Returns to Cropping & Cow-Calf Production Systems in Southwest Saskatchewan

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Introduction

This report provides an estimate of the difference in economic returns between cattle grazing and cropping marginal cropland in Southwest Saskatchewan, updating Knopf's (2020) work. For this project, crop production cost data and projected prices and yields from the Saskatchewan Government's Ministry of Agriculture are used to estimate net returns to cropping systems in the Brown Soil Zone. Returns to cattle production systems come primarily from a representative farm in Southwest Saskatchewan via a survey of Canfax Research Services member participants, with additional information coming from budgets retrieved from the Alberta and Saskatchewan provincial government agriculture departments. The focus of this report is upon the Southwest region of Saskatchewan, corresponding to the Brown Soil Zone for crop production, and the semi-arid shortgrass region for cattle production.

The objective of this research is to determine the long-term returns to cropping vs. livestock agricultural production systems in the region of interest. A key goal is to estimate an appropriate level of compensation for producers who sign conservation easements, which preclude land owners from (for example) converting grasslands to cropland for the duration of the easement, which can be as short as a few years, or may continue in perpetuity. Because conservation easements are contracts that bind all future owners of the land upon which the easement is registered, they often effectively restrict land from being employed in its most profitable use. Accordingly, the economic consequences of who enters into such contracts, under what terms, and the amount of compensation involved are important.

Data

Crop Farm Rotations & Cost-of-Production Assumptions

In order to determine the level of compensation required to ensure landowners are fairly compensated for signing conservation easements, it is necessary to calculate the potential lost economic returns from restricting land use. In order to do so, the discounted sum of net future cash flows must be discounted into current-day dollars. For the purposes of this research, publicly-available data sources comparing returns to land used in cropping vs. livestock production were used. Following Knopf (2020), the cropping system was a three-year crop rotation consisting of durum wheat – lentils (large green lentils) – canola. Small-area seeded acreage available through Statistics Canada (2022) was reviewed to confirm the prevalence of these crops in Saskatchewan Agricultural region 3, which falls almost entirely within the Brown Soil Zone. In 2021, those crops were the largest three by seeded acreage in this region.

Cropping budgets for each field crop came from the *Saskatchewan Crop Planning Guide 2022* (Saskatchewan Government, 2022), which provides detailed cost of production estimates for each significant field crop for each soil zone in the province; budgets for each crop are from the Brown Soil Zone, and include all feasible fixed and variable expenses.

Table 1 provides an abridged set of costs and returns for the three year crop rotation used for this research. Yearly per-acre returns over total expenses are $207.23 for durum wheat, $156.52 for

lentils, and $107.64 for canola. Note that these returns are sensitive to yields and prices, and are based upon *average* yields in the Brown Soil Zone.[1]

Table 1. Per-acre returns over total expenses to durum wheat, large green lentils, and canola, province of Saskatchewan, 2022

Per acre	Durum	Lentils	Canola
Revenue	$486.88 (38.9 bu @ $12.50)	$378.11 (1080 lbs @ $0.35)	$592.46 (34.8 bu @ $17.01)
Variable expenses	310.73	259.85	391.90
Other expenses	92.92	92.92	92.92
Total expenses	403.65	352.77	484.82
Returns over total expenses	$ 83.23	$ 25.34	$107.64

Cow-Calf Operation Characteristics & Cost-of-Production Assumptions

Production budgets for the cow-calf operation are taken from representative farm CA-SK-3, a 245 head cow-calf operation located in the semi-arid shortgrass (mixed grassland) region of Southwest Saskatchewan based upon data provided by members of the *Canadian Cow-Calf Cost of Production Network* (CRS 2022). Key assumptions about this representative farm are that the breed of cattle raised is Angus, the operation does not fertilize its hay or pasture, around 8,700 acres of land are owned or rented for grassland and crops (6% of land is for crops including hay), there is one bull for every 27 cows, a 17% culling rate, a 3% calf death loss, and only replacement heifers are retained by the operation. Table 2 provides an abridged set of costs and returns for this representative farm, based on a five-year average.

As Table 2 shows, given the set of revenues and costs reported by cost of production network members, the representative cow-calf ranch in Southwest Saskatchewan barely breaks even over the five year period from 2017 to 2021. In fact, the same representative farm experienced losses of $54,047 in 2021 and $9,134 in 2020 with an average loss of $541 over the 2017 – 2021 period (profits were $38,997 in 2017 and $14,522 in 2018). There is an obvious five-year trend toward lower profitability for this representative farm.

[1] The *Saskatchewan Crop Planning Guide 2022* also provides budgets based upon yields in the 80th percentile for each crop by soil zone. For the Brown Soil Zone, returns to durum, lentils and canola assuming 80th percentile for yields are $207.23/acre, $156.52/acre and $235.21/acre, respectively.

Table 2. Annual enterprise returns for representative cow-calf operation in the semi-arid shortgrass region of southwest Saskatchewan, 2017 – 2021

Category	Amount
Revenue	$251,061
Total farm costs	250,950
Returns over total costs	$ 111

Short-run negative returns for cow-calf operators in the Brown Soil Zone are not surprising. Nevertheless, given the considerable variability in cow-calf profitability and the negative returns associated with cow-calf production during the last few years, it is prudent to consider alternate information sources. Provincial government staff in Alberta and Manitoba do provide enterprise budgets for cow-calf operations; in Alberta the Ministry of Agriculture through its Agriprofit$ program published the *2016 -2020 Economic, Productive and Financial Performance of Alberta Cow/Calf Operations* (Oginskyy & Boyda 2022) while the corresponding publications in Manitoba are *2023 Cost of Production: Beef Cow Calf 300 Cow Herd, Corn-Silage Ration* (Government of Manitoba 2022a) and *2023 Cost of Production: Beef Cow Calf 150 Cow Herd, Hay Ration* (Government of Manitoba, 2022b).

One key difference between the cropping system enterprise budgets found in the *Saskatchewan Crop Planning Guide 2022* and the cow-calf enterprise budgets from the three Prairie provinces is that the latter include unpaid labour and management costs, while the former does not. For Alberta, Agriprofit$ allocates $59.42/cow for this type of cost, while in Manitoba the 150 cow herd budget allocates $208/cow for "labour and living" and $156/cow for the 300 cow herd. The CRS (2022) representative farm budget for Saskatchewan does not break things down this way, but specifies $65,618 for "opportunity costs" which are intended to cover unpaid land, renting out land opportunity costs of buying or selling feed production, and returns to the producer's own capital. For the 245 cow herd, this works out to $267.83 per cow, which is not out of line with the Manitoba enterprise budgeting numbers given the Saskatchewan numbers include more than just unpaid labour.

In order to account for this difference in methodology between the cropping and livestock systems, the latter are adjusted to provide consistency between the two. Table 3 illustrates this adjustment and translates the results for each province into a per-acre basis following the assumption made by Knopf (2020) of 0.2 AUM (5 cows/acre) for the Brown Soil Zone.

Table 3. Per-acre returns to cow-calf operations, by province

Category	Saskatchewan	Alberta	Manitoba	
			150 Head	300 Head
Per-cow net returns	($240.00)	$69.89	($91.67)	$34.76
Per-cow labour/mgmt.	240.00	59.62	208.00	156.00
Total per-cow	0.00	129.51	116.33	190.76
Total per-acre (based on 0.2 AUM)	$ 0.00	$25.90	$23.26	$38.15

As Table 3 shows, returns to cow-calf operations on a per-acre basis range from effectively $0 in the relevant region of Saskatchewan[2] to $38.15 per acre for a 300 cow herd in Manitoba. These are not too different from the assumptions made by Knopf (2020) of cow-calf returns in the order of $44.00 acre, given significantly lower returns in that sector over the last two years.

Accordingly, for the purposes of this report, returns to cow-calf operations in southwest Saskatchewan are assumed to be $30 per acre. Using this value as a long-term average accounts for variability in returns to livestock systems over time and space. The accompanying spreadsheet tool allows the interested reader to carryout personalized sensitivity analysis by varying this amount according to their own set of assumptions.

Discount Rate Assumptions

Because cash flows from future farming/ranching operations take place in dollars to be received at some future time, they must be *discounted* into current dollars to account for the time value of money. A thousand dollars received a year from today is worth less than $1,000 today, due to the cost of borrowing (the interest rate), inflation, and nearly all individuals' preference to have money immediately instead of at some point in the future. A *discount rate* thus accounts for inflation, risk and time preference. Accordingly, future cash flows can be discounted into today's dollars using the following formula:

$$Present\ Value\ of\ cash\ flow = \frac{Future\ Cash\ Flow}{(1+d)^t}$$

where d is the discount rate, and t is the number of time periods in the future at which the cash flow is realized. As a simple example, using this formula to calculate the present value of $1,000 received three years into the future with a five percent discount rate would yield:

[2] The enterprise return of $111 for Saskatchewan's representative 245 cow herd was rounded down to zero in Table 3 for ease of calculation.

$$Present\ Value\ of\ cash\ flow = \frac{\$1{,}000}{(1.05)^3}$$

which gives a value of $863.84. In other words, at a five percent discount rate, $1,000 to be received in three years is worth the equivalent of $863.84 today. As inflation, time preference or risk increase, so does the discount rate, and thus as any of those factors increase, money received in the future becomes worth less today.

The concept of discounting is important in the context of this research because when signing a conservation easement, a landowner (farmer or rancher, in this case) is (in exchange for a one-time fixed payment) agreeing to limit how she or he uses that land for some period of time, or perhaps indefinitely into the future. Limiting how the land is used is in turn likely to result in reduced returns to that land, as current and future owners of the land are restricted from converting the land into a more profitable use. For example, native grasslands with good grazing properties but marginal cropping potential are more likely to be converted to cropland as grain prices increase, but if a conservation easement restricts the landowner's ability to convert the land to crop production, the value of the land will not increase as crop prices increase because the land cannot be converted.

Accordingly, in order to ascertain whether the proposed value of a conservation easement is "fair", predicted incremental future cash flows from higher-value uses must be discounted to current dollars. This allows the observer to determine whether the easement adequately compensates the landowner for the restrictions on use.

Results

Table 4 provides discounted returns to the cropping and livestock systems on a per-acre basis for terms of 10, 25, 50 and 100 years assuming a 5% discount rate. Note that results are extremely sensitive to selection of the discount rate; assumptions regarding per-acre returns to cow-calf production and break-up costs for grasslands similarly have the potential to impact comparative returns between the two systems. Knopf (2020) assumed a discount rate of 2.6%; given significant increases in interest rates and inflation during 2022, it is reasonable to conclude that a higher discount rate is now appropriate. Knopf (2020) assumed a grassland break-up rate of $16.88 per acre based upon a publication from 2007; consultations with agricultural producers indicated that due to significantly higher fuel costs as well as herbicide costs and potential equipment rental, the cost to convert grassland into soil suitable for agricultural production could be as high as $500 per acre. For the purposes of this research, a cost of $250 per acre was assumed; this can be modified in the spreadsheet tool that accompanies this report.

Table 4. Discounted per-acre returns to cropping and livestock systems for 10, 25, 50 and 100 year periods, 5% discount rate, average yields

	10 Year NPV/acre	25 Year NPV/acre	50 Year NPV/acre	100 Year NPV/acre
Durum/lentil/ canola rotation	$560.67	$1,013.83	$1,305.81	$1,423.02
Cow-calf	231.65	422.82	547.68	595.44
Difference	329.02	591.01	758.13	827.58
Pasture break-up	250.00	250.00	250.00	250.00
Net difference	$ 79.02	$ 341.01	$ 508.13	$ 577.58

Because the three-year cropping rotation outperforms the cow-calf operation from a financial perspective, the longer the planning horizon the greater will be the profitability advantage to cropping, all other things being equal. However, because future returns are discounted into today's dollars, the further out into the future the cash flows take place, the smaller their differences are today – for example, in the first 50 years there is a $508 advantage to cropping, but over the 100 year period, there is only a $577 advantage, a difference of less than $70 over years 51 through 100.[3]

Sensitivity Analysis

Given the importance of the assumptions surrounding discount rate, per-acre returns to the cow-calf operation and crop yields, it is prudent to consider how alternate sets of assumptions affect the overall results. Table 5 presents model results for a case where the discount rate is doubled to 10%, reflecting a persistent period of high inflation and interest rates. While such a rate may seem extreme given the historic low interest rates experienced during the last several years; it is nevertheless the case that even with recent increases, rates remain low compared to several notable periods over the past several decades. As Table 5 shows, as the discount rate increases, the financial advantage to cropping decreases significantly, especially given relatively high costs of land conversion.

[3] The spreadsheet tool that accompanies this document was used to estimate the point in time at which additional future cash flows would not increase current present value – in other words, at what future point are cash flows so heavily discounted that they do not impact present value? The difference between the 250 year NPV and 200 year NPV was in the order of a few cents per acre, so the analysis was halted at that point.

Table 5. Discounted per-acre returns to cropping and livestock systems for 10, 25, 50 and 100 year periods, 10% discount rate, average yields

	10 Year NPV/acre	25 Year NPV/acre	50 Year NPV/acre	100 Year NPV/acre
Durum/lentil/ canola rotation	$443.09	$648.89	$707.30	$713.61
Cow-calf	184.34	272.31	297.44	299.98
Difference	258.75	376.58	409.86	413.63
Pasture break-up	250.00	250.00	250.00	250.00
Net difference	$ 8.75	$126.58	$159.86	$163.63

Sensitivity analysis continues with Table 6, which assumes 80th percentile crop yields for durum, lentils and canola in the Brown Soil Zone. The discount rate is returned to the original 5%. As expected, using higher yields (it may be reasonable to expect that farmers who are able to achieve these yields have a greater incentive to switch grassland to cropland) significantly enhances the advantage of cropping over livestock production.

Table 6. Discounted per-acre returns to cropping and livestock systems for 10, 25, 50 and 100 year periods, 5% discount rate, 80th percentile yields

	10 Year NPV/acre	25 Year NPV/acre	50 Year NPV/acre	100 Year NPV/acre
Durum/lentil/ canola rotation	$1,543.21	$2,810.10	$3,633.88	$3,954.07
Cow-calf	231.65	422.82	547.68	595.44
Difference	1,311.56	2,387.28	3,086.20	3,358.63
Pasture break-up	250.00	250.00	250.00	250.00
Net difference	$1,061.56	$2,137.28	$2,836.20	$3,108.63

The final sensitivity analysis increases per-acre returns to the cow-calf enterprise to $50 from $30, holding all other model inputs constant. Table 7 shows the results, bringing returns from livestock operations much closer to those from the three-year crop rotation.

Table 7. Discounted per-acre returns to cropping and livestock systems for 10, 25, 50 and 100 year periods, 5% discount rate, average yields, increased returns to cow-calf operation

	10 Year NPV/acre	25 Year NPV/acre	50 Year NPV/acre	100 Year NPV/acre
Durum/lentil/ canola rotation	$560.67	$1,013.83	$1,305.81	$1,423.02
Cow-calf	386.08	704.70	912.80	992.40
Difference	174.58	309.13	393.02	430.62
Pasture break-up	250.00	250.00	250.00	250.00
Net difference	($ 75.42)	$ 59.13	$ 143.02	$ 180.62

Conclusions

The objective of the research reported here was to compare the long-term returns from cropping and livestock production systems within the Brown Soil Zone in southwest Saskatchewan, in order to help ascertain whether current payments under conservation easement programs are adequately compensating farmers for engaging in more ecologically sustainable agricultural management practices (i.e. cow-calf production) rather than more intensive practices (i.e. growing annual crops).

The analysis carried out for this project assumed a three-year crop rotation of durum wheat, followed by large green lentils and then canola, for which revenues and costs were taken from the *Saskatchewan Crop Planning Guide 2022*. Livestock revenues and costs were based upon representative farm CA-SK-3, a hypothetical 245 head cow-calf operation in the Canadian Cow-Calf Cost of Production Network. Because that hypothetical farm has not been profitable for 2020 or 2021, cow-calf enterprise budgets from Alberta and Manitoba provincial government sources were consulted in order to estimate an overall return to cow-calf production. For the purposes of this research, it was assumed that per-acre returns to this type of operation were $30. Lastly, a discount rate of 5% was assumed for this analysis.

Results of the economic modeling and sensitivity analysis carried out showed that given current and expected economic conditions, there is a significant financial advantage to growing crops rather than raising livestock in the region of interest. As the discount rate and/or per-acre returns to cow-calf production increase, the advantage to cropping vs. livestock production becomes smaller. Similarly, if higher yields occur, the advantage to cropping becomes even greater. Prices for crops and livestock were static in this analysis, but have the potential to significantly affect the economic tradeoff between these two competing agricultural production systems.

Recommendations

How the results of this work might impact the nature, structure and amounts of conservation easements is an open question. The scope of this paper is limited to the potential private financial impacts of foregoing cropping in favour of raising livestock, which are considerable under any reasonable set of assumptions. Recognizing the societal benefits associated with protecting natural habitat, and that there is a tangible economic component to those benefits, only serves to underscore the importance of this question.

In the author's opinion, having studied the issue of farmland values and returns to various types of agricultural production operations for most of his professional career, the *entirety* of the foregone stream of future cash flows for the term of the easement should be awarded to farmland owners in exchange for granting a conservation easement. The current common method of basing easement value on "fair market value" is heavily flawed, for at least three reasons: first, markets for agricultural products are notoriously **thin**. What this means is that an asset's "fair market value" (call it a "true value") cannot be ascertained in the absence of an adequate number of buyers. This is quite commonly seen in cattle markets, where forward or futures contracts are based on a cash market price, but the cash market price is being determined by only a small number of players – i.e. the market is "thin." Land markets, especially in the area of interest for this research, can be similarly thin.

The second reason "fair market value" is suboptimal for conservation easement pricing is because most farmland buyers, unfortunately, do not have a strong sense of the expected future cash flows to the land parcel, especially over the very long term. Empirical research on farmland values typically employs an *adaptive expectations* approach, whereby the last few years of returns are used to form expectations about future returns. While quantitatively effective at predicting farmland prices, it is clear that using the recent past to predict the long-term future is not ideal. Only an approach that takes into account the full stream of discounted future cash flows can adequately capture the present value of an asset. Because farmland is infinitely (or near-infinitely) lived, the approach used in this research is the most appropriate for this problem.

A third reason why "fair market value" is not the best method for determining conservation easement payments is because factors other than expected returns (i.e. discounted future cash flows) can significantly impact land value. Land owners, for example, might bid lower for land if it is geographically distant from land they already farm – but that has nothing to do with the parcel's intrinsic value. Or "fair market value" could be determined by the value of surrounding parcels that were indeed *discounted* in the market due to the presence of wetlands, etc. – the very characteristics that conservation easements are intending to reward! In the end, only the method

proposed in this research – estimating the difference in land value in different uses – can truly capture the value of a conservation easement. It should be noted that in attempting to estimate this value, the characteristics of a particular land parcel – primarily its productivity rating estimated for (for example) crop insurance purposes – should be taken into account to the greatest extent possible.

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