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Opportunities and challenges for the Canadian agricultural sector

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Abbreviations and acronyms

AAFC	Agriculture and Agri-Food Canada
AFOLU	agriculture, forestry and other land uses
CDM	clean development mechanism
CH4	methane
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
EU ETS	European Union Emission Trading Scheme
FAO	Food and Agriculture Organization
GHG	greenhouse gas
IISD	International Institute for Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
LULUCF	land use, land use change and forestry
Mt	megatonne (millions of tonnes)
MRV	measurable, reportable and verifiable
N_2O	nitrous oxide
NGO	non-governmental organization
NRTEE	National Round Table on the Environment and the Economy
UNFCCC	United Nations Framework Convention on Climate Change
USDA	United States Department of Agriculture
VCS	Voluntary Carbon Standard
WCI	Western Climate Initiative
WTO	World Trade Organization

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1.0 Introduction

Agriculture is a critical sector for reducing greenhouse gas (GHG) emissions, especially in the short term. The sector is responsible for around 14 per cent of global emissions, and the Intergovernmental Panel on Climate Change (IPCC) reports that the agriculture sector has the potential to contribute significantly to GHG emission reductions, with potential ranges from 5 to 20 per cent of total carbon dioxide (CO_2) emissions by 2030 (Smith *et al.*, 2007). The agricultural sector offers relatively cost-effective options for significant emission reductions that can be undertaken quickly—essentially buying the time needed to undertake the required transformation to low-carbon energy systems and infrastructure.[1]

Canada's agricultural sector will be affected by policy decisions that respond to the climate change challenge. At the international level, decisions under the United Nations Framework Convention on Climate Change (UNFCCC)—such as the stringency of targets; the role of the land-use sector in offset markets; and the rules for accounting of GHG emissions in the land use, land-use change and forestry (LULUCF) sector—could have an impact on Canadian farmers. The domestic policy response in Canada and other countries could raise concerns about agricultural offsets, competiveness and increased production of biofuels. Dealing effectively with climate change in a manner that accounts for the Canadian agricultural sector will require efficient and effective mitigation policies that follow best practices, capitalize on mechanisms in an international agreement and avoid interference with global market development and access.

This paper examines some of the challenges and opportunities for the Canadian agricultural sector that may arise out of the evolving national and international climate change regimes. The paper is informed by a literature review and interviews with 16 Canadian agricultural experts, academics and practitioners (listed in Annex I). The following section of the paper describes mitigation potential in the agricultural sector in Canada. Section 3 examines biofuels, Section 4 looks at agricultural offsets in an emission trading scheme and Section 5 discusses competitiveness concerns. The paper concludes with a summary of implications for policy development.

[1] The Food and Agriculture Organization (FAO, 2008) estimated that mitigation efforts in developing countries through agriculture and forestry projects might cost about one quarter to one third of total mitigation in all sectors and regions, while generating one half to two thirds of all estimated emission reductions.

2.0 Mitigation potential in the Canadian agriculture sector

Canada's total emissions from the agriculture sector—namely enteric fermentation (methane or CH_4) and manure management (CH_4 and nitrous oxide or N_2O) and N_2O from agricultural soils—were 60 Mt in 2007, an increase of 23 per cent from 1990 (see Table 1 for a breakdown of these emissions).[2] The agriculture sector contributed about 26 per cent and 71 per cent of the total Canadian CH_4 and N_2O emissions, respectively, in 2007 (Environment Canada, 2009b). In the LULUCF sector, agricultural soils have changed from a source to a sink of carbon. The cropland category indicates a trend toward decreasing emissions, with a removal of 3.4 Mt in 2007; and a 16.4 Mt reduction in emissions over the 1990–2007 period. Overall, the agriculture sector was responsible for about 8 per cent of total GHG emissions in Canada in 2007.

Canadian agricultural mitigation potential was estimated at 18 Mt by Boehm *et al.* in 2004. The current potential is less, perhaps by as much as 10 Mt, given that the agricultural sector has experienced an increase in carbon sequestration because of greater uptake of such practices as low disturbance tillage, establishment of grass and reduction of summer fallow. It was suggested during interviews that much of the low-hanging fruit has been exploited, especially in the implementation of no-till practices, meaning that Canada will need to act on opportunities in the livestock sector, such as improved manure management and better feeding practices. Including offsets from this sector in a domestic emissions trading scheme is one way to encourage reductions.

Table 1: Agricultural GHG emissions in megatonnes carbon dioxide equivalent (CO_2e)

Activity	1990	2000	2005	2007
Enteric fermentation	17	23	24	23
Manure management	6	8	8.1	7.8
Agricultural soils (N_2O)	26	30	30	29
Sub-total	48	62	62	60
LULUCF – cropland	13	-1	-2	-3.4
Total agricultural emissions	61	61	60	56.6
Percentage of total emissions	10%	8%	8%	8%
Total GHG emissions	592	717	741	747

Source: Environment Canada, 2009b.

[2] Under the Kyoto Protocol, agricultural emissions refer to CH_4 and N_2O emissions (from fertilizers and livestock, among others), while emissions from land-use change (for example, conversion of forest to farmland and subsequent plowing) are considered as emissions from the LULUCF sector. This paper deals with all emissions from the agriculture sector—CO_2, CH_4 and, N_2O—unless explicitly stated.

Table 2: LULUCF emissions in megatonnes CO_2e

Activity	1990	2004	2006	2007
Forest Land	-79	110	33	38
Cropland (total)	13	-1	-2	-3.4
Cropland remaining cropland	-1.4	-9	-10	-11
Land converted to cropland	14	8	8	7.5
Grassland	NE	NE	NE	NE
Wetlands	5	3	3	3
Settlements	10	8	8	8
Total GHG emissions	-52	120	41	45

NE – not estimated

Source: Environment Canada, 2009b.

Table 2 indicates that change in cropland management resulted in a net sink of -3.4 Mt in 2007. A concern for Canada, which elected to report on cropland management for the entire commitment period under Article 3.4 of the Kyoto Protocol, is that soil carbon levels will reach equilibrium with the rate of carbon inputs and removals.[3] Saturation is expected to occur in Canada in the next few decades as croplands near maximum carbon storage capacity. This has implications for Canada's reporting to the Kyoto Protocol in that Canada would not be able to remove carbon at the same rate as the 1990 base year. Under the current net-net accounting rules, Canada would be debited because sequestration would be less than the base year, even though there would be no emissions from the cropland, and management practices would not change. To prevent a perverse effect, the saturation issue should be addressed in new rules in a post-2012 climate change agreement.

Options under consideration in the climate change negotiations include gross-net accounting, reporting under a broader agriculture, forestry and other land use (AFOLU) framework as set out in the 2006 IPCC GHG Inventory Guidelines (Eggleston, *et al.*, 2006), or allowing a country that has reached saturation to report zero. In interviews, the scientific community supported that agriculture and LULUCF categories be combined in an AFOLU sector for Kyoto Protocol reporting. Experts noted that LULUCF and agriculture are intimately related, and accounting for all facets of land use in one category would better capture tradeoffs. The science community noted that all LULUCF activities listed in Article 3.4 should be mandatory and included in reporting under the Kyoto Protocol.

[3] See Murphy *et al.*, 2009 (pp. 10–12) for a description of Canada's reporting requirements under the UNFCCC and Kyoto Protocol.

3.0 The bioenergy sector

Canadian governments, like many others around the world, have recently embraced biofuels as a seemingly win-win opportunity to address policy challenges, including climate change, rural development, and diversification of energy supply. The Canadian government has a 5 per cent biofuel target by 2010, and 2 per cent for diesel fuel and heating oil by 2012 (Environment Canada, 2009a). A number of programs promote renewable fuel technologies over the longer term, including initiatives to help farmers raise capital for construction or expansion of biofuel production facilities, and assistance to the private sector to help establish large-scale facilities for the production of next-generation renewable fuels.

Canada's forest and agricultural resources mean there is significant mitigation potential in the bioenergy sector through the production of a renewable supply of energy. BIOCAP (Layzell, 2006) estimated that Canada has the potential to provide 20 per cent of its energy needs from bioenergy by 2020—up from the approximately 5 per cent sourced from biomass in 2006. Reaching this target would result in GHG emission reductions of 70Mt CO_2e per year. BIOCAP estimated that a growth in bioenergy of 6 per cent per year would result in $7.8 billion per year invested in farms and forestry operations and 100,000 jobs across Canada (Layzell, 2006).[4]

Biofuel production is viewed by many as a benefit for farmers and rural communities, but there are a number of challenges related to bioenergy. One large issue is transportation distances and the costs associated with this, including specialized transport, storage and distribution infrastructure. These costs are likely to be high for provinces that do not produce biofuels locally—such as the Maritime provinces.

The National Round Table on the Environment and the Economy (NRTEE) reported that there is uncertainty about the impact of the federal government's biofuel regulation. The emission reduction factors used in the government's 2009 Climate Change Plan suggested that ethanol and biodiesel production respectively lead to 33.1 per cent and 66.5 per cent reductions in GHG emissions relative to production of gasoline and diesel from fossil fuel sources. But how the ethanol and biodiesel is produced—for example through feedstock, technology and induced indirect land changes—will have a substantial impact on the emission reductions. There is significant scientific controversy over the carbon neutrality of biofuels, particularly those derived from oilseeds (biodiesel), feed corn (ethanol) or even from cellulosic sources. To ascertain the true carbon neutrality of biofuels requires a careful life-cycle analysis of production cycles. Newer technologies, such as cellulosic ethanol, might lead to as much as 90 per cent emission reductions relative to fossil

[4] All dollar amounts are expressed in Canadian dollars, unless otherwise indicated.

fuels, while corn-based ethanol that uses coal-fired electricity to run the process could lead to higher overall emissions than gasoline (NRTEE, 2009).

Searchinger *et al.* (2008) noted that biofuels from waste products—such as crop waste, fall grass harvests and municipal waste—can avoid land-use change and its emissions. While some argue that using marginal farmlands is the best way to create clean energy sources and reduce GHG emissions, Searchinger *et al.* (2008, p. 1240) maintain that feedstocks produced on lands that generate little carbon today might help to keep land-use change emissions low, "but the ability to produce biofuel feedstocks abundantly on unproductive lands remains questionable."

Analysis is needed to understand the implications for global land-use change of farmers growing more of a specific biofuel feedstock. The global expansion of the use of important food crops such as oilseeds and corn as fuel will face challenges because of concerns about global food security, food inflation and world hunger. Alleviating hunger may no longer be just about poverty reduction and equitable food distribution, but instead might need to address accelerating the rate of gain in crop yields and food production capacity at both local and global scales.

There are also questions about the cost-effectiveness of public financing, and the introduction of market distortions because of Canadian government subsidies for biofuels. A C.D. Howe study determined that the most expensive government incentives were found to be liquid biofuels, which ranged from $195 to $430 per tonne of CO_2e for ethanol and $122 to $175 per tonne of CO_2e for biodiesel. Mitigation for renewable heat and power technologies (such as wind, solar, biomass heating) could be realized at $10 to $60 of government subsidy of CO_2e offset (Samson & Bailey Stamler, 2009). An IISD study came to similar conclusions, noting that government incentives amount to between $200 and $430 per tonne of CO_2e, from ethanol, and between $205 and $580 per tonne from biodiesel. Subsidizing corn or wheat ethanol or canola biodiesel with public money in Canada removes only one tonne of CO_2e, rather than up to 100 tonnes through purchasing emission reductions on the market (Laan, Litman & Steenblik, 2009).

Cropland waste streams can also be used for other value-added products. Ongoing research is investigating new technologies for the refinement of agricultural products, such as bio-composites and bioplastics. Unlike biofuels, these do not re-emit carbon to the atmosphere upon their use. Manufacturing these products from waste streams circumvents the issue of having to divert land and crops from food production. Canada is still learning from its experience with advanced bio-products, but is at the forefront of technology development from cropland waste streams.

4.0 Agricultural offsets and the carbon market

An emissions trading scheme in Canada could offer farmers an economic return for reducing GHG emissions. The federal government has undertaken work to develop an offset system, and this proposed system is designed to encourage cost-effective domestic reductions or removals in sectors not expected to be covered by proposed industrial air emissions regulations—such as agriculture, forestry and waste management. The proposed Canadian Offset System would issue offsets to projects that meet eligibility requirements and undergo independent third-party verification. Canada's emission trading system would likely be very closely aligned with and developed on a timeline that matches that of the United States. The Canadian government has committed to "continentalize" its emissions reduction plan and to harmonize Canada's actions with those of the United States. Consistent with this approach, Environment Minister Jim Prentice announced in January 2010 that Canada's new aim is to reduce GHG emissions by 17 per cent from 2005 levels by 2020 (a target that mirrors the expected American target[5]); and that Canada will only adopt a federal cap-and-trade program if the United States does the same (Prentice, 2010).

Farmers are currently participating in Alberta's carbon trading market, which was launched in 2007, and have completed transactions on the voluntary market through the Chicago Climate Exchange (CCX). Additionally, the Western Climate Initiative (WCI) is developing an emissions trading system that would include agricultural offset sales from producers in British Columbia, Manitoba, Ontario and Quebec. Canadian projects have access to the international market through the Voluntary Carbon Standard (VCS) Association, which announced in July 2009 that it would allow clean projects hosted in Canada to issue offsets without corresponding cancellation of credits under the Kyoto Protocol. VCS (2009) made the move because Canada has "no regulatory framework to implement the Kyoto Protocol, none is likely to emerge, and the country is unlikely to achieve its Kyoto Protocol reduction commitment."

Alberta has developed a number of protocols for agricultural offsets from Alberta-based projects.[6] These include five protocols for livestock (feeding), one for manure management and one for soil sequestration through reduced- or no-till practices. Thirty three of 44 projects listed in the Alberta Emissions Offset Registry in May 2010 were for soil sequestration, and approximately 33 per cent of the total 9,273,695 tonnes CO_2e of offsets transferred, issued or removed as of May 25, 2010 were

[5] The 17 per cent target is included in the Kerry-Lieberman bill released on May 12, 2010, and is the target the United States submitted to the UNFCCC in January 2010 (the submission notes that the final target will be in the range of 17 per cent, in conformity with anticipated U.S. energy and climate legislation).
[6] These protocols are also listed on Canada's GHG Offset System's Fast Track Process Protocol Eligibility List, in addition to a protocol for manure management from the California Climate Action Registry (Environment Canada, 2009c, Annex J).

for no- or reduced-till projects (Climate Change Central and Canadian Standards Association's GHG CleanProjects Registry, 2010). These projects potentially include thousands of farmers because they are aggregated projects, and represent over $13 million at the CCX 2008 average price of $4.43 tonne CO_2e.[7]

Farmers across Canada could potentially benefit from a national cap-and-trade system with agricultural offsets. Income generated from the sale of offsets could help farmers cope with higher input costs for fuel, transportation, fertilizer, machinery, and chemicals, which are expected to result partly from climate change regulations. It was stated during two interviews (one academic and one industry representative) that any funds farmers receive for offsets will only just make up for higher input costs.

In the United States, a study by the United States Department of Agriculture (USDA, 2009) estimated rising energy costs would decrease farmers' income by 1 per cent up to 2018, and by 7.2 per cent by 2048, but this would be more than compensated for by projected income growth for farmers through a cap-and-trade system. In the United States, the sale of carbon offsets has the potential to generate extra income for the farm sector of US$75 to 100 million each year from 2012 to 2016; US$1 billion each year between 2015 and 2020; and US$15 to 20 billion annually from 2040 to 2050. Upward demand for biomass is also expected to add to farm income. Other studies and groups are less enthusiastic, raising concerns that opportunities could be regional, that the carbon price will not make up for increases in input prices partly caused by the cap-and-trade system, and that if forestry offsets are more valuable than agricultural offsets, farmers might convert cropland to forests.

One major distinction to be made between agricultural mitigation and mitigation in other sectors (such as industry and transport) is the level of co-benefits that agricultural mitigation can provide. Actions that reduce emissions from manure can also protect water quality through decreased leaching of nutrients and pathogens (Smith *et al.*, 2007). Many practices aimed at increasing carbon sequestration also benefit soil quality, resulting in increased productivity of the land, hence greater food security (Scherr & Sthapit, 2009). An IISD analysis of zero-till for a small watershed in Southern Manitoba revealed the total public benefits of converting to zero-till would be $80.34 per hectare per year, made up of improved water quality through reduced phosphorous loading ($13.48/ha), decreased sediment load ($65.06/ha) and GHG sequestration ($1.80/ha) (McCandless *et al.*, 2008). The carbon value of $1.80/ha was based on a carbon price of $6 per tonne, the rate at which Canadian credits were trading on the CCX at the time. The public benefits of zero-till in this instance are significant: only 2 per cent of the total public benefits come from carbon sequestration and there is considerable potential to use the carbon financing to achieve other sustainable

[7] The average price of carbon on the CCX was taken from Hamilton *et al.*, 2009.

development goals. Another consideration is that the cost of agricultural mitigation was expected to decline as markets emerge for other ecosystem services. A challenge in predicting the impact of actions in the agricultural sector on mitigation is a lack of information about the costs of agricultural credits. Supply curves for agricultural mitigation in Canada have not been developed. Interviewees suggested that the cost structure of Canadian credits is higher than other developed and developing countries due to Canadian efficiency and adjusting to lower subsidies, but this can only be ascertained with an analysis of the likely supply of credits generated under various policy scenarios.

All experts interviewed stated that access to carbon markets is important for Canadian farmers and the system should be fair and transparent. The design of the Canadian policy framework will affect farmers in many ways; for example, exemptions for the oil sands could reduce demand for agricultural offsets. A number of critical issues and challenges for the agricultural sector in the development of a Canadian emissions trading system were noted by experts—including additionality, permanence, measurement, credit for early action, ownership of credits and linking with other systems—and are discussed below.

Ensuring integrity of credits from agricultural projects – To be eligible to receive credits through Canada's proposed Offset System, an overview of which was released in June 2009, projects must achieve real, incremental, quantifiable, verifiable and unique reductions of GHGs (Environment Canada, 2009c). The proposed system uses a regulatory surplus test whereby reductions/removals must exceed the baseline scenario in the project quantification protocol. This is a standardized approach where project proponents use protocols that are approved by Environment Canada.

Proving additionality—or proving that emission reductions are additional to business as usual or go beyond the baseline defined for the project type—is a concern. Some interview respondents believed proving additionality would entail unnecessary constraints for producers; but other respondents felt that robust criteria are needed to preserve the integrity of the system. Some felt the current guidelines would not achieve real reductions, nor stand up to international scrutiny.

Alberta is a case in point. Questions are being raised about offsets in Alberta's emission trading scheme—including by Alberta's auditor general. Concerns include the legitimacy of some of the agricultural credits (for example, lack of additionality and potential double counting), if the market will help combat climate change and how it affects consumers. Provincial rules dictate that projects are to demonstrate additionality through a regulatory surplus test, but anecdotal evidence suggests that farmers are being paid for continuing the same practices they have used for years (Fekete, 2009).

Similar concerns have been raised about the additionality of no- or reduced-till credits on the CCX. Natural Resources Defense Council and other environmental non-governmental organizations (NGOs) argued that farmers could receive CCX offset credits for no-till agriculture even if they had practiced it for years (Bryk, 2006). The CCX maintains that early action by proactive farmers should be rewarded and not penalized. CCX also argues that excluding farmers who have been practicing no-till agriculture can create perverse incentives because these farmers might stop no-till practices and take them up at a later time to earn offset revenues. Critics note that if these no-till credits enter a cap-and-trade system, no real emission reductions are achieved because the buyer of the credit will continue to emit (Stockholm Environment Institute, 2010).

Canadian farmers who acted early to reduce emissions are concerned they will not be able to benefit from the sale of offsets in the federal system—in that the reductions will not be additional, but business as usual. Farmers are asking for "credit for early action," similar to Alberta's system that allows farmers to get credit for reduced tillage practices back to 2002. The incremental criteria for the proposed federal system indicates that projects must have started on or after January 1, 2006, except for projects that are susceptible to easy reversal (such as reduced and no-till projects in agriculture), for which the minister may specify a normalized baseline in the Offset System Quantification Protocol that all projects can utilize regardless of start date. This is to ensure that farmers who were early adopters of no-till practices are not penalized.

Permanence – Offset credits must represent the permanent reduction of GHGs from the atmosphere. As such, rules are needed to address the potential for non-permanence or reversal of GHG removals specific to sinks projects such as no-till, grazing management, afforestation/ reforestation, and avoided deforestation. In Canada's proposed system, project proponents that are issued offset credits for sinks projects will have an obligation to address any reversals of carbon by maintaining the removals for a liability period that extends 25 years after the last offset credit is issued for the project. Proponents must confirm the maintenance of the carbon storage over the liability period by submitting certification statements to attest that no reversal has taken place. If a reversal occurs, the proponent will be required to replace all previously issued sinks credits with an equivalent number of credits that are in compliance. In addition, to mitigate the risk that a sink proponent will be unable to replace offset credits if a reversal occurs (for example, because of bankruptcy), proponents must apply a set discount factor to the GHG removals achieved from the project. Given the relatively slow accumulation of carbon in sinks, agricultural sink projects will be allowed to register for up to three consecutive registration periods (up to 24 years), while forestry sink projects will be allowed to register for up to five consecutive periods (up to 40 years).

In interviews, agricultural producer representatives were not pleased with the 25-year liability period, viewing it as unreasonably strict and expressing that the risk of reversals should not be the sole responsibility of the farmer. Many interviewees indicated that Alberta's buffer reserve, which uses an assurance factor to address the issue of permanence, is the most suitable option to guard against reversal. Albertan soil carbon credits are permanent with this assurance factor, which includes a built-in discount to account for future losses, and risk-sharing between farmers and government. The assurance factor for the tillage protocol accounts for the average risk of reversal across all farms within Alberta. It is a conservative estimate based on expert opinion and risk assessment of frequency of reversal of tillage practices. The Alberta government backs the liability of a reversal of soil carbon and shaves off carbon for every tonne created into a reverse-holdback. The VCS also uses a buffer (insurance) approach that creates permanent credits with no buyer or seller liability. A project risk assessment determines the buffer withholding percentage (between 10 and 60 per cent), which is placed in a shared VCS buffer pool. VCS projects have a minimum project life of 20 years, and a maximum 100-year crediting period.

Ownership of credits – Canadian agricultural policy has encouraged GHG emission reductions at the farm level, which has implications for ownership of offset credits. Interviewees expressed concern about the lack of clarity on ownership of credits, and who will be liable for any reversals of carbon storage. For example, the National Farm Stewardship Program's (NFSP) Environmental Farm Planning initiative, which is delivered in partnership with the provinces, devises environmental strategies for individual farms that include practices to mitigate GHG emissions. Ownership of carbon credits generated through NFSP-funded practices is unclear, which has implications for additionality. Emission reductions and subsequent credits created with funding from the NFSP could qualify as incremental under the federal definition, but would not be additional because their creation was spurred by the NFSP money, not the prospect of money from selling the carbon credits. In September 2009 the Manitoba government announced that carbon credits created through environmental farm plans funded partially through the federal/provincial Growing Forward agricultural policy framework would be owned by the province in proportion to its project contributions. If the farm program funded 70 percent of a project, the government would own 70 percent of the credits for the duration of the project. The province plans to retire the credits.

Limitations on credits – Many GHG accords restrict the use of offsets by setting limits on how many could be used to meet targets. Examples include:

- Limits on the amount of offset credits that can be used to meet targets: In the proposed WCI system, offsets can only be used to satisfy 49 per cent of an entity's mandated reduction (WCI, 2008). The European Union Emission Trading System (EU ETS) also sets limits on how many offsets member states can use.[8]
- Limits on geographic location: Alberta only allows offsets from projects based in the province. The proposed Canadian system allows firms to use clean development mechanism (CDM) credits from developing countries to a limit of 10 per cent of a firm's total target and will consider recognizing reductions originating in the United States if cross-border emissions trading occurs. The proposed U.S. system allows capped entities to utilize up to 2 billion tonnes of domestic and international offset credits each year (the government is expected to issue 5 billion tonnes of allowances). Initially, 75 per cent can be derived from domestic offsets and 25 per cent from international offsets.
- Limits on the types of projects: The EU ETS allows credits from CDM and joint implementation projects, except those from nuclear facilities and LULUCF activities. Credits from CDM forest projects are not accepted for compliance with proposed Canadian regulations; the temporary nature of sinks credits is considered to add complexity to the domestic system without significantly reducing compliance costs for regulated industry.

The Offset Quality Initiative (2008) and others make a case for allowing full unrestricted use of offsets to encourage cost-effective emissions reductions. However, regional North American accords and proposed domestic legislation in Canada suggest reluctance on the part of policy-makers to grant full market access. Complaints about the integrity of credits from overseas projects and arguments that the CDM is a "wealth transfer" have shaped the public debate (see for example, Wara & Victor, 2008). Farming groups suggest that restrictions on the use of offsets, such as the WCI restriction, could result in a low use of agricultural credits, and there are fears of reduced demand for Canadian agricultural credits because of competition from low-cost credits from developing countries.

Measurement, reporting and verification (MRV) – Canada is considered to be a leader in GHG reporting in the area of agricultural emissions and removals. The decision to account for cropland under Article 3.4 of the Kyoto Protocol has led Canada to develop robust MRV frameworks for cropland. Research in Canada demonstrates that it is possible to measure changes in the carbon stock of agricultural soils in a transparent, reliable, and verifiable way. The experience with domestic conservation agriculture programs and growing experience in the development of offset protocols means that Canada is a leader in these areas.

[8] See European Commission, 2007.

The opinions of expert interviewees on MRV were somewhat mixed. Most indicated that more research is required to understand the dynamics of GHG mitigation and sequestration. Some respondents felt that the science has reached the point where agricultural mitigation can be implemented reliably and measured on a broad scale. However, the science community felt that gaps in understanding are significant, noting that areas of greatest research need are grazing lands, haylands and crop rotations. One interviewee noted a concern that some protocols are based on too few replications. For example, emerging evidence indicates that the spring fertilizer application protocol under development in Alberta may not be accurate. The theory is that most N_2O is released during oxidation of ammonia to nitrites and nitrates, so the timing of fertilizer applications is less important than the specific nitrogen compounds applied. The major risk with inadequate protocols is that project proponents could be liable for additional reductions if protocols are found to overestimate reductions.

There was also caution that protocols should be based on sound local science, and that geographic variability of mitigation activities needs to be studied extensively. Theoretically, Alberta's tillage protocol could be used across Canada, but work is needed for soil zones outside of the Prairies with respect to the assurance factor that addresses the issue of permanence. The Ontario provincial government is evaluating a draft protocol for tillage system management that draws on Alberta's protocol, but is revised for the province's different carbon sequestration conditions.

Linkages with other systems – One significant challenge is potential linkages between the various offsets systems, in that agricultural credits acceptable in one system might not meet the standards of another. Differences in the treatment of sinks offsets could affect efforts to link trading schemes in the future; for example, the EU ETS does not include sinks offsets. The federal government is interested in harmonizing the Canadian emissions trading system with or linking to the U.S. domestic system to ensure that unnecessary barriers are not put in place for Canadian producers. But characteristics of the proposed federal system—including the intensity target and the option to pay $15 per tonne CO_2e into a technology fund—could limit linking options. Other systems that do not have an intensity target or similar price cap might not be interested in linking with the Canadian system.

An un-linked Canadian system offers greater flexibility in policy design, such as no limits on offsets and encouraging Canadian projects; but larger markets are good for global efficiency. Some interviewees indicated that Canadian agricultural offset providers will not necessarily benefit from the larger markets. Many soil regions in warmer climates support crops (such as trees) that grow at a much faster rate than in Canada; and these regions may have a competitive advantage in the supply of carbon sequestration offsets.

Need for awareness and information – While a number of farmers in Alberta have benefited from the sale of offset credits and producer organizations are increasingly active and informed on the carbon market, there is a need for more information. One interviewee noted that the most common question from farmers is "what will it cost me?" Many farmers think that a post-2012 agreement and more stringent emission reduction targets in Canada will result in opportunities for grain farmers but extra costs for livestock farmers. Farmers have changed their tillage practices, but this was based on economics, rather than a desire to reduce emissions. There is need to understand what happens on farms, and to provide information to farmers to lower transaction costs and encourage participation in the carbon market. Agri-environmental programming such as the NFSP could help to fill this need and enhance the ability of Canadian agricultural producers to act on opportunities in the carbon market.

5.0 Competitiveness

Generally, countries that will be more favourably or less adversely affected by climate change will gain a competitive edge for their agriculture sectors. Warmer temperatures, longer growing seasons and elevated CO_2 concentrations are generally expected to benefit agriculture in Canada, but these benefits could be counteracted by such factors such as reduced soil moisture, increased frequency of extreme climate events, soil degradation and pests (Lemmen & Warren, 2004). Some regions will likely benefit and others will lose, depending on regional variations that result from the nature of climate change, the characteristics of farming systems and the response of different groups. North American agriculture plays a significant role in world food production, and since Canada is generally expected to fare better than many other countries with respect to the impacts of climate change, international markets may favour the Canadian economy (Brklacich *et al.*, 1998). Research is needed to better understand how climate change (such as the effects of changing temperature and precipitation patterns) will impact Canadian agricultural production.

Canada's land base provides the sector with a tremendous advantage for diversification, and Canadian capacity for innovation could provide opportunity in the move to a low-carbon world. For example, Canada was previously only moderately competitive in oilseeds, but years of innovation in this area mean that Canada is now the world's leading canola exporter with over 70 per cent of the global export market. Innovation in the areas of soil science and renewable energy, if sufficiently promoted, could potentially propel Canada to a similar position in regard to non-food agricultural commodities.

The competitiveness of the Canadian agricultural industry could be affected by a post-2012 climate change regime that has stringent emission reduction targets for developed countries. Areas of concern discussed below include access to global markets, the U.S. system, low-cost offsets from developing countries and international trade rules.

Access to global markets – A concern is the impact of Canadian regulations on farmers who would face higher input costs, potentially limiting their ability to compete in world markets. Another issue for Canadian agricultural exporters is potential tariffs or barriers to trade that are a reaction to Canadian climate policy. For example, a country such as Japan that is an importer of Canadian pork may chose to put up barriers because Canada has a less robust GHG reduction target or is not acting sufficiently to meet its emission reduction target.

The U.S. system – The proposed Kerry-Lieberman bill (or the American Power Act), released in May 2010, includes an agricultural and forestry offsets program for up to 2 billion tonnes of offsets annually, of which 75 per cent must be from domestic sources. If domestic offsets fall short of the allowable limit, the ceiling on international offsets would be increased up to a maximum level of 1 billion tonnes per year. The USDA has primary authority over domestic agriculture projects and would make decisions based on the recommendations of an independent advisory committee on offset project eligibility, scientific uncertainty, quantification methodologies and related issues. The list of potential practices eligible as offsets includes altered tillage, cover cropping, nitrogen fertilization efficiency, farming methods used on certified organic farms, pasture-based livestock systems, livestock management, manure management, crop rotations and increasing carbon sequestration in soils. The Waxman-Markey bill, introduced in the House of Representatives in 2009, has a similar agriculture and forestry offset program. Agricultural soil sequestration is expected to be a multibillion dollar revenue source for farmers and a key source of offsets.

The Kerry-Lieberman bill also establishes a Carbon Conservation Program and fund designed to encourage GHG reductions and sequestration activities for landowners not eligible for the offset program. This will provide incentive for early adopters of conservation practices (including no-till agricultural practices) (Kerry, 2010).

Both U.S. bills include a border carbon adjustment to address competitiveness concerns that other countries are not taking comparable actions. This issue needs to be tracked, but as GHG emissions under the agriculture and forestry sectors are not regulated under the proposed U.S. cap-and-trade scheme, there is no significant concern that trade barriers would be erected in these sectors.

CDM offsets from developing countries – There are concerns that the Canadian agricultural sector could face competition from lower-cost offsets from developing countries. The proposed Canadian regulations limit the use of CDM credits to 10 per cent of each firm's regulatory obligation, and do not allow sinks projects. This could be a reaction to complaints about a wealth transfer to trade competitors (especially China); but the carbon market is intended to stimulate private sector investment and financing in developing countries, and such financing for developing countries is consistent with the Copenhagen Accord. There are also broader reasons to encourage the purchase of offsets from soil carbon sequestration projects in developing countries. These projects could offer significant economic and social co-benefits, and provide support for developing nations in their calls for increased participation in the carbon market. As well, Canadian firms might need access to international credits to meet stringent reduction targets, which could lead to a tight supply of offsets both domestically and internationally, and a price spike when compliance buying increases.

International trade policy – Canadian policies designed to reduce GHG emissions in the agriculture sector and enhance the role of agriculture in GHG mitigation could have trade implications. The International Centre for Trade and Sustainable Development and the International Food and Agricultural Trade Policy Council examined the impacts of domestic policies in the context of World Trade Organization (WTO) disciplines. The impact of policies on the competitiveness position of agriculture is complex, but rewarding beneficial mitigation in the agriculture sector is possible and likely. Governments could combine best practice promotion with the tailoring of existing subsidy systems to encourage change. Subsidies could be given for such practices as minimum tillage or co-generation of on-farm bioenergy. Conservation payments could incorporate incentives for carbon sequestration. These policies could be challenged by foreign competitors, but if they are part of a comprehensive environmental program they would appear to be consistent with trade rules (Blandford & Josling, 2009).

Blandford and Josling (2009) explain that the most likely area of conflict with WTO rules relates to subsidies. There is a lack of agreement on whether biofuels are covered by rules relating to agricultural products or whether they are industrial products and covered by other rules. If biofuel subsidies are counted as agricultural subsidies, the issue arises as to whether they should be notified as trade-distorting or trade neutral. To qualify as the latter, care needs to be taken to ensure that climate change subsidies are limited to the extra costs incurred by farmers to meet environmental standards. In regard to offsets under a cap-and-trade system, it is not clear if funds from the sale of offsets from agricultural carbon sequestration activities would be considered a subsidy. The WTO defines a subsidy as a financial benefit that comes from a governmental or public entity; whether leaving the operation of the carbon market to the private sector makes the offset mechanism less of a subsidy remains to be resolved. Domestic climate change policy to encourage emission reductions in the agriculture sector could be constrained by international trade obligations, but problems could be avoided by carefully crafting regulations and policies (Blandford & Josling, 2009).

6.0 Key issues for Canadian agriculture

Canadian domestic policy will be influenced by the international climate change regime—through both international emission reduction commitments and mechanisms to assist in reaching these targets such as the CDM—as well as domestic policies in other countries. Canada needs efficient and effective policies to reduce emissions that follow best practices, capitalize on mechanisms in an international agreement, and avoid interference with global development and market access. In addition, federal mitigation policy in the agriculture sector should be based on sound research, contribute to real reductions, minimize transaction costs and recognize the links between adaptation and mitigation in the agricultural sector.

Critical issues for the Canadian agricultural sector are summarized below:

- Achieving emission reduction potential in the Canadian agricultural sector will require policies to encourage carbon soil sequestration and reductions in the livestock sector. A national emission trading system could stimulate beneficial management practices for carbon sinks and emission reductions by offering economic return through the sale of offsets. An effective regulatory policy, including a cap-and-trade system, is needed to stimulate reductions in the agricultural sector.
- The design of a national emissions trading system will impact the agricultural sector. Agricultural offsets are likely to be included and would require robust standards and protocols to ensure the integrity of credits, highlighting the need for research and development programs. Leaving the operation of the carbon market to the private sector might lessen the perception that offset mechanisms are a subsidy under WTO rules. Options to address the 25-year liability issue, a concern of many in the agricultural sector, include the VCS and Alberta protocols that create permanent credits and thus no buyer or seller liability, and the establishment of an insurance or risk-sharing scheme by the Canadian private sector.
- The Canadian system should allow access to international credits from developing countries in the LULUCF sector through the CDM or other market mechanisms that may be agreed to under a new international climate change agreement. This will encourage private sector financial flows to developing countries in sectors that generate significant co-benefits. International agreement on stringent targets should generate sufficient demand for both Canadian and international agricultural offsets. Offsets should be constrained through robust standards for projects, not by having lax standards and then limiting through arbitrary caps (such as allowing no offsets from CDM projects in the LULUCF sector).

- Linkages with the American system are an important consideration in Canadian policy design, but foremost for the agricultural sector should be the development of effective and efficient policies that achieve Canadian goals. The impact of the technology fund and an emissions-intensity target for oil sands producers on agricultural offsets needs study. The fund and intensity target potentially could limit options for linking and lessen demand for agricultural offsets, but this requires further analysis.
- The bioenergy sector has considerable potential in Canada, especially for cellulosic ethanol, and can provide economic return to the Canadian agricultural sector. Well-designed policy should consider impacts of food security as well as cost effectiveness and promote those biofuels that provide the greatest GHG reductions at the lowest cost.
- The design of Canadian policy to encourage emission reductions in the agricultural sector will need to account for WTO rules and potential conflicts. As long as Canadian policies combine best practice promotion with subsidy systems that encourage positive change, they should be consistent with WTO rules. The most likely area of conflict is subsidies for biofuels, where the interaction between biofuel subsidies and other emission reduction incentives could create a trade-distorting impact. Careful policy design is needed to avoid interference with global market access and development.
- Support for research and development and awareness-raising for farmers is important. Some gaps in the research identified in this paper include: biofuels life-cycle assessment, specific climate change impacts on Canadian agriculture to identify opportunities and threats to competitiveness, impacts of linked emission trading systems on the agricultural sector, and the economic impacts of GHG regulations on farmers.

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Appendix: List of persons interviewed

- Daniel Bernier, Union des Producteurs Agricoles
- Carl Bérubé, Clubs Conseils en Agroenvironnement
- Stu Clark, Canadian Foodgrains Bank
- Don Flaten, University of Manitoba
- Nancy Lease, Quebec Ministry of Agriculture, Fisheries and Food
- Daniel Martino, Carbosur
- Don McCabe, Soil Conservation Council of Canada
- Brian McConkey, Agriculture and Agri-food Canada
- Calvin Mulligan, Farm Credit Corporation
- Nathaniel Newlands, Agriculture and Agri-food Canada
- Marco Rondon, International Development Research Centre
- Esther Salvano, Manitoba Agriculture, Food and Rural Affairs
- John Stone, International Development Research Centre
- Tony Szumigalski, Manitoba Agriculture, Food and Rural Affairs
- Laura Telford, Canadian Organic Growers
- Ian Wishart, Keystone Agricultural Producers
- André Vézina, Bio Terre