

# Agricultural Solutions to Climate Change:

## Findings from the Manitoba Agricultural Climate Initiative



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*The voice of  
Manitoba farmers*

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# Summary

In the coming decades, climate change is expected to bring profound changes to agriculture in Manitoba. To help farmers address this challenge, Keystone Agricultural Producers (KAP) created the Manitoba Agricultural Climate Initiative to:

1. Assess how climate change is likely to change agricultural production conditions in Manitoba;
2. Understand Manitoba farmers' priorities for managing these changes; and
3. Develop ideas on how government can support farmers' efforts to address these priorities — to mitigate and adapt to climate change.

This report is intended to be read by Manitoba farmers, to support their efforts to develop official KAP policies through KAP's democratic process. This report is also intended to be read by government officials, environmental organizations and the general public, to offer an agricultural perspective on the solutions to climate change.

To meet the first objective, KAP turned to the Prairie Climate Centre, a Winnipeg-based organization that makes the best available climate science accessible to decision makers and the public. The Prairie Climate Centre states that by the 2080s, if greenhouse gas emissions continue to rise on a global scale, Manitoba's summer temperatures and precipitation are expected to resemble conditions in present-day Kansas and northern Texas.

This would mean a growing season that is a full month longer on average, which would present opportunities to introduce new crop varieties to Manitoba. But these benefits will be limited by the risks, which are expected to include:

- New pests;
- Drier summers with three times the number of days above 30°C;
- Wetter winters, springs, and falls; and
- More extreme and variable weather in a less stable climate.

Governments can help farmers deal with wetter springs and drier summers in many ways:

- Streamline water management regulations;
- Regulate sustainable tile drainage according to the best available evidence and approaches;
- Build off of success stories like the Bifrost Agricultural Sustainability Community Service Cooperative (BASIC) to maintain ditches and other water management infrastructure effectively;
- Use big data and hydrologic models to make smart investments in natural infrastructure on farmland (e.g. enhance grasslands and soil health for water retention);
- Update data on the irrigation capacity of our groundwater resources; and

- Explore opportunities for field-level systems that combine drainage and water storage.

To help address pressures from new pests, extreme heat, and variable weather, governments can:

- Examine how barns are designed for different cooling needs in Kansas and northern Texas, which Manitoba summers are expected to resemble in the coming decades;
- Invest in better weather forecasting to prepare for more variable and extreme weather;
- Improve early warning systems for migrating pests and make the approval process for new pest management tools more responsive to changing needs; and
- Ensure that carbon pricing, adaptation measures, and other climate change policies are not contradicting each other.

In addition to adapting to a changing climate, farmers will continue to play a big role in reducing and sequestering greenhouse gas emissions to slow climate change. To support farmers' efforts, governments can:

- Raise the biodiesel mandate to B5 and minimize transportation emissions by using locally grown feedstock;
- Support efforts to adopt 4R nutrient stewardship; and
- Gain Manitoba farmers access to offset markets so they can be credited for beneficial practices.

The adoption of zero and minimal tillage across the Prairies over the past several decades has helped farmers mitigate and adapt to climate change at the same time, by increasing carbon sequestration and water retention. To support the development of new practices and technologies that hold multiple climate benefits, governments can:

- Use the Centre for Sustainable Agriculture, as proposed in Manitoba's Climate and Green Plan, to strengthen existing farmer-driven innovation networks;
- Allow soil carbon sequestration to be credited in offset markets and use an insurance-style approach to deal with the risk of losing this carbon back into the atmosphere;
- Reexamine sequestration models to ensure they are not underestimating the potential to sequester additional carbon in Canadian agricultural soils; and
- Scale up outcomes for our land, water and climate by investing green infrastructure dollars and other relevant funds in the provincial GROW program.

Farmers care about climate change because they are on the front lines of it, dealing with challenging conditions every year. And they know that the next generation of farmers — their children and grandchildren — may face even tougher challenges as the climate continues to change.

Now, in partnership with governments, industry and our communities, Manitoba farmers are ready to take the next steps to mitigate and adapt to climate change.

## About KAP

Keystone Agricultural Producers (KAP) works to be the voice of Manitoba farmers on public policy issues. We work with governments, industry and stakeholders to ensure primary agricultural production in Manitoba remains profitable, sustainable and globally competitive.

KAP is funded and directed by our members, which include agricultural producers across our province and 25 organizations representing specific crop, livestock and specialty commodities.

KAP has a grassroots democratic structure. Members from 12 districts across rural Manitoba meet to discuss current issues in agriculture. They develop resolutions to address their concerns and take these resolutions to one of the three advisory council meetings held each year, or to our annual meeting. Commodity member groups can also put forward resolutions.

At these quarterly province-wide meetings, resolutions are debated by representatives from all districts and commodity groups. If passed, a resolution becomes official KAP policy. At this point, the executive team and board of directors, with support from KAP staff, take action on these policies.

## KAP on the Environment and Climate Change

Among the wide range of issues that KAP deals with, climate change and other environmental matters come up often. In 2017, for example, 44% of KAP resolutions introduced and passed by farmers were related to environmental and land use issues.<sup>1</sup>

In addition, KAP plays an important part in the Environmental Farm Plan process. For producers that choose to complete an Environmental Farm Plan for their farm, KAP coordinates the reviewers that verify the completion of these plans. Having a non-governmental organization coordinate the reviews gives farmers confidence that the process is fair and transparent. Completing an Environmental Farm Plan helps farmers identify the agri-environmental assets and risks of their operations, outline beneficial management practices to enhance the assets and reduce the risks, and access funding to implement these practices.

KAP is part of the Environmental Farm Plan Advisory Committee, along with watershed districts, Manitoba Agriculture, and commodity groups. This committee reviews the status of Environmental Farm Plan uptake and beneficial management practice funding and makes recommendations for improvements.

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<sup>1</sup> Keystone Agricultural Producers, 2018 Annual Meeting: General Manager's Report

KAP is a member of the 4R Nutrient Stewardship MOU implementation committee which includes members from Manitoba Agriculture, Manitoba Sustainable Development and Fertilizer Canada. This committee works to promote the efficient use of fertilizer to reduce nutrient runoff and greenhouse gas emissions.

Learn more at [kap.ca](http://kap.ca).

## Purpose of the Manitoba Agricultural Climate Initiative

In the coming decades, climate change is expected to bring profound changes to agriculture in Manitoba. Farmers are always adapting to changing conditions, but climate change is adding an additional layer of complexity to this challenge.

To help address this challenge, with funding support from the Province of Manitoba, KAP created the Manitoba Agricultural Climate Initiative. This project aimed to:

1. Assess how climate change is likely to change agricultural production conditions in Manitoba;
2. Understand Manitoba farmers' priorities for managing the risks and opportunities of climate change; and
3. Develop ideas on how the three levels of government can support farmers' efforts to address these priorities — to mitigate and adapt to climate change.

This report presents the Climate Initiative's findings on each of these points. The ideas presented in this report do not necessarily reflect the official positions of KAP. Instead, this report is intended to be read by Manitoba farmers, to support their efforts to develop KAP policies according to the democratic process described in the previous section. This report is also intended to be read by government officials, environmental organizations and the general public, to offer an agricultural perspective on the solutions to climate change.

With all levels of government bringing in major climate change policies over the next several years, now is a critical time for farmers to get involved and shape these policies, for the benefit of our agriculture and our climate.

## Mitigation versus Adaptation

When developing a climate change strategy, it is important to clarify whether we are talking about mitigating climate change or adapting to it.

### Mitigation

Mitigating climate change is about reducing greenhouse gas emissions — for example, by improving the fuel efficiency of our tractors, combines, and vehicles of all types throughout the economy. The more that society can reduce its emissions on a global scale, the greater chance we have at slowing climate change and keeping our climate relatively stable.<sup>2</sup>

### Adaptation

Adapting to climate change is about managing the risks and opportunities that climate change is already creating in our production conditions, and preparing for the changes that are likely to occur in the decades to come. For example, the federal government could invest in improved weather forecasting, which would help farmers deal with more variable weather brought about by climate change.

Society needs to do both — adapt to the changing climate and mitigate the rate of change. Some actions accomplish both priorities at the same time. For example, healthy soils store more water *and* more carbon.

This report starts by examining adaptation, then shifts the focus to mitigation, and finishes with a look at actions that accomplish both.

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<sup>2</sup> Intergovernmental Panel on Climate Change, 2014: [Summary for Policymakers](#), page 8.

## Consulting with the Experts

For the overall direction of this project, KAP drew ideas from the BC Agriculture & Food Climate Action Initiative which, since 2008, has been developing tools to “enhance agriculture’s ability to adapt to climate change.”<sup>3</sup>

To accomplish the first goal of this project, “assess how climate change is likely to change production conditions in Manitoba,” KAP worked with staff from the Prairie Climate Centre. The results are detailed in the next section.



*Photo: Agricultural students, young farmers and experienced farmers discussed solutions to climate change and other agricultural issues at KAP’s 2017 annual meeting.*

The risks and opportunities of climate change for agriculture will vary by region and commodity. To accomplish the second goal of the Climate Initiative, “understand Manitoba farmers’ priorities for managing the risks and opportunities of climate change,” we consulted broadly with farmers across Manitoba. KAP:

- Shared information and gathered input at KAP meetings with our local districts, quarterly Advisory Council, policy committees, board of directors, and our 2017 and 2018 annual meetings;

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<sup>3</sup> [BC Agriculture & Food Climate Action Initiative](#), 2018.



- Shared information and gathered input at other agricultural events, including commodity group meetings, Ag Days, the Pembina Valley Co-op annual meeting and more;
- Conducted an in-depth survey by phone and online with 21 active KAP members, farmers who regularly attend KAP meetings;<sup>4</sup>
- Worked with Probe Research to conduct two focus groups, drawing from a broad sample of our members, so we could hear from members that don't necessarily attend KAP meetings but are active farmers; and
- Shared information and engaged with farmers through interviews with media, including the Winnipeg Free Press, CBC.ca, CKLQ Brandon, CKDM Dauphin, Manitoba Cooperator, Western Producer, Farmscape.ca, RealAgriculture.com and Farmers' Voice.

These consultations helped KAP understand Manitoba farmers' priorities for managing the risks and opportunities of climate change. To help translate these priorities into supportive actions that government can take (the third goal of this project), KAP gathered data and analysis from a wide range of literature and researchers, many of which are cited throughout this report.

KAP has also used this work to produce a report on how carbon pricing has affected agriculture around the world, and a literature review of agricultural climate change adaptation work done in Canada, both of which have informed the development of this final report.

The following sections explain what we heard from farmers and outline a set of ideas on how governments can support farmers' priorities on climate change.

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<sup>4</sup> Keystone Agricultural Producers, 2017: [Survey - Protecting the Environment and Managing Challenging Growing Conditions](#)

# How Climate Change Will Affect Agriculture in Manitoba

Climate change is altering the risks and opportunities faced by farmers around the world. To assess what Manitoba farmers are likely to face in the decades to come, KAP looked to the Prairie Climate Centre.

The Prairie Climate Centre is a collaboration between the University of Winnipeg and the International Institute for Sustainable Development, created to make the best climate science available to the public, policy makers and local leaders.<sup>5</sup>

The Prairie Climate Centre has created a tool called the Prairie Climate Atlas, a collection of interactive maps that aim to answer the question 'how is the Prairie climate going to change in the coming decades?'

The atlas answers this question in part through the use of 'spatial analogues'.

By the 2020s, the atlas projects that Manitoba's summer temperatures and precipitation will look more like current day North Dakota, shown in yellow on the map in Figure 1. This is a modest change expected in a short number of years.

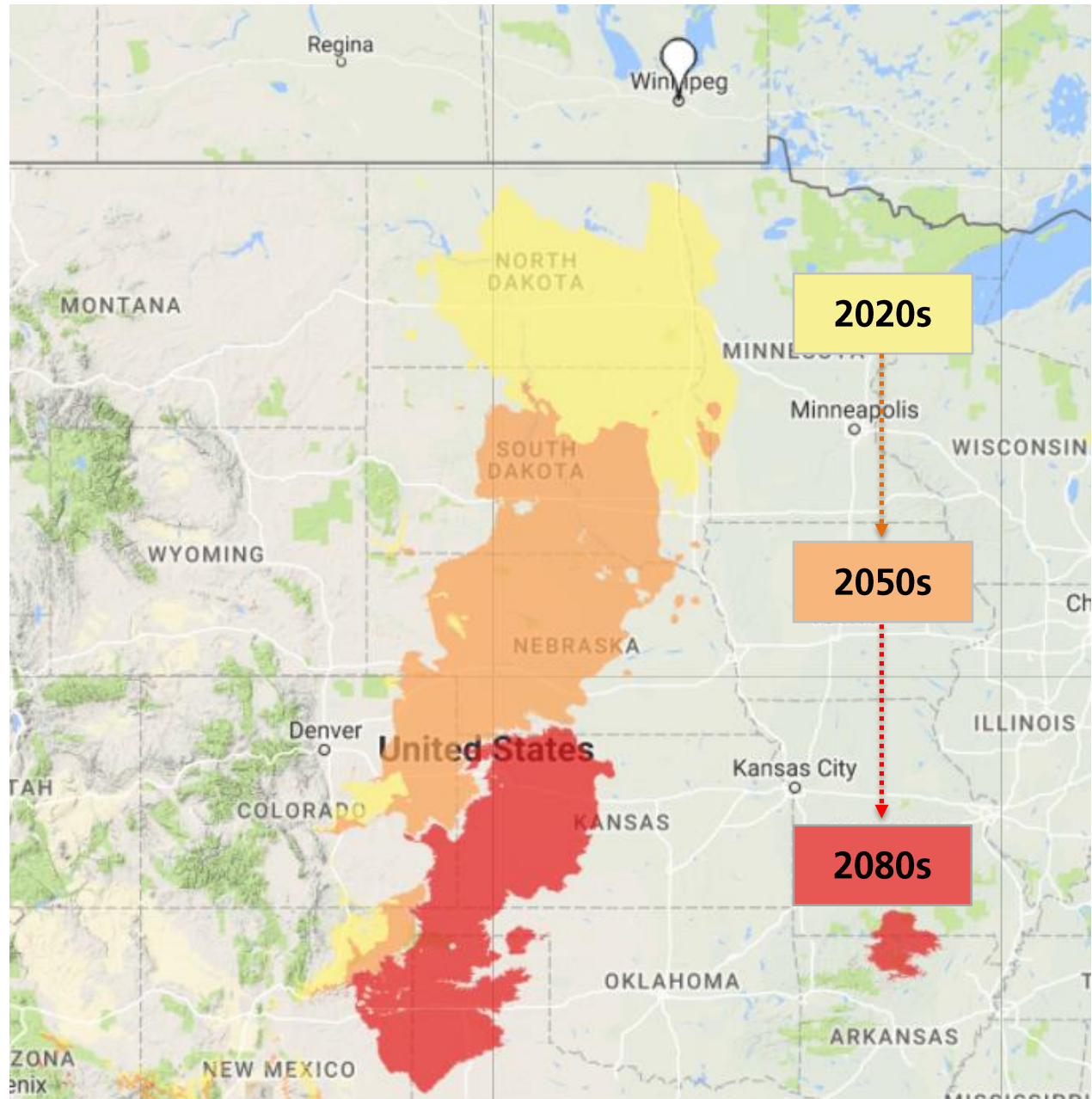
By the 2050s, if greenhouse gas emissions continue to rise on a global scale, the atlas forecasts that Manitoba's summers will look more like present-day South Dakota and Nebraska, shown in orange in Figure 1.

The red area in Figure 1 shows that by the 2080s, if emissions continue to rise, Manitoba's summer temperatures and precipitation will likely resemble summers in present-day Kansas and northern Texas.

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<sup>5</sup> [Prairie Climate Centre](#)

Figure 1: Spatial Analogues for Projected Changes to Southern Manitoba's Summer Climate. Source: Prairie Climate Centre.



For an interactive version of this map, visit [climateatlas.ca](http://climateatlas.ca).

This would, of course, fundamentally change agriculture in Manitoba. The next several sections elaborate on the temperature and precipitation changes that will be in store for Manitoba if our climate shifts in this way.

## Opportunities

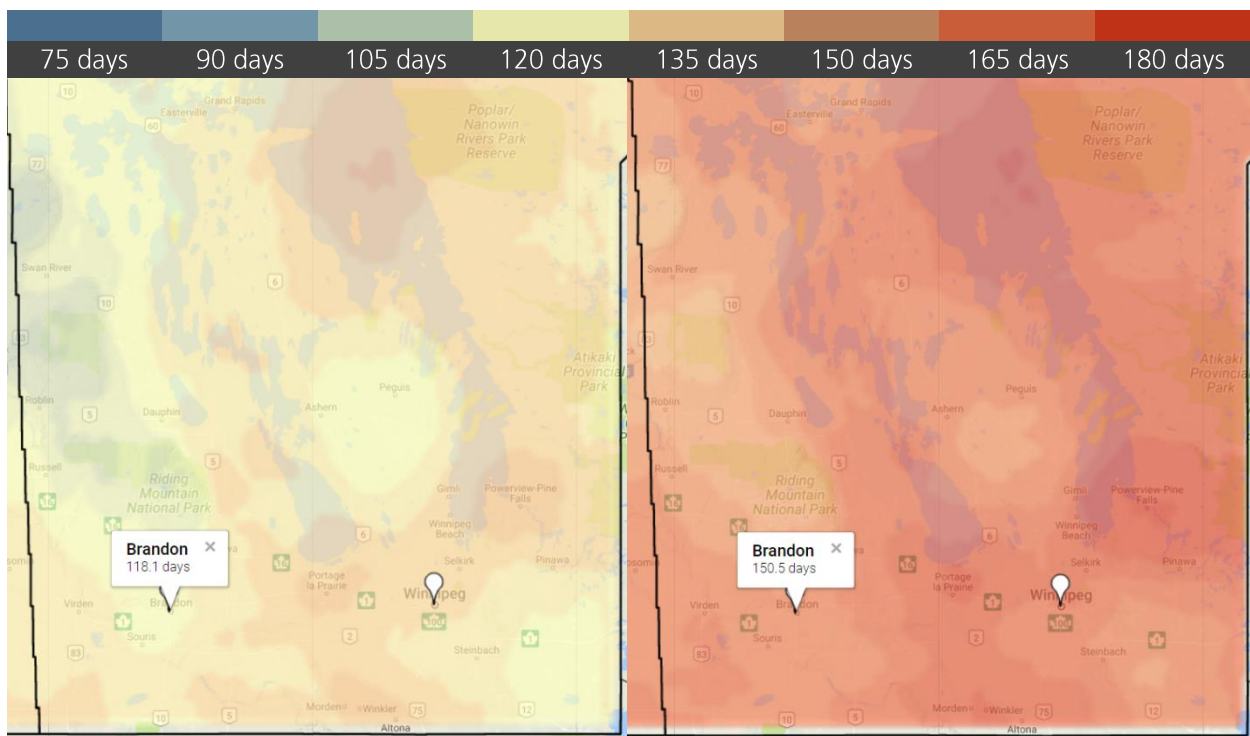
The Prairie Climate Atlas suggests that the biggest opportunity for Manitoba farmers is likely to be a longer growing season. The atlas states that "the frost-free period across the

southern Prairies has already increased by about one month over the last 100 years and is expected to increase by yet another month in the next 50 years.”<sup>6</sup>

Based on the average output from 12 peer-reviewed climate models, the map on the left in Figure 2 represents the average length of the frost-free period — the number of consecutive days and nights without frost — from 1981 to 2010. The red parts of the map represent a longer frost-free period, while the yellow and blue areas represent a shorter period (see the legend at the top). The Brandon area, for example, shows an average frost-free period of 118 days for the recent past.

These outputs match up closely with the actual recorded averages for this period. Since the atlas models can accurately recreate the long term averages of the past, this gives us confidence that it can say something credible about the changes we can expect in the decades to come.

Figure 2: Average Frost-Free Period, 1981-2010 and 2051-2080 (Prairie Climate Centre).



To view projections for your municipality in an interactive version of this map, visit [climateatlas.ca](http://climateatlas.ca).

<sup>6</sup> Prairie Climate Centre, 2016: [Prairie Climate Atlas - Frost Free Period](http://climateatlas.ca)



Over the next 10 to 30 years (not shown in Figure 2), if greenhouse gas emissions continue to rise globally, the Atlas projects the Brandon area will add 19 days, bringing the average frost-free period up to 137 days. More greenhouse gas emissions in our atmosphere traps more solar heat in our atmosphere, preventing it from escaping back into space. This changes our climate in many ways, including expanding the frost-free period.

In 30 to 60 years, if global emissions continue to rise, Brandon is projected to gain 33 days compared to the recent past, bringing the average frost free period up to 151 days (on the right in Figure 2).

A change in the growing season of this magnitude would present greater opportunities for livestock wintering and a range of new crops would become possible to grow in Manitoba.

## Risks

The opportunities of climate change, however, will be limited by the risks. If Manitoba summers resemble Kansas and northern Texas by the 2080s (as shown in Figure 1), longer growing seasons will be accompanied by more droughts and extreme heat.

Brandon, for example, is projected to go from a recent average of 14 days per year above 30°C to 49 days per year by the second half of the century.

At the same time, the atlas projects more precipitation for Manitoba in the winter, spring and fall. Figure 3 shows the projected changes to precipitation for Winnipeg and surrounding areas, in an average year for the given time period, if greenhouse gas emissions continue to rise. (The Winnipeg projections serve as an example of what could be in store for rural Manitoba as a whole — visit [climateatlas.ca](http://climateatlas.ca) to view projections for your local area.)

Spring in the 2051-2080 period is expected to show the greatest change, with a 26 percent increase in precipitation compared to 1981-2010. Similarly, the average Winnipeg winter in the latter half of the century is expected to get 22 percent more precipitation compared to the recent past.

*Figure 3: Projected Changes to Winnipeg-Area Precipitation in a High Emissions Scenario.*

*Source: Prairie Climate Centre*

Season	Recent Past: 1981-2010	2021-2050			2021-2050 +/- from Recent Past	2051-2080			2051-2080 +/- from Recent Past
		Low	Medium	High		Low	Medium	High	
Annual	525 mm	511 mm	553 mm	590 mm	+5%	528 mm	565 mm	599 mm	+8%
Winter	66 mm	65 mm	72 mm	85 mm	+9%	70 mm	81 mm	91 mm	+22%
Spring	117 mm	109 mm	128 mm	145 mm	+10%	132 mm	147 mm	163 mm	+26%
Summer	228 mm	212 mm	226 mm	247 mm	-1%	189 mm	214 mm	234 mm	-6%
Fall	113 mm	110 mm	125 mm	136 mm	+11%	110 mm	123 mm	139 mm	+9%

To view projections for your municipality using an interactive map of this data, visit [climateatlas.ca](http://climateatlas.ca).

These changes to our winters and springs would exacerbate spring flooding, which is already one of the toughest challenges that Manitoba farmers face.

In addition to these specific projections, the Prairie Climate Centre says that, in general, we can expect to face a less stable climate on the Prairies. While long-term average temperatures and precipitation may follow predictable trends, the conditions at any given point in time will likely become more variable. Extreme precipitation and weather is likely to become more frequent.<sup>7</sup>

The Prairie Climate Centre does not claim to make crystal ball predictions. Their atlas does, however, present a credible forecast of the direction we can expect to head in if greenhouse gas emissions continue to rise around the world.

If these trends become reality, they will be a total game changer for agriculture in Manitoba.

## Speaking Farmers' Language

To further investigate what climate change could mean for agriculture, KAP worked with several farmers, Manitoba Agriculture and the Prairie Climate Centre to identify agricultural metrics to add to the Climate Atlas.

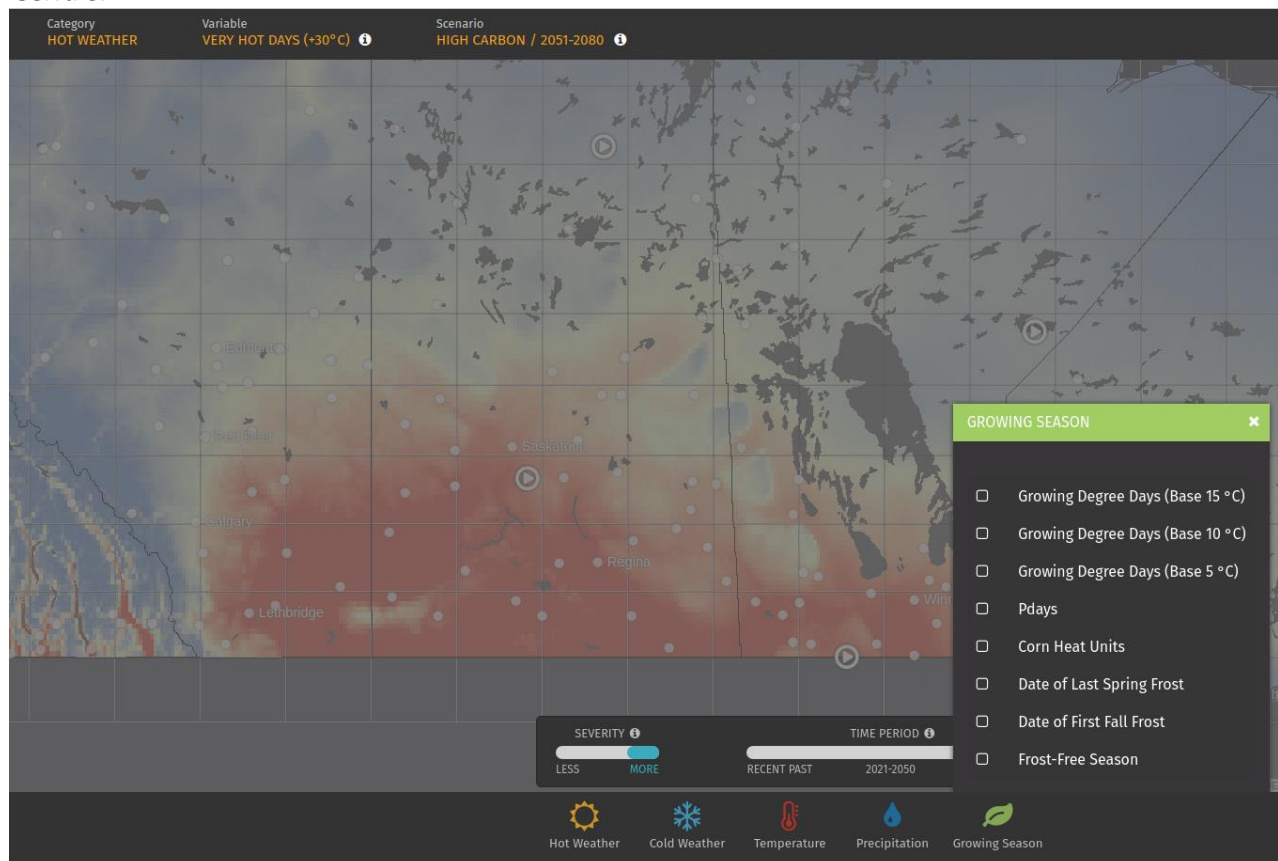
Based on the projections of temperature and precipitation that the Prairie Climate Atlas generates for the recent past (1981-2010), near future (2021-2050) and far future (2051-2080), the atlas can now display projections for Growing Degree Days (Base 5, 10, or 15°C), Potato Days, Corn Heat Units, the dates of the last spring frost and first fall frost, and more.

These metrics have been added to the successor of the Prairie Climate Atlas: the Climate Atlas of Canada. When the Prairie Climate Centre launches the new atlas in early 2018, farmers, government officials and the public will be able to visit the atlas online and view how these agricultural metrics are expected to change for their local area as the climate changes.

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<sup>7</sup> Prairie Climate Centre and the Prairie Climate Atlas: From Risk to Resilience, slide 34

Figure 4: A sneak peek of the agricultural metrics which KAP helped develop for the Climate Atlas of Canada, which will soon be open to the public. Source: Prairie Climate Centre.



In the meantime, the Prairie Climate Atlas, available at [climateatlas.ca](https://climateatlas.ca), tells an important story about the changes we can expect based on the projected days per year above 30°C, seasonal precipitation, frost-free period and more.

When consulting with farmers and developing climate change policies for agriculture, it is important that government officials and researchers be able to speak farmers' language. By working with the Prairie Climate Centre, KAP has shown how this can be done — how climate data can be translated into agricultural metrics.

# Building Resilience

The previous sections described the major changes that Manitoba farmers are likely to face in a changing climate. This section describes what we heard from farmers about the current challenges they face with production conditions. It connects this to ways in which governments can help farmers deal with these challenges and, at the same time, build resilience for (i.e. adapt to) a future climate that could look substantially different.

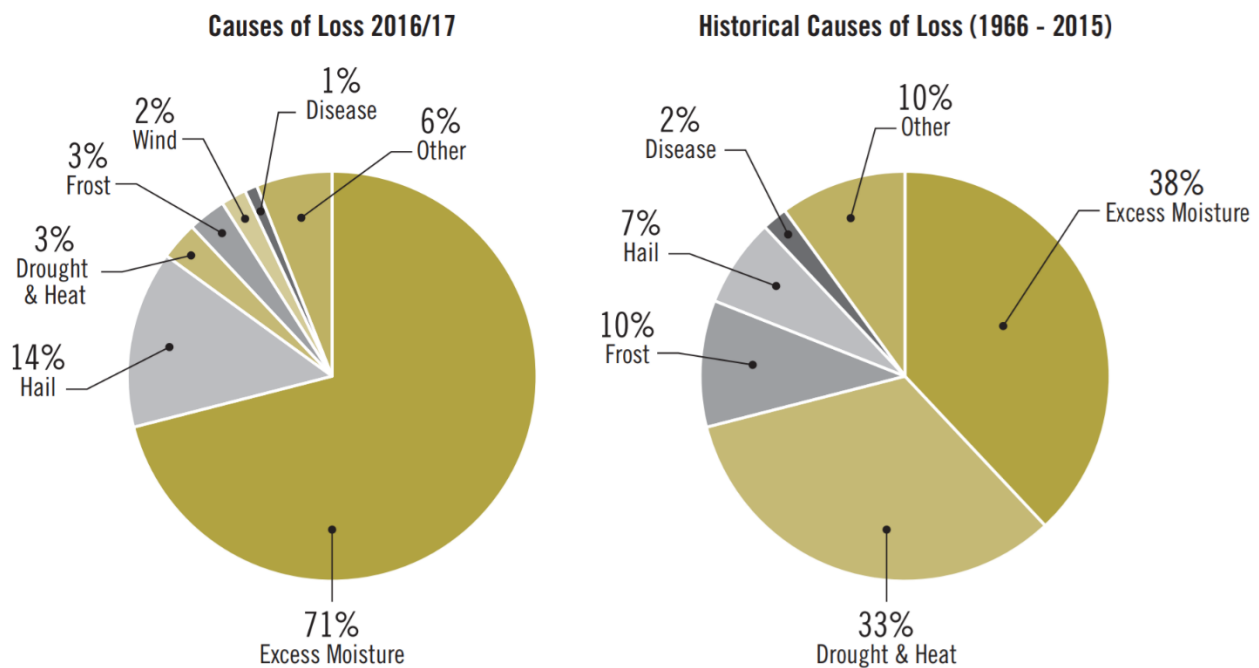
## Support Innovative Water Management

In large part, adapting agriculture to climate change is about addressing long-standing issues that will only grow in importance. Water management is one of those long-standing issues.

In recent years, the primary water management issue for most Manitoba farmers has been excess moisture. In our surveys with Manitoba farmers, many said that they have been significantly impacted by excess moisture in the 2000s and 2010s.

Insurance data tells the same story. The pie charts of Figure 5 show that excess moisture accounted for 71 percent of all AgrilInsurance losses in 2016/17, which far exceeds the historical average of 38 percent from 1966 to 2015. 'Drought and heat' was the cause of loss for 33 percent of claims from 1966 to 2015 compared to only 3 percent in 2016/17.

Figure 5: AgrilInsurance Causes of Loss. Source: MASC Annual Report 2016/17.



To deal with these challenges, Manitoba farmers have been improving their surface drainage, installing tile drainage, switching to tractors and combines with tracks to navigate wet fields, and more.



There are many ways for governments to support these efforts to deal with current water management challenges, in a way that will also help prepare agriculture for greater challenges to come with a changing climate. The following sections outline some of the ways that governments can help.

## Streamline Water Management Regulations

Farmers have told KAP that regulations often impede their ability to manage water effectively. Concerns include a cumbersome and lengthy licensing process for water management projects, a lack of appeals process for licensing decisions and illegal drainage impacting their land. KAP is hopeful that the Sustainable Watersheds Act will make progress in addressing these concerns.

In October 2017, KAP submitted 37 recommendations on how to make water management regulations, conservation districts and the GROW program work well for farmers and our environment. Conservation districts (to be renamed “watershed districts”) and GROW are discussed later in this report.

The Province of Manitoba should continue working to streamline water management regulations to ensure they are fair, effective and clearly communicated. These regulations must be practical and based on input from farmers throughout Manitoba.

## Facilitate Sustainable Tile Drainage

Tile drainage is an important tool for Manitoba farmers, and many are adopting this technology. While improperly designed tile drainage can have negative impacts downstream, when properly designed it can be a net benefit for not only the farmer installing it, but the watershed as a whole.

Each tile drainage system must be customized for its specific context. In many cases, tile drainage with controlled gates and holding ponds can reduce phosphorus runoff, reduce flooding on-field and downstream, and improve resiliency against droughts.<sup>8</sup>

Some municipalities have expressed concerns with tile drainage, particularly around the use of manure on tiled land. KAP wants everyone to have current and useful information on tile drainage so that municipal councillors and others can make informed decisions.

Fortunately, the Red River Basin Commission, Assiniboine River Basin Initiative and several watershed districts are developing a municipal by-law template for tile drainage that can work well for farmers, municipalities and their ecosystems.

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<sup>8</sup> Prairie Agricultural Machinery Institute, 2016: [Development of a Decision-Support Tool for Economic Considerations of On-Farm Surface Water](#), page 30.

KAP will continue to work with these stakeholders to gather and share best practices on tile drainage design and regulation.

## Find Creative Ways to Design and Finance Water Management Infrastructure

One of farmers' top concerns is that many municipal and provincial ditches, culverts and other parts of water management infrastructure are not properly maintained. Some farmers have told us that the province and municipality are doing a good job in their area, but many more have said their culverts are often full of debris and water is backing up onto their fields.

Fortunately, there are groups working on creative solutions to this challenge. The Bifrost Agricultural Sustainability Community Service Cooperative (BASIC) was established by farmers and other residents of the Bifrost-Riverton municipality in 2008 to improve water management infrastructure in the area. Since then, with support from federal and provincial funding, BASIC has conducted extensive land surveying and is now working on a plan to rehabilitate 220 miles of water management infrastructure.<sup>9</sup>

The International Institute for Sustainable Development is another group working on this issue. IISD is exploring options to purchase specialized mowing equipment that takes debris and phosphorus out of the watershed and converts it to biofuels. This could create a revenue stream for maintaining water management infrastructure while at the same time reducing phosphorus loading and greenhouse gas emissions.

Building off of recent success stories and promising initiatives, provincial and municipal governments should continue to work with stakeholders to find creative ways to design and finance water management infrastructure.

## Use Data, Models and Natural Infrastructure to Optimize Water Management

Manitoba Forage and Grasslands Association and the Assiniboine River Basin Initiative have worked with a company called Aquanty to customize its hydrologic modelling platform, HydroGeoSphere, for the Assiniboine River Basin. Their efforts have produced a promising new tool for farmers, governments and other stakeholders to optimize water management.

Using topographic and hydrologic data collected by LIDAR (Light Detection and Ranging) and other means, HydroGeoSphere can model the effects of flood and drought on urban, agricultural and other lands, and simulate possible actions to reduce the impacts.<sup>10</sup> It can help us determine which actions will build resiliency to climate change by simulating

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<sup>9</sup> The Express Weekly News, 2017: [BASIC addressing drainage infrastructure and excess moisture to improve farmers' futures](#)

<sup>10</sup> Manitoba Forage & Grassland Association: [The MFGA Aquanty Project](#)

hydrology changes under future climate scenarios such as those produced by the Prairie Climate Centre.

Preliminary results from the project are supporting the idea that increasing soil organic matter on crop and pasture land can be an effective way to manage excess moisture, for both individual farms and entire watersheds.<sup>11</sup>

Given this benefit, investments to support soil health improvements should be viewed as investments in “natural infrastructure” which can provide some of the same services as conventional infrastructure, such as flood mitigation.

In some cases, this type of natural infrastructure may be able to partially or fully replace new conventional infrastructure projects at a lower capital and maintenance cost, as a number of communities have done in working with the Municipal Natural Assets Initiative.<sup>12</sup>

Manitoba Infrastructure could use its upcoming “comprehensive review of its service delivery model” to integrate a systematic assessment of natural infrastructure alternatives into its delivery model. This will help the department achieve the highest possible value for money on flood protection, one of its top priorities.<sup>13</sup> Infrastructure Canada and municipalities should also ensure that natural options are considered in their spending decisions.

The Growing Outcomes in Watersheds (GROW) program could also play an important role in funding natural infrastructure, given that “soil health improvements” may be eligible for GROW funding.<sup>14</sup> This potential is explored further in the section titled *Ramping Up Innovation*.

Modelling tools like HydroGeoSphere can help governments determine the best fit for natural infrastructure investments. Overall, these tools can help farmers, watershed districts and governments manage water with greater precision.

## Reevaluate Irrigation Capacity

Although excess moisture has been a greater challenge for Manitoba farmers in recent years, drought concerns still exist. A statement from one producer in our consultations stood out: “One day we’re going to hit another dry cycle and we’re not ready.”

In addition to the risk of entering another short or medium term dry cycle, the Prairie Climate Centre projects that if global greenhouse gas emissions continue to rise in the coming decades, summer precipitation in Manitoba will decline due to climate change. By

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<sup>11</sup> Communication with Dr. Steven Frey, Senior Scientist with Aquanty, 2018.

<sup>12</sup> [Municipal Natural Assets Initiative](#), 2016

<sup>13</sup> Province of Manitoba, 2017: [Manitoba Infrastructure to Review its Service Delivery Model](#)

<sup>14</sup> Manitoba Sustainable Development, 2017: [GROW Public Consultation Document](#), page 5

the 2050s in a high-emissions scenario, southern Manitoba's summer climate is expected to resemble current-day South Dakota and Nebraska.<sup>15</sup>

To illustrate how fundamentally this could change our agriculture, in 2013, Nebraska had the largest number of irrigated acres for agricultural use in the United States, at 8.3 million acres. Nebraska irrigated 38 percent of its total farmland in 2013 compared to less than one percent in Manitoba in 2016.<sup>16</sup>

Manitoba's water resources and hydrology differ from Nebraska in many ways, of course. Manitoba's conditions will not become identical to current-day Nebraska. But the potential need for increased irrigation in the decades to come is something that governments must take seriously.

Whether permanent or cyclical, if Manitoba enters a dry period and we do not have sufficient ability to irrigate, potato growers and other farmers will be at risk for significant losses, and our province will be at risk for losing agricultural processors.

To manage this risk, the Province of Manitoba should invest in research to update its data on irrigation capacity, since much of our data on groundwater resources is several decades old.<sup>17</sup> Specifically, the province could update recharge yield assessments, reallocate water use licenses that have not been used and explore opportunities for drought-resistant field-level water storage combined with drainage systems.

These actions would help the agricultural sector in Manitoba understand its drought resilience and prepare for potentially drier summers in the decades to come.

## Prepare for More Extreme Heat

The Prairie Climate Centre projects that, if greenhouse gas emissions continue to rise globally at their current rate, Winnipeg and surrounding areas (for example) will move from 11 days above 30°C in an average year for 1981-2010, to an average of 26 days for 2021-2050, to 46 days for 2051-2080. This amount of heat would bring Manitoba's summer climate to resemble present-day Kansas and northern Texas.<sup>18</sup>

Barns are investments built to operate over multiple decades. The typical lifespan of a hog barn, for example, is approximately 30 years.<sup>19</sup> This long lifespan warrants an examination of how barns are constructed differently in Kansas and northern Texas compared to Manitoba to deal with different heating and cooling needs. This will be important to

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<sup>15</sup> Prairie Climate Centre, 2016: [Climate Atlas](#)

<sup>16</sup> Irrigated acres divided by total agricultural acres. US Department of Agriculture, 2013: [Irrigated Farms by Acres Irrigated](#) and Statistics Canada, Census of Agriculture, 2016: [irrigation in the year prior to the census \(Table 004-0210\)](#) and [number and area of farms and farmland area by tenure \(Table 004-0001\)](#)

<sup>17</sup> Manitoba Sustainable Development, Water Stewardship Division: [Reports, Studies, Plans and Publications](#)

<sup>18</sup> Prairie Climate Centre, 2016: [Prairie Climate Atlas](#)

<sup>19</sup> Western Producer, 2016: [Producers talk of hog barn expansion](#)



ensure that producers can continue to meet animal welfare standards and to ensure their livestock are not wasting energy on cooling themselves instead of growing. As well, farm building codes will need to be flexible to allow farmers to adapt their buildings to climate change.

## Help Farmers See Changes Coming

### Improve Weather Forecasting

In KAP's consultations for the Climate Initiative, farmers indicated that adapting to changing long term averages is one thing, but dealing with increasingly variable conditions is the tougher challenge.

Many farmers noted that it was difficult for them to make production decisions based on current weather forecasting capabilities. With even more variable weather and a less stable climate likely in store for Manitoba and Canada, the need to improve weather forecasting will only grow in importance.

The federal government took a step forward recently by investing in modernizing the Canadian Weather Radar Network and investing in a new supercomputer that will allow for "cutting-edge weather and climate models."<sup>20</sup> KAP hopes that these investments will translate into better weather information for farmers in Manitoba and across Canada, to help them make critical production decisions.

The Government of Canada should continue to invest in improved weather forecasting to help farmers prepare for severe weather which will become more common due to climate change.

### Improve Pest Early Warning Systems

The Prairie Climate Centre forecasts that, if greenhouse gas emission trends continue at their current rates, the Brandon area (for example) will go from an average winter with 11 days below 30°C (1981-2010) to 4 days (2021-2050) and eventually just 1 day (2051-2080).

While few Manitobans would be opposed to warmer winters, this trend increases the likelihood that certain pests will survive the winter and that new pests will be able to make Manitoba their new home. Manitoba farmers will need the best possible information about how climate change is affecting pest pressure on their commodities and how to respond.

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<sup>20</sup> Government of Canada, 2017: [The Government of Canada invests to modernize weather-forecasting infrastructure](#)

The governments of Manitoba and Canada should work to improve early warning systems for detecting new and changing pest pressures that could affect agriculture.

In addition, farmers have told KAP that a lengthy approval process for new pest management tools is a challenge they currently face. The Pest Management Regulatory Agency should explore ways to ensure the approval process can keep up with new pest challenges, particularly as our climate changes, while still ensuring that new products are safe to use.

## Send Clear Signals

Governments of all levels should work to ensure they are not sending mixed messages on climate change mitigation versus adaptation. For example, if Manitoba farmers will be facing wetter falls as forecasted by the Prairie Climate Centre, this will increase the need for grain drying — an adaptive measure.

On the other hand, applying a carbon tax to the natural gas and propane used to dry the grain is intended to send a message to become more fuel efficient or find lower-carbon energy sources — a mitigative measure. However, if few options on this front become available, the carbon tax on natural gas and propane is simply increasing the cost of adapting to climate change.

All levels of government should work to ensure that their climate change mitigation policies are complementary to their adaptation policies and are not sending contradictory signals to farmers.

## Make Crop Insurance Flexible

With climate change likely to bring a longer growing season to Manitoba, new crop varieties will become possible to grow here, and certain existing varieties will thrive.

Warm-weather crops like soybeans, for example, are likely to continue thriving in Manitoba as our climate warms. Soybeans also help farmers reduce nitrous oxide emissions by not requiring nitrogen fertilizer. Changes made to AgrilInsurance in 2018 will support these benefits. The changes include:

- “Creating a permanent insurance area to protect more than 200,000 acres of soybeans grown in areas previously eligible for coverage only on a test basis;”
- “Changing the soybean premium rate calculation to put more emphasis on actual losses, which will benefit producers and governments by lowering premiums;” and
- “Removing the pre-harvest claim deductible for corn and soybeans, which will provide equitable coverage for all major crops”.

For new and non-traditional crops (such as quinoa), a “novel crops insurance program” is being introduced which is expected to “include 10,000 acres and represent about \$1.8 million in coverage.”<sup>21</sup>

Work like this must continue to ensure that business risk management programs remain relevant and effective in a changing climate. Specifically, Manitoba Agricultural Services Corporation should continue work to make crop insurance contracts flexible to accommodate new varieties that may thrive in the decades to come.

## Protecting Our Climate

Over the past several decades, Manitoba farmers have done a great deal to reduce greenhouse gas emissions and protect our climate. They have moved to zero and minimal tillage, raised feed efficiency and more, as outlined in the final section, *Ramping Up Innovation*. Building off these successes, Manitoba farmers are ready to take the next steps to mitigate climate change. The following subsections outline some important ways in which government can support farmers on this front.

### Raise the Biodiesel Mandate

While some greenhouse gas reduction efforts will take decades to see transformational results, it is important to work in tandem on short-term efforts. The task of achieving strong outcomes on climate change mitigation must be shared between current and future generations of Manitobans.

The Province of Manitoba’s Climate and Green Plan lists ‘raising the biodiesel mandate from B2 to B5’ as the second largest emission-reducing action that Manitoba can take in the short term — it could reduce up to 431,000 tonnes of carbon dioxide over 5 years.<sup>22</sup>

Farmers are on board. At our 2018 Annual Meeting, members passed a resolution directing KAP to “encourage the early adoption of the B5 biodiesel mandate”.

Farmers want to be part of this clean fuel solution by providing locally grown, high quality feedstock. The Province of Manitoba should examine the potential for locally or regionally grown feedstock to minimize emissions from transporting the feedstock. Minimizing the lifecycle emissions of fuel must be a central goal of the biodiesel mandate.

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<sup>21</sup> Province of Manitoba, 2018: [Governments announce improvements to Agrilnsurance for 2018 growing season](#)

<sup>22</sup> Province of Manitoba, 2017: [Climate and Green Plan Discussion Paper](#), page 55.

## Support 4R Nutrient Stewardship

4R Nutrient Stewardship is a framework that helps farmers apply the right nutrient source at the right rate, at the right time and in the right place. The 4Rs offer an excellent way for farmers to reduce greenhouse gas emissions from fertilizer application while reducing nutrient runoff, reducing input costs and maximizing yields at the same time.

University of Manitoba researcher Mario Tenuta estimates that by applying 4R Nutrient Stewardship, Manitoba farmers can reduce over 1 million tonnes of carbon dioxide equivalent by 2025.<sup>23</sup> This would be a significant contribution to the province's climate change goals, reducing Manitoba's total emissions by 5 percent compared to 2015 levels.<sup>24</sup>

Approximately four million acres of cropland across Canada are already designated as practicing 4R Nutrient Stewardship. Fertilizer Canada aims to increase this to 20 million designated acres by 2020.<sup>25</sup> In Manitoba, Fertilizer Canada is working with KAP and the Province of Manitoba to reach our province's portion of this goal, by sharing best practices through interactive tools, workshops and 4R Farmer Advocates.<sup>26</sup>

The Province of Manitoba should continue working with Fertilizer Canada, KAP, universities, fertilizer retailers and other partners to support research and demonstration that identifies 4R strategies tailored to growing conditions in Manitoba.<sup>27</sup> Extension work must continue to build relationships and sharing of best practices between researchers and farmers across the province.

As federal, provincial and territorial governments develop a greenhouse gas offset system over the next several years, it is important that this system include a version of the Nitrous Oxide Emission Reduction Protocol (NERP). NERP lays out rules for implementing 4R practices and verifying the emission reductions so that a farmer can receive credit to be sold in an offset market.

Conservative estimates based on nitrous oxide research say that NERP can reduce on-farm nitrous oxide emissions by up to 25 percent.<sup>28</sup> Assuming an offset price of just \$10 per tonne of carbon dioxide equivalent, Manitoba farmers could generate \$11 million in offset credit sales through NERP.<sup>29</sup> NERP could create a significant opportunity for Manitoba farmers to take the next steps on climate change and be recognized for implementing beneficial practices.

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<sup>23</sup> Mario Tenuta, 2017: N<sub>2</sub>O Emissions Reductions from Agricultural Soils: Potential, Costs, Returns

<sup>24</sup> Manitoba emitted 20.8 million tonnes of CO<sub>2</sub>e in 2015. Environment and Climate Change Canada, 2017: [Greenhouse gas emissions by province and territory](#)

<sup>25</sup> Communication with Fertilizer Canada, 2018.

<sup>26</sup> Fertilizer Canada: [Nutrient Stewardship – Manitoba](#)

<sup>27</sup> Manitoba Co-operator, 2017: [What is 4R Nutrient Stewardship?](#)

<sup>28</sup> Fertilizer Canada, 2016: [4R Nutrient Stewardship - Greenhouse Gas Reduction](#), page 2

<sup>29</sup> Mario Tenuta, 2017: N<sub>2</sub>O Emissions Reductions from Agricultural Soils: Potential, Costs, Returns

The next section discusses offset markets in greater detail.

## Acquire Access to Offset Markets

Despite the difficulty in measuring total farm emissions from livestock and fertilizer application, there are reliable methods for measuring the *reduction* in these emissions from changing practices and technologies. A number of jurisdictions around the world have used these methods to gain farmers access to offset markets.

Farmers and certain other sectors can undertake specific changes in practices and technologies to reduce emissions, gain credits for these reductions, and sell the credits to large industrial emitters as an alternative to these facilities reducing emissions on-site.

KAP supports the province's efforts to gain Manitoba farmers access to national and international greenhouse gas offset markets,<sup>30</sup> to provide more opportunities for farmers to be part of the solution and to provide other provinces and countries with low-cost emission reduction options.

KAP has listened to the experience of farmers in other jurisdictions who have participated in offset markets and has learned some important lessons. Red tape must be streamlined to make it worth a farmer's time to take on an offset project, particularly if payments for these projects start at a modest level. As well, there must be a competitive market of project developers, the companies that help farmers navigate the offset system, to ensure that farmers get a fair share of the revenue from selling the credits.

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<sup>30</sup> Province of Manitoba, 2017: [Climate and Green Plan Discussion Paper](#), page 24.



## Ramping Up Innovation

The *Building Resilience* section of this report highlighted tactics for adapting Manitoba agriculture to a changing climate. *Protecting Our Climate* outlined ways to mitigate climate change by reducing greenhouse gas emissions. This final section, *Ramping Up Innovation*, explores actions that can support adaptation and mitigation at the same time.

### Learn from the Success Stories

To develop the next generation of climate change policy tools for agriculture, governments should study the success stories of the recent past. For example:

- Emissions from Canadian dairy farms have declined an average of one percent per year between 1990 and 2012.<sup>31</sup>
- Manitoba hog farms generate 35 percent fewer emissions than they did 50 years ago.<sup>32</sup>
- In many parts of Manitoba, the switch to minimal and zero tillage systems has led to a significant increase in soil organic matter,<sup>33</sup> which contributes to climate change mitigation and adaptation (see the next several sections).

The solutions differ by region, commodity, and even farm-to-farm. The common thread across all of the solutions is that they have come from researchers and farmers finding a more effective way to do things that benefitted both the environment and farmers' ability to make a living.

Based on this principle, there is much that the governments of Manitoba and Canada can do to support the next wave of agricultural innovation.

### Strengthen Innovation Networks for Win-Win Practices

Innovation is a constant force in agriculture, and governments have supported this force in many ways. Given the need to ramp up efforts to address climate change, however, the governments of Manitoba and Canada should work with universities and other partners to increase research, development and extension efforts for win-win agricultural technologies and practices that can reduce emissions, increase resiliency and increase farm profitability.

This fits well with the Province of Manitoba's consideration in its Climate and Green Plan to develop a "Centre for Sustainable Agriculture to support adaptation and resilience

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<sup>31</sup> Dairy Farmers of Canada, 2016: [proAction: Environment](#)

<sup>32</sup> Manitoba Pork: [Pigs and the environment](#)

<sup>33</sup> Agriculture and Agri-Foods Canada, 2016: [Environmental Sustainability of Canadian Agriculture](#), page 93

research, to seek new technologies to decrease emissions from crops and livestock, and to explore commercialization opportunities.”<sup>34</sup>

While administrative activities can be clustered, it is important that agricultural research take place across a geographically distributed network to account for the unique production conditions in each region. The centre should be connected to the wide range of agro-environmental research being done across the Prairies and beyond, and data collection should be standardized, to ensure the research is coordinated and systematic.

The activities of the Centre for Sustainable Agriculture should be farmer-driven, and Manitoba has good examples of how to structure farmer-driven research. Manitoba Beef and Forage Initiatives, for example, involves farmers at every level of its research, from the board of directors to the farm management decisions, demonstrations, outreach, sponsorship and animal care.<sup>35</sup>

The centre should make it a high priority to work with many farmers across Manitoba as part of a robust extension (knowledge sharing) strategy. There is no substitute for building trust between farmers and researchers one at a time.

Among the many areas where the centre could focus, KAP members see soil health innovation as a high priority. At our 2018 annual meeting, our members passed a resolution directing KAP to “encourage governments, universities, private industry, and farmers to research and develop model farms and BMPs which further foster and promote healthy soils and increase the sequestration of carbon into the soils.”<sup>36</sup> The next section expands on this priority.

## Support Soil Health Innovation

Darren Johnson, featured on the cover of this report, has been zero till on his farm for many years. Now Darren is working with Ryan Canart and the Upper Assiniboine River Conservation District to take the next steps to build soil health. Darren is experimenting with polycrops, cover crops and integrating livestock into his annual crop rotation.

Healthy soils help Darren grow healthy, resilient, high yield crops and contribute powerfully to climate change adaptation and mitigation.

As this report has detailed, water management will only grow in importance for farmers as they adapt to a changing climate. According to California’s Healthy Soils Initiative, “healthy soil can hold up to 20 times its weight in water. Increasing soil organic matter 1% can increase soil available water holding capacity by 3.7%” or 25,000 gallons per acre.<sup>37</sup>

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<sup>34</sup> Manitoba Sustainable Development, 2017: [A Made-in-Manitoba Climate and Green Plan](#), page 23

<sup>35</sup> Manitoba Beef and Forage Initiatives: [Funding/Governance](#)

<sup>36</sup> Keystone Agricultural Producers: [2018 Annual Meeting](#)

<sup>37</sup> State of California: [California’s Healthy Soils Initiative](#)

In terms of mitigating climate change, building off of the successes of zero and minimal tillage, Manitoba farmers hold the potential to sequester an additional 1.3 to 3 million tonnes of carbon dioxide equivalent each year into their soils.<sup>38</sup> Globally, an annual growth rate of 0.4 percent in soil carbon would sequester all greenhouse gas emissions generated by human activity.<sup>39</sup>

Agriculture is one of the few sectors that not only emits carbon but also manages a massive carbon sink — soils. Using certain practices and technologies such as those described by Darren, farmers can take steps to protect this carbon sink, increase it, and provide co-benefits such as increased water and phosphorus retention.

Yet soil carbon sequestration remains one of the most underutilized climate policy tools. Governments are not supporting and incentivizing practices that increase sequestration nearly as much as they should, given its potential impact.

### Pool Risk to Deal with Uncertainty

One concern governments have with soil carbon sequestration is that this carbon could eventually be released back into the atmosphere if practices or conditions change. This concern can be dealt with through a risk pooling, insurance approach. If practices that increase soil carbon sequestration are credited in an offset market, for example, a portion of the credits generated could be reserved and the value not paid out to the project owner. The reserved credits serve as compensation if carbon is eventually released on some of the credited acres.<sup>40</sup>

### Reexamine Sequestration Models

Another concern or belief that some governments have is that there is limited potential to increase soil carbon sequestration (store more carbon in the soil). The Century Model used by the Government of Canada suggests that “soil organic carbon levels out at a steady state after 20 to 30 years of direct seeding” meaning that little more could be gained on the Prairies in sequestering carbon, where direct seeding is already widely used.<sup>41</sup>

However, results from the Prairie Soil Carbon Balance Project show that “soil organic carbon has increased in minimum tillage fields far beyond what the Century Model predicts.” For the past 20 years, this project has measured soil organic carbon levels in 130 sites around Saskatchewan.

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<sup>38</sup> International Institute for Sustainable Development, 2017: [The Potential for Carbon Dioxide Equivalent Sequestration in Agro-Manitoba](#), page 12

<sup>39</sup> [4 per 1000 Initiative](#)

<sup>40</sup> The REDD Desk: [Permanence/Reversals](#)

<sup>41</sup> The Western Producer, 2018: [Carbon hits the east-west divide](#)

The Government of Canada should examine the results of the Prairie Soil Carbon Balance Project and other soil research and consider whether changes to the Century Model are needed.

As Saskatchewan farmer John Bennett says, “There is tremendous potential here that is not being recognized.”

## GROW the Protection of Our Land, Water and Climate

Manitoba’s relatively small population and massive land area must shape our environmental strategies. We can achieve the highest value for money by focusing on actions that protect our land, water and climate at the same time. Manitoba farmers already undertake many beneficial management practices — such as maintaining and enhancing soils, grasslands and shelterbelts — that simultaneously reduce and sequester greenhouse gas emissions, reduce and capture nutrient runoff, improve water management and enhance biodiversity.

The “Growing Outcomes in Watersheds” (GROW) program, under development by the Province of Manitoba, could offer an effective way for farmers to take the next steps on this front. GROW will fund projects that increase the ecological goods and services produced by farmland, such as those described in the previous paragraph. In October 2017, KAP submitted recommendations to the province on how to design GROW to work well for farmers and our environment.

For GROW to push the bar and achieve greater outcomes than its predecessor (the Growing Assurance: Ecological Goods and Services program under Growing Forward 2), GROW must be able to fund a significantly larger number of projects across Manitoba.

The Government of Canada should continue to work with the Province of Manitoba to ensure natural infrastructure projects on farmland are eligible for federal green infrastructure funding. As described in the *Building Resiliency* section, actions like improving soil health can provide important “infrastructure” services such as water retention.

The Province of Manitoba should also explore opportunities to fund GROW through the private sector. The New Acre Project run by Alternative Land Use Services (ALUS) Canada offers a successful model to follow.<sup>42</sup>

In addition, the province should use a portion of carbon pricing revenue to scale up GROW. Since GROW projects will be voluntary and farmer-driven, this could be an effective way to support farmers’ request to “reinvest all revenue collected through carbon taxes on agricultural inputs and transportation back into primary agriculture” as stated in a KAP

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<sup>42</sup> ALUS Canada: [New Acre Project](#)

resolution passed in 2017.<sup>43</sup> Since GROW could support many of the actions described throughout this section on *Ramping Up Innovation*, directing carbon pricing dollars into GROW could also deliver high value for money on climate change mitigation, adaptation and other environmental benefits.

## For the Next Generation

Through innovations over the past several decades, Manitoba farmers have made progress on addressing climate change. Farmers care about climate change because they are on the front lines of it, dealing with challenging conditions every year. They know that the next generation of farmers — their children and grandchildren — may face even tougher challenges as the climate continues to change.

Now, in partnership with governments of all levels, industry and their communities, Manitoba farmers are ready to take the next steps to mitigate and adapt to climate change.

## Acknowledgements

KAP would like to thank the Province of Manitoba for supporting the Manitoba Agricultural Climate Initiative through the Climate Change Action Fund.

Thank you to the staff and directors at Prairie Climate Centre for working with us to investigate how climate change is likely to change agriculture in Manitoba.

Thank you to all the farmers, researchers, advocates, civil servants, journalists and other people who have helped KAP seek solutions to one of the defining issues of our time.

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<sup>43</sup> Keystone Agricultural Producers: [2017 Annual Meeting Resolutions](#)