Canadian GHG emissions to agriculture with 8.1 percent as a current assessment.¹⁷ Viewed provincially, however, agriculture is

recognized as a far more significant contributor, with, for example, Manitoba's agricultural sector producing 30 percent.¹⁸

As communicated by AAFC, Environment Canada's *National Inventory Report for 1990–2011* elaborates the process of calculation:

In 2011, the net GHG emissions (emissions minus absorption by soils) from Canadian agricultural activities, excluding fossil fuel use, amounted to 42 million tonnes of CO₂ equivalents (Mt CO₂ e), which is equal to about 6% of Canada's overall GHG emissions. Total agricultural GHG emissions (not factoring in carbon sequestration by agricultural soils) comes to 8% of Canada's total emissions.¹⁹

In addressing trends, the AAFC noted that the contribution of methane (largely attributable to livestock operations) had increased by 2 percent with nitrous oxide emissions (associated with fertilizer use and manure) up by 31 percent.²⁰ These GHGs are highlighted for their dramatically greater greenhouse effect in comparison with the benchmark CO₂. Noting a long-term decline in net agricultural GHG emissions, the AAFC summarized long-term findings:

The index illustrates a relatively constant trend since 1981, with emissions caused by increased production being largely countered by improvements in production efficiency and by enhanced carbon storage in soils due to tillage reductions.²¹

The accompanying analysis identified several relevant trends. Firstly, prairie farmland is functioning more effectively as a carbon sink, a change attributed to the adoption of improved land management practices. Reduced GHG emissions were also associated with declining animal populations, notably beef and dairy cattle. Countering the declines were increased emissions associated with increased volumes of nitrogen fertilizer²² and eastern Canadian farm activity.²³

Mitigation in Agriculture

NATIONAL FRAMEWORK

The *Pan-Canadian Framework on Clean Growth and Climate Change* combines agriculture with forestry and waste in a highly generalized statement noting opportunities for carbon storage through land management practices and bioenergy. The framework was elaborated on through the 2017 Canadian Agricultural Partnership, including a projected investment of \$3 billion. Pursuant to this arrangement, provinces “will make investments to enhance carbon storage in agricultural soils, generate bioproducts and biofuels, and advance research and innovation to support GHG emission reductions in the agriculture sector.”²⁴

Several national research initiatives are seeking supportive insights, including a 2013 report by the Council of Canadian Academies. The project surveyed research oriented, in part, around climate change impacts and irrigation efficiencies using less energy to meet water requirements in the primary agricultural sector.²⁵ That invitation for research around the intersection of climate, water, energy, and agriculture²⁶ was echoed and elaborated in the 2016 call for Strategic Partnership Grant Applications from the Natural Sciences and Engineering Research Council (NSERC). In connection with the theme of “adapting agricultural production systems to climate change,” NSERC invited researchers to identify adaptation options and risk management tools while encouraging attention to synergies and trade-offs between adaptation and mitigation.²⁷

AAFC’s Agricultural Greenhouse Gases Program has sponsored GHG reduction or removal projects on livestock systems and cropping practices. Among the former are studies of cattle grazing systems, beef cattle diets, and hog manure application. One of the cropping studies seeks to increase soil carbon sequestration and reduce nitrous oxide emissions by comparing perennial cereal crop systems with annual cropping.²⁸

PROVINCIAL MITIGATION INITIATIVES

The implementation of specific operational initiatives is most apparent provincially. Alberta, for example, echoing FAO’s climate smart agriculture framework, anticipates improved productivity, strengthened resilience, and reduced GHG emissions. With a specific focus on GHGs, Alberta seeks to:

1. Reduce emissions from livestock, fertilizer, manure and fuel
2. Replace fossil fuels with bio-based renewable energy
3. Remove atmospheric carbon and store it in soils.²⁹

Most other jurisdictions are pursuing a comparable suite of measures directed at croplands, livestock, and energy, with the latter divisible into energy efficiency initiatives and renewable production.³⁰ Renewable biofuel programs, in turn, have on-farm and off-farm dimensions.

CROPLANDS

The emphasis in relation to croplands and GHG emissions/carbon retention is on farm practices, especially tillage, nutrient management, and irrigation.³¹ Conservation or “one-pass” tillage reduces soil disruption and lowers energy use. Agronomic improvements, particularly in relation to fallowing and cover crops, offer opportunities to reduce nitrous oxide emissions. The timing and monitoring of fertilizer applications via precision agriculture similarly offer benefits associated with lower fuel consumption and avoidance of unnecessary distribution of fertilizer.

Turning to irrigation, the individual farmer’s search for water efficiencies may initially be driven by the prospect of adapting to shortages, but the resulting innovations typically involve reduced energy use. This is a farm-level cost saving that contributes to substantial emission reductions.

Statistics Canada distinguishes several types of irrigation (sprinklers, micro-irrigation, and surface) and analyses their use in relation to separate categories of crops (field crops, e.g. canola and soybeans; forage crops such as hay and alfalfa; fruit operations where irrigation is also used as protection against frost and heat; and vegetable crops).³²

In addition to conventional water-conservation practices such as night/morning watering; water/energy-saving nozzles; pressure reduction; and soil enhancement and monitoring innovations are being introduced with a view to refining information on irrigation needs for particular crops in precise soil conditions with reference to current weather forecasting.³³

LIVESTOCK

Ruminants and their diets are the second centre of innovation.³⁴ This activity, in Alberta’s Ministry of Agriculture and Forestry assessment, has

the potential to increase feed utilization, lower costs, and reduce methane emissions. This represents the Canadian domestic equivalent of the Clean Development Mechanism projects that TransAlta Utilities initiated with Indian and Ugandan farmers nearly two decades ago in the *Kyoto Protocol* context.³⁵

Manure is a further focus of attention. Legislation designed to reduce nutrient flows into waterways and thereby prevent pollution has hugely expanded the use of manure management systems, including storage tanks.³⁶ Many of these are now being viewed as viable sources of methane-based biogas.

ENERGY EFFICIENCY AND BIOFUELS

In addition to the energy savings noted in connection with cropland management, a number of highly particularized energy efficiency programs and proposals are being developed, as illustrated by the guidance provided by the Ontario Ministry of Agriculture, Food and Rural Affairs that is specifically relevant to corn, grains, and hay.³⁷ On the livestock side, some advice is targeted at dairy producers, or exclusively designed for poultry operations, or aimed uniquely at hog farms. A similar approach is evident in British Columbia, where energy-saving guidance is directed to dairy, field crop, grain, greenhouse, nursery, orchard, poultry, and vineyard operations.³⁸ Even more, general guidance documents promoting energy savings within the climate response agenda underscore the complexity of agricultural operations. Instructional materials include efficiency guidance for lighting, fuel, ventilation, irrigation, crop drying and storage, and for standby emergency power systems.³⁹

As noted above, improved manure management facilitates methane capture for on-farm use or allows transfer off-site to centralized facilities. Threshold-based requirements along these lines have been introduced in some US states, or projects may be encouraged where offset arrangements operate to support the necessary capital investment.⁴⁰ In Canada, agricultural biogas is promoted alongside other green energy opportunities in Ontario,⁴¹ while in Alberta—with financing from major GHG emitters in the province—Lethbridge BioGas draws on an abundance of local manure (dairy, hog, and poultry) in combination with other organic materials to produce power for the energy marketplace.⁴²

Agricultural Related Non-Farm Mitigation

Additional mitigation opportunities involving the agricultural sector as producer, supplier, and shipper may also be noted.

The Canola Council of Canada emphasizes new market opportunities in biodiesel, including the European Union renewable fuels market.⁴³ More generally, in terms of market enhancement, the constitutionality of Canada's *Renewable Fuels Regulations*⁴⁴ was upheld with specific reference to the strategic inter-relationship between energy, environment, and agriculture.⁴⁵

A California company, Apeel Sciences, is developing fruit and vegetable coatings from natural materials. This innovation offers the possibility of lower energy requirements for shipping and refrigeration accompanied by reduced wastage.⁴⁶

Continued improvements to rail transportation—involving substantial food shipments—offer a significant opportunity for emissions reduction.⁴⁷

The Legal Framework

Through nutrient management legislation, or regulations calling for emissions reporting⁴⁸ or requiring the use of renewable fuels in specified circumstances,⁴⁹ for example, certain supports for mitigation initiatives in agriculture have been firmly established. Pricing of methane emissions federally is now addressed, together with specified exemptions for “farming” in the *GGPPA*. At the provincial level, British Columbia exempted agriculture from the carbon tax regime, while Manitoba has expressed concern that exempting agriculture from GHG reduction initiatives would place a disproportionate burden on other sectors.⁵⁰ Other observers point to differential impacts on a large agricultural sector as an argument for cap-and-trade over carbon taxes.⁵¹ Other mitigation support measures with firm legal foundations include the availability of favourable tax treatment (accelerated capital cost allowances) on investments in renewable energy equipment.⁵²

Generally, however, GHG mitigation measures in agriculture (more narrowly defined) have been encouraged or facilitated through policy rather than formally required. A software program made available through AAFC at no charge allows users at the farm level to estimate their current GHG emissions and then, by making an online substitution of a current practice for an alternative (adopting a new cropping rotation, for example) to obtain information estimating new GHG emission levels accompanied by a

cost-benefit analysis.⁵³ A farm practice alteration offering GHG mitigation in a cost advantageous manner would presumably be adoptable on a voluntary win-win basis.

Conclusion

While agriculture has not been overlooked from the mitigation perspective, its potential significance may not be fully appreciated. Given the internal diversity and complexity of the sector—with food production systems as a still more challenging consideration—it is easy to underestimate the extent of the agricultural or agri-food sector and its intersection with energy, water, transportation, and waste—on-site and off.

At least partially, in consequence, governmental measures have tended towards facilitation rather than prescriptive regulation.⁵⁴ Large-scale agricultural and food processing operations obviously have industrial attributes that invite appropriate regulatory interventions. But aspects of the overall agri-food landscape may be culturally distinctive because of the number of individual and smaller-scale operations involved.

To the extent that beneficial management practices offer both environmental and economic benefits, research to identify these and measures to enhance awareness and encourage adoption are highly attractive. In the same way that agricultural sustainability might benefit from a comprehensive, high-level national vision,⁵⁵ wider efforts to advance climate mitigation may be attractive alongside adaptation measures that have thus far tended to receive more attention.

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