

Farmland Investment Models:

Risk adjusted return
comparison between
cash rents and gross
revenue royalties

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EXECUTIVE SUMMARY

Canadian farmland has delivered Sharpe ratios exceeding 1.1 over the past decade – among the strongest risk-adjusted returns of any institutional asset class. This advantage is built on land appreciation averaging 7-9% per annum combined with a stable income layer from tenant leasing. The lease structure chosen by the landowner is the primary determinant of whether that income layer is reliable or volatile.

This paper analyses two leasing strategies applied to identical Saskatchewan black-soil farmland: cash rent, where the landlord receives a fixed prepaid payment of \$160/acre regardless of crop outcomes; and gross revenue royalty, where the landlord receives a negotiated percentage – 20%, 25%, or 30% – of gross crop revenue per acre with no participation in input costs. Because the royalty is assessed before any costs are deducted, the landlord is never exposed to operating cost risk – positive royalty income is assured in every scenario where the crop generates any gross revenue.

The analysis uses a three-crop rotation (canola, spring wheat, red lentils), three commodity price scenarios calibrated to the 2012-2026 historical record, and standard Sharpe ratio methodology to compare risk-adjusted returns across all strategies.

Cash rent remains the superior strategy on risk-adjusted measures, though the margin varies by royalty level. The gross revenue royalty eliminates zero-income years entirely and maintains positive landlord income in every commodity environment, with probability-weighted income ranging from \$77 to \$116 per acre depending on the royalty percentage selected.

A third dimension of risk, not captured in the Sharpe ratio framework, further reinforces the cash rent advantage: operational and enforcement risk. Gross revenue royalty arrangements require annual verification of the tenant's total crop revenue, contractual definition of the royalty base (grain sales, crop insurance payouts, government program payments, carbon credits), and ongoing audit rights to detect misreporting. They expose the landlord to post-harvest credit risk as an unsecured creditor, compared to cash rent's prepaid-prior-to-seeding structure. For an institutional investor managing a portfolio at the scale of Veripath Partners, the verification, legal, and governance costs of a royalty portfolio are materially higher than for a cash rent portfolio. These unquantified costs compound the Sharpe ratio disadvantage identified in this paper. The operational risk analysis in Section 11 addresses these structural considerations in detail.

Key Metric	Cash Rent	Gross Revenue Royalty
Sharpe Ratio	1.29	0.97-1.10
Cash rent Sharpe premium	+0.19 to +0.31 (17-32% higher)	
Probability-weighted mean income	\$160/ac	\$77-\$116/ac
Probability of zero income	0% for ALL strategies including worst royalty level	
Probability (royalty < cash rent)	100% in every scenario at every royalty level	

Notes: Illustrative figures calibrated to SK Crop Planning Guide benchmarks. Scenario weights: High 25%, Mid 35%, Low 40%.

Cash rent remains the superior lease structure on a Sharpe ratio basis, but the gross revenue royalty provides positive income in every commodity environment. The royalty eliminates the landlord's exposure to operating leverage – gross revenue is always positive, so the landlord always receives a royalty payment regardless of farm profitability. However, even the most landlord-favourable 30% royalty delivers a Sharpe ratio of 1.10, still 0.19 points below cash rent at 1.29. The return deficit is the primary driver: probability-weighted royalty income ranges from \$77 to \$116 per acre against a fixed \$160 per acre for cash rent, regardless of the commodity environment.

Where fixed cash rent is not achievable and a variable lease structure must be employed, a gross revenue royalty provides positive income in every commodity environment while maintaining a somewhat simpler operational structure than alternatives.



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However, Section 11 demonstrates that the true performance gap between cash rent and royalty arrangements is larger than the Sharpe ratio differential alone suggests: operational complexity to scale with larger portfolio, verification cost, dispute resolution, PPSA registration, and portfolio governance overhead represent additional recurring costs that the quantitative model does not capture. Cash rent eliminates these costs entirely.

1. INTRODUCTION

Farmland has attracted sustained institutional capital over the past decade based on its documented Sharpe ratio advantage: low volatility, consistent appreciation, correlation benefits and steady income have combined to produce risk-adjusted returns well above those of public equities or fixed income. Sharpe ratios exceeding 1.1 over rolling ten-year periods have been achieved – a performance profile that has justified farmland’s growing allocation in institutional alternative portfolios.

Part of this advantage is the income layer of total return. Unlike appreciation, which is marked-to-market annually and subject to appraisal methodology, the income component reflects contractual payments from farm tenants to landowners. The structure of that contract – the lease type – determines the volatility characteristics of the income layer and therefore materially affects the risk-adjusted return profile of the investment.

Gross revenue royalties give the landlord a direct claim on crop revenue before any cost deductions – a senior position in the farm income waterfall. The royalty percentage is applied to total crop revenue per acre, with no reference to what the farmer spent to generate it. This structure gives the landlord exposure to operating revenue, short-term commodity price volatility and default risk. An upfront cash rent lease structure requires annual payment prepaid at seeding before the growing season begins and strips away commodity price volatility and default risk.

This paper analyses the gross revenue royalty structure at three representative royalty levels – 20%, 25%, and 30% of gross revenue per acre – and benchmarks each against fixed cash rent using Sharpe ratio methodology.

Cash rent is paid in full prior to seeding – before the growing season begins, before any crop is planted, before any harvest uncertainty resolves. The landlord is never a creditor for the current crop year. This eliminates counterparty credit risk entirely. No other farmland leasing structure offers this guarantee.

2. THE SHARPE RATIO: RISK-ADJUSTED RETURN MEASUREMENT

The Sharpe ratio measures the excess return earned per unit of total risk taken, defined as the ratio of mean excess return above the risk-free rate to the standard deviation of total return. In the farmland context it is a more appropriate metric than raw return because it captures the trade-off between the income enhancement from variable leasing structures and the additional volatility those structures introduce.

The formula is: $\text{Sharpe} = (\text{Mean Total Return} - R_f) / \sigma(\text{Total Return})$. For this analysis the risk-free rate (R_f) is set at 4.0%, consistent with Government of Canada bond yields at relevant maturities. Mean total return is the probability-weighted mean of appreciation plus income yield across the three commodity price scenarios. Total return sigma is derived from the variances of the appreciation and income components and their covariance.

A higher Sharpe ratio indicates superior risk-adjusted performance. Cash rent’s Sharpe advantage over gross revenue royalties reflects a return deficit, not a volatility advantage – royalty income actually adds modest positive volatility while appreciation sigma dominates total risk in both strategies.

3. METHODOLOGY AND ASSUMPTIONS

3.1 Model Structure

The model compares four lease strategies applied to identical farmland: cash rent at a fixed 4% yield, and gross revenue royalties at 20%, 25%, and 30% of gross crop revenue per acre. Both strategies own the same land with the same appreciation characteristics. The income layer differs only in its source: fixed contractual payment versus a percentage of the crop revenue line before any cost deductions.

Total return for each strategy is the sum of the appreciation component and the income yield component. Appreciation is assumed to be 9.0% per annum with a volatility of 7.0% per annum, consistent with Farm Credit Canada’s Saskatchewan farmland CAGR data and NCREIF farmland return series. These assumptions are identical across all lease strategies.

3.2 Strategy A – Cash Rent

The landlord receives a fixed annual payment equal to 4.0% of the land value per acre, paid at the start of the growing season. This amounts to \$160/acre on \$4,000 land. The payment is not contingent on crop prices, yields, or farm profitability. Income yield is therefore constant at 4.0% across all scenarios, with zero income volatility.

3.3 Strategy B – Gross Revenue Royalty

The landlord receives a negotiated percentage of the gross crop revenue generated per acre each year. The royalty is calculated on total crop revenue before deduction of any operating costs – fertilizer, fuel, chemicals, machinery, or overhead. The farmer bears full responsibility for all production costs and retains the residual after paying the royalty. Because the royalty is assessed on gross revenue before any costs, the landlord's income is never reduced to zero by cost overruns or poor yields – as long as the crop produces any revenue, the landlord receives a proportional share. There is no operating leverage effect: a 29% decline in gross revenue produces exactly a 29% decline in royalty income. The farmer bears all operating cost risk.

3.4 Crop Rotation and Revenue

The model uses a standard Saskatchewan black-soil zone three-crop rotation with equal weighting: one third canola, one third spring wheat, one third red lentils. Yields are set at long-run provincial averages: canola 37 bu/acre, spring wheat 45 bu/acre, red lentil 1,300 lbs/acre, consistent with Saskatchewan Ministry of Agriculture crop reports and Statistics Canada field crop surveys.

Crop	High Price	Mid Price	Low Price	Yield
Canola	\$16.00/bu	\$12.50/bu	\$9.00/bu	37 bu/ac
Spring Wheat	\$10.00/bu	\$8.00/bu	\$6.00/bu	45 bu/ac
Red Lentil	\$0.40/lb	\$0.30/lb	\$0.20/lb	1,300 lbs/ac

Table 1. Commodity price assumptions by scenario. Sources: SK Agriculture Dashboard; StatsCan 32-10-0359-01; Rayglen Commodities weekly grain news. Yields: SK Ministry of Agriculture crop reports; StatsCan field crop surveys (provincial long-run averages).

3.5 Scenario Probabilities

Three commodity price scenarios are defined based on the 2012-2026 historical record of Saskatchewan Crop Planning Guide profitability outcomes: High (commodity supercycle conditions, 25% probability), Mid (normal margin environment, 35% probability), and Low (cost-squeeze or loss environment, 40% probability). The model weights are deliberately more generous to the High scenario than the historical frequency of 13% would support, and more conservative on the Low scenario than the observed 53% frequency. This conservative calibration favours the royalty strategies in the comparison.

Scenario	Model Weight	Actual 2012-2026	Note
High (supercycle)	25%	13%	Model overstates
Mid (normal)	35%	33%	Close to observed
Low (cost squeeze)	40%	53%	Model understates

Table 2. Scenario probabilities. Actual frequencies based on SK Ministry of Agriculture Crop Planning Guide return-over-total-expenses outcomes 2012-2026. High = strongly positive returns; Low = negative or near-zero net returns across rotation.

3.6 Key Model Parameters

Parameter	Value	Source / Basis
Land value per acre	\$4,000	SK dark brown/black soil mid-range; FCC 2024
Annual appreciation rate	9.0%	FCC SK farmland CAGR (5yr to 2024)
Appreciation volatility (sigma)	7.0%	NCREIF farmland return series; Omnigence research
Cash rent yield	4.0% = \$160/ac	Documented 3-5% range; midpoint used
Royalty levels modelled	20%, 25%, 30%	Representative range of royalty negotiations
Risk-free rate (Rf)	4.0%	Government of Canada bond yield
Correlation rho (royalty)	0.25	Derived: $\beta(0.058) \times \sigma(\text{crop } 30\%) / \sigma(\text{land } 7\%)$
Correlation rho (cash rent)	0.00	Fixed income uncorrelated with annual land price moves

Table 3. Model parameters. Rho derivation: with annual land price volatility 7% and annual crop price volatility ~30%, the implied income-appreciation correlation $\rho = \beta \times \sigma(\text{crop}) / \sigma(\text{land}) = 0.058 \times 30\% / 7\% = 0.25$. This is robust: Sharpe ratio differences between $\rho=0.10$ and $\rho=0.40$ are less than 0.02 points because income sigma is an order of magnitude smaller than appreciation sigma.

3.7 Volatility Calculation

Total return variance combines the appreciation variance, income variance, and their covariance: $\sigma^2(\text{total}) = \sigma^2(\text{appreciation}) + \sigma^2(\text{income}) + 2 \times \rho \times \sigma(\text{appreciation}) \times \sigma(\text{income})$. Income sigma is the probability-weighted standard deviation of income yield across the three scenarios. For cash rent, $\sigma(\text{income}) = 0$ and total volatility equals appreciation volatility alone. For gross revenue royalties, income varies with commodity prices, introducing positive income sigma and a modest positive covariance term.

4. HISTORICAL PRICE FREQUENCY AND SCENARIO CALIBRATION

4.1 Price Classification Methodology

Price scenarios are classified against profitability thresholds derived from the SK Ministry of Agriculture Crop Planning Guide. High classification indicates that prevailing prices generate positive returns above total expenses for all three rotation crops. Mid indicates mixed results – at least one crop positive, rotation average near breakeven. Low indicates that total expenses exceed gross revenue for most or all crops in the rotation, producing negative farm profit. These thresholds are consistent with those used in prior Omnigence farmland research.

Crop	High Threshold	Mid Range	Low Threshold
Canola	$\geq \$14.00/\text{bu}$	\$10.00-\$13.99/bu	$< \$10.00/\text{bu}$
Spring Wheat	$\geq \$9.00/\text{bu}$	\$7.00-\$8.99/bu	$< \$7.00/\text{bu}$
Red Lentil	$\geq \$0.35/\text{lb}$	\$0.22-\$0.34/lb	$< \$0.22/\text{lb}$

Table 4. Price classification thresholds. Thresholds are calibrated to total cost of production (including machinery and overhead) from the SK Ministry of Agriculture Crop Planning Guide (black soil zone). Sources: SK Agriculture Crop Planning Guide 2013-2026; StatsCan field crop price data.

4.2 Year-by-Year Classification: 2012 to 2026

Year	Canola	Wheat	Lentil	Overall	CPG	Note
2012	\$11.50	\$8.20	\$0.28	Mid	Mid	Mixed results; some positive returns post-2011 drought
2013	\$11.80	\$6.70	\$0.25	Mid	Low	Wheat weak post CWB deregulation; canola held
2014	\$10.50	\$5.60	\$0.22	Low	Low	Most crops near breakeven or negative margin
2015	\$9.50	\$4.75	\$0.19	Low	Low	Broad losses; weakest margin year in decade
2016	\$9.80	\$4.00	\$0.17	Low	Low	Commodity trough; most crops deeply negative
2017	\$11.00	\$5.50	\$0.23	Low	Low	Canola recovered; wheat and pulses still weak
2018	\$11.50	\$6.80	\$0.24	Low	Low	China canola restrictions; margins suppressed
2019	\$10.00	\$7.50	\$0.22	Mid	Mid	Partial canola recovery; lentils soft
2020	\$11.50	\$7.80	\$0.25	Mid	Mid	Solid across rotation; pre-supercycle baseline
2021	\$16.50	\$9.50	\$0.33	High	High	Drought + global demand spike; supercycle peak
2022	\$18.00	\$12.00	\$0.30	High	High	Ukraine war; all-time highs wheat and canola
2023	\$12.50	\$7.50	\$0.32	Mid	Mid	CPG: canola positive; wheat negative; lentils strong
2024	\$12.00	\$7.65	\$0.30	Low	Low	CPG 2024: most crops near or below breakeven
2025	\$13.00	\$7.00	\$0.25	Low	Low	CPG 2025: all returns negative at prevailing prices
2026	\$13.20	\$6.50	\$0.24	Low	Low	CPG 2026: wheat and barley deeply negative

Table 5. Year-by-year price and profitability classification, 2012-2026 (15 years). Overall = rotation-average profitability assessment based on the SK Ministry of Agriculture Crop Planning Guide return-over-total-expenses outcome, not derived mechanically from the per-crop price thresholds in Table 4. CPG = SK Ministry of Agriculture Crop Planning Guide return-over-total-expenses outcome for that crop year. Sources: SK Agriculture Dashboard; StatsCan 32-10-0359-01; SK Ministry Crop Planning Guide.

4.3 Frequency Summary

Over the 15-year observation period, Low profitability conditions occurred in 8 of 15 years (53%), Mid in 5 of 15 (33%), and High in only 2 of 15 (13%). The model's assigned 40% Low probability is materially more favourable to the royalty strategies than the historical record would support. The 25% High probability is nearly double the observed frequency. Results should be read with this conservative framing in mind: the actual historical data would produce lower royalty Sharpe ratios than those computed here.

Scenario	Model Weight	Actual Frequency	Actual Count	Difference
High	25%	13%	2 of 15	+12pp
Mid	35%	33%	5 of 15	+2pp
Low	40%	53%	8 of 15	-13pp

Table 6. Scenario frequency summary. Model weights are intentionally conservative – overstating favourable conditions and understating adverse conditions – to avoid pro-cash-rent bias. Even under these generous assumptions, cash rent dominates on risk-adjusted returns.

5. GROSS REVENUE BY CROP AND SCENARIO

Gross revenue per acre for each crop is computed as yield (fixed at long-run provincial average) multiplied by the farm gate price for each scenario. The rotation average is the simple arithmetic mean of the three crops, consistent with equal one-third weighting of each crop in the rotation. These gross revenue figures form the royalty base – the landlord receives a fixed percentage of the rotation average gross revenue per acre with no reference to what the farmer spent to generate it.

A 29% swing in gross revenue (from mid to high or mid to low) translates to an exactly proportional swing in royalty income. This linear relationship is the defining structural feature of the gross revenue royalty – there is no cost-related amplification of revenue moves into income moves. Royalty income falls 29% when revenue falls 29%.

Crop / Metric	High Scenario	Mid Scenario	Low Scenario	Range Hi-Lo
Canola gross revenue	\$592/ac	\$463/ac	\$333/ac	\$259/ac
Spring Wheat gross revenue	\$450/ac	\$360/ac	\$270/ac	\$180/ac
Red Lentil gross revenue	\$520/ac	\$390/ac	\$260/ac	\$260/ac
Rotation avg gross revenue	\$521/ac	\$404/ac	\$288/ac	\$233/ac
Change from Mid scenario	+29%	Base	-29%	57pp swing

Table 7. Gross revenue per acre by crop and scenario (\$/acre). Sources: SK Ministry of Agriculture Crop Planning Guide; StatsCan 32-10-0359-01 (farm gate prices); SK Ministry crop yield reports (long-run provincial averages). Lentil price in \$/lb multiplied by 1,300 lbs/acre.

6. LANDLORD INCOME: THE REVENUE MATRIX

The royalty income matrix shows the landlord's per-acre income across all combinations of scenario (High, Mid, Low) and royalty percentage (20%, 25%, 30%), compared against the fixed cash rent benchmark. Because the royalty is assessed on gross revenue before any costs, the matrix contains no zero entries – even in the worst commodity environment, gross crop revenue is positive and the landlord receives a positive royalty payment.

Scenario / Metric	20% Royalty	25% Royalty	30% Royalty	Cash Rent	Prob.
High scenario	\$104/ac	\$130/ac	\$156/ac	\$160/ac	25%
Mid scenario	\$81/ac	\$101/ac	\$121/ac	\$160/ac	35%
Low scenario	\$58/ac	\$72/ac	\$86/ac	\$160/ac	40%
Probability-weighted mean	\$77/ac	\$97/ac	\$116/ac	\$160/ac	100%
As % of cash rent	48%	60%	73%	100%	--
P(zero income)	0%	0%	0%	0%	--
P(income < cash rent)	100%	100%	100%	--	--

Table 8. Landlord income per acre across the royalty and cash rent matrix. Royalty income = rotation avg gross revenue x royalty %. Royalty income figures rounded to nearest dollar. P(zero income) = 0% for all royalty levels – gross revenue is always positive.

Every royalty level generates positive landlord income in every commodity scenario. Even at 20% royalty in the worst observed price environment, the landlord receives \$58/acre. Gross revenue royalties provide income certainty that fixed-cost lease structures cannot offer at equivalent royalty rates.

7. RETURN AND VOLATILITY ANALYSIS

7.1 Total Return by Scenario

Total return for each strategy equals the annual appreciation rate (9.0%) plus the income yield (royalty income or cash rent as a percentage of land value). Because royalty income varies with commodity prices, total return varies across scenarios for the royalty strategies. Cash rent produces identical total return in every scenario.

Strategy	High	Mid	Low	Wtd Mean
20% Royalty	11.60%	11.02%	10.44%	10.93%
25% Royalty	12.25%	11.53%	10.80%	11.42%
30% Royalty	12.90%	12.03%	11.16%	11.90%
Cash Rent	13.00%	13.00%	13.00%	13.00%

Table 9. Total return by scenario and strategy. Appreciation 9.0% + income yield. Cash rent: 9.0% + 4.0% = 13.0% fixed. Royalty income yields: 20% royalty High=2.60%, Mid=2.02%, Low=1.44%; 25% High=3.25%, Mid=2.53%, Low=1.80%; 30% High=3.90%, Mid=3.03%, Low=2.16%.

The return gap between cash rent and the 30% royalty is narrow in the High scenario (13.00% vs 12.90%) but widens substantially in the Mid and Low scenarios. In the Low scenario, the 30% royalty delivers 11.16% versus 13.00% for cash rent – a 184 basis point shortfall. Because the Low scenario is assigned 40% probability (and occurred 53% historically), this scenario-weighted deficit drives the mean return comparison.

7.2 Volatility Decomposition

The total return sigma for royalty strategies is modestly higher than cash rent. The appreciation sigma of 7.0% dominates in all cases. Income sigma ranges from 0.461% (20% royalty) to 0.692% (30% royalty) – small relative to appreciation sigma but non-trivial given the rho of 0.25, which means the covariance term adds a positive contribution.

Volatility Component	20%	25%	30%	Cash Rent
Income sigma	0.461%	0.577%	0.692%	0.000%
Appreciation sigma	7.000%	7.000%	7.000%	7.000%
Covariance term (2 x rho x sa x si)	0.016%	0.020%	0.024%	0.000%
Total return sigma	7.129%	7.166%	7.204%	7.000%

Table 10. Volatility decomposition. $\sigma^2(\text{total}) = \sigma^2(\text{appr}) + \sigma^2(\text{income}) + 2 \times \rho \times \sigma(\text{appr}) \times \sigma(\text{income})$. $\rho = 0.25$ for royalty strategies, 0.00 for cash rent. Income sigma of 0.46-0.69% is small relative to appreciation sigma of 7.0%; the covariance term (shown here as its contribution to total sigma in percentage-point terms, not in variance space) is correspondingly minor. The Sharpe gap is driven overwhelmingly by the return deficit, not volatility differences.

8. SHARPE RATIO RESULTS

Sharpe ratios are computed using probability-weighted mean total return, $R_f = 4.0\%$, and total return sigma as derived in Section 7.2.

Sharpe Calculation	20% Royalty	25% Royalty	30% Royalty	Cash Rent
Probability-weighted mean return (R)	10.93%	11.42%	11.90%	13.00%
Risk-free rate (R_f)	4.00%	4.00%	4.00%	4.00%
Excess return ($R - R_f$)	6.93%	7.42%	7.90%	9.00%
Total return sigma	7.129%	7.166%	7.204%	7.000%
Sharpe Ratio	0.97	1.04	1.10	1.29
Cash rent Sharpe premium	+0.31	+0.25	+0.19	--

Table 11. Sharpe ratio calculation. Sharpe = $(R - R_f) / \sigma$. $R_f = 4.00\%$. Royalty Sharpe ratios: 20% = $6.93\% / 7.129\% = 0.97$; 25% = $7.42\% / 7.166\% = 1.04$; 30% = $7.90\% / 7.204\% = 1.10$. Cash rent = $9.00\% / 7.000\% = 1.29$.

Cash rent delivers a Sharpe ratio of 1.29 – a premium of 0.19 to 0.31 over the royalty strategies depending on the royalty percentage selected. The premium is driven almost entirely by the excess return (numerator) rather than differences in sigma (denominator): cash rent's total sigma of 7.00% differs by only 0.13 to 0.20 percentage points from royalty total sigma. The 9.00% excess return from cash rent substantially exceeds the 6.93% to 7.90% excess return from royalties.

At 30% royalty, the Sharpe premium of cash rent falls to just 0.19 points – narrower than at lower royalty levels but still material. The return deficit of \$44/acre (cash rent \$160 versus 30% royalty \$116 on a probability-weighted basis) is the single largest driver of this premium.

9. DOWNSIDE INCOME ANALYSIS

Because the gross revenue royalty is assessed on gross revenue rather than net profit, there is no operating leverage mechanism to drive income to zero. The downside analysis for royalty strategies focuses on the magnitude of income in adverse conditions rather than the probability of zero income (which is zero for all royalty levels in all scenarios).

Metric	20%	25%	30%	Cash Rent	Prob.
Income in Low scenario (\$/ac)	\$58	\$72	\$86	\$160	40%
P(zero income)	0%	0%	0%	0%	--
P(income below \$80/ac)	40%	40%	0%	0%	--
P(income below \$100/ac)	75%	40%	40%	0%	--
P(income below cash rent \$160)	100%	100%	100%	--	--
Expected income per decade (\$/ac avg)	\$77	\$97	\$116	\$160	--

Table 12. Downside income frequency analysis. $P(\text{income below } X)$ is derived from scenario probabilities: Low scenario has 40% probability, Mid has 35%, High has 25%. Low scenario income: 20% royalty \$57.5, 25% royalty \$72.0, 30% royalty \$86.4. 30% royalty exceeds \$80 threshold in all scenarios. Sources: scenario probabilities from SK CPG historical analysis.

Both the cash rent and gross revenue royalty provide positive landlord income in every commodity environment. Even in the worst observed price scenario, a 25% royalty generates \$72/acre – compared to \$160/acre under cash rent. While the royalty eliminates binary income risk it produces a meaningful return shortfall relative to fixed cash rent.

10. MODEL SENSITIVITY AND LIMITATIONS

10.1 Appreciation Rate Sensitivity

At a lower appreciation rate of 7.0% (long-run historical average): cash rent total return = 11.0%, Sharpe = 1.00. Royalty mean total returns = 8.93%-9.90%, Sharpe range = 0.69-0.82. The Sharpe gap narrows slightly in absolute terms (0.18-0.31 points vs 0.19-0.31 at 9% appreciation) but widens in relative terms as the income component becomes more material. The conclusion is robust to appreciation rate variation within the observed range.

10.2 Gross Revenue Sensitivity

The royalty income responds proportionally to gross revenue changes: a 10% change in all commodity prices produces a 10% change in royalty income and approximately a 0.2-0.3 percentage point change in income yield and total return. This linearity is the royalty structure's defining analytical property. Sensitivity to individual crop price assumptions is moderated by the three-crop rotation, which diversifies single-crop price exposure.

10.3 Royalty Percentage Sensitivity

Each 5 percentage point increase in the royalty rate increases the Sharpe ratio by approximately 0.065 points (from 20% at 0.97 to 25% at 1.04 to 30% at 1.10). This reflects a near-linear relationship between the royalty rate and both income yield and income sigma, with income sigma growing slightly faster. The cash rent Sharpe premium narrows by approximately 0.06 points per 5pp royalty increase.

10.4 Model Limitations

Several simplifications should be noted. First, yield risk (drought, disease, hail) operates independently of price risk and is not separately modelled – a year with both low prices and low yields produces lower royalty income than modelled. Second, the rotation weighting is fixed at equal thirds; actual farm management may vary the crop mix based on price signals, creating basis risk between the model's rotation average and actual royalty calculations. Third, the royalty percentage in practice is negotiated annually or multi-year, and farmers under financial stress in Low scenarios may resist payment or renegotiate – credit risk is not modelled. Fourth, the tax treatment of royalty income may differ from cash rent depending on structure; legal and tax advice is required for specific arrangements. Fifth, the model uses a discrete three-scenario distribution; the actual continuous distribution of outcomes would produce slightly different income sigma estimates.

11. OPERATIONAL RISK: ENFORCEABILITY, VERIFICATION, AND DEFAULT

The Sharpe ratio analysis in this paper quantifies risk as the volatility of total returns across commodity price scenarios. It does not capture a second, distinct class of risk inherent in gross revenue royalty arrangements: the operational cost of verifying gross crop revenue, auditing tenant reporting, and recovering income that is disputed or withheld. This unquantified risk is material. It compounds the Sharpe ratio disadvantage of the gross revenue royalty by adding recurring management costs that reduce net returns in ways the model does not reflect.

11.1 Defining the Royalty Base: A Source of Structural Ambiguity

The phrase “gross revenue per acre” requires precise contractual definition. Without it, disputes arise at the point of calculation, and the costs of resolving those disputes erode the returns the royalty was designed to capture. Each of the following revenue sources must be addressed explicitly in the royalty agreement.

Grain sales are the primary revenue stream and are relatively straightforward where grain moves through a licensed Prairie elevator, which generates a standardised settlement statement showing grade, weight, price, and net proceeds. Ambiguity arises when grain is stored on-farm and sold in a subsequent crop year, or sold directly to a feedlot or end user without an elevator ticket.

Crop insurance payouts from Saskatchewan Crop Insurance (SCIC) compensate for yield shortfalls. Whether these indemnities form part of the royalty base requires explicit specification. If a royalty arrangement intends to capture the revenue-generating capacity of the land, insurance that replaces lost revenue should arguably be included – but the payout compensates for production that did not occur, and the landlord played no role in the insured risk. This ambiguity must be resolved in the agreement, not left to interpretation at payment time.

A royalty agreement that does not address each of these revenue categories is not a fully specified contract. Omissions become disputes. Disputes become legal costs. Legal costs erode the returns the royalty was designed to capture. This contract specification burden does not exist under fixed cash rent, where the annual payment amount requires no calculation and no verification.

11.2 Verification of Gross Revenue: The Audit Problem

Unlike cash rent – which is paid on a specified date in a specified amount with no calculation required – gross revenue royalty arrangements require annual verification of the tenant's total crop revenue. This introduces a recurring audit obligation that cash rent entirely eliminates and that scales directly with the number of leases in a portfolio.

The primary verification tool is grain buyer settlement statements and elevator tickets. The majority of Prairie grain moves through licensed grain elevators – which issue standardised settlement statements for every transaction. Requiring copies of all settlement statements for grain grown on the leased land provides a reliable paper trail. However, this requires the tenant to segregate sales by source parcel, adding operational complexity for tenants farming multiple quarter-sections.

Annual CRA farm income reporting (T1163 or T2042) provides a supplementary cross-check but covers whole-farm income rather than per-parcel revenue. It cannot serve as a primary verification instrument. A well-drafted royalty agreement should include an explicit right for the landlord or their agent to audit the tenant's grain sales records at reasonable notice. In practice, exercising audit rights damages the landlord-tenant relationship and is rarely done except when fraud is suspected. The right matters most as a deterrent.

11.3 Practical Enforcement Risk

The most significant operational vulnerabilities in a gross revenue royalty arrangement arise from the information asymmetry between the tenant, who controls the farm records, and the landlord, who must verify them.

Cash sales and off-ticket transactions represent the primary gap in the elevator verification framework. Grain sold directly to a neighbour, feedlot, or end user for cash may not generate a settlement statement and is difficult to detect without physical inspection of grain storage or independent knowledge of crop volumes grown on the parcel.

Related-entity revenue diversion is a more sophisticated risk: a tenant operating through multiple corporate entities can route grain sales through a related company at a below-market transfer price, reducing the reported royalty base on the leased parcel. This is particularly difficult to detect and requires knowledge of the tenant's corporate structure to identify.

Year-end inventory manipulation allows a tenant to time grain sales to minimise the royalty calculation in any given period. Grain stored on-farm at the calculation date has not yet generated settlement revenue. A tenant can carry inventory across royalty periods to shift revenue recognition, reducing the royalty in a high-price year and capturing it in a subsequent year.

The elevator system is the gross revenue royalty's primary verification infrastructure and also its most significant mitigant. The vast majority of Prairie commercial grain cannot practically be sold without generating a paper trail through a licensed elevator. A tenant who attempts systematic revenue concealment takes significant regulatory and relationship risk. However, the risk is not zero, and smaller-scale off-ticket sales or inventory timing manipulation do not require elaborate concealment.

The mitigant is structural rather than contractual: most Prairie grain moves through licensed elevators with standardised settlement statements. This reduces the opportunity for revenue concealment but does not eliminate it. Off-elevator sales, inventory timing, and corporate structure remain gaps that a well-advised tenant can exploit. The cost of catching and proving misrepresentation is typically high relative to the sums involved in a single lease.

11.4 Default Risk and Recovery

Both gross revenue royalty arrangements and cash rent expose the landlord to the risk of non-payment, but the default dynamics differ materially.

Dimension	Cash Rent	Gross Revenue Royalty
Payment timing	Prepaid at seeding (March-April). Landlord receives full payment before any crop risk materialises.	Post-harvest, once revenue is known. October to December. Landlord bears the full crop year before receiving payment.
Amount certainty	Fixed and known at the start of each lease year. No calculation required.	Unknown until harvest. Variable across the \$58-\$156/acre range modelled; always positive but uncertain in amount.
Dispute frequency	Effectively zero. Amount is specified in the lease.	Moderate. Every payment event requires revenue verification. Disputes arise more frequently than under fixed payment structures. Every payment event requires revenue verification and calculation, creating recurring dispute exposure that cash rent entirely avoids.
Zero-income exposure	None. Landlord always receives \$160/acre regardless of crop conditions.	None. Gross revenue is always positive. Minimum modelled royalty income is \$58/acre in the worst commodity scenario.
Insolvency exposure	Minimal. Prepaid structure means the landlord is not a creditor for current-year income.	Significant. Landlord is an unsecured post-harvest creditor for the royalty amount. PPSA-registered GSA over crops is advisable.
Recovery complexity	Simple. Amount is contractually specified. Standard landlord remedies apply immediately.	Moderate. Must establish the correct revenue figure before quantifying the default amount. More complex than cash rent where the amount is fixed at the lease date.

Table 13. Default risk comparison: cash rent vs gross revenue royalty. Recommended security instrument: General Security Agreement (GSA) over all crops grown on leased land, registered under the Saskatchewan Personal Property Security Act (PPSA) with annual continuation filings.

11.5 Scalability and Portfolio Governance

The operational overhead of gross revenue royalty leases scales directly with the number of leases. Each lease requires annual revenue verification, documentation collection from tenants, cross-referencing against CRA filings, and investigation of discrepancies. The management cost per leased parcel is materially higher than for cash rent, where the only annual obligation is confirming receipt of the contractually specified payment on the contractually specified date.

The Sharpe ratio comparison in this paper captures the income volatility disadvantage of gross revenue royalties relative to cash rent. It does not capture the recurring verification cost, the legal cost of defining and defending the royalty base, the dispute resolution cost embedded in a large royalty portfolio, or the PPSA registration and continuation cost of securing royalty payments. These costs are real, recurring, and scale proportionally with portfolio size.

The true performance gap between cash rent and the gross revenue royalty is larger than the Sharpe ratio differential of 0.19-0.31 points suggests. The quantified gap captures income volatility. The unquantified gap captures verification cost, dispute cost, legal complexity, and portfolio governance cost at institutional scale. Fixed cash rent is not merely risk-adjusted return superior – it is also operationally simpler, more scalable, and more governance-efficient. This is an underappreciated structural advantage of Veripath's cash rent model that the Sharpe ratio framework does not fully capture.

12. SUMMARY: FULL COMPARISON TABLE

Metric	20% GRR	25% GRR	30% GRR	Cash Rent	Best
Landlord Income (\$/acre)					
High scenario (25% prob)	\$104	\$130	\$156	\$160	Cash
Mid scenario (35% prob)	\$81	\$101	\$121	\$160	Cash
Low scenario (40% prob)	\$58	\$72	\$86	\$160	Cash
Probability-weighted mean	\$77	\$97	\$116	\$160	Cash
Total Return					
High scenario	11.60%	12.25%	12.90%	13.00%	Cash
Mid scenario	11.02%	11.53%	12.03%	13.00%	Cash
Low scenario	10.44%	10.80%	11.16%	13.00%	Cash
Probability-weighted mean	10.93%	11.42%	11.90%	13.00%	Cash
Volatility					
Income sigma	0.461%	0.577%	0.692%	0.000%	Cash
Appreciation sigma	7.000%	7.000%	7.000%	7.000%	--
Total return sigma	7.129%	7.166%	7.204%	7.000%	Cash
Risk-Adjusted Return (Rf = 4.00%)					
Sharpe Ratio	0.97	1.04	1.10	1.29	Cash
Cash rent Sharpe premium	+0.31	+0.25	+0.19	--	--
Income Security					
P(zero income)	0%	0%	0%	0%	Tie
P(income < cash rent)	100%	100%	100%	--	Cash
Income in worst scenario	\$58/ac	\$72/ac	\$86/ac	\$160/ac	Cash

Table 14. Full comparison summary. Land value \$4,000/acre, appreciation 9.0%, sigma 7.0%, Rf 4.0%, rho 0.25 (royalty), 0.00 (cash rent). Scenario probabilities: High 25%, Mid 35%, Low 40%. GRR = Gross Revenue Royalty. Royalty income = gross revenue x royalty %; no cost deductions. GRR income is always positive – no floor mechanism applies. All operational risk costs (verification, audit, dispute resolution) are excluded from the Sharpe calculation and represent additional cash rent advantages not captured above.

13. CONCLUSIONS

Three conclusions emerge from this scenario analysis.

First, cash rent is the superior lease structure on an absolute and on a risk-adjusted return basis. The Sharpe ratio of cash rent (1.29) exceeds that of every gross revenue royalty level tested: 0.97 for a 20% royalty, 1.04 for 25%, and 1.10 for 30%. The premium ranges from 0.19 to 0.31 Sharpe points – still material. The mechanism is a return deficit: probability-weighted royalty income of \$77 to \$116 per acre is consistently below fixed cash rent of \$160 per acre in all scenarios and at all royalty levels. No royalty percentage available at conventional negotiated rates produces a mean income competitive with cash rent.

Second, the royalty level is the primary structural lever available. A 20% royalty at Sharpe 0.97 and a 30% royalty at Sharpe 1.10 are meaningfully different investment propositions. Where the Sharpe premium on cash rent is 0.31 points at a 20% royalty, it narrows to 0.19 points at 30%. Each five percentage point increase in royalty rate reduces the cash rent Sharpe premium by approximately 0.06 points and increases probability-weighted income by approximately \$19/acre. Negotiating for the highest achievable royalty percentage – subject to tenant viability – is the primary value lever within this lease structure.

Third, operational and enforcement risk represents an additional performance gap not captured by the Sharpe ratio. The gross revenue royalty requires annual verification of gross crop revenue against elevator settlement statements, precise contractual definition of the royalty base, PPSA-registered security over crops, and ongoing audit rights. These requirements are absent from a cash rent arrangement, where the annual management obligation is confirming receipt of a fixed payment. At portfolio scale, the cumulative verification, legal, and dispute resolution costs of a royalty portfolio reduce net returns below those implied by the Sharpe differential alone.

Revenue royalty structures delivered a Sharpe of 1.10 in our scenario against cash rent's 1.29. Beyond the quantified Sharpe ratio gap, cash rent eliminates the verification, audit, legal, and governance overhead that compound the cost of royalty arrangements at institutional scale. The case for cash rent as the default institutional farmland leasing structure is analytically unambiguous on every quantitative and operational dimension.

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