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Feeding Our Great Cities: Climate Change and Opportunities for Agriculture in Eastern Canada and the Northeastern US

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CLIMATE CHANGE

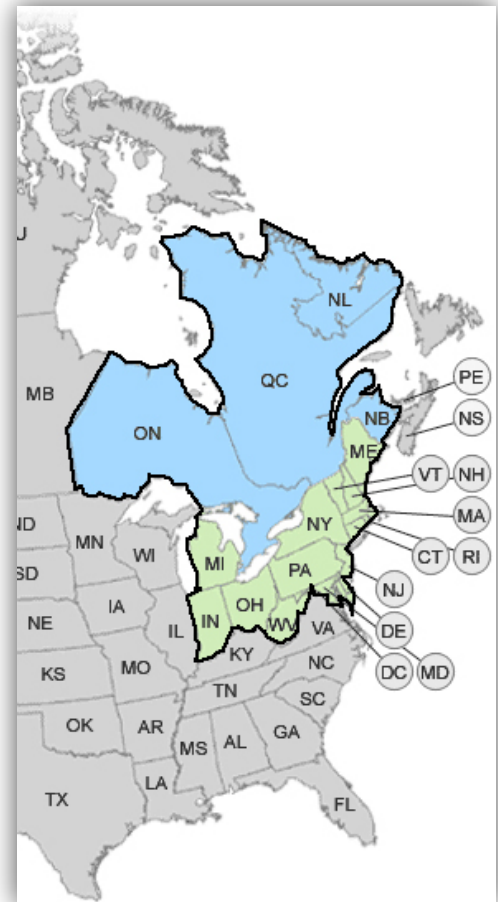
The climate is changing—it is getting warmer, and the evidence is all around us. Springs are arriving earlier, summers are longer and hotter, and winter temperatures are warmer. In the Northeastern US, lilacs, grapes and apples are blooming earlier,¹ and plant hardiness zones have shifted northward.² The average annual temperature in the Northeast US has risen 1.0°C (1.8°F) over the last 100 years. Winter temperatures have risen even faster, as much as 2.4°C (4.4°F) in the last 30 years. Consistent with a warmer and moister atmosphere, we are also observing more severe weather—storms, hail, wind—and shifts in precipitation patterns.³ The decade 2000-2009 was the hottest recorded ever,⁴ and the trajectory is set for the average global temperature to continue to warm into the future—1.8° to 4.0°C (3.2 to 7.2°F) by 2100 with smaller increases near the equator and greater at the poles. With its more northerly latitude, the increase across Canada is expected to be 5° to 8°C (9° to 14.4°F).^{5,6}

The anticipated increases in temperature along with changes in precipitation patterns and greater variability in the weather have profound implications for agriculture and the security of our food supply. Although Eastern Canada and the Northeastern US will face challenges because of climate change, this region will also be presented with enormous opportunities. With adequate precipitation and overall warmer conditions,⁷ a more intense and diverse agriculture is on the horizon if we adapt to changes and begin to plan strategically for the future.

To set the stage and begin to lay the groundwork for a warmer future, a group of Canadian and US public and private agricultural sector leaders have engaged in a dialogue to catalyze and facilitate multi-disciplinary and multi-institutional research collaborations among universities, government agencies and the private sector. These dialogues were aimed at helping agriculture adapt to a warming climate between now and 2025 and to also lay the foundation for the years beyond when the challenges will greatly intensify. The respective organizations have the capacity to respond to the challenge before us, but partnerships are essential to help ensure that we leverage our collective ability to contribute to the needs of the region.

AGRICULTURE'S ECONOMIC VITALITY

Agriculture in the region is a major industry. Across the 15 states in the NE US (see map) there are nearly 374,000 farms comprising 26.4 million hectares (64.5 million acres) of farmland generating a total value of agricultural products of over \$38 billion per year.⁸ In Eastern Canada, the six provinces have 100,000 farms with 10 million hectares (25 million acres) of cropland and total gross farm receipts of almost \$20 billion.⁹ Agriculture in the region is diverse including extensive vegetable production, dairy and related field crops, ornamentals and fruit. In aggregate the annual farm-gate value across the region is approximately \$58 billion. Agriculture is a major economic engine, employing hundreds of thousands of people, helping maintain the viability of rural landscapes, preserving open space and the environment, and helping to feed our great cities. The economic impact is multiplied many times once the wholesale and retail sectors are added in. In New York City for example, over \$30 billion is spent annually on food.¹⁰ In Canada, sales for food manufacturers in Ontario and Quebec were \$32.0 and \$19.5 billion, respectively, in 2010.¹¹ A warming climate will bring change to agricultural and food systems locally, regionally and internationally and the impacts will not be uniform. Challenges faced in some regions may result in opportunities for others.



For example, changes in patterns of winter snowfall and spring snowmelt in the western US mountain ranges will likely reduce the availability of irrigation water for some agriculture in California—the source of 50% of fruit and a good portion of the vegetables for the US.¹² This will be further exacerbated by the intensifying competition for water resources between the urban and agricultural sectors. In Alberta, the Peyto glacier, one of many glaciers feeding small rivers flowing out of the Rocky Mountains used to irrigate crops, has lost 70% of its mass during the past few decades.⁶ Increasing temperatures in California are of concern to the future of the grape and wine industry but warmer winters and a longer growing season open up opportunities to grow a wider range of high value, less cold tolerant varieties in the Northeastern US and Eastern Canada. These examples depict challenges to agriculture in other regions of North America, but at the same time opportunities for agriculture in this region.

Weather vs. Climate: What is the Difference?

Weather is the atmospheric condition (e.g., temperature, precipitation, humidity, wind) at any given time or place. In most places, weather is highly variable and can change from hour to hour, day to day, and season to season. In contrast, climate refers to long-term “weather averages” such as the average number of heat waves per year over several decades. The World Meteorological Organization considers the statistical mean and variability of factors such as temperature and precipitation over a period of three decades to evaluate climate trends, but climate can refer to other periods of time, sometimes thousands of years, depending on the purpose.

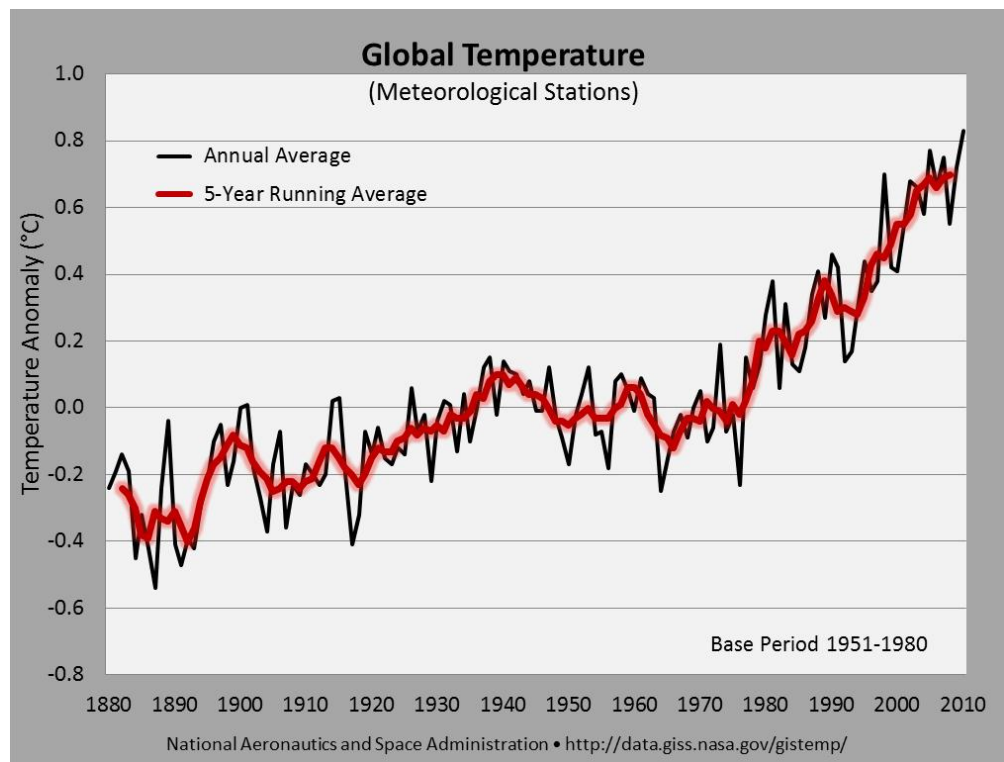
Figure on page 3 reflects global temperature trends 1880-2010

Strategic planning to adapt to the changes is critically important if we want the agricultural sector to thrive and help meet the food needs of Boston, Montreal, New York, Philadelphia, Quebec, Toronto and the other cities and rural areas in the region—116 million people in total which is 74% of the Canadian and 30% of the US population.

THE CHALLENGE

Put simply, agriculture will no longer be business as usual. More uncertainty and risk will become the norm. Growing seasons in Eastern Canada and the Northeastern US will become longer and warmer with a greater frequency of high summer temperatures putting stress on plants and animals, and warmer temperatures during the winter. The latter will allow more insect and weed pests to survive year to year.⁶ The greater variability in weather is expected to result in more crop flooding interspersed with more periods of drought—in other words, more extreme weather. All of this poses challenges for agriculture.

What was witnessed in 2011 may be typical of upcoming years—cool, wet springs followed by hot, dry summers. The cool wet spring resulted in late planting of many crops, some so late they had to be abandoned or replaced by alternative crops of lesser value. Some planted fields were drowned out. Cutting, drying and harvesting of hay crops was especially challenging. In addition, wet, cool conditions fostered plant diseases and often delayed herbicide and fertilizer applications. The hot, dry conditions that followed can reduce crop yields. Each day over 30°C (86°F) results in a 2% loss in corn grain yield. Tomato fruit yield drops when temperatures exceed 30°C (86°F) and milk production by dairy cows decreases with excessive heat.¹³



THE OPPORTUNITY

Despite these challenges there are enormous opportunities for this region. Because of adequate water and longer growing seasons, there is an opportunity to grow new crops and new varieties. For example, winter canola, historically difficult to grow because of cold winter temperatures, now has the potential to be a new and economically important crop for use as food-grade cooking oil. Longer-season varieties of field corn have the potential for higher yields. Double cropping (the practice of growing consecutive crops in one year) will become more viable and offer greater economic returns to farmers. Private and public plant breeding programs have an opportunity to develop new crop

varieties that are more tolerant of heat, drought, and pests and can take advantage of elevated levels of CO₂—the changing conditions we expect to see in the region.¹⁴

Taking advantage of the changes makes good business sense for agriculture, but providing the answers to a long list of rapidly evolving questions will be critically important. For agricultural producers, timing of investments will be everything. With increasing variability in precipitation, when should farmers invest in irrigation equipment or install more field drainage tile to address excess water? With rising summer temperatures, when should dairy farmers invest in improved ventilation or cooling systems? With warmer winter temperatures, when should fruit growers switch to new varieties that are less tolerant of extreme winter cold? With longer seasons, what is the optimal planting date as well as expected date of harvest? These questions need to be answered from a multitude of perspectives—not just agronomic and economic, but also social and environmental.

The evidence for climate change

The climate is warming due to human activity, primarily the burning of fossil fuels that releases enormous amounts of greenhouse gases into the atmosphere. The evidence:

- Atmospheric CO₂ has increased from 270 ppm to 390 ppm today, the highest in 650,000 years.
- Global temperatures have increased since the late 1800's and most of this increase has occurred since the 1970's. The ten warmest years on record have occurred in the past 12 years.
- Sea levels are rising—in part due to glacial ice melting and in part to expansion of seawater as it warms. The rate of sea level rise in the last decade is nearly double that of the last century.
- Glaciers are retreating up-slope almost everywhere and Arctic sea ice has declined rapidly over the last several decades.
- Since the beginning of the industrial revolution, the acidity of ocean surface waters has increased by about 30% as CO₂ emitted by human activity is absorbed into the oceans.
- Wild plants flower in the Northeast about 12 days earlier than a century ago and birds migrate north earlier as well.

Along with adapting to the changes, agriculture also has the opportunity to mitigate climate change through practices such as improved energy use efficiencies, conversion of waste streams to energy, improved fertilizer and manure management, increasing soil organic matter (carbon) through reduced tillage and cover cropping, and perhaps even application of biochar as a soil amendment. Many of these mitigation practices make good business sense, offering benefits on-farm as well as through the entire food system.

REGIONAL EXPANSION

On balance—weighing the challenges and opportunities—with careful strategic planning and investment, agriculture in the region is well positioned to expand and diversify. As other regions of North America and around the globe face serious challenges, it opens up new opportunities for the Northeastern US and the Eastern Canada with its abundant water and longer growing seasons. Being home to many great cities and over 116 million people, the region also has unparalleled markets that

could be supplied with more regionally produced fresh market and processed products—meeting the demand for more locally produced food and helping to address food security concerns. The region is positioned to meet the demand for a lower carbon footprint food supply, resulting in new job creation and economic development opportunities.

It is an understatement to say that the rate at which change is occurring is a concern. But the time to act is now. The following recommendations for action originate from the joint US-Canadian dialogues. Our focus is on near-term actions to be taken between now and 2025 that will help ensure that the region is able to take full advantage of the opportunities now emerging. To succeed we need to modify or redirect agricultural research and outreach priorities in the public and private sector to keep pace with the rapidly changing conditions. We also need to lay the groundwork for the longer-term—the decades beyond 2025 when the challenges will intensify even more.

- Partnerships are critical: The Canadian-US collaboration is intended to be a working model of how countries and organizations from the public and private sector can partner to effectively address the challenges and opportunities associated with climate change.
- Farm-level impact of climate change needs to be documented to identify trends and new research questions, helping to set priorities.
- Improved on-farm water management is a high priority. With fluctuations ranging from drought to flooding, improvements in drainage and irrigation technologies are needed. Existing proven technologies need to be implemented and new technologies explored.
- New crops and cropping systems best adapted to the emerging conditions need to be developed and deployed.
- Plant and animal production systems need to be recoupled.
- New and better decision-making tools based on sound economics are needed for farmers. For example, farmers will need to know when it is economically justified to install more drainage tile or irrigation equipment.
- Communication strategies that convey the challenges and opportunities of climate change need to be enhanced and directed at the agricultural community as well as decision and policy makers. Producers need to be kept up-to-date on the latest adaptive tools to help their operations remain competitive and viable.
- An increase in public sector investment in climate change related research and education is imperative.

CONCLUSION

We face one of the greatest challenges ever. A warming climate is a global issue, affecting all people and the life support systems they depend on—natural and human managed. Agriculture has the opportunity to help mitigate the challenge as well as adapt to the changes that will occur. Agriculture in Eastern Canada and the Northeastern US is ideally positioned to take advantage of the near-term changes in climate—adequate water resources and longer and warmer growing seasons, allowing for an expansion and diversification of the agricultural commodities grown. Add to this enormous and diverse markets, encompassing our many great cities and rural communities, and we have the basis for an expanded, more sustainable local food system. We also have the capacity to stay abreast of the change thanks to the research capacity at our universities and private sector institutions.

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At time of publication (September 2011) US and Canadian dollars were considered equal in value.