Title: Growing Conditions Are Changing – Here's How Agriculture Can Respond

Purpose: To raise awareness among farmers and the general public of potential climatic risks for agriculture in Manitoba and how to increase preparedness on farms

Key Message

Growing conditions are changing. Even if we don't know what the future holds, we know we want to increase our resilience to be better prepared for the challenging conditions we already face.

Date: October 2019

Summary

- Evidence suggests that farmers in Manitoba need to prepare for a higher frequency of extreme weather events (ex: excess moisture, drought and heat) than what has occurred in the recent past.
- Building adaptive capacity will not only help agriculture respond to changing conditions, but will also help the sector deal with long-standing issues such as water management.
- Examples of impacts that could become more frequent in the future include farm land being too wet to seed, crop failures because of drought, and yield loss because of heat stress.
- To adapt to the increasing risk of these impacts, farmers can manage soil to increase water holding capacity, seed early so crops develop before heat waves occur, and choose crops with tolerance to extreme conditions.
- The capacity for farmers to plan in a way that allows flexible and adaptive responses to extreme events is just as important as specific individual actions taken ahead of time.
- The building of adaptive capacity in agriculture will need to occur across the sector, at the community, watershed, provincial and national levels, and within both government and industry, in addition to the farm level.

Potential Climatic Risks

Agriculture has always faced risks due to weather; however, due to rising concentrations of atmospheric greenhouse gases, and the extra heat they trap, certain weather events are expected to occur more frequently than they have in the past. For example, based on global climate model projections, the number of days per year above 30°C is expected to rise across Manitoba in coming decades (Figure 1). Even if extreme weather events like drought don't increase in frequency in coming years, we know they have occurred regularly in the past and we expect them to occur again (Figure 2.) For Manitoba, the list of potentially damaging weather-related events that we might expect to increase in frequency in coming decades includes the following:

- Heavy precipitation (both rain and snow)
- Flooding
- Drought
- Summer heat waves
- Extremely mild winters (potential for overwinter survival of crop pests)
- Winter thaws (loss of protective snow cover for winter cereals and perennial forages)

Other weather events that may or may not change in frequency but still need to be taken into account by farmers include:

- Spring and fall frosts
- Freezing rain and ice storms
- Tornadoes and extreme winds
- Hail
- Periods of high humidity
- Insufficient heat unit accumulation to ripen crops
- Winter storms
- Extreme cold

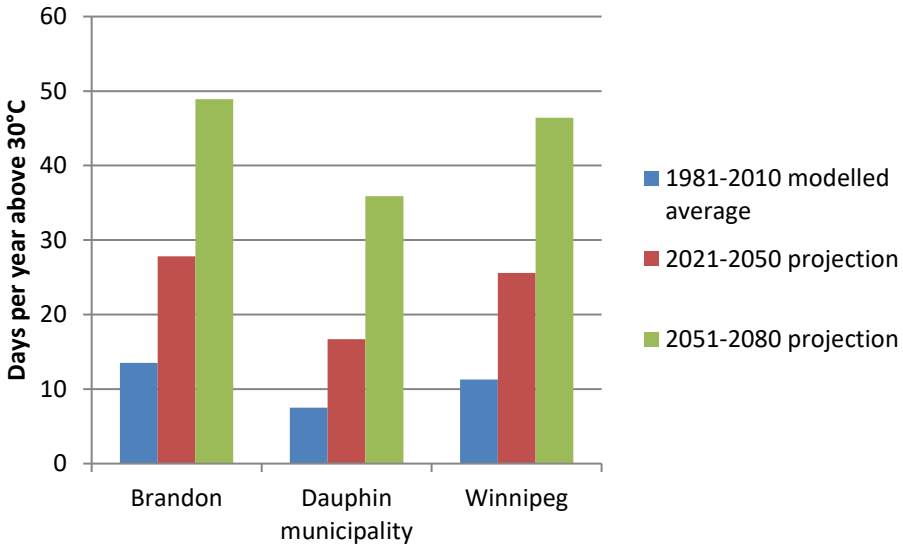

Figure 1. Days per year above 30 degrees Celsius.
Source: Prairie Climate Centre - http://climateatlas.ca/home.html

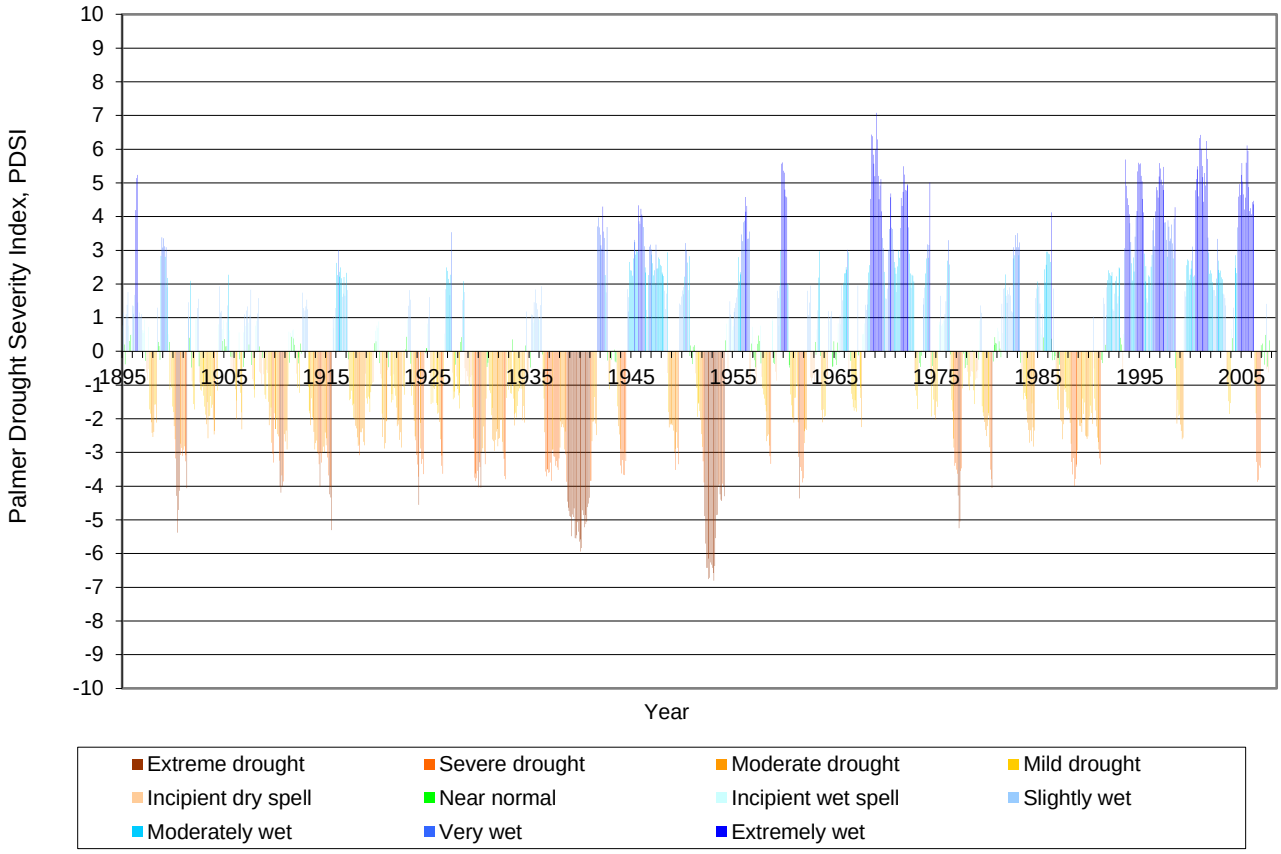

Figure 2. Historic Palmer Drought Severity Index for the Winnipeg area from 1895 to 2007.

Manitoba examples of impacts due to extreme weather

Below are examples of the impacts that three types of weather events have had on agriculture in Manitoba:

- Excess moisture:
  - unseeded and drowned out acres
    - over 1.6 million acres in 2010 ($200.0 million in crop insurances payments for excess moisture crop loss)
    - over 3.4 million acres in 2011 ($282.7 million in crop insurance payments for excess moisture crop loss)
    - almost 1.6 million acres in 2014 ($126.0 million in crop insurance payments for excess moisture crop loss)

      -Source: Manitoba Agriculture Services Corporation
- Drought
  - 1988 drought: crop failures, yield losses, feed shortages, financial hardship
  - 2011 summer drought after spring flooding caused yield losses and crop failures ($81.7 million in crop insurance payments for drought and heat crop loss)
- Extreme heat
  - 1936 was the most intense heat wave on record for MB:

    "The Deadliest Heat Wave in History - July 5-17, 1936. Temperatures exceeding 44°C in Manitoba and Ontario claimed 1,180 Canadians (mostly the elderly and infants) during

the longest, deadliest heat wave on record. Four hundred of these deaths were caused by people who drowned seeking refuge from the heat. In fact, the heat was so intense that steel rail lines and bridge girders twisted, sidewalks buckled, crops wilted and fruit baked on trees."

-Source: Environment and Climate Change Canada
https://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=6A4A3AC5-1

These examples of costly impacts are motivation to be well prepared for extreme weather.

Options to Adapt to Potential Risks

There are ways to plan and prepare for weather events like excess moisture, drought, and heat waves. Below are some actions for farmers, industry and government to consider:

- Unseeded acres and drowned out crops:
  - Plant crops that can de-water the soil so that seeding the following year can begin earlier in spring; plant something, even as late as early September, on land that was too wet to seed or drowned out in spring or early summer, to avoid having land lie fallow, because fallow land will conserve soil moisture. Fallow land may decrease soil aggregation and contribute to poor soil structure and poor water infiltration.
  - Build soil organic matter (SOM) to increase soil water holding capacity, e.g. minimize tillage; maximize organic inputs from crop growth, manure and compost.
  - Manage soils to increase water infiltration rate, e.g. minimize tillage; maximize organic inputs to increase soil aggregation; grow crops that can produce root channels for infiltration through compacted soil layers.
  - Improve drainage systems.
  - Develop on-farm and watershed-based water storage capacity.
  - Breed crops for flooding tolerance.
- Drought
  - Seed as early as possible, while still taking late spring frost risks into account, to allow crops to make use of early-season soil moisture while avoiding the hottest and potentially driest parts of summer.
  - Plant crops that are deep rooting or have a high water-use-efficiency.
  - Build SOM to increase soil water holding capacity.
  - Develop on-farm and watershed-based water storage.
  - Plan for livestock feed shortages due to poor hay and pasture yields; plan livestock water sources in times of drought.
  - Breed crops for drought tolerance.
- Heat stress on crops
  - Seed as early as possible, while still taking late spring frost risks into account, to avoid having flowering and grain filling periods coincide with the hottest part of the summer.
  - Manage soils to minimize risk of drought stress which will exacerbate the impacts of high temperatures.
  - Develop crop genetics that have improved heat tolerance.
  - Grow crops and varieties that have tolerance to heat stress e.g. corn instead of barley.
  - Plan for entirely new cropping systems if intense heat waves become the norm.

Vulnerability, Flexibility and Adaptive Capacity

Your adaptive capacity will depend on your own farm's specific context (e.g. soil type, proximity to water), your knowledge, and your capabilities to act on the options available to you (Figure 3), but also

on the health of the agricultural sector as a whole. To reduce vulnerability to extreme weather impacts on agriculture we also need to think beyond just the farm gate and specific individual actions, and consider how to build adaptive capacity across the sector. Adaptive capacity can be defined as "the presence of available resources and the ability to mobilize those resources to effectively respond to various challenging conditions in both the immediate and long-term (BC. 2012)." In other words, we need knowledge, skill and money to avoid a crash when stressful conditions hit. Knowledge, skill and financial flexibility must be available across the sector, not just on individual farms.

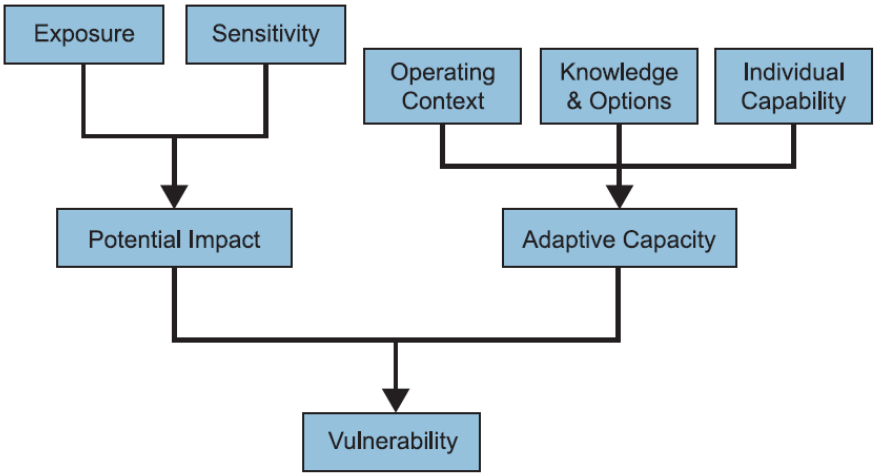

Figure 3. Linked human and biophysical factors that determine the ultimate vulnerability of agricultural systems to climate change (Marshall et al. 2010).

To increase adaptive capacity across Manitoba's agricultural region means increasing available resources across at least five areas: financial resources, physical resources, human & social resources, knowledge resources, and policy & regulatory resources (British Columbia Agriculture & Food Climate Action Initiative. 2012) (Figure 4.). The BC Agriculture and Food Climate Action Initiative published a provincial climate change risk and opportunity assessment in which the authors state, "In part because future climate conditions may be unexpected or unprecedented, managing the effects of climate change requires, above all, flexibility to address a range of potential impacts and to change course as required (British Columbia Agriculture & Food Climate Action Initiative. 2012)." Flexibility is enhanced when the above mentioned resources are available and mobilized when needed.

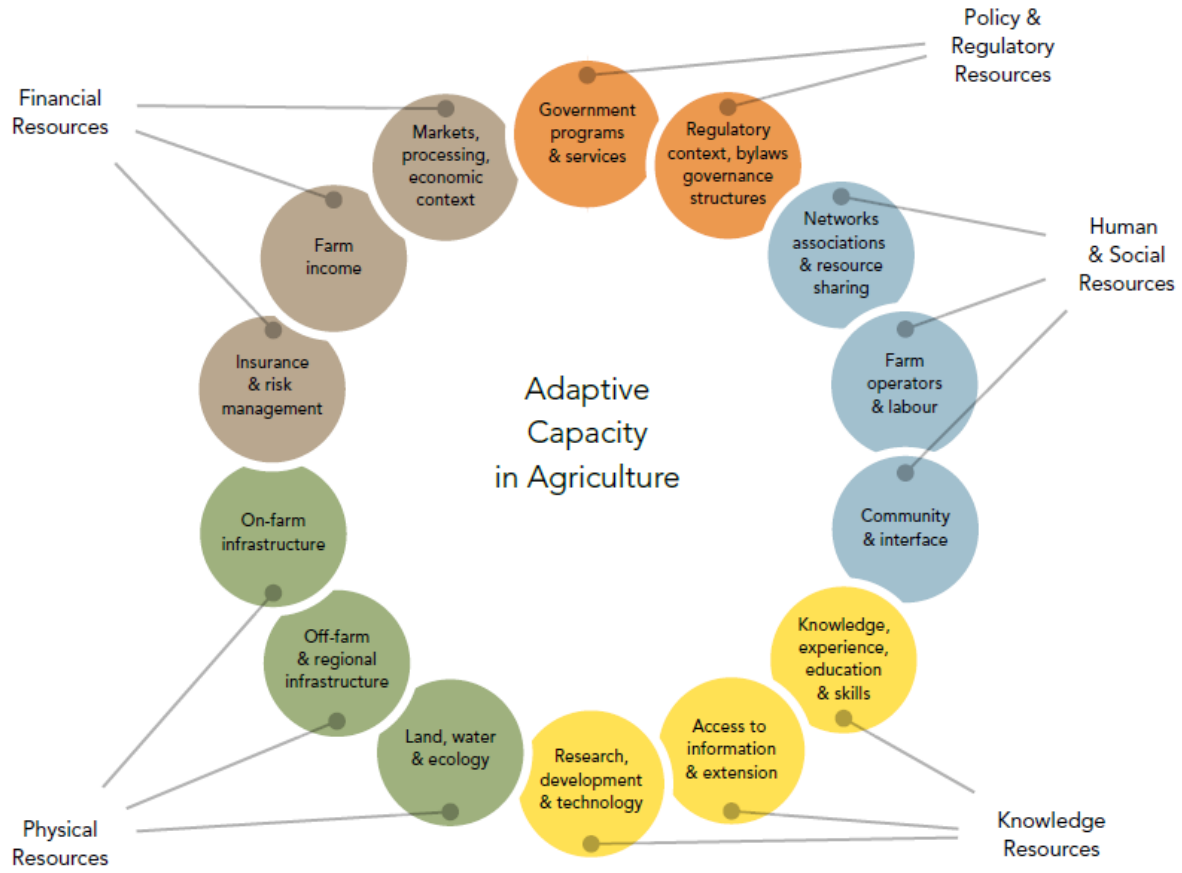

Figure 4. Elements of adaptive capacity in agriculture (British Columbia Agriculture & Food Climate Action Initiative. 2012).

Individual action is required to build adaptive capacity in agriculture; however, the ability to respond to challenging conditions can only be maximized when communities, businesses, governments and other agriculture-related institutions are also engaged. As an example, a USDA technical bulletin on climate change adaptation states, "Government policy and programs will be crucial to effective adaptation efforts as the agricultural system responds to projected increases in temperature and precipitation variability and extremes accompanying climate change that likely will be outside the range of individual, community, and institutional experience (Walthall et al. 2012)." In summary, preparing for extreme weather events in agriculture requires on-farm planning and action combined with sector-wide and society-wide planning and action.

References

British Columbia Agriculture & Food Climate Action Initiative. 2012. *BC Agriculture Climate Change Adaptation Risk + Opportunity Assessment – Provincial Report*. 66 pages. http://www.bcagclimateaction.ca/wp/wp-content/media/AdaptROseries-Provincial.pdf

Marshall, N., Stokes, C., Howden, S., Nelson, R. 2010. Chapter 15 Enhancing Adaptive Capacity, *in* C. Stokes and M. Howden (eds.), *Adapting agriculture to climate change: Preparing Australian agriculture, forestry and fisheries for the future*. CSIRO Publishing, Collingwood, Vic.

Walthall, C.L., J. Hatfield, P. Backlund, L. Lengnick, E. Marshall, M. Walsh, S. Adkins, M. Aillery, E.A. Ainsworth,C. Ammann, C.J. Anderson, I. Bartomeus, L.H. Baumgard, F. Booker, B. Bradley, D.M. Blumenthal, J. Bunce, K. Burkey, S.M. Dabney, J.A. Delgado, J. Dukes, A. Funk, K. Garrett, M. Glenn, D.A. Grantz, D. Goodrich, S. Hu, R.C. Izaurralde, R.A.C. Jones, S-H. Kim, A.D.B. Leaky, K. Lewers, T.L. Mader, A. McClung, J. Morgan, D.J. Muth, M. Nearing, D.M. Oosterhuis, D. Ort, C. Parmesan, W.T. Pettigrew, W. Polley, R. Rader, C. Rice, M. Rivington, E. Rosskopf, W.A. Salas, L.E. Sollenberger, R. Srygley, C. Stöckle, E.S. Takle, D. Timlin, J.W. White, R. Winfree, L. Wright-Morton, L.H. Ziska. 2012. *Climate Change and Agriculture in the United States: Effects and Adaptation*. USDA Technical Bulletin 1935. Washington, DC. 186 pages.
https://www.usda.gov/oce/climate_change/effects_2012/CC%20and%20Agriculture%20Report%20(02-04-2013)b.pdf