Cultivating Change: Opportunities and Barriers for Natural Climate Solutions in the Canadian Prairies

FINAL Report

Prepared For

Nature United

Prepared By

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serecon

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1.0 Executive Summary

1.1 Report Purpose

This report provides Serecon's independent analysis supporting the Canadian Prairies focal area for Nature United's public policy campaign for Natural Climate Solutions. In addition to quantitative benefit and cost analysis, the findings of this report are intended to also provide recommendations for how to minimize identified adoption and agricultural practice maintenance risks. These recommendations are intended as a guide for initiatives undertaken to expand adoption of reduced tillage, Cover Crops, and grassland conservation in the Canadian Prairies.

1.2 Report Overview

We conducted analysis regarding the following key considerations for the NCS applicable to the Canadian Prairies:

- Areas of Opportunity;
- Benefits and Costs of adoption;
- Risks to successful adoption; and
- Implementation Recommendations

Our analysis focused on elements of the Canadian Prairies NCS Cost-Benefit Analysis for which estimates relate to agricultural practices and production. Table 1 below is a summary of these selected elements as well as the identified risks to farm adoption, and NCS implementation recommendations.

Table 1. Canadian Prairies Hotspot Natural Climate Solutions Elements Considered

Agricultural Practice Type	Practice	Description	Benefits Analyzed	Costs Analyzed	Adoption Risks	Recommendations
Regenerative Cropping	Reduced Tillage	Adoption of no-till (zero-till) or minimum till annual crop seeding systems.	• Yield gains	• Seeding Equipment	• Agricultural Economy Downturns Challenge Practice Change • Farm Succession Challenge reduces Innovation • Rented Land Reduces Incentive to Invest	• Support Crop Production System Flexibility • Enable Research and Practice Demonstration Applicable to Target Farms
	Cover Crops	Simplified to two types employed: • Clover under-seeded to spring wheat; or • Legume-based mix relay-cropped with dry peas or fall-seeded crops.	• Fodder value • Pollination	• Seed • Seeding application		
Improved Pasture	Grassland Conservation	Avoidance of conversion of natural grasslands to cultivated crops or built-up uses.	• Fodder Value	• Conservation Easements	• High Crop Margins Incentivizes Grassland Conversion	• Consider the Co-Benefits of Livestock Grazing • Support Perpetual Easements

1.3 Benefit and Cost Findings

Our analysis found co-benefit values and costs that broadly support Oxford Economics' NCS findings for the Canadian Prairies. Table 2 provides a summary of our findings alongside the values used by Oxford Economics.

Table 2. Benefit and Cost Finding Summary, 2025 CAD $ per hectare

NCS Practice	Type	Benefits		Costs	
		Serecon	Oxford Economics	Serecon	Oxford Economics
Reduced Tillage	Yield Gain	88	63	$99 - 296	$260
Cover Crops	Fodder Value	105	104	$100 - 166	$246
	Pollination	18	17		
Grassland Conservation	Fodder Value	50	130	$1,934 - 4,835	$9,669

1.4 Conclusion

In conclusion, our analysis broadly supports the Canadian Prairies Cost-Benefit Analysis (CBA) findings of Oxford Economics. Our analysis found significant financial co-benefits to reduced tillage, Cover Crop adoption and grassland conservation. Analysis of costs supported those figures applied by Oxford Economics, and indicated their conservative nature, particularly with respect to grassland conservation.

We recommend that actions which are taken to support these three NCSs should first and foremost consider the highly variable nature of farm activities and avoid over-prescriptive policy or programs supporting Cover Crops or reduced tillage. We also recommend that grassland conservation be considered through the cost-effective lens of conservation easements, and the potential for alignment of ecosystem outcomes with appropriate cattle grazing.

2.0 Background and Overview

2.1 Serecon's Report Context

Nature United is undertaking a public policy campaign to cultivate support for a suite of solutions for lowering Canada's net greenhouse gas emissions. These 'Natural Climate Solutions' (NCS) have been targeted for their co-benefits and wide geographic applicability.

This report provides independent, supportive analysis to Nature United's Canadian Prairies focal area for research into the economics of NCS. Our analysis was conducted and reported upon with a clear mandate to critically review the cost and benefit estimations made by Oxford Economics in a complementary report. Serecon has done so with the perspective of farmers, so that the diverse set of barriers to adoption experienced by farmers and land managers are reasonably considered.

All concluding financial figures within this report are expressed in 2025 CAD$.

2.2 Report Overview

We conducted analysis regarding the following key considerations for the NCS applicable to the Canadian Prairies:

- Areas of Opportunity;
- Benefits and Costs of adoption;
- Risks to successful adoption; and
- Implementation Recommendations

We conducted supporting analysis for elements of the Canadian Prairies NCS Cost-Benefit Analysis for which estimates relate to agricultural practices and production. Table 1 above is a summary of these selected elements as well as the identified risks to farm adoption, and NCS implementation recommendations.

2.3 Canadian Prairies Region Overview

The prairie provinces include 82% of the agricultural land in Canada[1] and include a wide variety of annual and perennial crops and natural lands grazed by livestock. Within the Prairies Ecozone, nearly 56% of the total area is in production of cereal, oilseed, and pulse annual crops as well as perennial forage crops. A considerable 19% of the region is grassland, and the balance is developed, forested, or water (see Table 3 and Figure 1).

Table 3: Canadian Prairies Ecozone Land Cover Summary, 2023

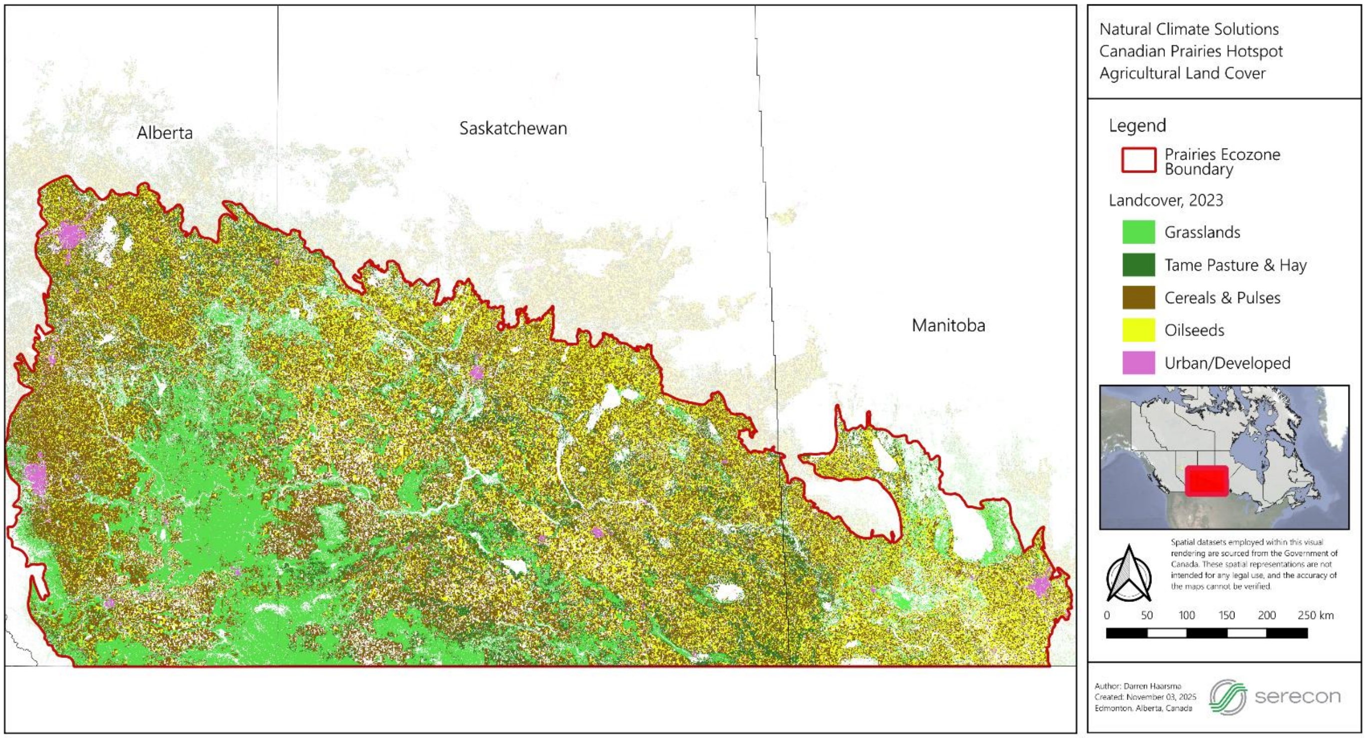
Landcover Type	Hectares	Acres	Portion of Region
Cropland	26,155,135	64,630,688	55.9%
Grassland	8,833,563	21,828,191	18.9%
Urban/Developed	1,331,274	3,289,648	2.8%
Forested & Water	10,428,912	25,770,362	22.3%
Total Area	46,748,908	115,518,889	100%

Source: Agriculture and Agri-food Canada, 2023 Annual Crop Inventory.

These statistics demonstrate the outsized impact that agriculture has in the Canadian Prairies Ecozone. This broad footprint provides a significant opportunity for the impactful implementation of NCSs.

1 Statistics Canada. Census of Agriculture 2021. Total Area of Farms by Province.

Figure 1: Canadian Prairies Ecozone and Agricultural Land Use



*Source. Agriculture and Agri-food Canada. 2023 Annual Crop Inventory.

2.4 Area of Opportunity of NCS

Regenerative cropping practices are widely practiced within the Canadian Prairies Ecozone, however there is considerable opportunity for further adoption. In the following sections the reasonable expansion area for the existing regenerative cropping practices of reduced tillage and cover cropping are discussed and estimated. This expansion area, or 'area of opportunity' details the geographic magnitude of the targeted NCS. The area of opportunity for preserving grasslands is not addressed, as the avoided grassland conversion is substantiated by extrapolations of historical rates of grassland loss to cropland and development.

2.4.1 Reduced Tillage

Adoption of minimum and no-till annual crop production systems is already quite high by Prairie farmers, however, there exists additional opportunity for practice change. Conventional tillage is estimated to still be practiced upon about 23 million acres, or 35% of Canada's prairie cropland, though there are several constraints to reduced tillage being adopted upon this entire remaining acreage.

For instance, nearly 5.5 million acres of cropland (Table 4) occur upon land with a high clay content, which is highly productive, but vulnerable to soil compaction. These lands typically require periodic tillage to avoid accumulating compaction from farm equipment. Another barrier to reduced tillage exists for the 750,000 acres where root crops are grown, which most typically require significant soil disturbance for harvest operations. In both cases, reduced tillage may still be practiced within the crop rotations, however the required periodic tillage is likely to offset the long-term carbon sequestration and erosion regulation benefits of reduced tillage and so we have removed these areas from our estimation.

Accordingly, we estimate that the total opportunity area within the Canadian Prairies for reduced tillage is about 16.8 million acres, or 26% of the cropland (Table 4).

Table 4. Reduced Tillage Area of Opportunity Estimation

Metric	Acres	Hectares	Calculation	Data Source
Total Annual Cropland	64,630,688	26,155,152	A	2023 Annual Crop Inventory
Reduced Tillage	41,605,197	16,837,052	B	2021 Census of Agriculture
Conventional Tillage	23,025,491	9,318,100	C (A-B)	2021 Census of Agriculture
Red River Clay Cropland	2,462,582	996,573	D	Surficial Geological Map of Manitoba Map 81-1
Other Cropland with Clay >50%	3,035,112	1,228,268	E	Soil Landscapes of Canada 3.2
Cropland with Root Crops	750,868	303,866	F	2023 Statistics Canada Acreage with assumed lands in 4-year rotation
Area of Opportunity	**16,776,929**	**6,789,393**	**G (C-D-E-F)**	

2.4.2 Cover Crops

Cover Crops remain in their infancy in the Canadian Prairies, with an estimated current application upon about 780,000 acres, or 1.2% of total annual cropland. There is currently no prairie-wide acreage data collected for Cover Crops, and so an estimate was necessary. This estimate is based on the number of farms employing Cover Crops in 2021[2] and the average portion of surveyed farm's acreage Cover Crops were implemented on, in 2020[3].

There are a wide range of circumstances where Cover Crops are feasibly applied, though there are many factors which influence the potential rate of adoption and success. To depict a defensible business case, it is recommended to assume two leading Cover Crop types are employed to applicable acres. Given the challenges to adoption, described in more detail below, it is recommended to also apply a frequency factor as the filter for the Cover Crop area of opportunity. This frequency factor accounts for the likelihood in any given year that the conditions are suitable for Cover Crop application.

2 Statistics Canada. Census of Agriculture. 2021. Census Consolidated Subdivision.
3 Morrison, C. and Lawley, Y., 2021. Prairie cover crop survey report. *Department of Plant Science, University of Manitoba*.

Cover Crops have been constrained to those which are additive to existing annual crop rotations, and which include nitrogen fixing legumes and provide forage potential for those farms which choose to terminate Cover Crops through fall grazing. Such Cover Crops have three proven applications:

- following the mid-summer harvest of fall-seeded winter wheat or fall rye,
- seeded concurrent with or shortly after spring wheat seeding, and
- seeded following late summer harvest of early maturing yellow peas.

There are many other Cover Crop configurations, however for the purpose of analyzing the benefits and costs of Cover Crops, we have assumed the above configuration as reasonably representing the diverse agricultural practice.

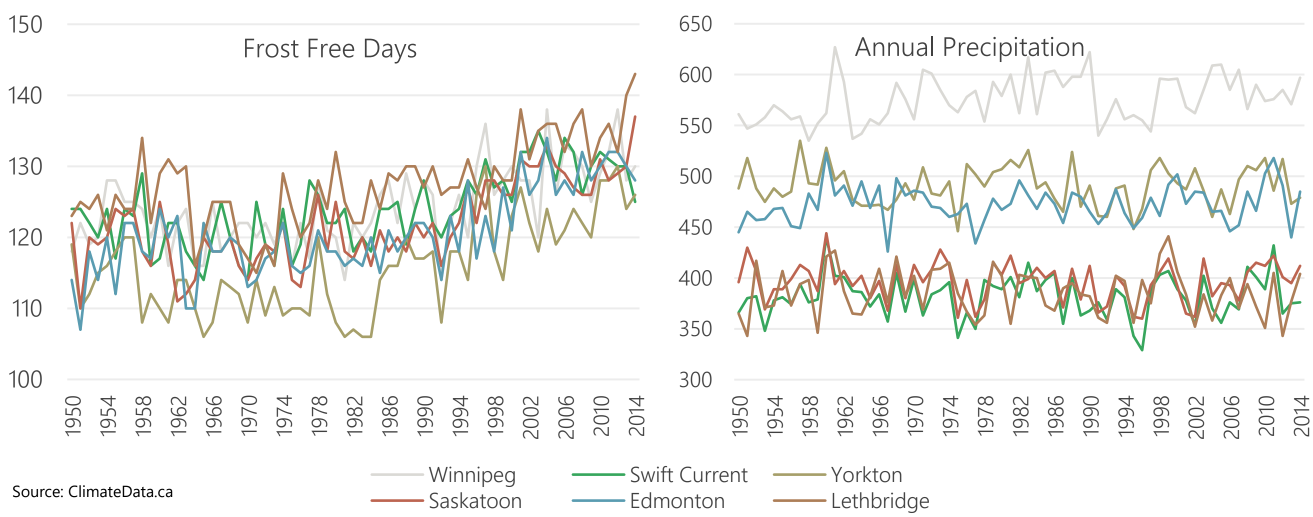
Table 5. Cover Crop Area of Opportunity Estimation

Cover Crop Scenario	Total Acres[4]	Applicable Acres*	Applicable Hectares	Applicable Primary Crops
Following Fall-seeded Crops	~1M	~0.3M	~0.1M	Winter Wheat, Fall Rye
Inter-seeded Spring Application	~19M	~5.7M	~2.3M	Spring Wheat
Following Early Harvested Spring Crops	~2M	~0.6M	~0.2M	Yellow Pea
Total	**~22M**	**~6.6M**	**~2.6M**	

*Total acres multiplied by an Application Frequency Factor of 0.3

Growing season length and precipitation significantly impact success rates of Cover Crops, and both vary across the Canadian Prairies Ecozone and across time (Figure 2). Many farms in this region grow Cover Crops opportunistically when the moisture conditions and growing season support establishment. Accordingly, it is suggested that for the identified Cover Crop Scenarios, an Application Frequency Factor of 0.3 is defensible. This factor implies that 30% of fields where the identified Cover Crops could be planted, would be included in the total area of opportunity. This would imply an applicable Cover Crop acreage potential for the business case of about 6.6 million acres (Table 3) or about 2.7 million hectares.

Figure 2: Frost Free Days and Annual Precipitation of Canadian Prairie Locations, 1950-2014



Source: ClimateData.ca

4 Agriculture and Agri-food Canada. Annual Crop Inventory, 2023.

3.0 Benefits to Adoption

3.1 Benefits Overview

Reduced tillage, Cover Crop adoption and conservation of grasslands provide significant carbon sequestration potential while also offering potential financial benefits alongside other ecosystem service co-benefits. In this section, the yield improvement from reduced tillage practices as well as the fodder value of Cover Crops and retained grasslands are estimated. In each case, the financial benefits to farmers are quantified as a co-benefit to the Canadian Prairies NCSs adoption.

3.2 Yield Gains of Reduced Tillage

Reduced tillage supports improved soil functioning, which commonly improves soil moisture storage, improves nutrient cycling and yields other positive soil function effects. Significant adoption of this practice has facilitated the accumulation of a robust literature which for most crops depicts clear yield gains upon the Canadian Prairies. These yield gains have shown to be strong for canola, pulses and wheat; while barley has had a negative effect[5]. With the production value effect of these yield gains taken together, the **weighted average yield gain benefit is $36 per annual crop acre, or $88 per hectare.**

There are likely to be yield effects from reduced tillage upon other Prairie crops not included in the calculation of this yield gain effect (Table 6), such as oats, corn, flax and various specialty crops. The meta-study informing the estimated yield gain effect does not include these crops, and so we based the estimated benefits from reduced tillage upon this subset of crops, which represent 94% of the annual cropland acres.

Table 6. Crop Production Value of Yield Gains from Reduced Tillage

Crop	Average Yield Per Acre[6] (Mt/acre)	Average Production Value per Acre[7] ($2025)	Yield Gain[8] (%)	Value of Gain Per Acre ($2025)	Total Acres	Weighted Value Per Acre* ($2025)
Canola	0.91	572	10	57.22	19,044,623	17.92
Wheat	1.42	427	7	30.38	28,332,040	14.15
Barley	1.48	391	-4	-15.64	5,803,884	-1.49
Dry Peas	1.07	469	9	42.21	2,521,307	1.75
Lentils	0.59	466	9	41.98	3,437,543	2.37
Soybeans	0.83	360	9	32.36	1,691,704	0.90
				Totals	**60,831,100**	**35.60**

*'Value of 'Gain Per Acre' multiplied by the crop's share of total acres.

5 Lower barley yields have been theorized, though not confirmed to be due to insufficient fertilization in no-till seeding practices or due to the concentration of barley production upon higher moisture soils upon which no-till practices result in a less significant yield improvement effect.

6 Statistics Canada. Table: 32-10-0359-01 (formerly CANSIM 001-0017). 2015-2025 Average Yields.

7 Statistics Canada. Table: 32-10-0077-01 (formerly CANSIM 002-0043). January 2024 to July 2025 Prices by Province.

8 Vanden Bygaart, A.J. and Liang, B.C., 2023. Crop yields under no-till in Canada: implications for soil organic carbon change. *Canadian Journal of Soil Science*, *104*(1), pp.22-27.

3.3 Fodder from Cover Crops

Benefits from Cover Crops vary significantly by level of production and by the crop and the production system integration method. Evidenced productivity of Cover Crops established within the Canadian Prairies is highly variable and driven in large part by available soil moisture and growing season length. For those who have adopted Cover Crops, a prairie-wide survey indicated that 46% of farms terminate annual Cover Crops at the end of each growing season by grazing with livestock[9]. We recommend this percentage be applied as the appropriate scaling factor to the Cover Crop area of opportunity to estimate the financial benefits of fodder.

For those farms which graze Cover Crops, fodder value is a benefit contingent upon the average level of expected Cover Crop productivity and nutritional value. As stated, Cover Crop productivity and nutritional value are highly variable, and so reasonable assumptions are required to estimate the benefit value. In alignment with the assumed applicable Cover Crops, we calculate the average of recorded legume Cover Crop yields for the Canadian Prairies, found to be the average of the low and high recorded yields; 0.46 tonnes per acre (Table 7).

When a price of $200 per MT[10] is applied to the average productivity values, it is reasonable to expect about $92 per acre or $227 per hectare of fodder value. With a scaling factor of 0.46, the effective **fodder value benefits are $42 per acre or $105 per hectare of adopted Cover Crops**.

Table 7. Pulse Cover Crop Reported Productivity, Canadian Prairies

	Tonne per Acre		
Study Location	Low	High	Cover Crop
Manitoba[11]	0.24	0.73	Red Clover
	0.16	0.48	Alfalfa
	0.15	0.52	Chickling Vetch
Saskatoon, Saskatchewan[12]	0	0.57	Red Clover
	0.02	1.00	Alfalfa
Manitoba[13]	0.04	0.59	Sweet Clover
	0.34	1.50	Red Clover
	0.06	0.95	Pea
Averages	**0.13**	**0.79**	
Total Average	**0.46**		

3.4 Pollination Impact from Cover Crops

Wild pollinators and domesticated honeybees provide significant pollination benefits to natural systems and to Canada's agricultural system. Cover Crops have the potential to provide a source of food for pollinators in the fall season; when food sources are typically sparse, especially within annual cropland areas. In doing so, Cover Crops may improve the variety and number of pollinators which in subsequent years improve yields of pollination dependent crops.

9 Morrison, C. and Lawley, Y., 2021. Prairie cover crop survey report. *Department of Plant Science, University of Manitoba*.

10 Alberta Agriculture and Irrigation. Average Farm Input Prices for Alberta. 2024-2025.

11 Martens, J.R.T., Hoeppner, J.W. and Entz, M.H., 2001. Legume cover crops with winter cereals in southern Manitoba: Establishment, productivity, and microclimate effects. *Agronomy Journal*, *93*(5), pp.1086-1096.

12 Blackshaw, R.E., Molnar, L.J. and Moyer, J.R., 2010. Suitability of legume cover crop-winter wheat intercrops on the semi-arid Canadian prairies. Canadian Journal of Plant Science, 90(4), pp.479-488.

13 Cicek H., Entz M. H., Martens, J. R. T., and Bullock, P. R., 2014. Productivity and nitrogen benefits of late-season legume cover crops in organic wheat production. Canadian Journal of Plant Science. 94(4): 771-783.

Pollination benefits are reasonably estimated by multiplying a cover crop 'Pollination Impact Factor' to the portion of Canadian Prairies crop production value dependent on pollination. The Impact Factor is complex and depends on the cover crop species, timing of flowering, pollinator species and many ecological factors which impact the successful foraging of pollinators. An Impact Factor is therefore not directly estimable for the cover crop application. We assume a potential 10% increase in pollination as a result from Cover Crops in the Canadian Prairies.

Using Pollination Dependency Factors for all Prairie crops with some level of pollination dependency (Table 8), we find an expected crop production value dependent on pollination of $4.6B. When this total value is applied to all 64.6 million annual cropland acres in the Canadian Prairie Ecozone, the pollination value amounts to $71 per acre. With the assumed Pollination Impact Factor of Cover Crops of 0.1 (10% improvement in pollination) applied, we estimate a **Cover Crop pollination benefit of $7 per acre or $18 per hectare**.

Table 8. Pollination Dependency and Estimated Pollination Benefits in the Canadian Prairies

Crop	Total Acres[14]	Average Yield Per Acre [15] (Mt/acre)	Average Production Value per Acre[16] ($2025)	Pollination Dependency Factor[17]	Estimated Pollination Dependent Value ($2025)	Cover Crop Benefit (Pollination Impact Factor of 0.1)
Canola	19,044,623	0.91	572	0.4	4,359,255,264	435,925,526
Soybean	1,691,704	0.83	360	0.25	152,047,073	15,204,707
Flaxseed	284,229	0.63	422	0.05	5,993,931	599,393
Mustard	511,714	0.37	279	0.25	35,743,836	3,574,384
Dry Peas	2,521,307	1.07	469	0.025	29,563,078	2,956,308
Fababeans	40,636	1.02	389	0.25	3,952,500	395,250
Total	**24,094,212**				**4,586,555,682**	**458,655,568**

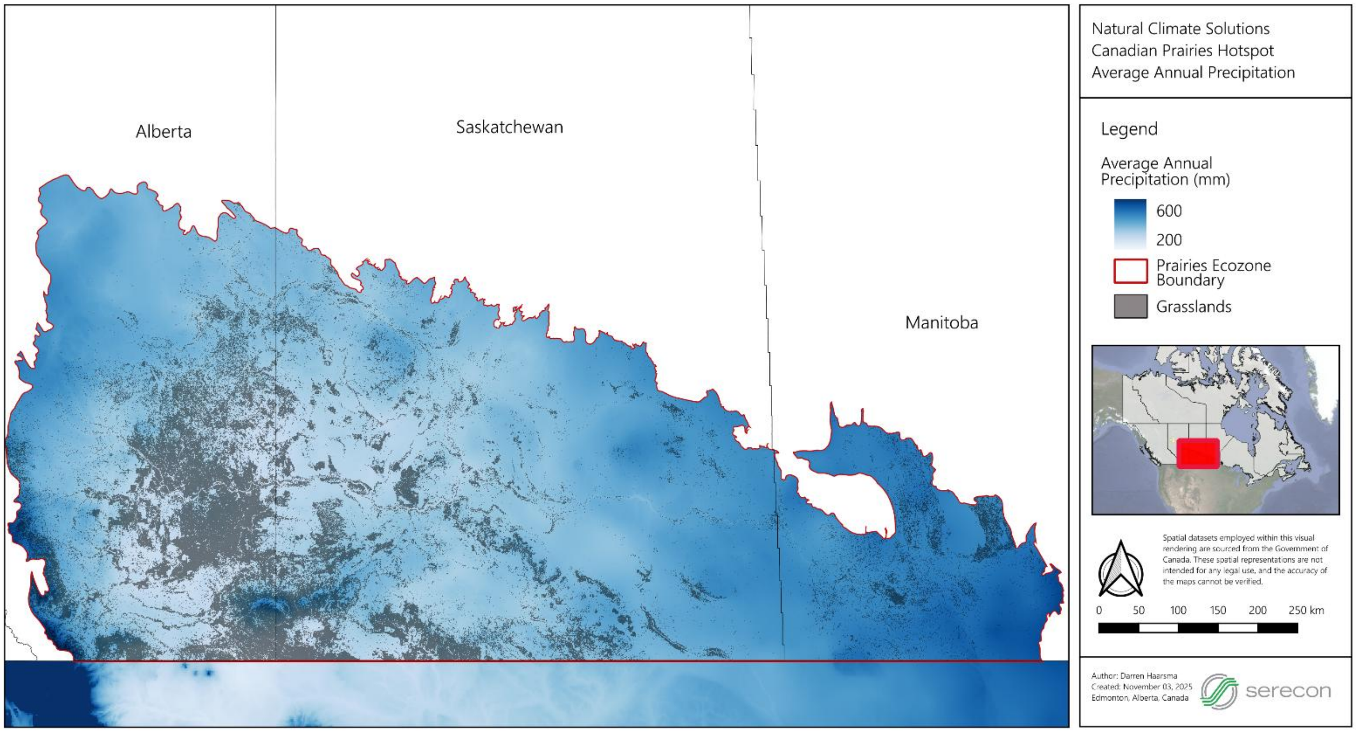
3.5 Fodder Value of Conserved Grasslands

Native grasslands are frequently grazed by cattle, and when grazed, have been shown to improve carbon sequestration potential[18], soil nutrient regulation[19] and water quality regulation. Actions taken to conserve grasslands therefore produce fodder value as a strong co-benefit to target ecosystem services.

We estimated this fodder value by applying average precipitation-based pasture productivity measures to 2025 grazing rental prices. Figure 3 illustrates the variability in annual precipitation. This variability drives a wide variety in average productivity levels of grasslands. Average annual precipitation is significantly higher in Alberta's western foothills area, the Cypress Hills of southeast Alberta and southwest Saskatchewan and Manitoba.

14 Agriculture and Agri-food Canada. Annual Crop Inventory, 2023.
15 Statistics Canada. Table: 32-10-0359-01 (formerly CANSIM 001-0017). 2015-2025 Average Yields.
16 Statistics Canada. Table: 32-10-0077-01 (formerly CANSIM 002-0043). January 2024 to July 2025 Prices by Province.
17 Klein A-M, Vaissière B E, Cane J H, Steffan-Dewenter I, Cunningham S A, Kremen C and Tscharntke T 2007 Importance of pollinators in changing landscapes for world crops Proc. Biol. Sci. 274 303–13.
18 Lynch, D.H., Cohen, R.D.H., Fredeen, A., Patterson, G. and Martin, R.C., 2005. Management of Canadian prairie region grazed grasslands: Soil C sequestration, livestock productivity and profitability. *Canadian journal of soil science*, *85*(2), pp.183-192.
19 Sollenberger, L.E., Kohmann, M.M., Dubeux Jr, J.C. and Silveira, M.L., 2019. Grassland management affects delivery of regulating and supporting ecosystem services. *Crop Science*, *59*(2), pp.441-459.

Figure 3: Canadian Prairies Average Annual Precipitation, 1991-2020



Source: Agriculture and Agri-food Canada. Agroclimate Data. 2021.

The average annual precipitation for grasslands within the Canadian Prairies from 1991-2020 is 365mm. There is little grassland in areas with average annual precipitation greater than 550mm, and 55% of grasslands have average annual precipitation between 250-350mm. Annual rainfall below 300mm, especially in the warmer, southern portion of the Canadian Prairies is likely insufficient to support on-going crop production without irrigation. Therefore, there is a considerable portion of grasslands for which cattle grazing is likely much more economical than crop production. Table 9 illustrates Alberta's wide range in grassland average annual precipitation rates, and similar average to Saskatchewan's grasslands. Manitoba's grasslands have significantly higher average precipitation; however, the total area is much less significant than in the other two provinces.

Table 9. Average Annual Precipitation upon Grasslands in the Canadian Prairies Ecozone, 1991-2020

<table>
<tr><th colspan="2">Metric</th><th>Alberta</th><th>Saskatchewan</th><th>Manitoba</th></tr>
<tr><td rowspan="3">Annual Average Precipitation (mm)</td><td>Minimum</td><td>250</td><td>272</td><td>432</td></tr>
<tr><td>Maximum</td><td>756</td><td>493</td><td>583</td></tr>
<tr><td>Average</td><td>348</td><td>364</td><td>491</td></tr>
<tr><td colspan="2">Grassland area (acres)</td><td>11,515,377</td><td>8,639,844</td><td>1,672,970</td></tr>
</table>

Sources: Agriculture and Agri-food Canada. Agroclimate Data. 2021.; Agriculture and Agri-food Canada. Annual Crop Inventory, 2023.

To estimate average grassland pasture productivity, the average precipitation rates are applied to the stocking rates under the assumption that rangeland is all in 'Good' condition. This results in Animal Unit Month (AUM) ratings from 0.25 to 1.00 per acre, and a grassland area-weighted average of 0.37 AUM per acre.

Table 10. Range Stocking Rates for Normal Soils in Precipitation Zones

Average Annual Precipitation Zone (mm)	Stocking Rates for Various Range Condition Classes (AUM per acre)				Proportion of Grasslands
	Excellent	Good	Fair	Poor	
150 - 250	0.2	0.15	0.1	0.05	-
250 - 350	0.3	0.25	0.2	0.15	55%
350 - 450	0.5	0.4	0.3	0.2	28%
450 - 550	0.8	0.65	0.5	0.35	15%
550 – 650	1.2	1.00	0.8	0.6	2%

Source: Government of Alberta.1988. Guide to Range Condition and Stocking Rates for Alberta Grasslands.

The value for this level of pasture productivity may be estimated based on average grazing rental rates, or prices. These prices vary based on water access and geography of grasslands, however in our opinion it is reasonable to use an average price of $55 per AUM. Most prices currently are around $45-60 per AUM, with some reporting as high as $90 per AUM. **At an average price of $55 per AUM, and an average pasture productivity of 0.37 AUM per acre, the fodder value of conserved grasslands is $20 per acre or $50 per hectare.** Considering only the pasture productivity impact of precipitation, fodder value may however range from nearly 200 percent higher in high precipitation areas to as much as 50 percent lower in low precipitation areas.

3.6 Benefits Summary

The analysis in this section clearly demonstrates the significant financial co-benefits farmers experience from reduced tillage, Cover Crop adoption and conserved grasslands. Improving upon or leveraging these co-benefits is an important enabling approach for implementing the Canadian Prairies NCS's.

Table 11. Summary of Benefits

NCS Practice	Benefit Type	Benefit ($2025 per acre)	Benefit ($2025 per hectare)
Reduced Tillage	Yield Gain	36	88
Cover Crops	Fodder Value	42	105
	Pollination	7	18
Grassland Conservation	Fodder Value	20	50

4.0 Costs to Adoption

4.1 Costs Considered

The costs to adopting the NCS practices within the Canadian Prairies Ecozone are unique to the agricultural circumstances of the region. Accordingly, the following sections of the report include analysis of specific costs intended to support the CBA findings of the Oxford Economics NCS Report.

4.2 Costs of Reduced Tillage

Transitioning from conventional cultivation to no-till or minimum-till production typically requires a one-time capital investment in seeding equipment. Estimating the net cost of this equipment trade is complicated by the wide range in new and used equipment costs, and a significant variation in the cultivation tools used. Furthermore, farms which transition to a reduced tillage system are likely to keep aged, lower value cultivation equipment to use around ephemeral wetlands, or to remedy isolated instances of field rutting or compaction.

Considering this operational reality, we posit that a reasonable estimate for the average costs of adopting reduced tillage accounts simply for the difference in seeding tool costs. There are low-cost conventional tillage broadcast seeding systems, however, to compare the modern seeding system alternatives, we have assumed conventional tillage would require an Air Hoe Drill. Minimum-tillage systems would require an Air Drill with Independent Openers, and no-till requires an Air Disc Drill.

The differences in capital cost per acre listed in Table 12 indicates that a shift to minimum tillage represents a $40 per acre capital cost ($160 less $120) and $120 per acre ($240 less $120) to shift to no-till. **Therefore, we conclude that the one-time cost for reduced tillage ranges from $40-120 per acre or $99-296 per hectare.** It is reasonable to apply a simple average of about $200 per hectare.

Table 12. Reduced Tillage Capital Cost Estimates

Seeding Tool	Equipment Description	New Cost	Cost per Acre (2,500-acre farm)
Air Hoe Drill	Small, 27-50 ft.	$300,000	$120
Air Drill	Small, 25-45 ft.	$400,000	$160
Air Disc Drill	Small 30-49 ft.	$600,000	$240

Source: Government of Manitoba. 2024/2025 Cost of Production – Farm Machinery. Pages 21-22.

4.3 Costs of Cover Crops

As we have discussed, Cover Crops differ widely in crop mix, application method and the growing season timing in which they are seeded. The costs for each specific application type vary according to this wide variety, and so an estimation of costs requires an assumption of the type of application. With an average Cover Crop mix, seed costs are estimated at $40.59 per acre, and those implemented as shoulder-season Cover Crop require an additional application cost of $26.71 per acre. **Considered together, we estimate that Cover Crops cost between $41-67 per acre or $100-166 per hectare.**

Table 13. Cover Crop Costs per Acre

Cover Crop Type	Seed Costs	Application Costs	Total Cost
Inter-seeded Full Season	$40.59	-	$40.59
Separate seeding, Shoulder Season	$40.59	$26.71	$67.30

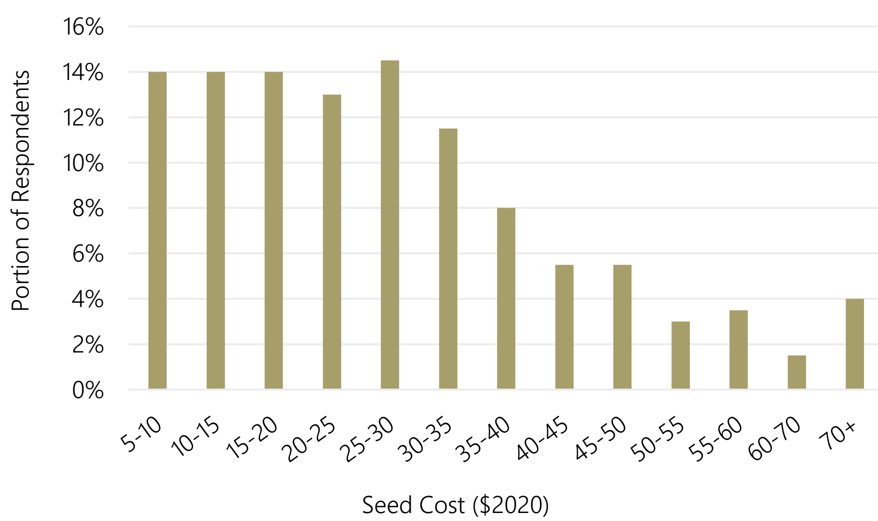
Source: Morrison, C., Lawley, Y. 2021. 2020 Prairie Cover Crop Survey Report. Department of Plant Science, University of Manitoba.

The following sections detail the seed and seed application costs considered in this cost conclusion.

4.3.1 Seed Costs

Cover Crops range from a single species to a mix of more than a dozen plant species, and so the costs widely range based on the number and specific species implemented. Costs may also differ depending on whether the seed is grown on-farm or sourced from a certified seed grower. Seed costs from the Prairie Cover Crop Survey Report[20] (Figure 4) have illustrated this variance in a reported range from $5 to upwards of $70 per acre. From this sample, our analysis found a surveyed farmer weighted average cost of $31.51 per acre ($2020), which indexed forward to 2025[21] results in an **estimated seed cost of $41 per acre or $91 per hectare.**

Figure 4: Prairie Cover Crop Survey Seed Cost Summary, 2020



4.3.2 Seeding Application Costs

Application costs are highly variable and driven by the type of equipment used and the point in the growing season in which the Cover Crop is seeded. Innovation will reduce this cost, though there may be trade-offs with seed application effectiveness. For example, aerial drone broadcast applicators lower application cost, though this approach may have a lower rate of successful establishment. It is reasonable to assume, however, that shoulder-season Cover Crop applications would employ seeding tools already operated by a farm, and so we have taken the average costs of the most common seeding applicators. Accordingly, the cost of seeding equipment, tractor, labour and fuel required for a shoulder season application, has an **average cost of $27**

20 Morrison, C. and Lawley, Y., 2021. Prairie cover crop survey report. *Department of Plant Science, University of Manitoba*.
21 Statistics Canada. Farm Input Price Index, Quarterly. Table 18-10-0258-01. Price Index for: 'Commercial seed and Plant'.

per acre[22] or $66 per hectare. Full season Cover Crops may in some instances be seeded concurrent to the main spring seeded crop in the same seeding application, and so no additional seeding application costs would be incurred.

4.3.3 Productivity Costs not Accounted For

Like any crop, the success of Cover Crops hinges on adequate available moisture. Shortfalls in fall moisture will challenge the establishment and productivity of Cover Crops, and shortfalls during the following spring (due to low snowmelt levels or precipitation) will challenge the successive crop. In a season with low precipitation, there is a risk that the fall Cover Crop growth will reduce available soil moisture and if not replenished the following spring, this will have a negative impact on yield of the successive crop. This risk is accounted for in our analysis using a Cover Crop practice frequency factor of 0.3, which implies that in some portion of years, such as years with inadequate precipitation, Cover Crops will not be employed.

4.4 Costs of Avoided Grassland Conversion

Grassland conversion pressures exist from a combination of demand for residential development, commercial development and cropland use. It is reasonable to conclude that the cost of avoiding this conversion is the land value because the value corresponds to the level of risk, or demand for converting grasslands to residential, commercial, or crop production. As noted in section 3.5, there are significant portions of existing grasslands where the average precipitation is not sufficient for crop production, and so the relative economics of cattle grazing are likely to be favourable.

As an alternative to incurring the entire land value to conserve grasslands, a lower cost option is the application of conservation easements which restricts certain uses for a period of time or in perpetuity. Easements vary widely in the specific land uses which are constrained, with some constraining only the number of residential dwellings and their positions on the land, while others constrain any development or change in land use.

There is a growing historical set of conservation easements from which the effective land value cost may be reviewed based on comparing sale prices before and after easement. The variety in easement details paired with a wide variety in other attributes of grassland parcels yields a dataset by which we may conclude a cost estimate for conserving grasslands. Based on a review of this dataset, conservation easements have been shown to have a wide range of impact to land values, from almost zero impact to about 60% of land value. Most of these easements result in a decrease of land value between 20-50%, though as noted above, easements vary significantly in the specific types of development that are restricted.

Oxford Economics apply a 2018 average land value of $7,605 per hectare[23], or $9,669 indexed forward to 2025 prices, to their cost for conserving grasslands. **If conservation easements between 20-50% of land value were instead used to estimate the costs, the 2025 cost per hectare ranges from $1,934 to $4,835 per hectare, or $783 to $1,956 per acre.** It is therefore evident that the use of full land value as the cost of conserving grasslands is a very conservative input to the CBA conducted to support this NCS.

22 Source: Government of Saskatchewan. 2024-25 Farm Machinery Custom and Rental Rate Guide.

23 Drever, C.R., Cook-Patton, S.C., Akhter, F., Badiou, P.H., Chmura, G.L., Davidson, S.J., Desjardins, R.L., Dyk, A., Fargione, J.E., Fellows, M. and Filewod, B., 2021. Natural climate solutions for Canada. *Science advances*, *7*(23), p.eabd6034.

4.5 Cost Summary

Our cost analysis broadly supports and indicates the conservative nature of the costs included in Oxford Economics' CBA supporting Canadian Prairies NCSs (Table 11). The costs of transitioning to reduced tillage, adopting Cover Crops and conserving grasslands may in some cases be lower than estimated and will vary significantly across the diverse agricultural landscape of the Canadian Prairies.

Table 14. Summary of Costs

NCS Practice	Serecon Cost ($2025 per hectare)	Oxford Economics ($2025 per hectare)
Reduced Tillage	$99 - 296	$260
Cover Crops	$100 - 166	$246
Grassland Conservation	$1,934 - 4,835	$9,669

5.0 Risks to Implementation

5.1 Accounted for Risk

Success of the NCSs on the Canadian Prairies are affected by two main elements of uncertainty, as follows:

1. adoption level risk, and
2. practice maintenance risk.

The first relates to the barriers which may undermine the successful adoption of practices. The second is the risk that despite adoption, a practice may not be maintained due to various external and internal factors commonly impacting farms in Western Canada.

Within the Area of Opportunity calculations some barriers to adoption are considered such as the soil suitability for reduced tillage, or soil moisture limitations impacting Cover Crop implementation, and so these barriers to adoption are not considered here.

5.2 Adoption Risk Factors

The following sub-sections describe three adoption risk factors which challenge the implementation of reduced tillage, Cover Crops, and grassland conservation in the Canadian Prairies Ecozone.

5.2.1 Agricultural Economy Downturns Challenge Practice Change

Practice changes which require additional costs with deferred benefits are challenging in periods with simultaneous or individual incidence of:

- low agricultural commodity prices,
- poor or highly variable yields,
- rising capital or operating costs.

In times of narrow margins, farm operations typically reduce the level of practice innovation to minimize their internal risk.

5.2.2 Farm Succession Challenge reduces Innovation

The succession of farms from one generation to the next is challenged by a reduction in the number of younger people entering the agriculture industry, which is in part a result of the increasing capital requirements to purchase land and farm equipment. Some farms in succession use the generational hand-off as an opportunity to innovate the farm system, while other farms struggle through the significant financial transition and avoid complicating operations by simply maintaining existing practices and farm equipment.

5.2.3 Rented Land Reduces Incentive to Invest

About 43% of cropland in the Canadian Prairies was rented as of 2021[24], with the highest portion of land rented in the high productivity black chernozem soils. Farms that rent cropland do not have the same incentive to invest in soil health if they do not have a long-term rental arrangement where they can expect to experience productivity improvements. This is particularly evident in the case of Cover Crop implementation where uncertainty of tenure would undermine the incentive to plant nitrogen fixing crops for future crop benefits. This barrier is evident in the

24 Statistics Canada. Census of Agriculture 2021. Land Tenure.

Prairie Cover Crop Survey, which found 69% of Cover Crop practicing farms owned all, or most, of their land base[25].

5.3 Risk Factors for Practice Maintenance

Once the barriers to adoption are overcome, there is risk of reversion back to historical practices due to periods of economic stress or change. Specific examples include:

- *Reduced Tillage* – the risk of reverting to conventional tillage is reasonably low due to the sunk costs into the seeding and spraying equipment necessary for reduced tillage crop production. There are, however, instances where tillage may be returned to, which include years where higher precipitation has drowned out portions of fields.
- *Cover Crops* – extended periods of drought challenge the maintenance of adoption due to consistent and seasonally specific water demand of Cover Crops.
- *Avoided Grassland Conversion* – there is a persistent risk that grasslands may be converted to cropland use when cropland margins are high and precipitation is sufficient.

Further detail for factors impacting Cover Crop and avoided grassland conversion are provided below. As noted, reduced tillage has a fairly low risk of practice reversion, and so factors are not elaborated upon below.

5.3.1 Variable Weather and Climate

Climate change is affecting precipitation patterns and growing season length within the Canadian Prairies. Growing season length has increased by 10-15 days from 1990 to 2020; representing a significant 10% increase in the frost-free period (Figure 2). These shifts affect both the timing and degree of moisture or heat available to crops, which in turn impacts the success of reduced tillage or cover crop practice adoption.

While an extended frost-free period improves the available season for Cover Crops grown following the primary crop, Cover Crop adoption may still not occur. Farmers may instead shift the primary crops produced to take advantage of potentially superior economics of other commodity crops such as corn, soybeans, or later maturing varieties of currently prevalent prairie crops.

5.3.2 High Crop Margins Incentivize Grassland Conversion

The pressures for converting grassland ebb and flow with market conditions, and so the permanence of avoided conversion of grasslands is nearly always in question. For instance, in periods with high annual crop margins and comparatively low cattle margins, there is significant pressure to plough grassland for crop production. This challenge will always be present unless actions are taken which provide long-term certainty and incentives to conserve grasslands.

5.4 Risk and Mitigation Summary

Production systems vary significantly among farms, and each farm is evolving driven by market, environment and social pressures. These dynamic systems are exposed to many elements of risk and so approaches taken to encourage practice adoption should account for or align with these pressures to achieve long-term benefits.

25 Morrison, C., Lawley, Y. 2021. 2020 Prairie Cover Crop Survey Report. Department of Plant Science, University of Manitoba. Page 13.

Adoption risks may be mitigated by ensuring the implementation strategy addresses the production system risk component of practice adoption. Examples of such mitigation may include the recognition of cover crops as an insurable crop or a qualifier for an insurance discount, regional demonstration sites, or cost-sharing of upfront costs. If the operating reality of Canadian Prairie farms is considered in providing support to adoption, the likelihood is significantly improved of adoption across the wide variety of operating circumstances.

The risk that regenerative cropping or conserving grassland practice changes may be reversed is considerable given the dynamic nature of agricultural systems. For Cover Crop adoption, this may be mitigated by supporting research and practice development in a variety of production systems and locations. Supporting on –the-ground demonstrations would ensure Cover Crop types are adopted and evolve with those suitable for the changing climate of each area within the Canadian Prairies.

Any action to conserve grasslands should strive to provide a form of permanence to avoid conversion from taking place. For instance, the use of easements applied in perpetuity avoids the risk of future economic pressures incentivizing conversion after a temporary action is taken to conserve grasslands. In the following section we summarize our recommendations for how these risk mitigation considerations should be implemented.

6.0 Implementation Recommendations

6.1 Guiding Principle

Throughout this report it has been highlighted how the dynamic nature of farm production systems challenges actions taken to support adoption of reduced tillage, Cover Crops and grassland conservation. As a core principle, NCSs should be actioned in ways that account for the variability of farm activities and thereby ensure the benefits from these solutions are long lasting, and the change is resilient. Below are four recommendations for how this resilience may be achieved.

6.2 Regenerative Crop Production

Crop production systems vary significantly between farms and evolve as farms experiment with different equipment and techniques. Policy which supports the adoption of reduced tillage and cover crops should leverage and not undercut this strength of the Canadian agricultural system.

6.2.1 Support Flexibility in Crop Production System

Flexibility in practice change should be implemented through non-prescriptive support, which focuses on the outcomes and not on the inputs or specific prescriptions. Such support ensures that farmers have the agency to innovate and are incentivized to find outcome-oriented solutions appropriate to their circumstances.

6.2.2 Enable Research and Practice Demonstration Applicable to Target Farms

Farmers may more effectively find solutions applicable to their operations through avenues for regionally focused research and demonstration. When farmers see a practice and the results in a setting like their farm practiced by another farmer, they are more likely to pursue a practice change on their own farm. Therefore, it is important that research or demonstration farms reflect the operating circumstances of the region. Examples of such avenues include regional applied agricultural research organizations, farmer-to-farmer networks, and industry-driven programs.

6.3 Grassland Conservation

Preserving native grassland is, as described above, constantly challenged by the comparatively stronger economics of annual crop production over cattle production. In 2025, the inverse of this dynamic holds, with poor commodity crop economic conditions and strong cattle economics. This circumstance may therefore be an opportunity for land management decisions to lean on improved cattle grazing economics to achieve long-term grassland conversation impacts.

6.3.1 Consider the Co-Benefits of Livestock Grazing

Grasslands can provide strong, and even improved, ecosystem benefits when appropriately managed for cattle grazing. Along with the co-benefit of fodder value, the potential for improved ecosystem function from grazed grasslands supports the aligned objectives of preserving grasslands for livestock grazing.

6.3.2 Support Perpetual Easements

Conservation easements can conserve grasslands at a significantly lower cost than outright purchase of lands, and if specified, may enable continued agricultural, recreational and residential activities on the land. The use of term-based easements has been encouraged to retain future opportunities for development; however, these temporary easements are much less likely to be pursued by landowners. In contrast to perpetual easements, temporary or term-based easements do not qualify for eco-gift federal tax credits, and the impermanence does not align with the legacy goals of many landowners who value preserving grasslands.

6.4 Conclusion

In conclusion, our analysis broadly supports the Canadian Prairies Cost-Benefit Analysis findings of Oxford Economics. Our analysis found significant financial co-benefits to reduced tillage, Cover Crop adoption and grassland conservation. Analysis of costs supported those figures applied by Oxford Economics, and indicated their conservative nature, particularly with respect to grassland conservation.

We recommend that actions which are taken to support these three NCSs should first and foremost consider the highly variable nature of farm activities and avoid over-prescriptive policy or programs supporting Cover Crops or reduced tillage. We also recommend that grassland conservation be considered through the cost-effective lens of conservation easements, and the potential for alignment of ecosystem outcomes with appropriate cattle grazing.