
MANITOBA

Economic Impacts of the 2021 Drought on Crop Production in Manitoba



Summary

Drought is one of the most expensive natural disasters in Canada, and the agriculture sector is particularly vulnerable to it. Many studies suggest that droughts will become more frequent and severe in the future. The expected increase in the frequency and intensity of drought events reinforces the importance of improving the quality and reliability of impact assessments.

Lack of information on drought costs (economic, social and environmental) could lead to under investment in drought mitigation actions. Proper assessment of drought costs is essential to develop effective and sustainable drought mitigation strategies. This analysis will contribute to this effort by shining light on the economic effects of the 2021 drought on crop production in Manitoba.

With record high temperatures and low precipitation, Manitoba experienced severe to exceptional drought conditions throughout most of its agricultural region in 2021. The drought led to a significant reduction in crop yield, on average, ranging from 22 to 37 per cent at the provincial level and from 10 per cent to over 70 per cent at the rural municipality level compared with the previous year. On the other hand, on average, all major field crops saw a significant price increase in Manitoba, ranging from 10 to 45 per cent. Although crop prices were very high, farmers with grain contract may not fully benefit from the price increase observed in 2021 as portions of their crops may have been contracted at much lower prices. Some farmers may have to buy out their grain contracts due to drought-related production shortfalls.

The economic effects of the 2021 drought were estimated in two steps. The first involved estimating the direct effects of the drought based on Statistics Canada's data on harvested acres, crop yield, and crop prices. The second step of the analysis involved estimating the indirect impact of the drought on total crop output, employment, gross domestic product (GDP), and tax revenue using the Manitoba Bureau of Statistics input-output model.

The estimated direct economic effect of the drought on crop production is \$75 million loss in crops sales (close to \$100 million if the indirect effects are included), \$47 million in total nominal GDP, and \$9 million loss in municipal, provincial and federal taxes collected in Manitoba. The Manitoba economy also lost an estimated 267 jobs due to the drought. Elevated crop prices in 2021 helped to partially offset the effects of the drought, specifically related to the sharp decline in harvested crop volumes.

If the 2021 crop prices had remained within the previous five-year average prices, the direct loss related to the drought would have been estimated at \$1 billion in crop sales, \$663 million in GDP, and \$133 million in municipal, provincial and federal tax losses. While the higher crop prices might have helped farmers to minimize losses due to the drought, a significant portion of drought cost is transferred to consumers through higher food prices. Beyond the financial burdens, drought creates stress for farmers, which can lead to mental health problems including anxiety, depression, and psychological instability and distress.

The drought significantly increased crop insurance and recovery costs to governments. The cost of the crop insurance program in Manitoba increased by more than six-fold from \$62 million in 2020 to \$469 million in 2021 calendar year. The analysis provided in this report demonstrates the importance of continued investment in drought risk reduction strategies. Risk reduction involves taking risk mitigation actions in advance of the drought with the objective of either reducing exposure to drought or increasing the capability to withstand the negative impact of the drought. These risk mitigation strategies are generally related to soil and water conservation, crop management, plant breeding and infrastructure development. The Government of Manitoba should continue to invest in risk management strategies and drought monitoring, analysis and planning to mitigate the impacts of future droughts.

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1. Introduction

Droughts are one of the world's most significant natural hazards with major economic, social, health, and environmental effects¹. Agriculture is considered to be one of the most vulnerable sectors to drought. The Intergovernmental Panel on Climate Change (IPCC) Assessment Report² indicates an increased frequency, intensity and severity of drought as manifestations of climate change becoming more apparent. The effects of drought increases along with the global demand for food and water. Extreme weather events such as droughts, excess moisture, and heat waves in major crop producing regions can lead to a substantial decrease in crop yield affecting crop prices and both regional and global food security. The Canadian agricultural sector has experienced many drought years over the past 100 years. As they are sheltered by major mountain ranges, the Canadian Prairies are more susceptible to drought generally receiving little precipitation but with high variability³.

The cost of these droughts to the Canadian economy is significant. Farm income dropped by 97 per cent in the prairie provinces between 1928 and 1932 while Canada's agricultural export decreased by 67.8 per cent during the same time⁴. The estimated economic cost related to the 1979 and 1988 droughts across the prairie provinces reached \$3.4 billion and \$4.1 billion, respectively. The 2001 and 2002 droughts led to a \$3.6 billion loss of agricultural production, a \$5.8 billion drop in Canada's GDP, and a loss of over 41,400 jobs across the country over two years⁵. The prairie provinces accounted for 78.6 per cent (\$4.5 billion) of the GDP loss due to the 2001 and 2002 droughts. According to the Institute for Catastrophic Loss Reduction's *Canadians at Risk* report (2010)⁶, drought was responsible for five out of the ten most expensive Canadian natural disasters that occurred between 1938 and 1998, accounting for 65 per cent of the \$26.2 billion damage related to natural disaster during that period.

The prairie provinces experienced yet another significant and widespread drought in 2021. The objective of this report is to assess the direct economic effects of the 2021 drought on crop production, and the resulting total economic impact on Manitoba's economy. A better understanding of how drought affects the economy will help policy makers to make decisions that support future drought mitigation strategies.

The remainder of report is organized into six sections. Section two highlights the 2021 drought in the context of some of the major historical droughts in Manitoba and Western Canada. Section three provides the summary of the 2021 drought's effects on crop yield and the changes in crop prices. Section four presents the methodology used in the analysis, and section five presents the result of the economic impact analysis. Section six highlights the provincial business risk management program (AgrilInsurance) while the final section provides some discussions and conclusions.

¹ Wheaton E., Kulshreshtha S., Wittrock V., and Koshida G. 2008. Dry times: hard lessons from the Canadian drought of 2001 and 2002. *The Canadian Geographer*, pp 241-262.

² [IPCC AR6 WGIII Full Report.pdf](#).

³ Yusa A., Berry P., Cheng J., Ogden N., Bonsal B., Stewart R and Wald R. 2015. Climate Change, Drought and Human Health in Canada. *International Journal of Environmental Research and Public Health*. ISSN 1660-4601.

⁴ Cherneski P. 2018. The impacts and costs of drought to the Canadian Agriculture Sector. [Slide 1 \(icidonline.org\)](#).

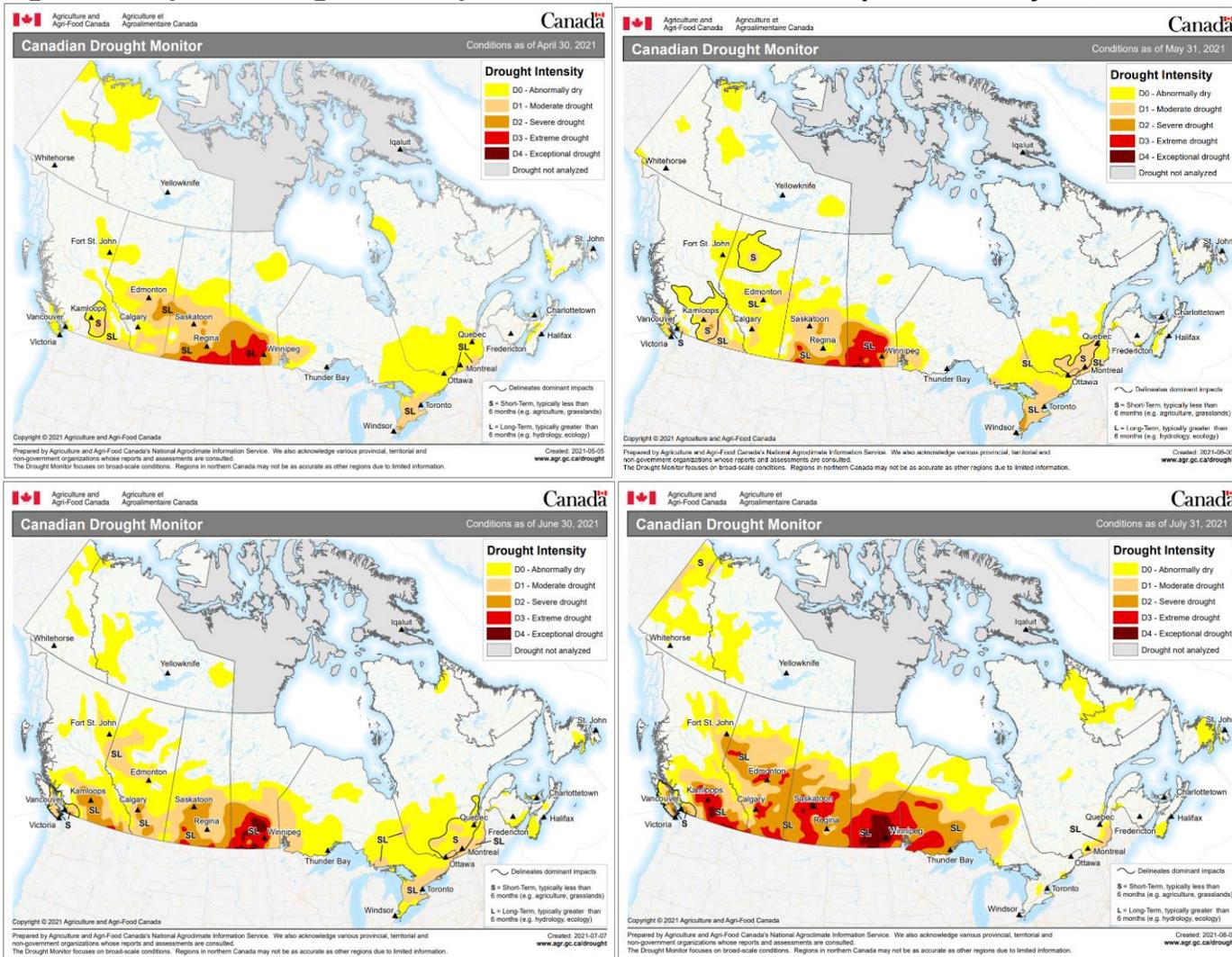
⁵ Wheaton E., Kulshreshtha S., Wittrock V., and Koshida G. 2008. Dry times: hard lessons from the Canadian drought of 2001 and 2002. *The Canadian Geographer*, pp 241-262.

⁶ Institute for Catastrophic Loss Reduction (ICLR). 2010. *Canadians at Risk: Our exposure to natural hazards* ([Layout 1 \(iclr.org\)](#))

2. Highlights of the 2021 Drought and Other Major Historical Droughts in Western Canada

With record high temperatures and very low precipitation in 2021, Manitoba experienced extreme drought conditions throughout most of its agricultural regions. A greater portion of the agricultural region in Manitoba was already experiencing dry conditions in April and May of 2021, well before the crop planting season. As the crop growing season progressed, severe to extreme drought conditions expanded to more areas across the province. During the months of May, June, and July in 2021, most of the agricultural regions in Manitoba experienced moderate to severe dry conditions with some pockets of extremely dry conditions in the Interlake and eastern regions (Figure 1). At the end of July 2021, almost all of Manitoba's agricultural regions were classified as extreme drought conditions (a 1 in 20-50 year event) or exceptional drought conditions (a 50+ year event)⁷. While the rain in August 2021 helped to improve conditions slightly, drought conditions persisted as almost the entire agricultural region in Manitoba remaining under extreme or exceptional drought conditions at the end of August 2021. The extreme drought conditions forced some cities and rural municipalities including the cities of Morden and Winkler, the rural municipalities of Stanley, Armstrong, and St. Laurent to declare a State of Emergency in 2021.

Figure 1. Maps of Drought Development Across Canada from April 30 to July 31, 2021.



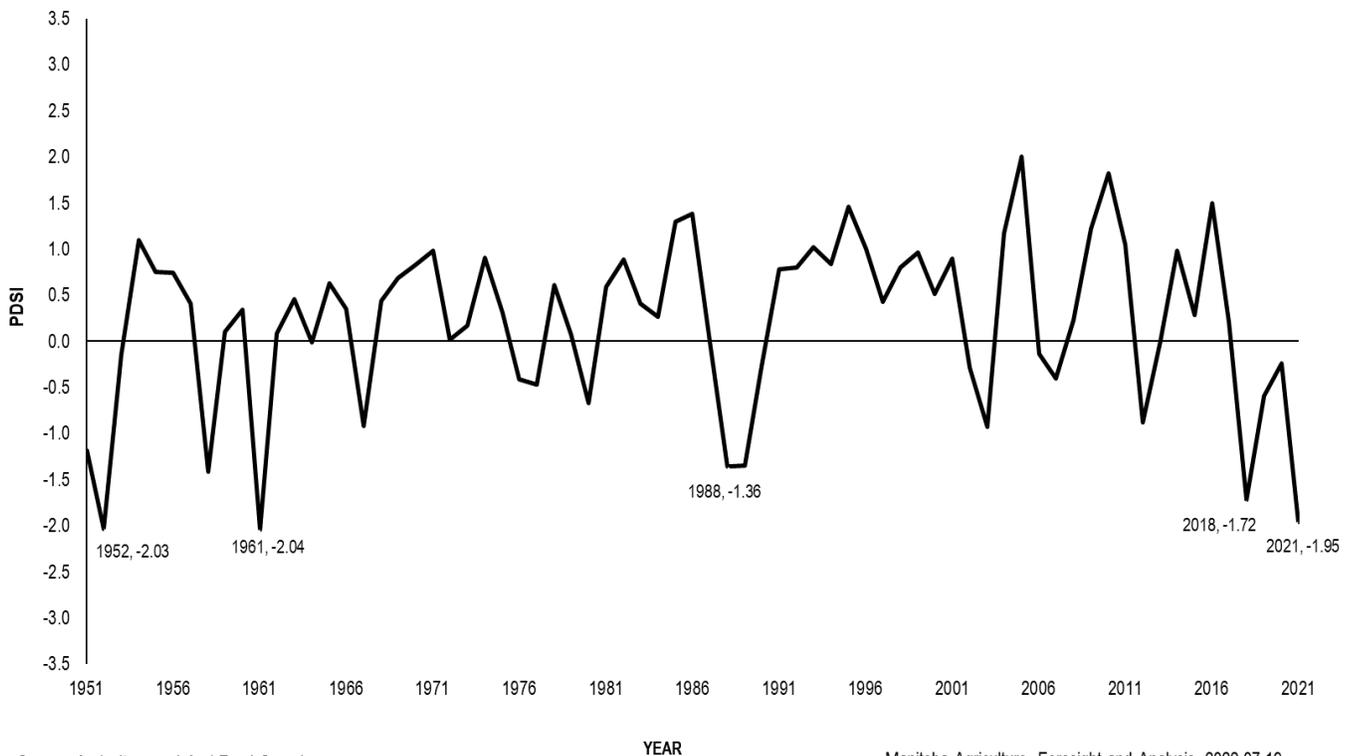
⁷ [drought_conditions_report_july_2021.pdf \(gov.mb.ca\)](https://www.gov.mb.ca/drought/drought_conditions_report_july_2021.pdf).

The 2021 drought was comparable to some major historical droughts. Over the last 100 years, several extensive long-duration droughts with severe economic impacts have occurred in 1930s, 1960s, 1980s, and more recently in the early 2000s. The Palmer Drought Severity Index (PDSI)⁸ data obtained from the Agriculture and Agri-Food Canada for 12 weather stations from 1951 to 2021 was used to identify the major historical drought years across the different regions in Manitoba. The drought years identified based on the PDSI values are mostly consistent with the drought years indicated in the published drought impact literature.

The PDSI index is usually shown as positive values for above normal soil moisture and negative values for below normal soil moisture where the PDSI value typically ranges from -4 (extremely dry) to +4 (extremely wet)⁹. A PDSI value of -3.0 or lower represents a moderate to severe drought condition while a value -4.0 or lower represents an extreme drought condition¹⁰.

Based on the average PDSI value from the twelve weather stations across Manitoba, since 1951, 2021 was the third driest year following 1961 and 1952. Among the 12 stations, in 2021, the lowest PDSI was recorded at the Morden station (-3.25) followed by Selkirk (-3.24), Swan River (-3.18) and Winnipeg Forks (-2.99). The year 2021 was the driest at the Winnipeg and Selkirk stations since 1951 while it was the second and third driest year at the Morden and Swan River Stations. The station level PDSI values indicate the regional variation in temperature and rainfall distribution. According to the PDSI value, some of the wet years in Manitoba were 1995, 2005 and 2011. The average PDSI value for twelve weather stations¹¹ and PDSI for four individual stations across Manitoba are present in Figure 2 and 3 below.

Figure 2. Average PDSI values for 12 weather stations across Manitoba.



Source: Agriculture and Agri-Food Canada

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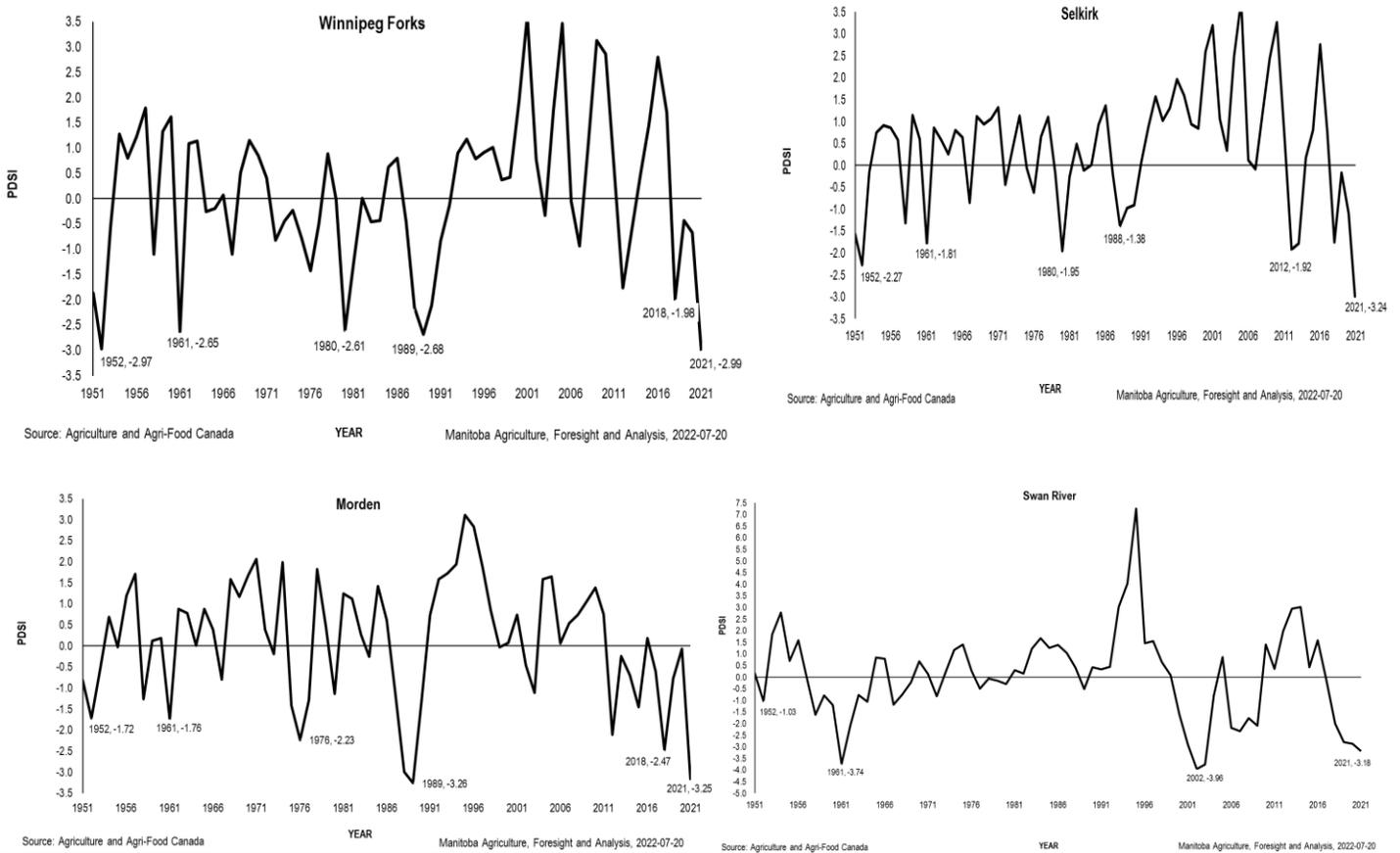
⁸ The PDSI uses precipitation and temperature data to study moisture supply and demand using a simple water balance model and provides a good indication of a meteorological drought⁸ at a given location and over a given time period.

⁹ [Palmer Hydrological Drought Index - Open Government Portal \(canada.ca\)](https://open.canada.ca/data/graphic?table=1466&tableContext=1466)

¹⁰ [Canadian Prairie Drought: A Climatological Assessment \(alberta.ca\)](https://www.alberta.ca/canadian-prairie-drought-a-climatological-assessment.aspx)

¹¹ The stations are: Brandon, Dauphin, Emerson, Fisher Branch, Winnipeg Forks, Morden, Selkirk, Swan River, Pilot Mound, Sprague, and Malta.

Figure 3. PDSI Values at the Winnipeg Forks, Selkirk, Morden, and Swan River Stations.

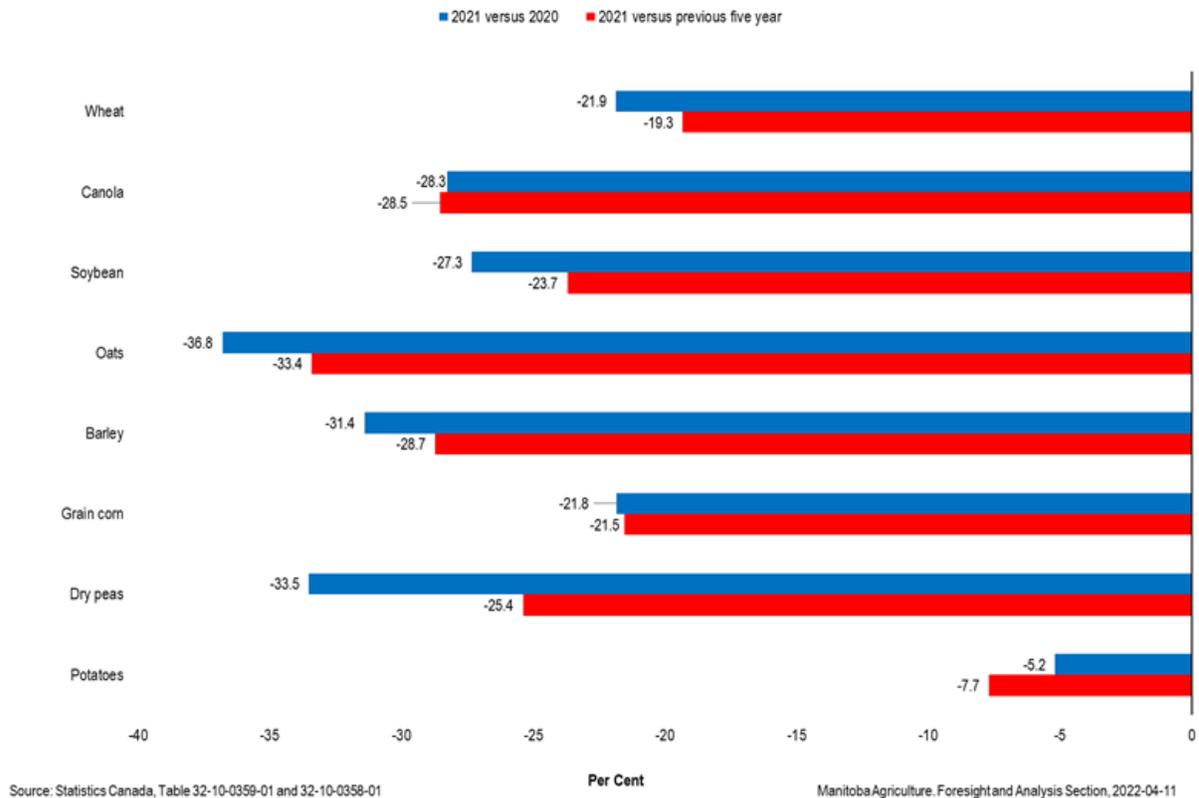


3. Drought effect on Crop Yield in Manitoba

3.1 Change in Crop Yield per Acre

The 2021 drought led to a significant decline in crop yield in Manitoba. In 2021, oats, dry peas, and barley showed the largest decline in yield per acre compared to the previous year. Oats yield declined by 36.8 per cent, dry peas by 33.5 per cent, and barley by 31.4 per cent. Manitoba's top crops also showed large decline in yield where canola yield declined by 28.3 per cent, wheat by 21.9 per cent and soybean by 27.3 per cent. All the major field crops have shown more than 21.8 per cent drop in yield per acre in 2021 compared to 2020. Among the major field crops, compared to the previous five-year average, oats (33.4 per cent), canola (28.5 per cent), and barley (28.7 per cent) showered the largest decline in yield per acre. Alberta and Saskatchewan observed even more severe crop yield decline due to the drought in 2021. The overall percentage change in total crop production volume corresponds to the per cent decline in yield per acre. Figure 4 shows the changes in average yield per acre for major field crops in 2021 compared to 2020 and the previous five-year average (2016-2020).

Figure 4. Per Cent Change in Average Yield per Acre due to the Drought in 2021



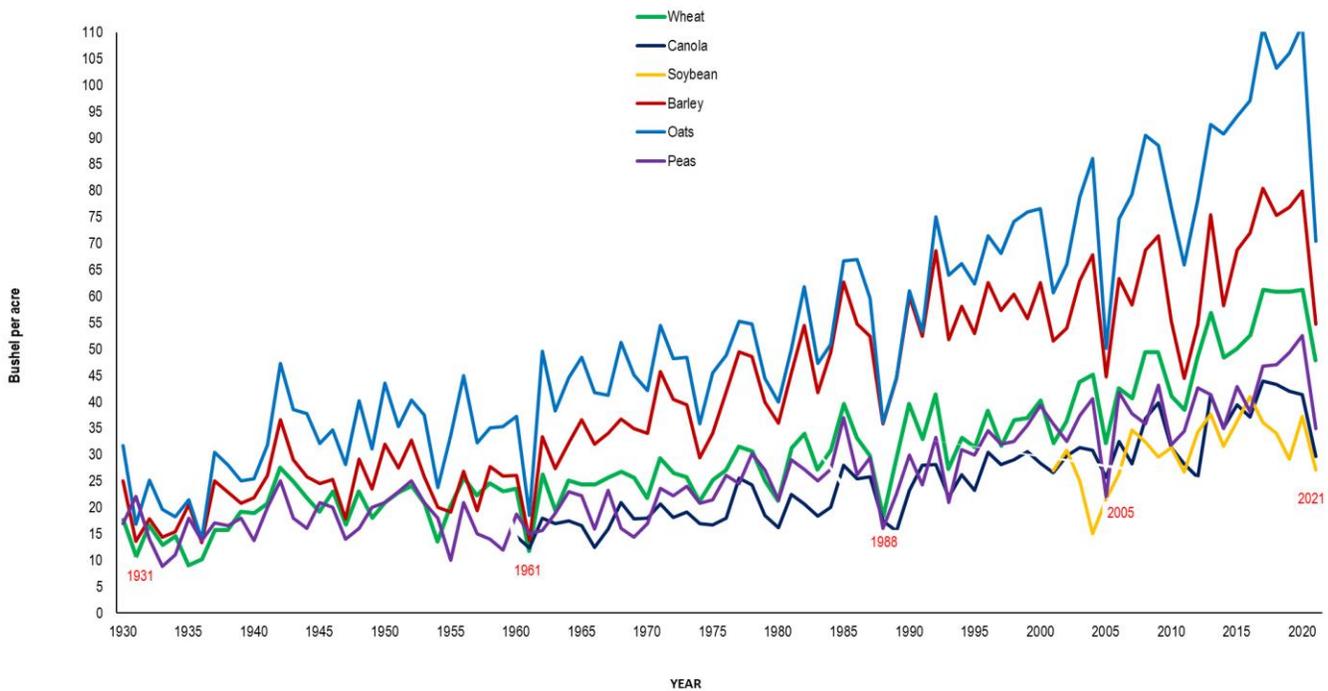
The crop yield decline in 2021 is comparable to major historical drought years. The droughts in 1931, 1961, and 1988 led to a significant crop yield reduction similar to or higher than the 2021 drought, ranging from 15 to 50 per cent. While the multi-year drought that occurred in 1999 to 2002 had a significant effect on Alberta and Saskatchewan, it had less impact on crop production in Manitoba.

Over the last 80 years, the largest drop in wheat yield due to drought occurred in 1961 where average wheat yield per acre dropped by 50.4 per cent compared to the preceding year. The 1931 and 1988 droughts caused the second (39.5 per cent) and third (38.8 per cent) largest drops in wheat yield per acre on record since 1930. The 2021 drought led to the fifth largest decline in wheat yield on record during the same period where wheat yield decreased by 21.9 per cent from 61.3 bushel per acre in 2020 to 47.9 bushels per acre in 2021.

For canola, the largest yield decline due to drought occurred in 1988 where yield per acre decreased by 32.2 per cent compared to the year before. The drought in 2021 led to the second largest yield decline in canola since 1930, where yield declined by 28.3 per cent from 41.4 bushels to 29.7 bushels per acre. As soybean is relatively a recent introduction to Manitoba, data on yield per acre is only available since 2001. The 2021 drought caused the second largest drop in soybean yield per acre since 2001. In 2021, soybean yield declined by 27.3 per cent from 37.3 bushels to 27.1 bushels per acre from the previous year. Similar to wheat, the largest barley and oats yield decline occurred in 1961 followed by 1931. The 2021 drought caused the fifth and sixth largest decline in oats and barley yield per acre on record since 1930, respectively. The 1988 drought had the largest impact on dry peas yield where yield per acre decreased by 45.2 per cent compared to the yield level in 1987. The dry pea yield decline in 2021 was the sixth largest on record since 1930.

Figure 5 shows the effects of the major droughts on crop yield for the main field crops in Manitoba. The wet conditions during the cropping seasons of 1995, 2005 and 2011 also caused significant yield reductions in most crops.

Figure 5. Trends in Crop Yield and effects of Droughts on Yield, 1930-2021



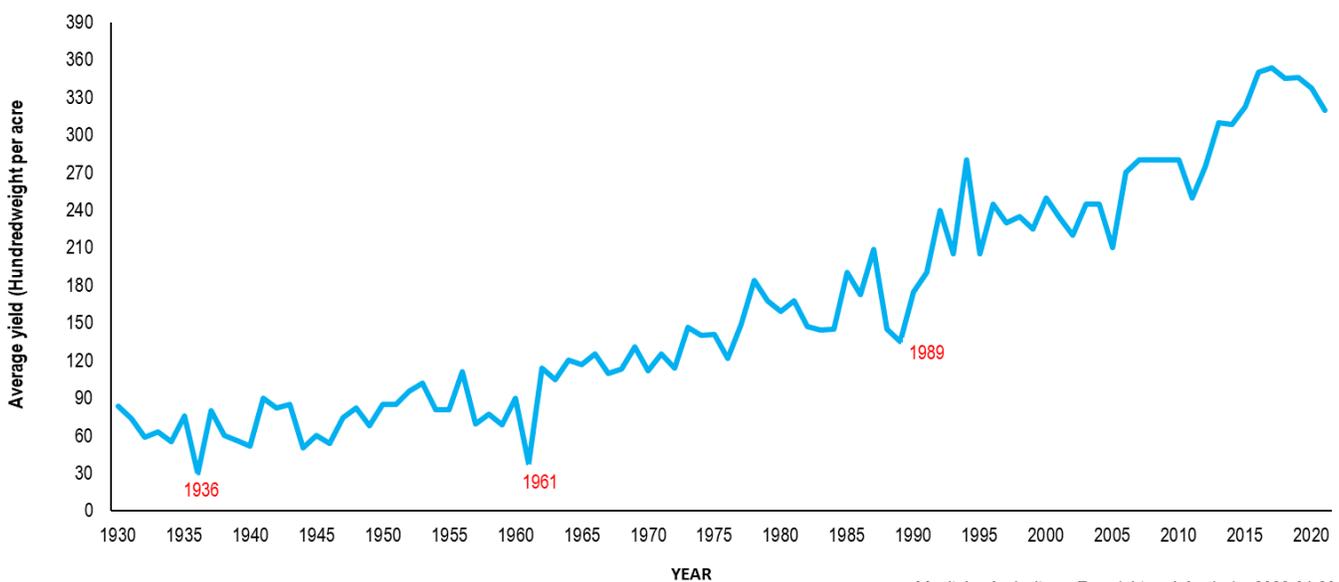
Source: Statistics Canada, Table 32-10-0359-01

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As most potato production occurs under irrigation in Manitoba, the 2021 drought did not have a significant effect on yield. Provincially, potato yield declined by 5.2 per cent 2021 compared with 2020. This is the smallest yield decline among all the major field crops grown in 2021. The yield data from Manitoba Agricultural Service Corporation (MASC) shows that the average yield per acre for non-irrigated processing potato was down by 24.8 per cent in 2021 compared to 2020 while irrigated processing potato yield was only down by 7.8 per cent, highlighting the importance of irrigation in minimizing the harms of drought on potato yield.

The 1936, 1961, and 1988/89 droughts had significantly affected potato yield where yield per acre declined by 60 per cent, 58 per cent, and 37.5 per cent, respectively. In recent years, potato yield has been more negatively impacted by excess moisture than by drought. Excess moisture led to 26.8 per cent yield decline in 1995, 14.3 per cent in 2005, and 10.7 per cent in 2011.

Figure 6. Trends in Potato Yield and Impact of Droughts on Yield, 1930-2021



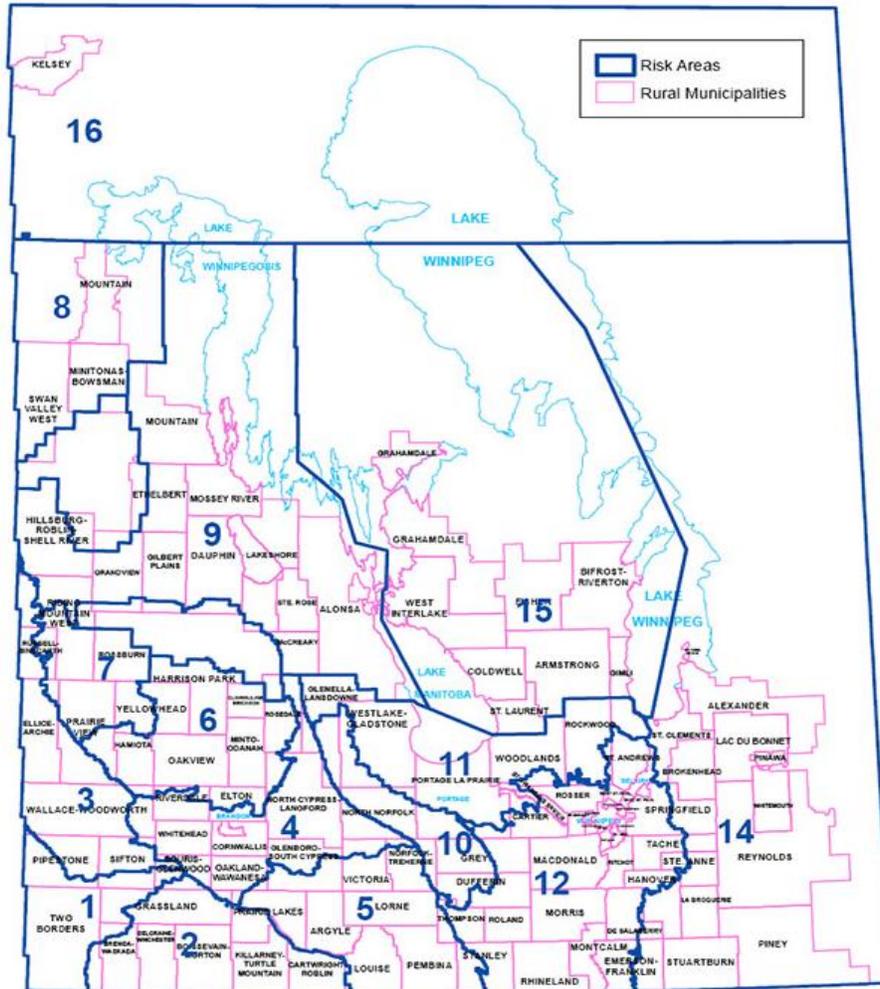
Source: Statistics Canada, Table 32-10-0358-01

Manitoba Agriculture, Foresight and Analysis, 2022-04-20

3.2 Drought effect on Crop Yield by Region

The Manitoba Agricultural Service Corporation divides Manitoba's agricultural region into 15 risk areas (RA)¹² of similar crop production risks (Figure 7). The RAs are used to determine crop insurance premiums and insurance coverage levels. While the distribution of crop seeded acres varies according to RA, most of the crop acres are located in RAs 12, 9, 6, 5, and 2. The RA 12 has the highest proportion of seeded acres for most crops. In 2021, RA 12 accounted for 16.1 per cent of all wheat seeded acres, 16.9 per cent of canola acres, 34.6 per cent of soybean, 33 per cent of oats, and 50.3 per cent of corn (Table 1).

Figure 7. Map of Risk Areas in Manitoba



While the ramification of the 2021 drought were widespread across the agricultural region in Manitoba, it significantly varied by RAs (Table 1)¹³. For most crops, the 2021 drought led to a large yield decline in the RAs 11, 12, and 15 compared to 2020 yield levels. The largest wheat yield decline of 41.5 per cent was observed in the RA 15 (some of the RM that declared state of drought emergency are located in this RA), soybean in the RA 12 (35.3 per cent down), and peas in the RA 14 (59.4 per cent down). For canola (53.1 per cent down), oats (54.6 per cent down), corn (44.1 per cent down), and barley (52.6 per cent down) the largest yield decline was observed in the RA 11. While it only accounts for a very small percentage of crop acres (less than one per cent for all major crops), the RA 16 did not show large changes in crop yield. Relatively, the drought had small or no effect on crops yield in the RA 6 and 7.

¹² While technically the RAs are 1-15, there is RA 16 on the map as there is no RA 13.

¹³ MASC data is used to examine the regional impact of the drought on yield. Statistics Canada and MASC reports similar provincial level aggregate yield decline for wheat, barley, peas, and oats. However, MASC data shows higher yield decline for canola (34.1 per cent vs 28.3 per cent) and corn (30.2 per cent vs 21.8 per cent). For Soybean, Statistics Canada data shows higher yield decline (27.3 per cent vs 24.1 per cent)

Table 1. Percentage of Harvested Acres and Per Cent Change in Average Yield per Acre (2021/2020) by Risk Area

Risk Area	Wheat		Canola		Soybean		Oats		Corn		Barley		Peas	
	Per cent of harvested acres	Per cent change in yield	Per cent of harvested acres	Per cent change in yield	Per cent of harvested acres	Per cent change in yield	Per cent of harvested acres	Per cent change in yield	Per cent of harvested acres	Per cent change in yield	Per cent of harvested acres	Per cent change in yield	Per cent of harvested acres	Per cent change in yield
1	3.8	-21.2	3.9	-19.7	2.5	-11.0	7.6	-36.7	1.0	-0.5	6.3	-16.9	7.3	-21.0
2	10.4	-20.9	10.0	-23.6	7.9	-14.4	9.6	-41.4	5.9	-8.2	8.6	-23.6	8.3	-29.9
3	5.2	-24.8	4.8	-32.5	1.1	-6.2	2.7	-37.7	0.8	-37.0	5.7	-41.9	8.5	-35.6
4	6.9	-14.5	6.4	-22.9	5.4	-1.6	2.8	-27.5	4.3	-36.0	7.6	-27.2	4.6	-28.8
5	10.3	-22.9	9.3	-35.6	8.1	-27.1	9.7	-35.4	7.7	-30.0	9.5	-31.1	9.1	-29.0
6	10.3	-1.6	10.5	-14.1	3.4	2.8	4.4	-7.1	0.5	16.1	15.7	-1.3	10.4	-12.4
7	5.7	-3.1	5.9	-15.0	0.5	26.8	2.2	-10.9	0.0	NA	6.4	-15.3	6.7	13.0
8	5.4	-18.7	7.0	-25.2	1.4	6.2	1.8	-47.1	0.0	NA	1.8	-28.9	10.9	-33.9
9	10.5	-19.0	12.0	-28.1	6.1	5.1	6.0	-31.5	1.6	NA	9.0	-31.0	18.0	-36.6
10	1.6	-41.8	2.3	-32.6	5.6	-21.4	5.8	-44.5	15.9	-16.8	3.4	-50.7	2.3	-43.9
11	7.9	-38.5	5.7	-53.1	10.4	-31.9	5.5	-54.6	5.6	-44.1	9.9	-52.6	3.6	-52.4
12	16.1	-31.0	16.9	-49.0	34.6	-35.3	33.0	-49.2	50.3	-35.4	10.6	-47.0	6.7	-36.6
14	2.5	-10.6	1.8	-39.7	8.9	5.4	4.2	-44.9	5.9	-15.1	1.5	-33.0	0.4	-59.7
15	2.9	-41.5	2.6	-45.4	4.1	5.3	4.7	-49.8	0.4	NA	3.5	-48.5	3.1	-50.0
16	0.5	62.7	0.8	91.8	0.0	NA	0.1	112.9	0.0	NA	0.5	119.2	0.0	NA
Overall	100.0	-22.6	100.0	-33.7	100.0	-25.1	100.0	-41.5	100.0	-32.5	100.0	-35.8	100.0	-31.8

Source: Manitoba Agricultural Service Corporation

Manitoba Agriculture, Foresight and Analysis, 2022-08-19

There are larger crop yield variations at the rural municipality (RM) level. Figure 8 shows the top ten crop producing RMs and the change in average yield per acre (by percentage) between 2020 and 2021. In 2021, the top ten RMs accounted for 29.1 per cent of wheat harvested acres, 31.6 per cent canola, 41.4 per cent soybean, 45.8 per cent oats, 81.7 per cent grain corn, and 48.9 per cent dry peas.

Overall, in 2021, only few RMs reported positive average yield per acre compared with 2020 (Table 2). The largest decline in canola yield per acre was in the RM of Glenella-Landsdowne (66 per cent down), which is also the top RM with canola harvested acres. The RM of Rockwood saw the largest decline in wheat yield per acre where yield declined by 48.2 per cent compared to the previous year. For soybean, the largest yield decline was reported in the RM of Macdonald (58.4 per cent down), oats in the RM of Roland (67.5 per cent down), grain corn in the RM of Portage La Prairie (74.0 per cent down), and dry peas in the RM of Alonsa (46.2 per cent down). For all crops except soybean and grain corn, the smallest yield decline in the top 10 RMs was more than ten per cent. At the Emerson-Franklin RM, soybean average yield per acre increased by 33.1 per cent between 2020 and 2021 while grain corn yield decreased only by 1.2 per cent. For most crops, in 2021,

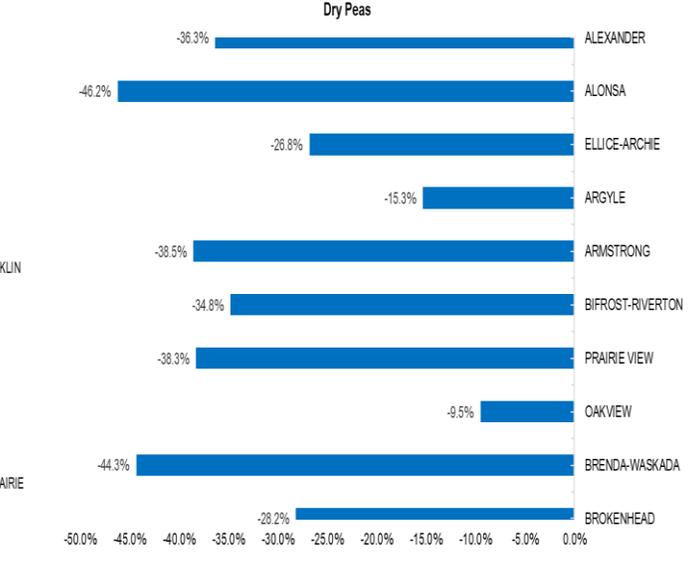
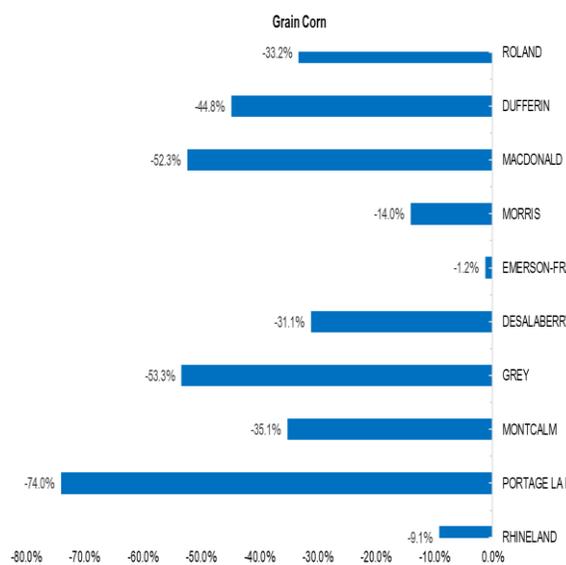
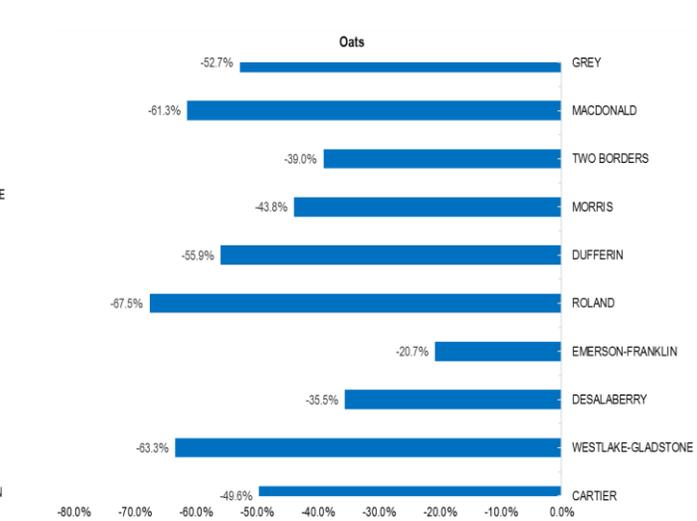
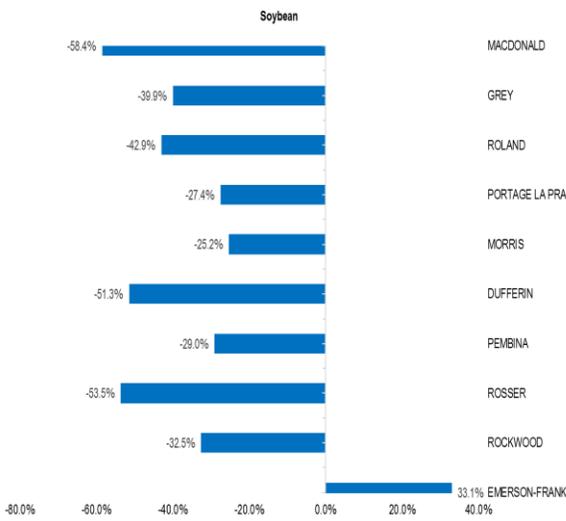
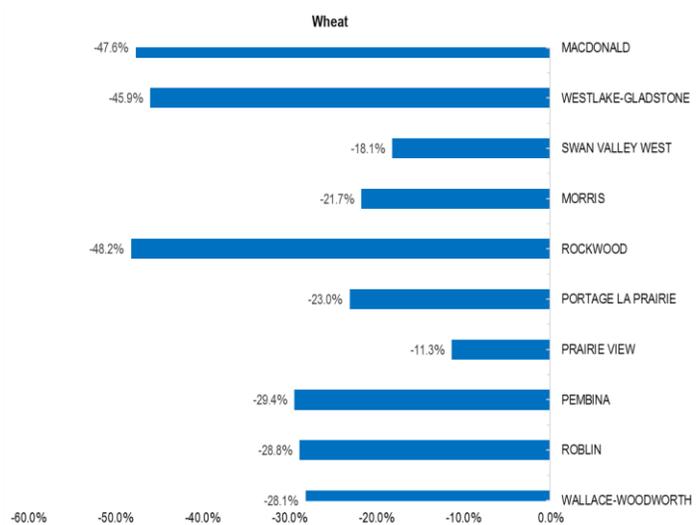
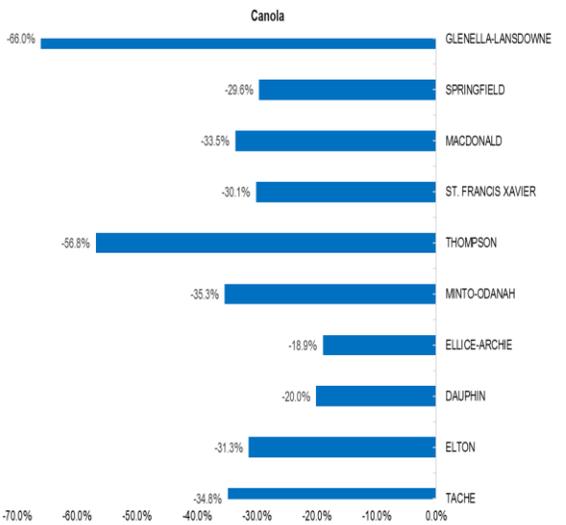
Table 2. Number of RMs Reporting Positive Yield per Acre in 2021 Compared with 2020

Crop type	Total number of RM reporting	Number of RM reporting positive average yield per acre
Canola	92	2
Wheat	95	9
Soybean	77	20
Oats	82	9
Corn	28	3
Barley	79	13
Peas	64	4

Source: Manitoba Agricultural Service Corporation Manitoba Agriculture,

Foresight and Analysis, 2022-10-17

Figure 8. Per Cent Change in Crop Yield for the Top Ten Crop Producing RMs between 2021 and 2020



Source: Manitoba Agricultural Service Corporation (MASC)

Manitoba Agriculture, Foresight and Analysis, 2022-08-19

Source: Manitoba Agricultural Service Corporation (MASC)

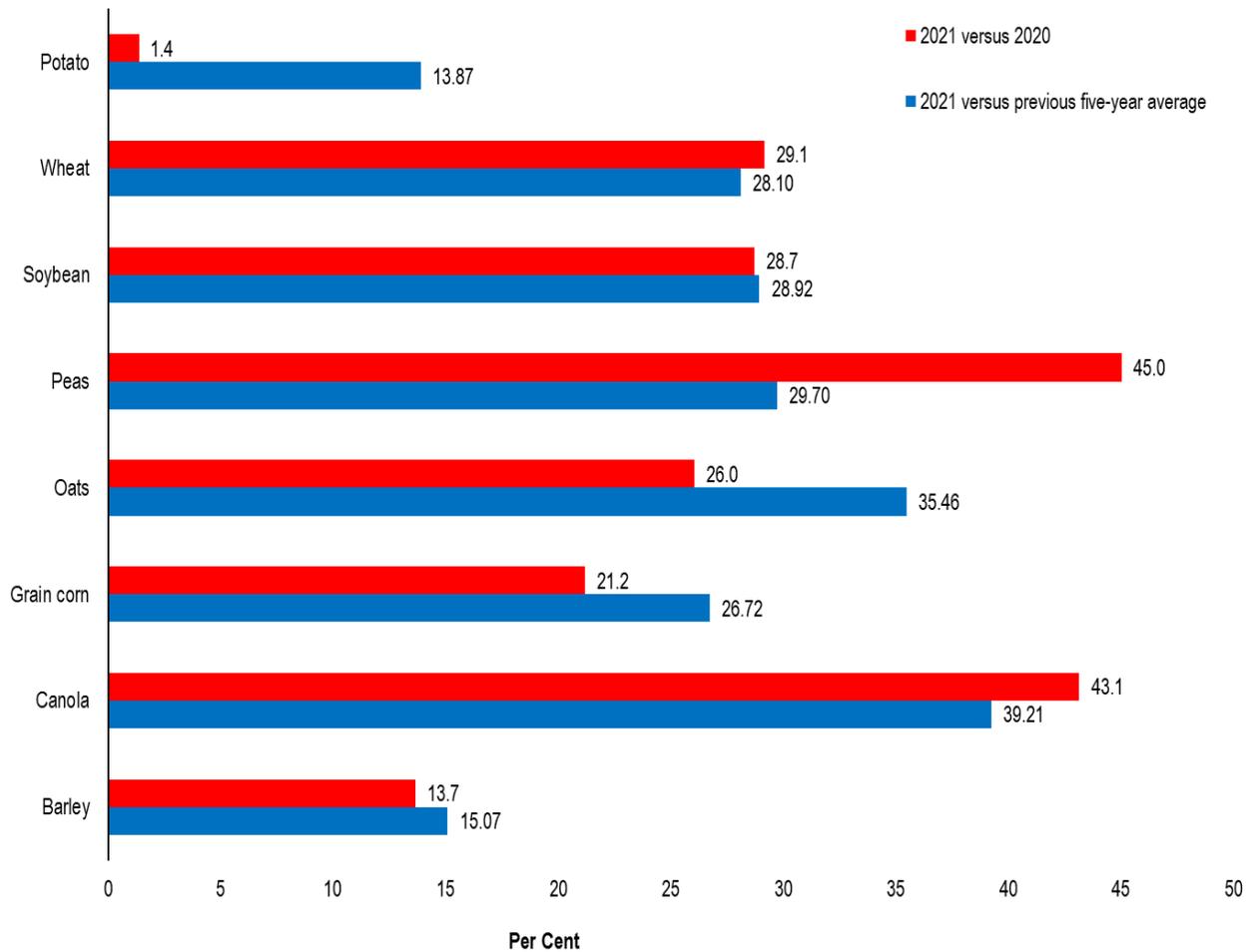
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3.3 Crop Prices

Crop prices saw large and rapid increases in 2021, mainly caused by supply chain related disruptions due to the COVID-19 pandemic. The drought that occurred in North America and several other parts of the world including in South America, Europe, Asia and Africa also played its part in pushing crop prices higher as it negatively affected supply of agricultural products. All major field crops saw a price increase in Manitoba, ranging between 10 to 45 per cent on average.

Compared with the 2020 prices, peas (45.0 per cent), canola (43.1 per cent), and wheat (29.1 per cent) showed the largest price increases in 2021. Prices of soybean and oats also increased by 28.7 per cent and 26.0 per cent, respectively. Canola, oats, and soybean prices showed the largest price increase in 2021 compared to the previous five-year average prices. Figure 9 shows per cent changes in prices between 2021, 2020 and the previous five-year average.

Figure 9. Per Cent Increase in Crops Prices in 2021 Compared to 2020 and the Previous Five-Year Average



4. Methodology

Assessing how drought affects the economy is complex because of data limitation and its simultaneous effects on multiple sectors over an extended period. Input-output (IO) model is widely used to evaluate the indirect economic impacts, while the magnitude of the direct losses due to drought is generally estimated by comparing the economic output of a specific sector in a drought year with that of the previous non-drought year(s).

The IO model uses the direct impact as the starting point of analysis to derive the indirect impacts through forward and backward economic linkages. This approach assumes that negative effects triggered by changes in final output or demand will transfer through a multiplying effect to production and employment of the other economic sectors in the region. If the direct impacts of drought on production are incorrectly measured, the resulting estimates would not be precise.

The economic impacts of the 2021 was estimated in two stages. The first stage involved estimating the direct impacts of the drought based on Statistics Canada's data on harvested acres, crop yields, and crop prices.

The direct impacts of the drought on crops output value was estimated following the three steps described below:

- i. Estimate the "quantity effect" of the drought, which corresponds to the loss suffered by farmers due to a decrease in production. This was calculated by taking the difference in production volume between the year of drought (2021) and the previous year (2020) and multiplying it by the average crops price in the previous five years.
- ii. Estimate the price effect, which is the effect associated with the price change (increase) caused by the reduction in crop production volumes and other factors. The price effect is obtained by multiplying the price change (price difference between the drought year (2021) and average price in the previous five years) by the crop production volume in the drought year (2021). For famers, price increase (although not necessary due to the drought) represents a benefit while it negatively affects consumer.
- iii. The sum of the quantity effect and the price effect will give the total direct impact of the drought on the cop sector.

The second stage of the analysis involves estimating the indirect and induced impacts of the drought on total output, employment, GDP, and tax revenue using the Manitoba Bureau of Statistics (MBS) IO model. The IO model also breaks down the indirect impacts by industry, which helps to understand the sectors that are most affected by the drought indirectly.

Two scenarios were considered for the estimation of the indirect economic impacts of the drought. The first estimation is based on the total direct effects of the drought (i.e. based on the sum of the quantity and price effect). This result is the estimated likely actual economic impact of the 2021 drought. The second set of the indirect impacts were estimated based on only the quantity effect. This will provide an economic impact estimate of what would have happened if crop prices were consistent with the previous five years average.

As acres allocated to a given crop could change from year to year depending on the prevailing weather condition and input and (expected) output prices, the 2021 harvested crops acres were considered when estimating the total production volumes in 2020 and 2021. Doing this allowed the isolation of the effects of the drought on production volume from that of changes in seeded/harvested acres. The crop prices used in the estimating of the drought economic impact are the average prices and do not reflect what individual farmers observed when they sold their crops. Not all crops produced in Manitoba in 2021 were included in this analysis due to lack of data. The crops included in the analysis accounted for 98 per cent of the total harvested crop acres in 2021, thus, the missing crops will not significantly influence the estimates provided here.

5. Results

5.1 Direct Economic Impacts

Table 3 reports the direct economic impacts of the 2021 drought on crop production sales in Manitoba. The estimated total direct loss of the 2021 drought is \$75.5 million in crop sales value. However, if the crop prices in 2021 had remained within the previous five-year average (2016-2020), the drought would have caused much larger loss reaching \$1.1 billion in crop sales value (see quantity effect in Table 3). The significant increase in crop prices in 2021 have compensated the significant decline in crop production volume by almost 93 per cent of the losses (price effect in Table 3). Some farmers with grain contract may have not fully benefited from the price increase observed in 2021 as portion of their crops might have been contracted at much lower price-level. Some farmers may have to buyout their grain contracts because of the production shortfalls due to the drought.

Table 3. Direct Effects of the 2021 Drought on Crops Sales using the Previous Five-Year and 2021 Prices (Canadian Dollars)

Type of crop	Quantity effect ¹⁴	Price effect	Total direct effect
Barley	-\$42,526,106	\$13,995,593	-\$28,530,513
Canola	-\$433,625,421	\$431,589,177	-\$2,036,244
Corn for grain	-\$43,991,354	\$42,048,370	-\$1,942,985
Oats	-\$74,439,963	\$45,330,317	-\$29,109,646
Peas, dry	-\$29,751,461	\$17,522,798	-\$12,228,663
Soybeans	-\$144,901,425	\$111,336,268	-\$33,565,157
Wheat	-\$251,663,857	\$252,800,922	\$1,137,065
Flax	-\$14,139,705	\$13,526,016	-\$613,690
Potato	-\$18,675,930	\$47,314,862	\$28,638,932
Total	-\$1,054,095,511	\$979,591,496	-\$74,504,015

Based on the direct estimates, the 2021 drought caused the largest loss in soybean (\$33.6 million) production value followed by oats (\$29.1 million) and barley (\$28.5 million). For wheat and potato, the price increases were large enough to compensate for losses in production volume and resulted in overall positive direct effects. The estimated results are not sensitive to the different price assumptions considered in the analysis. If the 2020 crop prices were used instead of the previous five-year average prices, the total direct loss would increase to \$91.2 million. This is because the crop price increases observed in 2021 were larger when compared to the previous five-year average prices than compared to the 2020 prices. Thus, when the 2020 prices are used, production loss offset by price increase is relatively smaller.

5.2 Total Economic Impacts

While drought-induced production losses negatively affect agricultural output, the total economic impact and the distribution of losses depends on the interaction between the supply and demand of agricultural products. Economic losses due to drought are not completely borne by farmers as a portion of the losses are passed on to consumers through increased food prices. As the prices increase, more losses will be passed on to consumers. There is possibility that farmers are better off from the drought effect if price increases by a higher percentage than the output decreases. The overall impact of the drought is larger than the losses borne by farmers.

The total economic impacts of the 2021 drought in Manitoba is presented in Table 4. When the indirect impacts of the drought are considered, the drought generated estimated losses of \$97 million in output, \$47 million in provincial nominal GDP, and 267 jobs in Manitoba. The estimated loss in taxes collected in Manitoba due to the drought amounts to \$9.4 million.

¹⁴ To estimate the quantity effect, the 2020 production volume was considered instead to the five-year average production volume. To use the five-year average production volume, one needs to assume that the harvested areas remained the same for all the crops over the five years period. If the five-year average production volume was used instead of the 2020 production volume, the quantity effects of the drought would have been a loss of 980 million.

Table 4. Total Economic Impacts of the 2021 Drought in Manitoba (\$Millions)

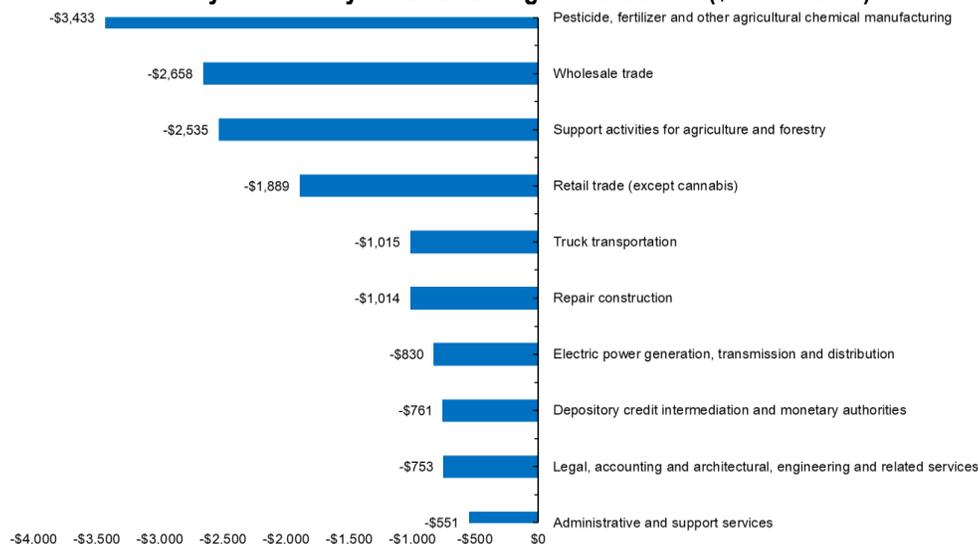
	Direct Impact	Indirect Impact	Total Impact
Output	-\$75	-\$23	-\$97
GDP (nominal)	-\$34	-\$13	-\$47
Employment (persons)	-140	-127	-267
Tax revenue			
Provincial taxes	-\$3.4	-\$1.3	-\$4.7
Municipal taxes	-\$0.5	-\$0.2	-\$0.7
Federal taxes	-\$2.5	-\$1.5	-\$4.0
Total tax collected in Manitoba	-\$6.4	-\$3	-\$9.4

As presented in Table 3, the direct impacts of the drought would have been worse if there hadn't been a large increase in crop prices. Table 5 presents the total economic impacts of the drought if the 2021 crop prices had been within the five-year average prices. Under this scenario, the total loss in provincial output due to the drought would have reached close to \$1.4 billion. The provincial GDP would have dropped by \$663 million. The Manitoba economy would have also lost an estimated 3,774 jobs due to the drought while the total taxes collected in Manitoba would have declined by \$133 million.

Table 5. Total Economic Impacts of the 2021 Drought in Manitoba if the 2021 Crop Prices were the Same with the Previous Five-Year Average Crop Prices (\$ Millions)

	Direct Impact	Indirect Impact	Total Impact
Output	-\$1,054	-\$319	-\$1,373
GDP (nominal)	-\$487	-\$175	-\$663
Employment (persons)	-1,983	-1,791	-3,774
Tax revenue			
Provincial taxes	-\$48	-\$18	-\$66
Municipal taxes	-\$7	-\$3	-\$10
Federal taxes	-\$35	-\$22	-\$57
Total tax collected in Manitoba	-\$90	-\$43	-\$133

The top ten industries indirectly affected by the drought accounted for 70 per cent of the total indirect losses. Agricultural input manufactures and suppliers, wholesale trade, and agricultural support service providers accounted for the large share of the indirect losses.

Figure 10. Top Ten Industries Indirectly Affected by the 2021 Drought in Manitoba (\$ Thousands)

Source: Model estimation based on direct output loss

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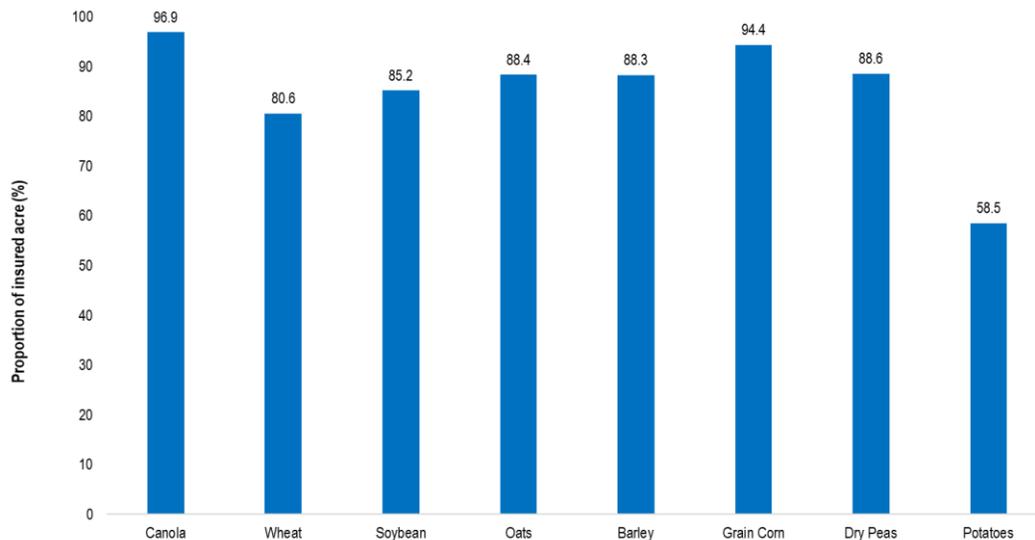
6. Overview of Government Supported Risk Management Program

The findings of this report reinforce the importance of business risk management programs for producers such as AgrilInsurance¹⁵, which provides production guarantee to producers based on their probable yield. If production falls below that of expected yield due to a natural peril, farmers are eligible for compensation.

The Manitoba Agricultural Services Corporation (MASC), which administers the province's AgrilInsurance programs, offers flexible and affordable insurance to producers throughout Manitoba with over 70 different insurable crops. Insurance coverage is based on a 'probable yield' for each insured crop, which is the tonnage of production MASC expects to be harvested. About 9.5 million acres or 81.0 per cent of all seeded acres in Manitoba were protected by AgrilInsurance in 2021 where canola accounted for 35.1 per cent of the total insured acres followed by wheat (24.6 per cent), soybean (11.8 per cent), oats (6 per cent), corn (3.9 per cent), barley (3.8 per cent), and peas (2.1 per cent).

In 2021, among the major crops, canola had highest proportion of insured acres where 96.9 per cent of all canola acres were covered by AgrilInsurance followed by grain corn (94.4 per cent), and dry peas (88.6 per cent). See Figure 11. With 58.5 per cent and 80.6 per cent, potatoes and wheat had the lowest percentage of insured acres among the top Manitoba crops in 2021. Overall, crops with high production risks have higher proportion of insured acres.

Figure 11. Proportion of Insured Acres in 2021 in Manitoba



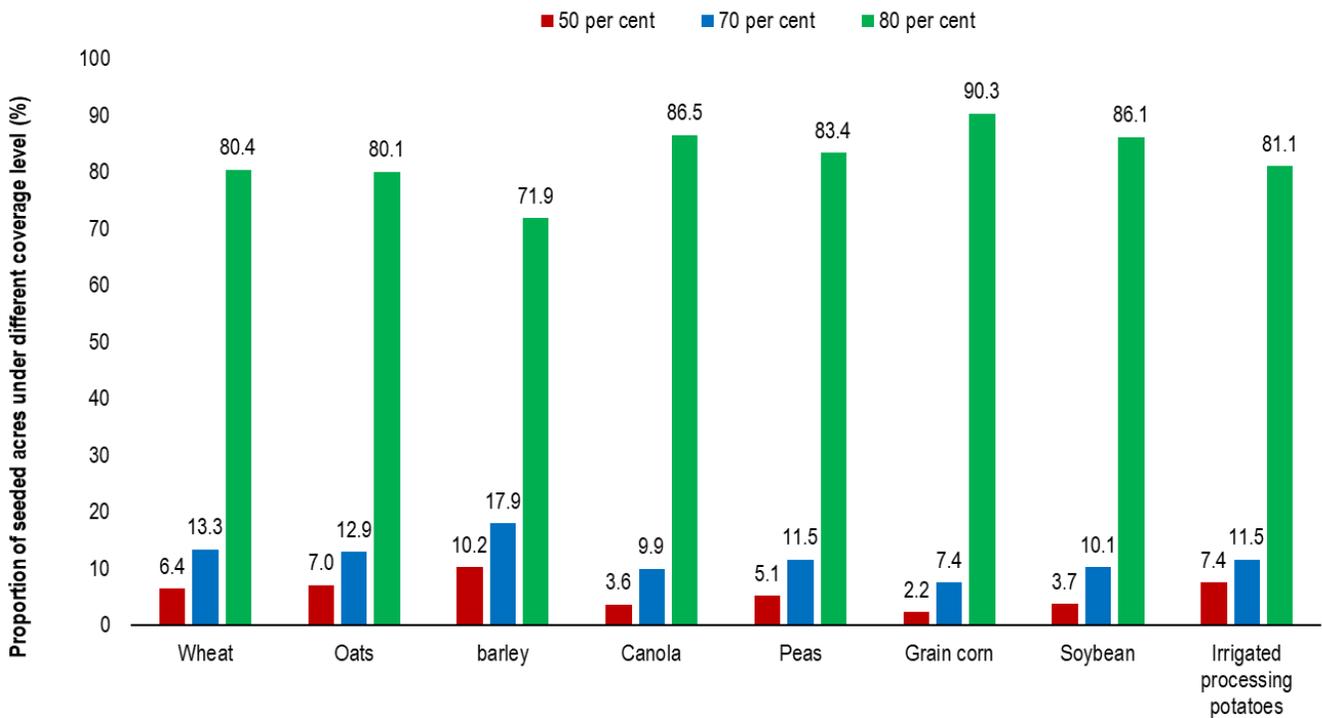
Source: Manitoba Agricultural Service Corporation (MASC) and Statistics Canada, Table 32-10-0359-01

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Producers can select a coverage level of 50 per cent, 70 per cent or 80 per cent of the probable yield depending on their comfort level for risk. The large majority of seeded acres in Manitoba are insured with the 80 per cent coverage level. In 2021, grain corn had the highest proportion of seeded acres (90.3 per cent) insured with 80 per cent coverage level followed by canola (86.5 per cent) and peas (83.4 per cent) (Figure 12). With only 71.9 per cent of seeded acres insured with 80 per cent coverage, barley had the highest proportion of seeded acres covered with 50 per cent and 70 per cent coverage level among the major field crops.

¹⁵ AgrilInsurance is a business risk management program run by provinces with federal financial contribution through the Canadian Agricultural Partnership. AgrilInsurance provides production risk protection to farmers by minimizing the economic effects of production and quality losses caused by natural perils including drought, excess moisture (rainfall and flood), frost, hail, fire, excess heat, wind, wildlife, disease and pests. For most AgrilInsurance programs, premiums are shared 40 per cent by participating producers, 36 per cent by the Government of Canada and 24 per cent by the Government of Manitoba while administrative expenses are fully funded by governments, 60 per cent by the federal Governmental and 40 per cent by the Government of Manitoba.

Figure 12. Proportion of Crops Seeded Acres Under different Levels of Insurance Coverage in 2021

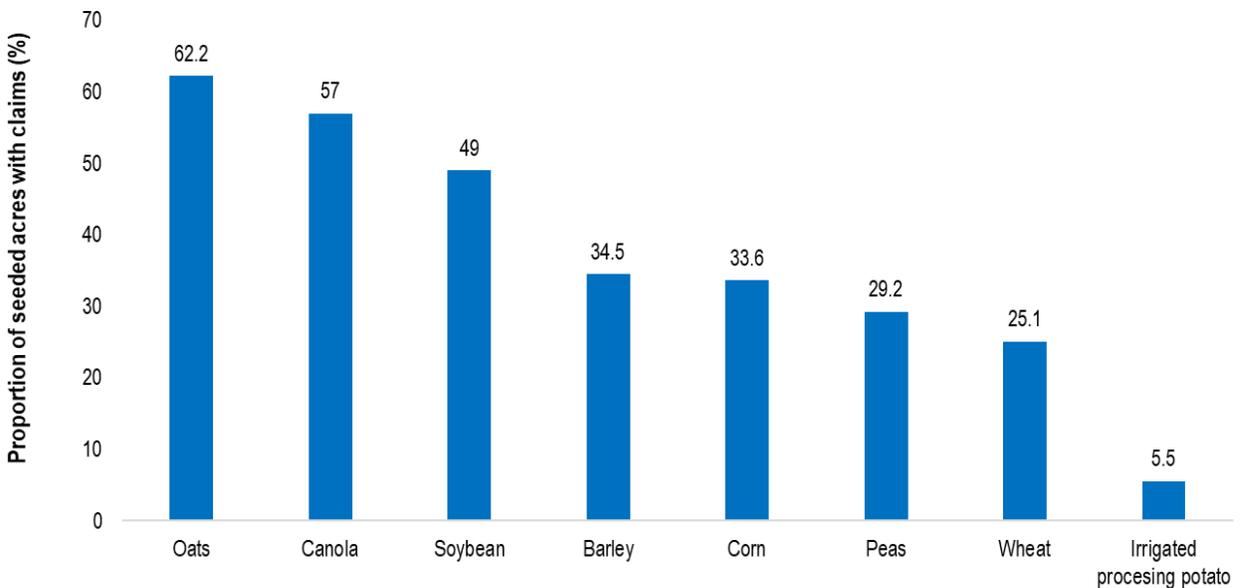


Source: Manitoba Agricultural Service Corporation (MASC)

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As shown in Figure 13, the proportion of seeded acres with claims also varied among the different crops in 2021. Oats had the highest proportion of seeded acres (62.2 per cent) with insurance claims, followed by canola (57.0 per cent), and soybean (49.0 per cent). Irrigated processing potatoes had the lowest proportion of seeded crops with crop insurance claims, where a claim was submitted on only 5.5 per cent of the seeded acres.

Figure 13. Proportion of Seeded Acres with Crop Insurance Claim in 2021

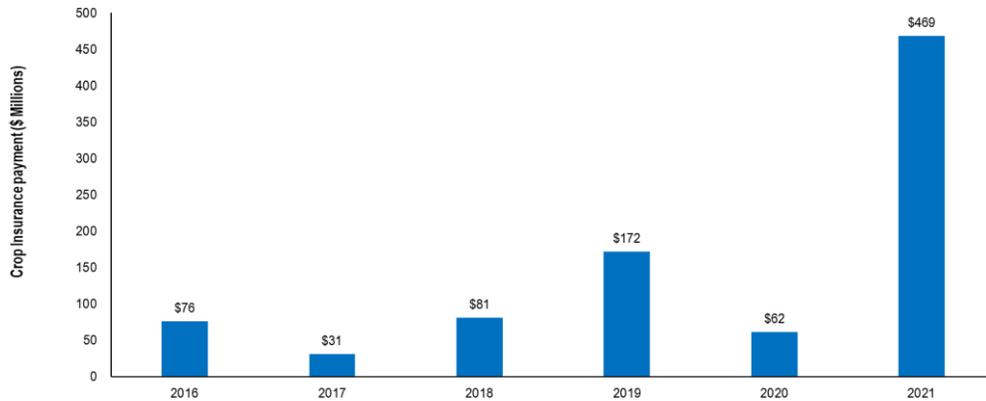


Source: Manitoba Agricultural Service Corporation (MASC)

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The 2021 drought led to a record high crop insurance payment in Manitoba (Figure 14). The total crop insurance payment surged by 659 per cent from \$62 million in 2020 to \$469 million in 2021¹⁶. The crop insurance payout increased by 455 per cent compared to the previous five-year average payment. The majority of the crop insurance payments in 2021 were related to production losses due to the drought.

Figure 14. Total Crop Insurance Payment in Manitoba, 2016-2021

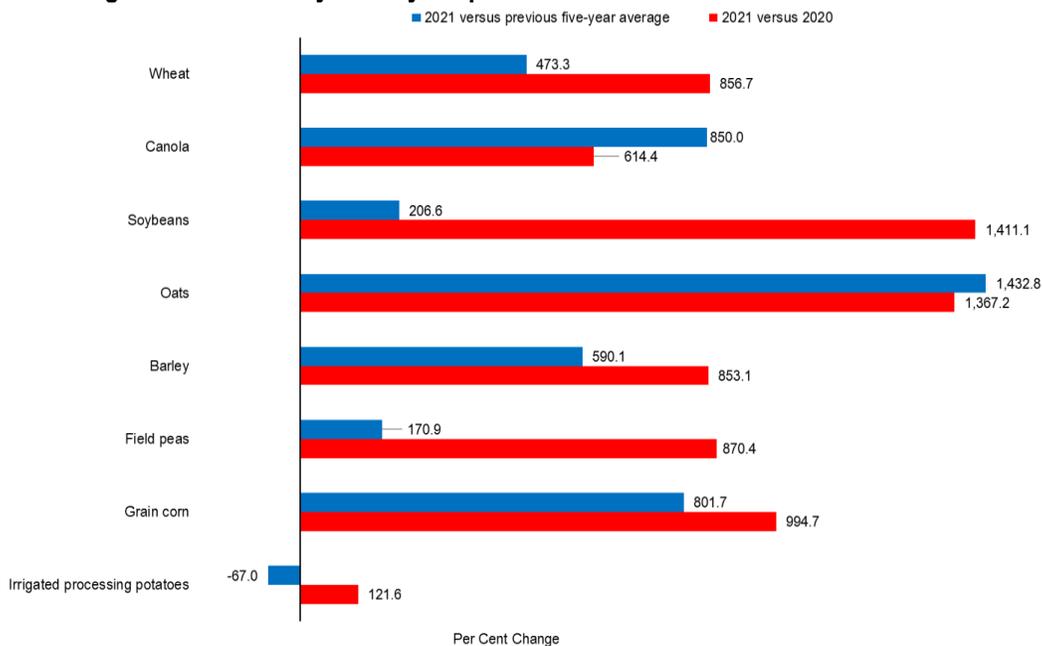


Source: Manitoba Agricultural Service Corporation (MASC)

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Soybean, oats and grain corn saw the largest increase in insurance payout in 2021 compared to the previous year. Soybean insurance payment increased by 1,411 per cent followed by oats (1,367 per cent), and grain corn (995 per cent). As the large majority of the crop is produced under irrigation, potato saw the smallest increase in insurance payment in 2021. Compared to the previous five-year average, oats (1,433 per cent), canola (850 per cent), and grain corn (802 per cent) saw the largest increase in insurance payment.

Figure 15. Per Cent Change in Insurance Payment by Crops



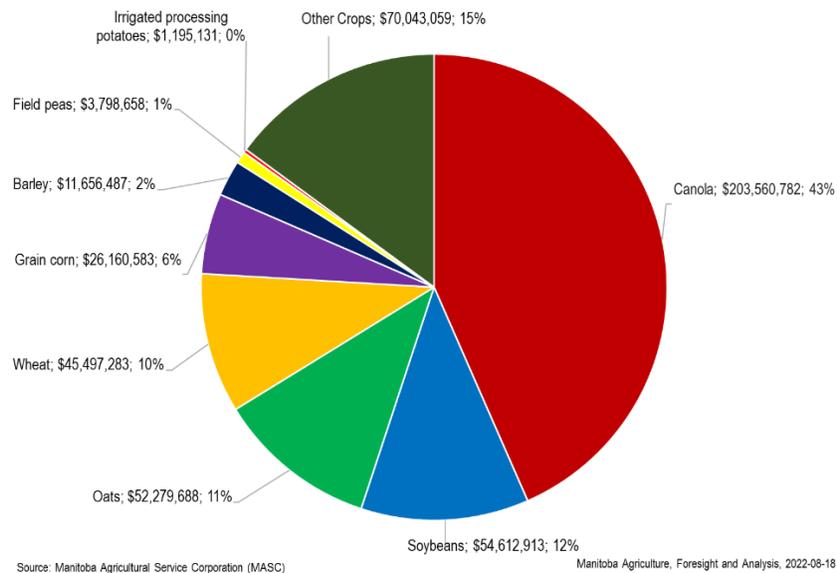
Source: Manitoba Agricultural Service Corporation (MASC)

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Crop insurance payment in 2021 significantly varied by crops. Canola producers received the largest crop insurance payment of \$203.7 million, which was 43 per cent of the total crop insurance payment in 2021. The next highest payment of \$54.6 million was made to soybean producers, followed by oats at \$52.3 million. Wheat producers received the fourth largest insurance payment accounting for 10 per cent (\$45.5 million) of the total crop insurance payment in 2021. The insurance payment corresponds with the proportion of insured acres, the level of yield loss and the coverage level.

¹⁶ The AgrInsurance payments reported in this report are based on the calendar year. MASC uses fiscal year for its annual reports as the result the values reported in this report may not match with what is reported in MASC's annual reports. Based on the fiscal year, AgrInsurance payment increased by more than seven fold from \$69.9 million in 2020/2021 to \$598.4 million in 2021/2022.

Figure 16. Insurance Payment by Crops in 2021



The crop insurance payout significantly varied by RMs depending on the proportion of insured acres and severity of the drought at the local levels. In 2021, the RMs of Macdonald received the highest crop insurance payment amounting \$41.1 million followed by Westlake-Gladstone (\$27.5 million), Portage La Prairie (\$23.1 million), Dufferin (\$20.5 million), and Morris (\$16.7 million). The top five insurance payout receiving RMs accounted for 27.5 per cent of the total crop insurance payments in 2021 while the top 20 RMs received 63.3 per cent of the total crop insurance payment. Most of top insurance receiving RMs had also the highest proportion of insured crop seeded acres in 2021.

Table 6. Top 20 Crop Insurance Payment Receiving RMs in 2021

Rural Municipality (RM)	Per cent of the total crop insurance payment in 2021 (%)	Per cent change in insurance payment between 2021 and the previous five-year average (%)	Per cent change in crop insurance payment between 2021 and 2020 (%)
Macdonald	8.8	1,740	2,113
Westlake-Gladstone	5.9	788	1,899
Portage La Prairie	4.9	426	1,055
Dufferin	4.4	1,382	3,900
Morris	3.6	662	1,144
Rockwood	3.3	2,357	2,637
Grey	3.2	693	1,307
Stanley	3.1	1,404	5,051
Roland	3.0	919	1,733
Woodlands	2.8	1,267	1,224
Pembina	2.5	919	1,026
Cartier	2.2	658	585
Bifrost-Riverton	2.2	804	1,179
Rosser	2.2	1,391	4,219
Springfield	2.1	701	1,112
Rhineland	2.0	199	2,545
Fisher	1.9	897	986
Glenella-Landsdowne	1.9	664	863
North Norfolk	1.7	376	1,292
Two Borders	1.7	361	451
All Other RMs	36.9	237	307
Total	100.0	455	659

Source: Manitoba Agricultural Service Corporation (MASC)

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7. Discussion and Conclusion

The total economic impacts of the 2021 drought related to the crop production sector is close to \$100 million drop in crop revenue. The significantly high crop prices in 2021 helped to offset the impacts of the sharp decline in harvested crop volumes. If the 2021 crop prices had remained close to the 2020 prices or the five-year average prices, the total impacts of the drought would have been about \$1.4 billion.

Producers may also take the perspective of how much revenue could have been earned had yields been average with high prices. This could be the missed opportunity due to the drought. Even though the higher crop prices have helped farmers to minimize the drought losses, a significant portion of the drought cost is transferred to consumers through higher food prices, particularly hurting low-income families. Some farmers with grain contract may have also not fully benefited from the price increase observed in 2021 as portion of their crops might have been contracted at a lower price. Some farmers may have to buy out their grain contracts because of the drought-induced production shortfalls.

Droughts also affect government in two ways: reducing tax revenues and increasing program and emergency response costs. The 2021 drought reduced total tax collected in Manitoba by over \$9 million, while it increased crop insurance cost by more than six-fold from \$62 million in 2020 to \$469 million in 2021. Beyond its financial burdens, droughts also create stress to farmers that can lead to mental health problems.

The key to better dealing with drought lies in taking the steps necessary to enhance adaptive capacity and decrease vulnerability. Generally, there are two strategies to deal with natural disasters such as drought: risk reduction and risk transfer.

Risk reduction involves taking risk mitigation actions in advance of the drought with the objective of either reducing exposure or increasing the capability to withstand the negative impact of the disaster. These mitigation strategies are generally related to soil and water conservation, crop management, plant breeding and infrastructure development. Specific examples include increasing on-farm adoption of beneficial management practices such as zero-tillage, cover-crops, and leaving crop residue on the field to increase soil moisture, and reduce evaporation and soil erosion. Developing irrigation infrastructure where economically and environmentally feasible and breeding crop varieties that use less water, withstand dry conditions and reduce the demand for irrigation are equally important. An increased investment in drought monitoring, analysis and planning is also very essential in mitigating the impacts of drought.

Investing in drought mitigation help reduce the costs of drought and communities' vulnerability to them. Risk transfer, on the other hand, involves shifting much of the loss due to the drought from individual farmers to society at large (including the government). This enables farmers to cope with or recover better from the impacts of the drought. Risk transfer is mainly implemented in Manitoba through different insurance programs such as AgriInsurance, AgriStability, and AgriInvest. The results of this analysis reinforces the importance of investing in both risk reduction and risk transfer strategies.

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