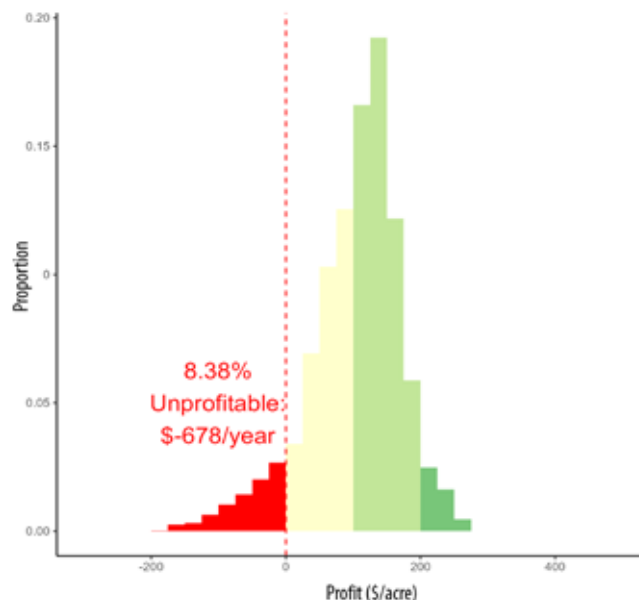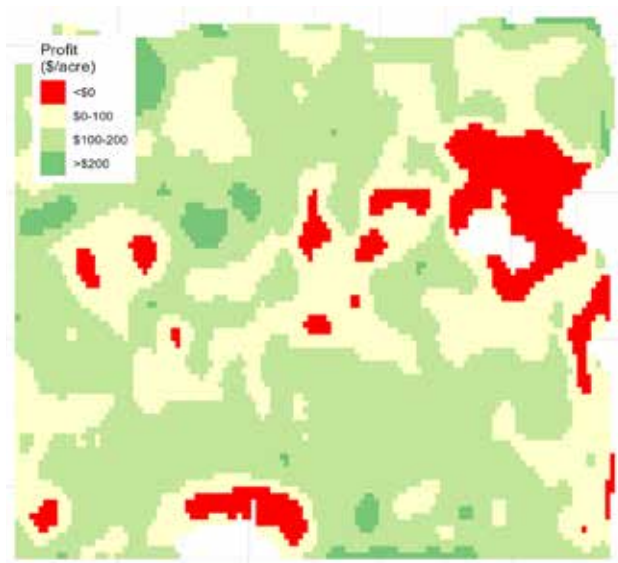# Prairie Precision Sustainability Network (PPSN) Marginal Areas Valuation

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Summary
Using Prairie Precision Sustainability Network (PPSN) yield predictions, costs of inputs and crop prices from 2019-2022:
- 20% of cropland acres were unprofitable in a given year;
- 8.5% of acres were unprofitable in the same spot each year; and
- this translates to 7.3M acres of marginal land in total (cropland represents 86M acres across all three Prairie provinces).

The distribution of marginal areas was highly right-skewed: many quarter sections had almost no marginal land, while a small number of quarters had large amounts of marginal land.

The average dollar value lost to marginal areas was -$68.1 per acre ($926 per quarter section).
- If marginal areas are also able to produce a hay crop (at $64/acre), this results in a financial opportunity of roughly $132 per acre ($1782 per quarter section).

These values varied strongly with location, suggesting that payments for marginal areas should be higher in some areas than others.

Preamble
Marginal areas are areas of marginal crop production, i.e. where the cost of preparing/seeding/spraying is greater than the value of the harvested crop, on a consistent basis. To determine appropriate payment for MAP areas, it is worth knowing how much money would be saved if a grower had converted MAP areas to forage. This summary serves as a first step towards a full economic valuation of MAP areas.

The Prairie Precision Sustainability Network (PPSN) is a DUC-funded initiative focused on the use of DUC's Marginal Areas Program (MAP), where marginal crop land is removed from production and seeded to perennial forage. Phase I of PPSN ended in March 2025, and delivered data products on crop production estimates from 2019-2023 for six key target landscapes (plus stability estimates) across the Canadian prairies:

      Alberta: Calgary West/Clear Lake and Vermillion/Viking
      Saskatchewan: Leonore/Quill South, Lightning and Upper Assiniboine
      Manitoba: Turtle Mountain (Minnedosa/Shoal) and Riding Mountain (Killarney)

Production & Profitability Data

To calculate profit in a given area, we need the following information:

$$Profit = (Yield \times Crop\ Price) - Production\ Cost$$
$$dollars/acre = (bushels/acre \times dollars/bushel) - dollars/acre$$

- *Yield* maps provided by PPSN for canola and wheat (2 most common crops on the prairies).
- *Crop Price* varies daily, but average values for a given year were taken from Statistics Canada – this is likely an underestimate, as a) growers will often store grain for long periods in order to get a higher price for it at the elevator, and b) crop prices vary across Canada (depending on a given elevator's distance to main railways & ports). This is beyond the scope of the work, as selling behaviour is based on individual growers' storage capacity, risk thresholds, and the behaviour of commodity markets.
- *Production Cost* was taken from crop production guides published by all three provinces. Production costs vary by soil zone, and were mapped onto soil zones from each province.

Hay production

Hay production is likely limited in marginal areas due to salinity or other soil-related factors, but only one study in North America (Clay et al. 2023) has studied this. They found that forage production in restored saline areas was roughly 25% of non-saline hay production during dry years, and roughly 50% during wet years. The number of growers that choose to harvest a hay crop is limited. Haying depends on a) the size and configuration of the patch (very small areas, or areas at the back or center of a cropped quarter are unlikely to be hayed), and b) equipment and time from the growers (many grain farmers don't have haying equipment). Because haying is variable, most of the economic value from marginal areas is derived from the fact that no inputs are being added to these areas, meaning that areas with negative profitability are removed from production.

Hay yields and prices were gathered from existing provincial records, and cutting/baling costs were taken from the Saskatchewan provincial forage harvest guide. Estimated baling costs for small areas are likely higher, but this gives a general idea of the value of marginal land hay on the prairies. This leads to values of roughly $26-122/acre of hay production (mean: $64/acre) in marginal areas, depending on the year and province:

Province	Year	Yield (t/ac)	Hay Price ($/t)	Baling Costs ($/t)	Profit ($/ac)	"Wet Year" Profit 50% production ($/ac)	"Dry Year" Profit 25% production ($/ac)
Manitoba	2019	1.52	200.0	35	250.8	83.2	41.6
	2020	1.37	115.2		109.9		
	2021	0.91	179.6		131.6		
	2022	2.00	121.6		173.1		
Saskatchewan	2019	1.29	90.7	35	71.9	52.1	26.1
	2020	1.03	110.7		78.0		
	2021	0.62	208.7		107.7		
	2022	1.09	181.4		159.6		
Alberta	2019	1.91	163.4	35	245.2	122.0	61.1
	2020	1.84	154.8		220.5		
	2021	1.16	184.0		172.8		
	2022	1.66	239.6		339.7		

Table 1: Hay yields and revenue estimates for the three prairie provinces

Overall Profitability

Estimates were calculated for Overall and Conservative profitability. Conservative estimates were calculated from data where the 2021 (heat-dome year) was removed, as well as pixels with only 1 year of data,

The percentage of consistently unprofitable land (i.e. unprofitable every year in the same spot) was 8.5% (5.3% conservatively) across target landscapes (see Table 1).

Within unprofitable field zones, the overall loss of profit was -$68.1 per acre, which translates to $926 in lost profits on an average quarter section (see Table 1).

Most land had positive profits in most years, but a significant amount of land only produced a profit in a small fraction of years. 3% of land had no profits in any years observed, while 19.4% had positive returns in <50% of years (Table 2).

This varied strongly by target landscape. In Lenore-Ponass, 34.6% of land turned a profit less than 50% of the time, while in Turtle Mountain it was 4.4% of land.

Opportunity Costs of Haying
- Not all marginal areas are able to be hayed, but assuming that all consistently marginal acres were hayed and hay was sold at an average value, this would result in an additional $64/acre from areas of formerly -$68.1/ac profit. This translates into an average financial opportunity of $132/acre for converting marginal acres, or $1782 for the average quarter section.
- NOTE: these values will vary depending on province, and do not account for planting and harvesting costs.

Target Landscape	Average Profit ($/ac)	Unprofitable (%)	Average loss in unprofitable areas ($/ac)	Average loss per quarter-section ($)	Estimate
Overall	**189.7**	**8.5**	**-68.1**	**-924**	
calgary_clear_lake	218.0	8.5	-87.6	-1189	
lenore_ponass	106.9	17.2	-69.0	-1895	
lightning	161.6	9.2	-59.7	-878	
quill_south	129.6	15.3	-74.2	-1817	Overall
riding_mountain	268.4	2.3	-59.7	-216	
turtle_mountain	284.5	1.2	-60.8	-118	
upper_assiniboine	174.4	8.8	-80.9	-1142	
vermillion_viking	182.6	5.3	-68.2	-580	
Overall	**235.0**	**5.3**	**-64.4**	**-541**	
calgary_clear_lake	273.9	3.3	-72.3	-384	
lenore_ponass	179.4	8.0	-65.9	-839	
lightning	196.7	7.1	-59.1	-675	
quill_south	187.3	9.0	-66.4	-960	Conservative
riding_mountain	287.2	2.7	-56.7	-243	
turtle_mountain	311.6	1.1	-62.4	-114	
upper_assiniboine	226.3	6.5	-78.9	-817	
vermillion_viking	225.8	3.0	-66.7	-320	

Table 2: Overall profitability predictions for PHJV target landscapes. % unprofitable indicates % of land that has profits <$0/ac. Average loss in unprofitable areas indicates average losses in areas with profits <$0. Average loss per quarter section (% unprofitable x average loss in unprofitable x 160 acres)

Target Landscape	% years profitable	Overall		Conservative	
		% of land	Cumulative % of land	% of land	Cumulative % of land
Overall	0	3.2	3.2	1.8	1.8
	50	12.1	19.4	9.1	13.7
	100	54.3	100	73.1	100
calgary_clear_lake	0	4.3	4.3	1.0	1.0
	50	15.5	23.4	14.1	16.6
	100	55.4	100.0	71.7	100.0
lenore_ponass	0	6.8	6.8	3.0	3.0
	50	23.4	34.6	14.6	18.7
	100	39.7	100.0	77.2	100.0
lightning	0	3.1	3.1	2.4	2.4
	50	11.7	20.2	11.4	17.5
	100	53.8	100.0	66.8	100.0
quill_south	0	5.6	5.6	3.6	3.6
	50	14.9	28.2	11.0	18.7
	100	39.0	100.0	69.1	100.0
riding_mountain	0	0.7	0.7	0.9	0.9
	50	7.0	9.9	4.4	9.3
	100	62.8	100.0	72.3	100.0
turtle_mountain	0	0.5	0.5	0.4	0.4
	50	3.4	4.8	3.1	4.4
	100	79.1	100.0	86.9	100.0
upper_assiniboine	0	3.4	3.4	2.3	2.3
	50	12.2	19.4	10.2	15.4
	100	51.9	100.0	71.2	100.0
vermillion_viking	0	2.1	2.1	0.8	0.8
	50	12.0	17.8	6.3	10.0
	100	45.5	100.0	71.6	100.0

Table 3: Proportion of years profitable, separated by target landscape and estimate type (Overall vs Conservative). % of land is the % of land profitable at a given % years profitable (e.g. % years profitable of zero indicates that this % of land was never profitable)