



## Canfax Research Services

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## Economics of Replacement Heifers

Beef replacement heifers are a vital part of herd management, though the decision to place a heifer into the breeding herd rather than the feeder market can be challenging; especially when prices for feeder cattle are high.

evaluate different options to choose a strategy that will best meet the needs of the operation.

The purpose of this factsheet is to demonstrate two methods to measure the difference in cost of retaining home-grown replacement heifers versus selling those lighter-weight heifers and purchasing heavier heifers or bred heifers.

The two methods of analysis are:

1. **Partial budgeting**, which compares the current practice with a proposed change in practice to determine least cost.
2. **Net present value calculation**, which demonstrates the point at which benefits equals cost (breakeven), considering the expected value of the calves produced over the life of the cow.

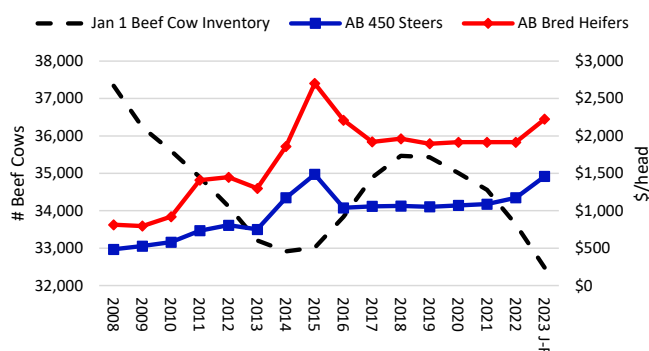
Discussion on the **non-monetary aspects** of heifer retention or purchase is included.

### ASSUMPTIONS

This analysis has several assumptions to provide a baseline. OMAFRA (2022) determined the percentage of heifers that come into heat for breeding at various weights and the recommended average daily gain to attain the optimal weight. According to the study, for most breeds and crosses, heifers should weigh from 650 to 850 lbs at breeding time with an average daily gain of 1.25 to 1.75 lb per day from weaning to first breeding. Based on that study, this analysis assumes that:

1. Heifer weaning weight is 450 lbs in November,
2. Breeding age is 15 months on June 1,
3. Breeding weight is 750 lbs,
4. Average daily gain is 1.6 lbs per day.

Chart 1. Cattle Cycle and Price Trends



The North American beef herd has been liquidating since 2018. On January 1<sup>st</sup>, 2023, North American beef cow inventories at 32.5 million head were two percent below the previous low in 2015 and was the lowest level since 1962. Tightening cattle supplies are supporting all weights and classes of cattle prices to levels last seen in 2015. For example, 450 lb steers prices in February 2023 at \$329/cwt were up 24 percent from a year ago, and only six percent shy from the all-time monthly high of \$348/cwt established in April 2015.

Strong calf prices can boost interest in retaining or purchasing breeding females to replenish the cow herd, especially in areas with adequate rainfall for pasture rejuvenation and feed supply. However, it can be easy to overpay for breeding stock when cattle prices are high. Understanding future price and cost expectations can be a useful guide when making long-term investments. As replacement strategies have important implications on farm profitability and herd productivity. It is crucial for producers to carefully

The assumption of the 450 lb weaning weight is based on the 750 lb breeding weight and 1.6 lb average daily gain. While this is lower than the 533 lb reported by the Western Canadian Cow-calf Survey (2017) and the 523 lb reported by the Farm Management Survey (2017), producers can adjust the weaning weight assumption based on their own situation.

Manitoba Ag has determined the recommended dietary requirements for replacement beef heifers to reach the desired weight at breeding. The following costs are averaged over the winter-feeding period (December to May) but will vary depending on the weight of the replacement heifer at a given point.

1. 12.75 lbs per day of alfalfa/grass hay per day,
2. 3.5 lbs per day of barley, and
3. 0.06 lbs per day of mineral.

The winter-feeding period is approximately 180 days from December 1<sup>st</sup> to May 31<sup>st</sup>.

Cull cows are not included in this analysis, as they will be culled regardless of whether a heifer is purchased or retained from within the herd.

It is also assumed that a bull is currently present in the herd to breed the group of heifers that is most economical for the operation.

Using the assumptions from above, the [replacement heifer development cost calculator](#) from the Western Beef Development Centre can be used to determine the cost to develop replacement heifers.

## KEY ECONOMIC FACTORS TO CONSIDER

The main economic factors considered when deciding whether to retain or purchase breeding females, include:

1. Opportunity cost - the foregone revenue by retaining the heifer,
2. Cost of gain (winter feed and grazing),
3. Vet (health cost),
4. Breeding (bull or AI cost), and
5. Yardage, including labour (variable cost).

## Opportunity Cost

The opportunity cost of retaining heifers for herd replacement is the lost revenue from not selling the heifers in the fall and instead feeding them through the winter to breeding.

In the second half of 2022, heifer prices climbed on strong demand for replacement feedlot cattle, as feedlots bid aggressively to procure cattle to fill pen space. Alberta 450 lb heifer prices increased over 18 percent from the second quarter to the fourth quarter and averaged \$1,084/head. *The increase in feeder cattle prices means the opportunity cost of raising replacement heifers is higher.*

## Cost of Gain

Based on the assumptions, each 450 lb heifer that is retained for breeding is estimated to consume 2,295 lbs of alfalfa/grass hay, 630 lbs of barley, and 10.8 lbs of mineral over the winter-feeding period. The total cost for each input is listed below (Table 1) using select years as examples and assumes no feed wastage.

	2022	2021	2017	5 yr avg
Hay	\$284	\$163	\$128	\$164
Barley	\$230	\$163	\$92	\$129
Mineral	\$9	\$8	\$6	\$6
<b>Total</b>	<b>\$524</b>	<b>\$334</b>	<b>\$226</b>	<b>\$299</b>

Source: Alberta Ag, Canfax Research Services

Winter feed costs for heifers retained in the winter of 2021/22 for breeding replacements in 2022 were 57 percent higher than those retained in the winter of 2020/21 and 75 percent higher than the five-year average. The cost of gain on 450 lb heifers in the winter in 2021/22 to breed at 750 lbs in June 2022 was \$1.75 per pound of gain compared to \$1.11 per pound of gain in the winter of 2020/21 and a five-year average of \$1.00 per pound of gain.

**Yardage costs** are a vital but sometimes overlooked cost, especially those costs that can easily be transferred to the remaining herd or to other parts of the operation. Yardage is assumed at \$94.33/head for the entire winter-feeding period.

**METHOD 1 - PARTIAL BUDGETING**

Partial budgeting is a tool where the primary function is to compare an existing practice with a proposed new practice to determine which practice provides the lowest cost. Any costs that don't change between practices (e.g., fixed costs) are excluded.

We recognize that drought conditions during the 2021 growing season prevented producers from typical replacement heifer practices. Young replacement heifers may have been sold, due to feed limitations. The following scenarios assume feed was available, as it allows us to use the most recent prices with limited price projections into the future.

**Scenario 1 – Retain 450 lb Heifers vs. Purchase Bred Heifers**

This scenario assumes that a 450 lb heifer sold in November 2021 is immediately replaced with a bred heifer. This scenario examines the following changes in costs:

1. Winter 2021/22 feed and yardage costs,
2. Summer 2022 bull, pasture, and vet costs.

Feed and management costs from November 2022 March 2023 calving are not included, as they will be incurred regardless of which group of heifers are being cared for in November 2022.

A 450 lb heifer sold in November of 2021 in Alberta was \$185/cwt (\$832/head) and bred heifer price was \$1,722/head in November. The difference in price between a 450 lb heifer and a bred heifer in November 2021 was \$890/head. Non-feeder costs for the winter of 2021/22 were \$618/head and costs for the summer of 2022 totaled \$348/head for a total cost of \$966/head (Table 2).

For an operation culling 40 cows every year, and assuming a five percent death loss on winter backgrounded heifer calves, and an 82 percent conception rate on 750 lb heifers 52 heifer calves must be retained in this scenario.

Retained Heifer Inputs	\$/head	\$ Group
450 lb Heifer Price	\$832	\$43,264
Winter Feed	\$524	\$27,248
Winter Yardage	\$94	\$4,888
Summer Pasture	\$143	\$7,007
Summer Yardage	\$126	\$6,174
Total Vet and Medicine	\$28	\$1,456
Bull Costs	\$51	\$2,499
<b>Total Heifer Development Cost</b>	<b>\$1,798</b>	<b>\$92,536</b>
<b>Bred Heifer Price</b>	<b>\$1,722</b>	<b>\$68,880</b>
Sell 9 open 950 lb Heifers	--	\$17,404
<b>Net Cost of Raising Heifers</b>		<b>\$75,132</b>

Source: Canfax, Canfax Research Services

*Under this scenario, a bred heifer purchased for less than \$1,798 is a more economical option than retaining a heifer through the winter as a replacement and breeding her in June 2022. For a group of bred 40 heifers, after accounting for death loss and reproductive efficiency, a heifer purchased for less than \$1878 is a more economical option than retaining heifers for breeding.*

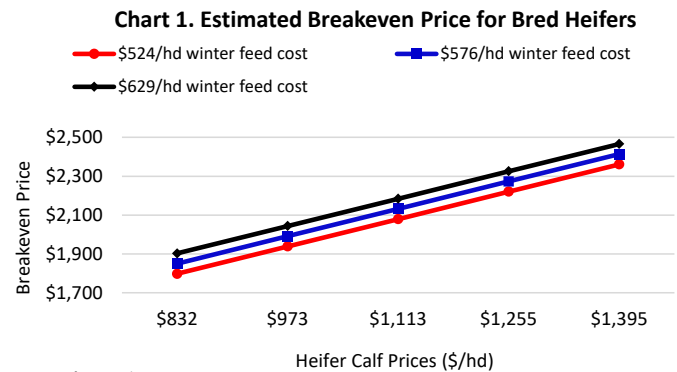


Chart 1 shows how changes in feed costs and changes in calf prices can affect the point at which purchasing bred heifers, while holding everything else constant. **When winter feed cost and calf price increase, the breakeven price for bred heifers also increases.** For example, when calf price increases from \$832/head (\$1.85/lb) to \$1,113/head (\$2.47/lb), and winter feed costs increase 10 percent to \$576/head, the breakeven cost of a bred heifer increases to \$2,131/head.

## Scenario 2 – Retain 450 lb Heifers vs. Buy 750 lb Heifers to Breed

This scenario assumes that 450 lb heifers are sold at weaning in November. Heifers in the 750 lb weight class are purchased the following spring, eliminating winter feed, yardage, vet, and labour costs that would have been incurred with winter feeding lighter-weight heifers.

Retained Heifer Inputs	\$/head	\$ Group
450 lb Feeder Heifer	\$832	\$34,935
Winter Feed	\$524	\$22,008
Yardage	\$94	\$3,962
Vet and Medicine	\$17	\$715
<b>Total Costs</b>	<b>\$1,467</b>	<b>\$61,620</b>
<b>750 lb Replacement Heifer</b>	<b>\$1,385</b>	<b>\$55,400</b>
<b>Extra Cost from Raising Heifers</b>	<b>\$82</b>	<b>\$6,220</b>

Source: Canfax, Canfax Research Services

For an operation culling 40 cows every year, and assuming a five percent death loss on winter backgrounded heifer calves, 42 heifer calves must be retained in this scenario.

A 450 lb heifer sold in November of 2021 in Alberta was \$185/cwt (\$832/head). Development costs include the cost of winter feed (\$524/head), yardage (\$94/head), and vet and medicine of \$17/head. Total costs are \$1,467/head. Total revenue foregone by retaining the heifers is \$34,935.

Total feed costs for the heifer group (42 head) being winter backgrounded from December 2021 to May 2022 are \$22,008, with winter yardage costs of \$3,962, vet costs of \$715. Total costs of retaining 450 lb heifer group are \$61,620.

A 750 lb heifer purchased in June 2022 was \$185/cwt (\$1,385/head) or \$55,400 to replace 40 cull cows. In this example, it cost an additional \$6,220 to retain 42 heifers from the herd and winter background them than to sell those heifers at weaning in November and purchase replacement heifers in the spring. *Each 450 lb heifer that was retained through the winter of 2021/22 cost an additional \$148 per head compared to purchasing a 750 lb replacement heifer the in the spring of 2022.*

If no death loss occurred between December weaning and June breeding, two excess heifers can be sold as 750 lb feeder heifers. Even with the additional revenue, retaining heifers through the winter to bring into the breeding herd still cost an extra \$3,450, or \$86/head.

It should be noted that while the Alberta feeder heifer price was used for replacement heifer prices in the calculation above, Lee Schultz of Iowa State University found that 6–700 lb heifers marketed as replacement heifers commanded a premium of up to USD\$15/cwt over similar weight feeder heifers in the fall of 2022, or approximately USD\$100/head. Accordingly, **if 750 lb replacement heifers in Alberta had a price premium of \$156/head (using an exchange rate of CDN\$0.75/USD) over feeder heifers, there would be no cost savings by purchasing replacement heifers compared to retaining home-raised heifers.**

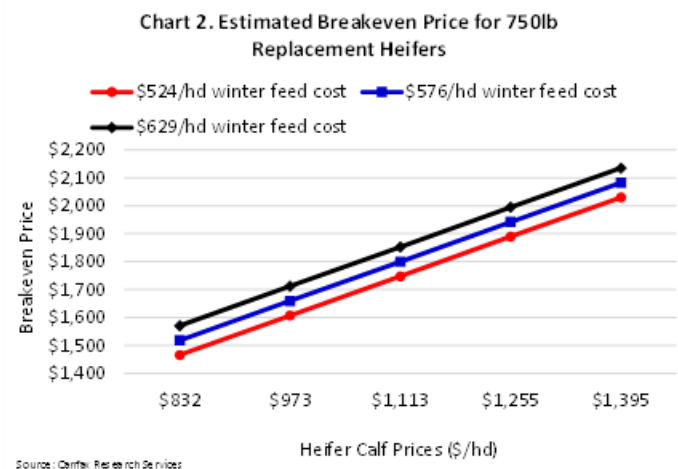


Chart 2, above, shows how changes in feed costs and changes in calf prices can affect the point at which purchasing 750 lb heifers in following spring is the better option. For example, a 450 lb heifer that costs \$1,113/head (\$310/cwt) with winter feeding costs of \$524/head has a total cost of \$2,030/head (including yardage and vet costs). In this example, a 750 lb heifer purchased for under \$270/cwt is less costly than retaining a 450 lb heifer through the winter.

### Scenario 3 – Retain 750 lb Heifers to Breed vs. Sell Backgrounded Heifers at 750 lb and Purchase Bred Females

This scenario assumes heifers are backgrounded and sold at 750 lb and bred heifers are purchased. A purchased heifer will be bred prior to purchase, eliminating the need for a bull, and the cost of grazing the home-raised heifer for the summer. Thus, the cost savings from bull purchase and maintenance need to be included in the analysis as well as the reduction in costs from pasture rental and yardage.

Assumptions for this scenario include herd sire costs of \$5,000 (minus \$2,000 when sold for slaughter) spread over five years, annual maintenance costs, pasture rental, yardage, and vet costs. Bull costs are converted to cost per heifer for consistency. The last assumption is that 40 bred heifers are purchased confirmed six-months pregnant. This implies that a pregnant heifer which has been retained on the farm will require one month of winter feed in addition to summer pasture to align her gestation length with the heifer that has been purchased six-months pregnant in December.

Heifer Inputs	\$/hd	\$ Group (40 hd)
750 lb Open Heifer	\$1,385	\$67,865
Pasture	\$143	\$7,007
Yardage	\$126	\$6,174
Vet and Medicine	\$11	\$539
1 Month Winter Feed	\$146	\$7,154
<b>Total Heifer Inputs</b>	<b>\$1,811</b>	<b>\$88,739</b>
Total Bull Costs	\$51	\$2,499
<b>Total Heifer Costs</b>	<b>\$1,862</b>	<b>\$91,238</b>
Sell 9 open 950 lb Heifers	--	\$17,404
<b>Net Costs</b>	<b>--</b>	<b>\$73,834</b>
Heifer Bred 6 Months	\$2,130	\$85,200
<b>Total Savings from Homegrown</b>	<b>\$268<sup>1</sup></b>	<b>\$11,366</b>

Source: Canfax, Canfax Research Services

Bred heifers purchased in Alberta auction marts in December 2022 ranged from \$1,750 to \$2,950/head with an average price of \$2,130/head.

*An individual heifer backgrounded for breeding assuming a successful pregnancy resulted in a cost savings of \$268.*

Assuming an 82 percent conception rate on 750 lb heifers, 49 heifers will be required for 40 successful pregnancies. Total costs for the group of heifers are \$91,238. Selling nine open heifers in December 2022 reduced costs by \$17,404. **Every backgrounded heifer that was retained for breeding provided a cost savings of \$284 (\$11,366 for 40 head) compared to purchasing bred heifers.**

### METHOD 2 – NET PRESENT VALUE

Net Present Value (NPV) is the total of all future cash flows (revenue and cost) over the lifespan of the breeding female (seven years) discounted using a standard interest rate to determine what her total value is today. It is commonly referred to as the time value of money.

If NPV is positive, she provides more total revenue over her lifespan than what the total costs over her lifespan are, and a higher price can be paid. If the NPV is negative, over her lifetime she will not provide enough revenue to cover her costs, and a lower price should be paid.

As the NPV method takes into account the expected value of the calves produced over the life of the cow, moisture conditions and cattle supplies are the major larger, behind-the-scenes events that are expected to influence calf prices for the next number of years.

The North American cow herd is expected to begin rebuilding in 2024, assuming adequate rainfall for grassland rejuvenation across North America. As more heifers are retained for breeding, a further reduction in feeder supplies will continue to support prices. By 2025, some price reductions may be observed, though

<sup>1</sup> Additional cost savings on the group is due to the extra revenue obtained by selling open heifers.

assuming demand for North American beef remains high, calf prices will remain above historical levels.

An increase in rainfall is expected increase North American crop production and lower crop prices. The global beef herd is expected to remain at current levels, stabilizing supply.

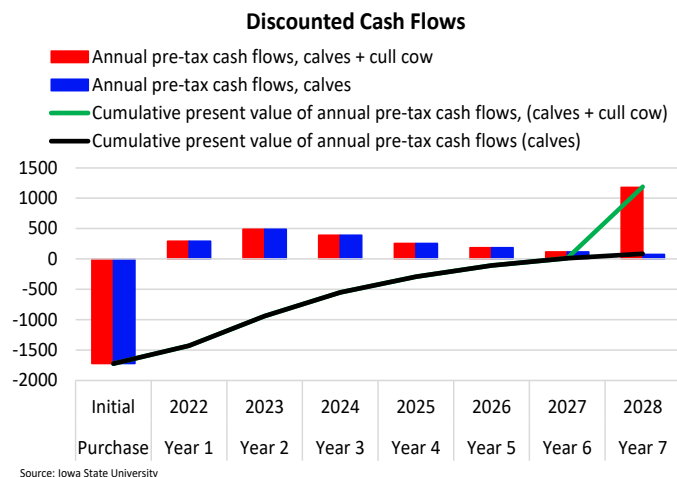
**NVP OF A SINGLE BREEDING FEMALE**

Scenarios for individual breeding females will be analyzed using the [Net Present Value of Beef Replacement Females –Single Replacement](#) from Iowa State University.

**Scenario 1 – Baseline**

The baseline NPV calculations assume:

1. average bred heifer prices of \$1,722 per head.
2. the breeding female produces a live calf every year, with a seven-year production lifespan (i.e., no death loss).
3. salvage value of \$1,553/head.
4. annual maintenance costs, including feed, labour, and yardage of \$1,062 per year.
5. average 550 lb steer prices over the lifespan of the cow are assumed at \$290/cwt, average 450 lb heifer prices are \$252/cwt.
6. an average interest (discount) rate of five percent.



This scenario provides an NPV of \$1,189 over the lifetime, and a payback period of five years. The maximum price that has been determined to breakeven on the purchase of the replacement bred heifer using these assumptions is \$2,911 per head.

Remember that the NPV calculator took all future cashflows for the seven years that the breeding female is going to be in the herd and found that using the projected calf prices and breeding female maintenance costs, she will provide total revenue that is higher than total costs by \$1,189 per head for a replacement bred heifer.

*The NPV calculator has determined that if replacement bred females can be purchased for \$2,911 per head or less, it is better to purchase replacement females than it is to retain home-grown females for breeding.*

**Scenario 2 – Open in First Year**

It is not uncommon in Western Canada to have open two-year old heifers. An NPV scenario using this single change to the above assumptions is also easily calculated from the NPV single replacement heifer calculator. All calf price and cow maintenance assumptions remain the same, but she will now only produce six calves over her lifetime, rather than seven. An additional year of feed and management inputs are required, but revenue in the first year is not realized. Incorporating the change into the calculator, the NPV on this open two-year old heifer becomes -\$296. The maximum price that should be paid under this scenario is \$1,426 per head for a replacement bred heifer.

**Scenario 3 – Open in Sixth Year**

If this replacement female was open in her sixth year rather than her first, her NPV would be \$269, with a maximum price of \$1,991 per head for a replacement bred heifer.

**Scenario 4 – Calf Prices Reduced by 10 Percent**

If average annual calf prices were reduced by 10 percent from years three to seven, in line with expectations of future North American cattle supplies, and average input prices remain at \$1,062, the NPV is reduced to \$664, the payback period is increased to seven years and the maximum price that should be paid for that replacement bred heifer is \$2,386 per head for a replacement bred heifer.

**NET PRESENT VALUE OF A BREEDING FEMALE GROUP**

Similar analysis can be conducted for an entire group of heifers, though additional assumptions are required.

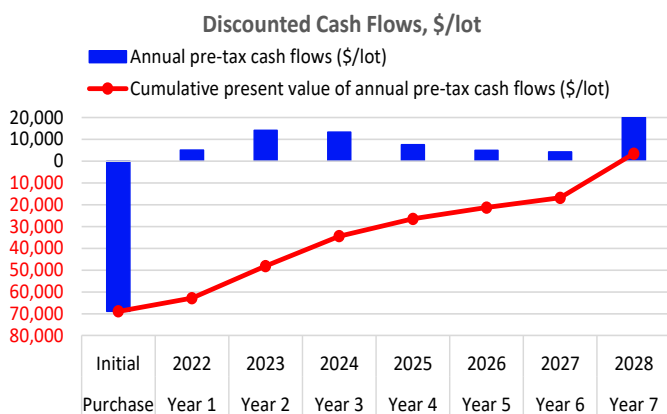
Group NPV scenarios are determined using [Net Present Value of Beef Replacement Females - Group](#) from Iowa State University.

This assumes that this is a closed group of replacement females, that is, new animals are not introduced to the group to replace the ones that are culled. The reasoning for this is to determine the NPV of only this group of replacement females.

**Scenario 1 – Baseline**

In year-one, 40 heifers were purchased. Annual death losses are assumed to be 0.5 percent per year. The conception rate for the group in the first year is 84 percent. The group conception rate from year-two to seven is 88 percent on average. From year-one to six, the average cull rate is nine percent with the remainder of the cows being culled at the end of the seventh year. Average steer calf prices are \$290/cwt; average heifer prices are \$252/cwt. In year one, the cull weight is 1,200 lbs; from year-two to seven it is 1,350 lbs. Average cull cow prices are \$113/cwt.

*Using the base set of assumptions, this group of 40 heifers is expected to provide an NPV of \$3,428, with a maximum price of \$1,808 per replacement bred heifer.*



Source: Iowa State University

**Scenario 2 – Calf and Cow Prices Reduced by 10 Percent**

If calf prices and average annual cow costs drop by ten percent from year-three to seven, the NPV for the group of heifers becomes negative and the maximum price is reduced by \$255 to \$1,467 per replacement bred heifer.

**Scenario 3 – Conception Rate Reduced**

**Lower conception rate reduces the NPV of breeding females.** For the third scenario, conception rates in the first year drop from 84 percent in the baseline to 82 percent; and the average conception rate from year-two to seven drops from 88 to 87 percent. Under this scenario, the NPV for the heifer group is \$353 compared to \$1,189 in the baseline. The maximum price that should be paid is \$1,731 per replacement bred heifer.

Both individual heifer and heifer group NPV calculators can be valuable tools when considering the purchase of replacement females that are expected to be in the herd for several years. The value of these calculators is that they only measure the value of the group in question, an aspect of analysis that sometimes can get lost once the replacement females enter the herd.

**OTHER CONSIDERATIONS**

There are additional non-monetary considerations to account for when determining whether to retain heifers or purchase replacement heifers.

Possibly the most important factor is the **history of the herd** (calving ease, maternal instincts, previous calf feed conversion rates or average daily gain, animal temperament, etc.) that cannot be determined in the auction mart reliably, or at all in some instances. However, it is within the control of each cow-calf producer to put a value on the cost of each of those traits. There are also costs associated with introducing new animals into the existing herd, through reduced feed intake and stress until the **herd hierarchy** is re-established.

The **stress placed on bred heifers** that go through auction marts and the risk associated with health

issues or pre-birth calf loss should not be overlooked, as these can be costly. These can be more challenging to quantify and may vary considerably between producers. This also extends to moving bred heifers from the original herd to the auction mart and moving from the auction mart to the new herd. Also, segregation protocols surrounding health status can increase production costs, or reduce farm productivity until the purchased bred heifers can be incorporated into the main herd. The per head cost that each producer determines is appropriate can be subtracted from the cost of raising homegrown heifers or added to the cost of each purchased heifer.

**Previous knowledge of management** for purchased heifers. The difference between home-raised heifers and purchased heifers lies in the fact that previous knowledge of the existing cow herd can provide valuable insights on the anticipated increase in heifer management at calving, where purchased heifers will not come with that previous knowledge.

## CONCLUSION

Two methods of determining the cost of replacement breeding heifers were demonstrated, complete with calculator to show how each method can aid in determining the optimal choice using a farm owner's own information. The first method, partial budgeting for replacement heifers, compared the cost of raising replacement heifers versus the cost of purchasing replacement heifers. This method is very straight forward and practical for those wanting to determine the price at which purchasing replacement heifers is more cost effective. The second method, net present value (NPV), is less intuitive and requires several assumptions.

The results produced are meant only as a guideline, and will vary by operation based on several factors, including feed input quantity and cost, the cost and amount of labour, and the size of and interest rate on an operating loan. Factors that can affect profit include the cost of the replacement heifer as well as input and management costs invested in the heifer prior to the birth of her calf. There is a constant tension between retaining heifers from within the

herd or purchasing replacement heifers, with both costs and benefits to each.

Every ranch is different, with myriad management styles. What is determined as efficient on one operation will not work well on another. When incorporating all of these aspects into a heifer retention versus bred heifer purchase costing scenario, it may increase the cost of replacement heifers to the point at which retaining heifers from within the herd may become the more advantageous option.

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