The 2017 Drought in the Canadian Prairies

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Key Messages

- The 2017 drought on the Canadian Prairies was notable because of its rapid onset and severe intensification. Conditions quickly deteriorated due to an early snow melt and below-normal precipitation in the spring. The region then faced its driest summer in 70 years resulting in significant impacts.
- Drought impacts on the agricultural sector were severe. Crops were impacted by poor germination, stunted growth, and early maturation. Drought resulted in poor pasture productions unreliable water supplies.
- In response to the drought federal and provincial governments collaborated on monitoring and developing appropriate responses. Both levels of governments established or enacted programs and policies to assist. These actions included water testing for livestock, opening land for livestock grazing, and providing assistance for uninsurable losses from wildfires.
- There is a need for increased investment in drought monitoring, analysis and planning. Drought response plans need to be improved to help guide decisions and triggers during a drought situation.

The most significant Canadian drought in the past decade occurred in the summer of 2017. The drought resulted from below-normal snowfall during the winter, a dry spring, and, in many regions, less than half of normal rainfall during the agricultural growing season. This drought was particularly notable due to its rapid onset and severe intensification. The drought hit the agricultural sector hardest, though impacts were also seen in urban infrastructure, and the tourism industry. Wildfires caused by the drought created further economic and agricultural damages. In response, collaboration between federal and provincial governments allowed for improved monitoring and resulted in drought management teams establishing policies and programs to assist agriculture producers. This report acts as a case study of flash drought as it examines the conditions that led up to the 2017 drought and its devastating impacts. The results of this case study show that there is a need for improvements to monitoring drought, information systems, and communication and collaboration between federal and provincial governments to reduce negative outcomes of future droughts.

Introduction

The summer of 2017 represents the most recent substantial drought to affect the Canadian Prairie region. Despite above normal soil moisture and adequate surface water supplies going into the winter season, abnormally low snowfall and a warm, dry spring led to rapidly intensifying drought conditions.

The agricultural sector faced the most severe impacts throughout the region; however, the 2017 drought impact went far beyond agriculture. Drought conditions continued to intensify throughout the summer with many regions recording less than half of normal rainfall during the growing season with a large region being below the 10th percentile (see Figure 1). Southern agricultural regions, especially in southern Saskatchewan, experienced rapidly deteriorating conditions throughout the spring and early summer resulting in severe drought and a wide range of impacts. Across the prairie region, no other summer as far back as 1948, had been so dry. Total rainfall in Regina from April to October was 119.3 mm compared to the previous record of 151.5 mm in 1961.[i] Agriculture, the dominant industry of this region, was the most severely impacted. Drought conditions led to heat stress in crops, accelerated crop maturation, poor grain fill, reduced livestock feed production, livestock mortality, poor water quality, and limited water availability. In addition to the agricultural impacts, wildfires, poor air quality, land subsidence, reduction of recreation and tourism opportunities, impacts to mental health among agricultural producers, and a wide range of additional economic losses were observed. Of the three prairie provinces, Saskatchewan experienced the most severe impacts and the largest extent of drought. At its peak, more than 42 percent of the province's agricultural area was experiencing drought conditions, of which 11 percent was in the D3-Extreme Drought or D4-Exceptional Drought classifications, according to the Canadian Drought Monitor. It is noteworthy, that this was the first time in 15 years that the province experienced a D4-Exceptional Drought.

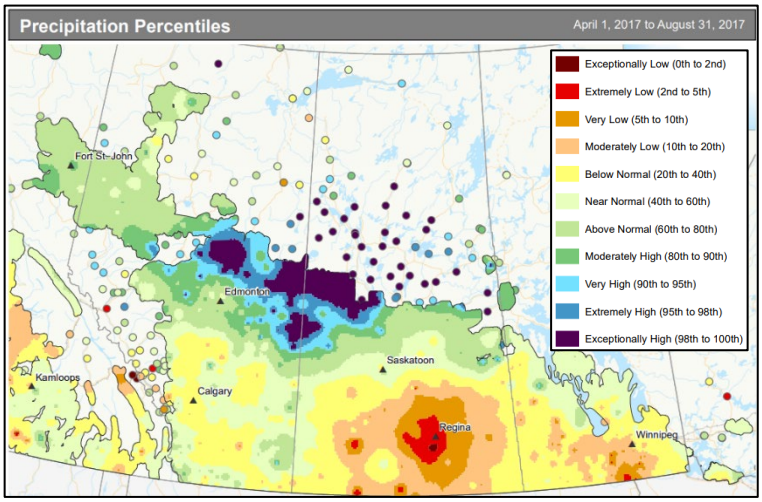

Figure 1: Prairie Precipitation Percentiles (Apr. 1 to Sept. 30) (AAFC, 2017)

This case study provides an overview of the 2017 Flash Drought in the prairie region, including the conditions that led up to the drought and the impacts resulting from this severe event. In addition, this case study provides the opportunity to evaluate and

improve monitoring, information systems, communication and improve collaboration and reduce associated risks of future drought. Although this case study will focus on the Canadian Prairies, the 2017 drought was not confined to that region. The northern central plain states, including Montana, North Dakota, and South Dakota, had exceptional drought conditions even more widespread and severe than the Canadian Prairies.

Physical and Social-Economic Characteristics of the Canadian Prairie Region

The Canadian Prairie region is the northern extent of the North American Great Plains and primarily resides within the southern portions of the three Prairie Provinces: Alberta, Saskatchewan, and Manitoba. Situated east of the Rocky Mountains, west of the Canadian Shield and south of the Boreal Forest, this region is a vast grassland plain with various mountain-fed streams running from the west (see Figure1). The southern Prairie region largely consists of agricultural land and grasslands and contains more than 80% of Canada's cropland and rangeland.[ii]

Figure 2: Canadian Prairie Region (NRCan)

Situated in the interior of the continent, the Canadian Prairies are situated far from the moderating effects of the oceans, leading to weather and climate extremes. Being a semiarid continental climate, the region experiences large daily and annual ranges of temperature and precipitation, four distinct seasons, and a relatively short growing season. The Prairie region is positioned in the rain shadow of the Rocky Mountains and is characterized by hot, dry summers and long cold winters.[iii] Temperatures can range from -40°C in the dead of a northern winter to +35°C during summer in the southern regions.[iv] During the summer season, maximum temperatures exceed 30°C on an average of 10 to 20 days in the southern Prairies.[v] Annual average precipitation in the Prairie region is highly variable from east to west, with eastern Prairie region receiving almost twice as much as western regions. On average 450 mm is received however south western portions of the region typically receive far less, with annual averages between 300 and 350 mm.[vi] Due to high variability in annual precipitation, droughts are a recurring feature in the Canadian Prairies. [vii]

The Primary industries in the region include agriculture, consisting of livestock, cultivating crops, and production of oil.[viii] Primary Agricultural crops include Wheat, Barley, Canola and livestock is primarily beef cattle. The Canadian prairies are very important to the

agricultural sector making up 80 percent of the country's crop including approximately 77.3 million acres of farmland.[ix] The prairie provinces of Alberta, Saskatchewan and Manitoba, which collectively support just over 80% of the Canada's 13 million cattle.[x] The value of farm assets in the prairie provinces was estimated at $280 billion in 2016, Those assets generated gross receipts of $38.3 billion in 2016. accounted for close to 4 percent of Canada's total GDP in 2016.[xi] Due to the high economic dependence on agriculture, drought can have devastating impacts in the Prairies.[xii]

Evolution of the 2017 Drought

By the end of the 2016 growing season, the Canadian Prairies had received abnormally high precipitation. With most areas receiving twice the normal September-October precipitation, any moisture deficits were resolved, and soil moisture and surface water supplies were at or near capacity by the time of freeze-up. Favorable soil moisture and water supply conditions going into the winter provided optimism for good soil moisture and water availability for agricultural production in the spring.

The 2016-17 winter season was abnormally dry throughout much of the southern Prairies. Despite being the driest season in the Canadian Prairies, with approximately 15 percent of the region's annual precipitation, the winter season plays an extremely important role in agriculture. Precipitation in the winter both recharges soil moisture and surface water supply and protects soil moisture and fall-seeded crops from the extremely low temperatures.

During the spring of 2017 moisture levels and surface water supplies were adequate due to fall precipitation. However, an early snow melt exposed the moisture-rich soils to drying conditions much earlier than normal. With soil exposed to drying winds and the daily freeze-thaw cycle, surface soil moisture quickly diminished. Below-normal precipitation through April continued through southern regions of Manitoba and Saskatchewan. Despite deteriorating conditions, good subsoil moisture and surface water supplies persisted. At the end of April, the southern Prairies continued to be drought-free with only a very small area classified as abnormally dry (see Figure 3).

By the time soil temperatures had risen enough to begin agricultural seeding, many regions' soils had dried considerably, leaving producers reliant on scattered precipitation for germination. Precipitation across much of the southern prairies was below 60 percent of normal with large regions in southern Saskatchewan below 40 percent of the normal. 2017 May 1 to June 30 precipitation rated among the 10th driest in many southern prairies locations. Compare to the historical record, southwestern southwester Manitoba rated as the 4th driest May-June on record. However, at the end of June, the Canadian Drought Monitor had rated very little of the region in drought; just 7.5 percent Moderate Drought-D1 and 1.5 percent in a Severe Drought-D2 (see Figure 3).

Drought conditions continued to intensify throughout southern and central Saskatchewan, southern Alberta, and to a lesser degree Manitoba in July with record low monthly

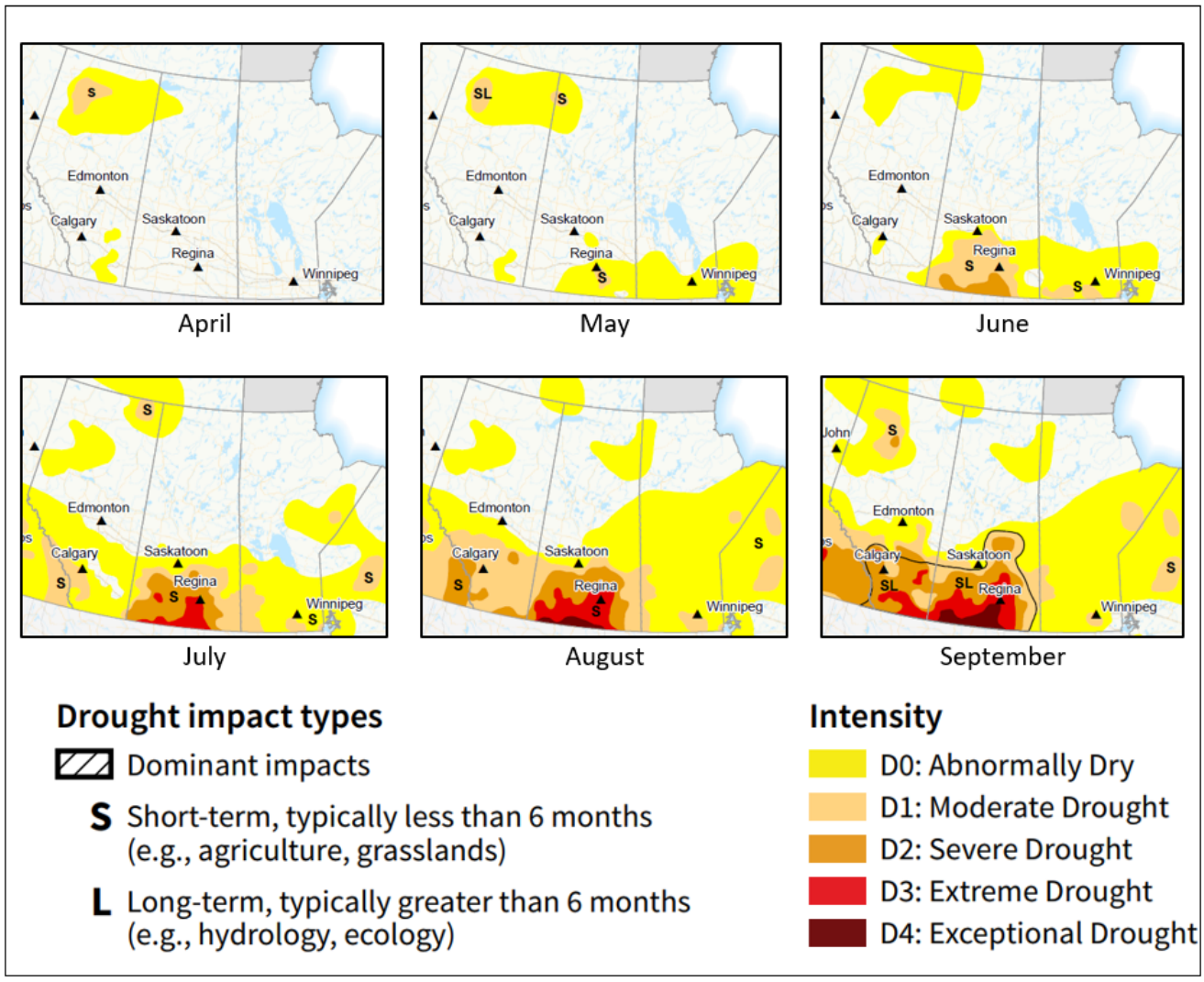

Figure 3 - Canadian Drought Monitor Assessments (April - September) (AAFC, 2017)

precipitation. Large regions of the southern prairies recorded less than 10 mm of precipitation, representing 5 to 10 percent of normal (see figure 4). Throughout July drought impacts emerged as a significant concern to agriculture and urban regions. The month of August continued to be dry in most regions, with below 40 percent of normal precipitation. Overall, the southern Prairies faced their driest summer in 70 years, with many areas recording less than half the normal rainfall during the growing season.[xiii] As of Augusts 31, the Canadian Drought Monitor rated over 68 percent of the Prairie agriculture landscape as abnormally dry or drought representing 1.3 million square kilometres.

Dry conditions continued to intensify throughout southern Alberta and Saskatchewan into fall with high winds fanning localized wildfires across southern Alberta and Saskatchewan. Manitoba received some relief with late summer and early fall precipitation helping improve drought conditions though it was not sufficient to recharge subsurface soil moisture or alleviate drought concerns. As a result, much of the southern Prairie region ended the growing season and entered winter with significant moisture deficits and in a severe drought classification according to the Canadian Drought Monitor.

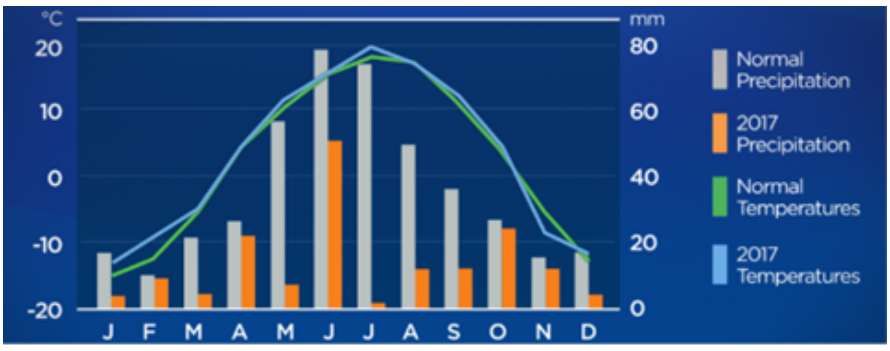

Figure 4 – 2017 precipitation and temperature averages compared to normal for Regina,SK. (Lizée, 2018)

Impacts of the 2017 Drought

Although drought impacts were not limited to the agriculture sector, this sector felt the largest and most severe impacts. Agricultural regions throughout the southern prairies, especially in southern Saskatchewan, experienced a wide range of drought impacts to both crops and livestock.

Crop Impacts

Due to the early spring, a limited snowpack, high temperatures, and dry conditions, seeding of crops in the southern portions of the Prairie region was completed well ahead of the five-year average. Continued dry conditions, however, resulted in poor germination and uneven sprouting. Many producers were forced to reseed and hoped for additional precipitation. Uneven crop development resulted in crops growing at different stages within the same field, making it hard to time herbicide and fungicide application as well as harvest. Warm dry condition resulted in stunted crops and early maturity in many regions. Harvest was completed well ahead of the five-year average, across the southern Prairies, as a result. Despite drought conditions, overall crop production fared better than initial expectations, given the severity and extent of drought across the regions. The abnormally high 2016 fall precipitation played a critical part in ensuring the impacts of drought through the 2017 season were mitigated. Crops that were established early were able to use timely rains to develop rooting down to the subsoil moisture and performed much better than originally predicted.

Livestock Impacts

4By the end of June, producers were noticing dry pastures and below normal first cut hay, which resulted in regional concerns for feed availability. Many producers in the southern portion of the prairie agricultural zone were not able to get a second cut of hay in areas that traditionally provide two cuts each year. Drought also impacted the nutritional value of pasture and forage crops. To increase nutrition intake, producers were forced to provide supplemental feed resulting in additional labour and expense for livestock producers. As the summer progressed, low hay yields and poor pasture productivity resulted in declining feed availability and rising costs for feed. The price of feed across the Prairies rose to over $200 a ton, double the 2016 average (Manitoba Agriculture Services Corp). Producers unable to find affordable additional feed supplies or relocate their livestock to regions with better pasture conditions were forced to reduce their herds to manage feed supplies through the fall and winter months. At the end of September, forage supply shortages were widespread across Alberta and Saskatchewan (see figure 5).

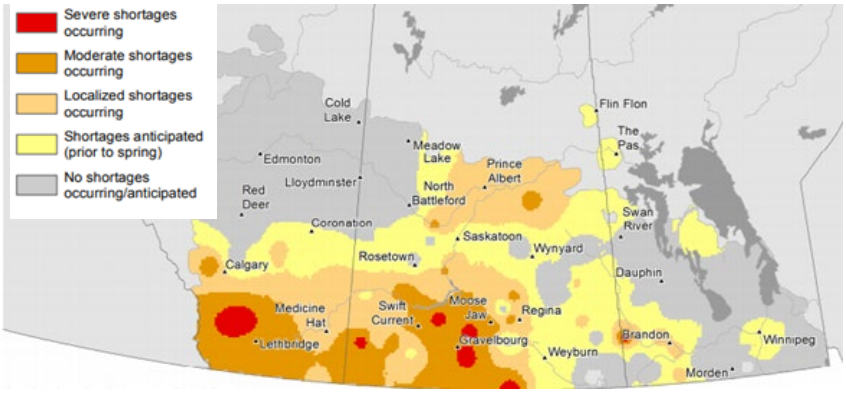

Figure 5: Livestock Feed shortages due to Drought as of Sept. 30, 2017. (AAFC)

In addition to feed supplies, heat stress, water scarcity, and water quality quickly emerged as issues for Prairie livestock producers. Water supplies that were previously reliable were negatively affected, and several failed to meet the requirements. On July 7, more than 200 cows and calves were found dead in a pasture in southwestern Saskatchewan as a result of water salinization (salt poisoning), heat stress and dehydration. Sulphate levels in the water were reported to be more than three times the lethal concentration.[xiv] Following this discovery, the province recommended producers have their water in stock ponds tested resulting in a high demand on testing labs in the province and producers hauling water to ensure livestock health.

Wildfire

Late in the summer, abnormal hot, dry weather persisted resulting in an abnormally high number of wildfires on rangeland in Alberta and Saskatchewan. These fires destroyed homes, agriculture machinery and infrastructure, damaged crops, reduced feed supplies,

and resulted in significant livestock loss. One extraordinary large wildfire on October 17, in southwestern Saskatchewan, spread quickly, fanned by strong winds, and burned more than 360-square kilometers (over 85,000 acres) of mixed-used farmland.[xv] Approximately 750 cattle were also killed for an estimated loss of about $1 million.[xvi] The wildfire resulted in hundreds of people being evacuated from their communities, resulting in serious injuries to two men and the death of one individual while fighting the fire. In addition to this wildfire, many others caused devastating impacts for ranchers, farmers, and small communities across the southern Prairie region.

Urban impacts

The 2017 drought did not just impact agriculture as urban areas were also significantly impacted. In some regions, groundwater sources were being depleted and clay-rich soils contracted and cracked. Many urban and rural centres issues water restrictions early summer to conserve limited water resources. This shifting of the ground caused significant damage to buildings' foundations. In southern Saskatchewan this resulted in serious damage to electrical services and over 1,200 electrical supply repairs were required.[xvii] In some cases, underground electrical wires were pulled from electrical meters due to shifting soils, resulting in home fires.

Tourism Impacts

With Provincial fire bans in place and off-road vehicle bans through much of the southern Saskatchewan and Alberta local tourism was significantly impacted. Many campgrounds and recreational areas closed for a portion of the season due to wildfire concerns further impact the economy in rural areas. By the end of august all federal land and provincial parks were closed in Saskatchewan due to fire concerns.

Drought Response

Concern for the rapidly developing drought in 2017 started throughout June and early July by both provincial and federal experts. As drought severity and extent continued to grow and impacts expanded through July, it was clear that governmental response was required. Agriculture and Agri-Food Canada (AAFC) has the federal mandate in Canada to monitor and report on drought conditions in and out of agricultural regions. However, agriculture is a shared jurisdiction with the provinces, and individual provinces each have some role in monitoring and response activities. Agriculture Canada also collaborates with other federal departments in their monitoring efforts including Environment and Climate Change Canada and Natural Resources Canada.

Within the federal drought mandate, AAFC provides continuous near-real-time monitoring and assessments of weather and climate conditions that impact the agricultural sector. As part of their Drought Early Warning System (DEWS), the Department has a wide range

of monitoring activities including the use of climate station data, satellite imagery, various models and a network of impact reporters. All the products produced from the Department's monitoring activities are provided to producers and the industry through the Departments Drought Watch website. The suite of map products includes climate parameters at the various temporal and regional scales, drought indices, satellite surface moisture, satellite derived vegetation production and extreme weather forecasts. The collection of agroclimate related risks from producer and industry representatives provides valuable information not found in other data sources. This information is critical to understand the impacts that producers are facing. when these reports are mapped, they provide the ability to see the extent and severity of the issues facing the agricultural sector. In addition, the Department's National Agroclimate Information Services collaborated with affected provinces to gather addition information and provide updates and information to their provincial monitoring or policy committees.

Each month the data and information from all the monitoring activities is combined and analysed to develop a comprehensive drought assessment for Canada. The Canadian Drought Monitor follows the Drought Monitor process first established by the United States and later adopted by for use in other countries.[xviii] The process uses a convergence of evidence approach to produce one drought map for the country representing both short term and long-term impacts. The classification is made up of a 5-class scale from D-0 Abnormally Dry to D-4 Exceptional Drought based on the historical percentile classes. These Drought assessments are widely used by federal and provincial agencies as well as media to communicate drought conditions across the country.

In 2017, AAFC worked with provincial drought management and policy teams to help develop an appropriate response to help producers through the severe drought conditions. The Livestock Tax Deferral provision provided early and widespread eligibility (see figure 6). The Livestock Tax Deferral provision allows farmers who sell part of their breeding herd due to drought or flooding in prescribed regions to

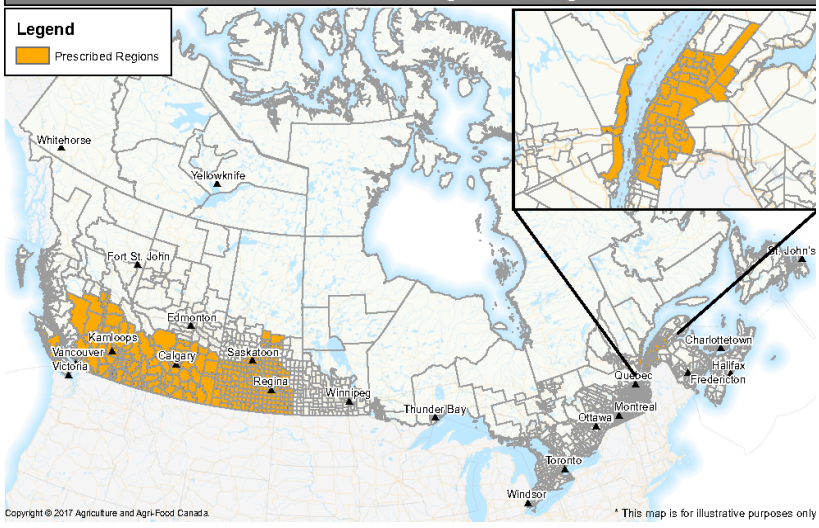

Figure 6 – Livestock Tax Deferral Prescribed Regions (AAFC.

defer a portion of sale proceeds to the following year.[xix]

In addition, provincial governments put in place policies and programs to assist with local needs. Crop, forage, and livestock specialists in all three provinces increased extension efforts for producers with articles, radio interviews, town hall meetings, etc. to provide information on water quality, grazing, feed supply, and crop production. The province of Saskatchewan provided free water testing for livestock producers through the provincial lab and local agriculture offices. Saskatchewan opened 90,000 acres of Fish and Wildlife Development Fund lands for livestock grazing. The Saskatchewan government announced that they would match donations of up to $100,000 for producers affected by wildfires. Also, the Provincial Disaster Assistance Program (PDAP) provided assistance for impacts to grazing and feed supply caused by wildfires. Typically, PDAP does not provide assistance for wildfire losses because most fire losses are insurable, however tame and native grazing lands are not insurable.

Conclusion

Although droughts are not uncommon in the region, the drought of 2017 was especially noteworthy due to its rapid onset and severe intensification. The defining characteristic of the 2017 drought onset was the early spring and rapid decline in soil moisture. Other factors, including stronger-than-normal spring winds, played a secondary role. Grasses and other forage species, which dominate much of the region, suffered from the lack of spring precipitation leading to reduced forage production and a decline in pasture and range conditions for summer grazing.[xx] Water supplies faced localized quality issues from an increase of nitrates requiring significant monitoring and testing. Although crop production was impacted locally, provincial yields show only small reductions from the average. This is largely due to the significant soil moisture reserves from the 2016 fall rain. Fall wildfires were an unusual impact of the 2017 drought. Although wildfires are not uncommon in the spring and fall in the southern prairies, the number and destructiveness of fires during the harvest season in 2017 was much higher than previous drought years.

Federal and provincial governments responded with a variety of activities and programs directed at the most impacted regions recognizing the extreme impacts on the livestock producer's community. The unusual rapid onset of this drought provided federal and provincial drought managers with a number of important lessons including highlighting potential areas for improved monitoring and response. It is acknowledged that there needs to be increased investment in monitoring networks, analysis and drought planning. The National Agroclimate Information Service has recognized the need to look beyond traditional drought indicators and develop and incorporate indicators that utilize

evaporative stress, evaporative demand and vegetative health to improve advanced warning. This drought, more than other recent droughts, reinforced the need to develop relationships and networks with federal and provincial governments as well as adjacent state officials to ensure that there is good collaboration and communication during crisis situations. Finally, the 2017 drought highlighted the need to improve or update drought response plans to help guide decisions and triggers during a drought situation to ensure that the various administrations know their roles and avoid causing unnecessary delays in programs or actions.

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