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Bull Valuation

Bull selection is one of the most important decisions for cow-calf producers, with implications for short- and long-term profitability of the operation. Bulls contribute 50% of the genetic material of the calf, and the choice in bull can be immediately seen in the subsequent calf crop. If the operation retains heifers and/or bulls, the genetics of the selected bull will be passed down for generations to come. On average, 90% of the genetic change in the cowherd comes from the bull (Wagner et al., 1985).

Introducing new genetics is a permanent change to the herd, compared to the temporary nature of supplements or management practices. As such, bull selection is a long-term investment into the operation. Research in the area of beef cattle genetics has been growing significantly. There is rich opportunity to improve profitability through sire selection. However, with a multitude of traits, breed differences, operational goals, and management practices, bull selection can be a complex decision.

There are a range of different beef operations in Canada, and there is no type of bull that is optimal for all operations. ***Before selecting a bull, operational goals should be established, and the management and breeding practices that fit those goals determined.*** To assist the bull selection decision, maintaining consistent record keeping on the herd will help to identify areas of strength and weakness in the herd, and guide producers towards the type of genetic change they want to see.

Choosing a bull that aligns with the operation depends on factors such as: ***the intensity of the operation, heifer retention (i.e., terminal versus maternal sires), labour availability, nutrient availability, and time of marketing.*** For example, a full-time farmer who observes the cattle multiple times a day may not prioritize calving ease in a bull as much as the hobby

farmer. A farm with limited nutrition may prefer smaller and less productive cattle that are more efficient at converting low quality forage. A farm that auctions their calves at weaning may choose a mixed breed program with high weaning weights, while a farm that direct markets their beef may prefer the uniformity of a purebred program. Effective sire selection requires an understanding of the characteristics of the available genetics as well as those of the operation.

Different traits of bulls can contribute to different impacts on the bottom line of the operation. For example, a bull with a higher calving ease EPD may contribute to more live calves. Not surprisingly, bulls with higher calving ease (or lower birth weights) sell for a higher price (Simms et al., 1997). With the large variation in bulls available, bull prices extend over a wide range. Bulls can vary in price from \$3,000 to over \$20,000 per head. Identifying a fair price during sire selection contributes to higher efficiency in operation economics. To estimate breakeven bull price, a bull valuation calculator was developed. The purpose is to provide a general idea of how much a bull is worth based on key farm parameters.

BULL VALUES – TWO SCENARIOS

The value a bull provides depends on his individual performance, the environment (pasture productivity), management (cow:bull ratio) and markets (calf price). For example, large framed bulls require more feed, leading to a higher maintenance cost but may be offset by heavier calves at sale time.

Two scenarios were studied for this calculator— a low maintenance farm versus a high maintenance farm. Table 1 shows the parameters entered for each farm. The default values in the calculator are the averages of the two scenarios. The low maintenance farm is

assumed to have a larger pasture size reducing the cow to bull ratio, multiple bulls in a field with potential for fighting as well as rough terrain contributing to reduced bull longevity, reduced feeding over fewer days, resulting in lower maintenance costs. This management style is reflected in the cow herd as well with a lower weaning rate and lower weaning weights.

Table 1. Parameters used for annual bull maintenance cost between two farm scenarios

Parameter	Low Maintenance	High Maintenance
Days on feed	120	200
Feed cost per day	\$1.00	\$2.00
Veterinary cost per year	\$75	\$125
Labour per year	\$100	\$200
Pasture & yardage per year	\$200	\$400
Total annual maintenance cost	\$495	\$1,125

The high maintenance farm is assumed to have smaller breeding pastures, more labour, and more feed, which leads to a higher cow to bull ratio, greater longevity, higher weaning rates, and higher weaning weights.

Table 2. Parameters and bull value from two farm scenarios

Parameter	Low Maintenance	High Maintenance
Interest rate	3.0%	3.0%
Years of service	4	8
Cow to bull ratio	18	30
Expected weaning rate	80.0%	90.0%
Expected calf weight (lb)	500	550
Expected calf price (\$/lb)	\$2.22	\$2.22
Bull maintenance cost	\$495	\$1,125
Bull salvage value	\$2,200	\$2,200
Bull death loss	4%	4%
Bull breakeven price	\$3,325.37	\$6,374.31

Even keeping key parameters like the proportion of the calf value attributed to the bull and expected calf price constant, a large variation in bull value is seen. The high maintenance farm has a breakeven bull price more than double that of the low maintenance farm. In fact, the low maintenance farm would have had a much lower breakeven price if the annual maintenance cost was similar to the high maintenance farm. However, the lower annual maintenance cost helped to offset the lower cow to bull ratio and lower weaning rate.

For the high maintenance farm, the producer can afford to pay more for a bull given the expected performance of both the bull and its offspring. The large variation in bull prices on the market reflects the different abilities of the bull to bring value to an operation. This is impacted not only by the bull but also the environment and management system used by differing operations.

DRIVING FACTORS OF BULL PRICE

The value a bull provides is in the calves sired over a lifetime, the long-term genetic change of the herd, and salvage value at the end of a productive life. As long-term genetic change is not readily measurable by producers, this parameter was excluded from the calculator.

Table 3. Summary of the effect of increasing different parameters on the bull value estimated by the calculator

Parameter	Increase by:	Effect on bull value
Maintenance cost	\$100	Decrease by \$520
Years of service	One year	Increase by \$350
Expected calf price	\$10/cwt	Increase by \$300
Cow to bull ratio	One cow	Increase by \$280
Expected weaning rate	1%	Increase by \$80
Expected calf weight	One pound	Increase by \$10
Death loss	0.5%	Decrease by \$15

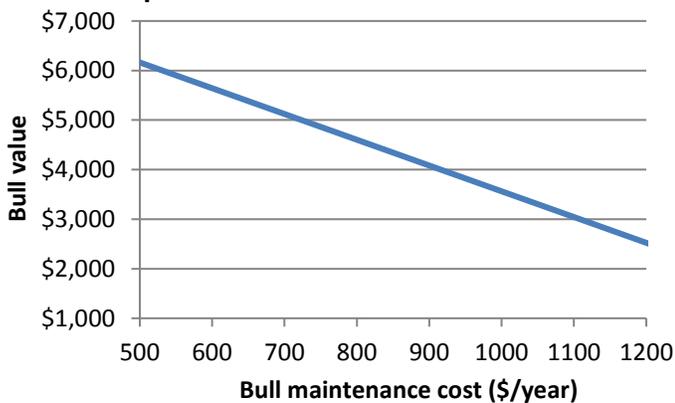
The value provided depends on **cost factors** (i.e., bull maintenance cost and death loss), **performance factors** (i.e., years of service, the expected cow to bull

ratio, expected weaning rate, expected weight of feeders, and proportion of the calf value attributed to the bull), and **price factors** (i.e., expected price of feeders and salvage value).

COST FACTORS

Annual maintenance cost: The cost to maintain a bull each year has a significant impact on bull value. This cost includes winter feed (e.g., hay, barley, pellets, supplements, mineral), veterinary services (e.g., breeding soundness exams, deworming), pasture, yardage and labour costs. An increase in maintenance cost by \$100 results in a \$520 difference in bull price, assuming all other parameters are kept constant. However, a higher maintenance cost may also improve sperm quality (e.g., feeding vitamin A for sperm quality), increase breeding efficiency (e.g., to maintain a stable body condition over the breeding season) and heavier salvage weight.

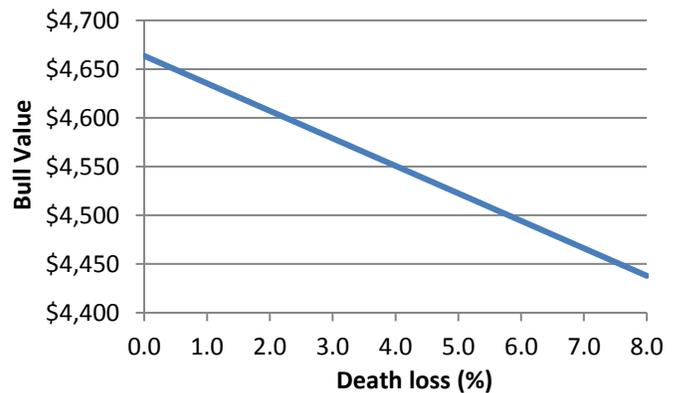
Figure 1. Effect of bull maintenance cost on the bull breakeven price



All other variables held constant at default values

Death loss: According to the WCCCS 2017 survey, death loss for bulls averaged 4%. Disease or injury may lead to death of the bull before the end of the predicted years of service. For every 0.5% increase in death loss or culling rate, bull breakeven price is reduced by around \$15 per head.

Figure 2. Effect of death loss on the bull breakeven price

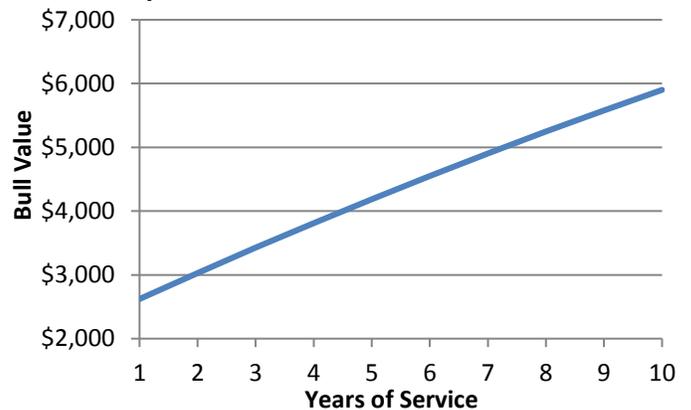


All other variables held constant at default values

PERFORMANCE FACTORS

Years of service: The number of years of service greatly affects the value the bull provides, with each additional year adding around \$350 per head to the value of the bull. Longevity is affected by factors such as conformation, number of bulls in a breeding field (i.e. fighting), pasture size and terrain. Older bulls may have more injuries and less years of service available; however, they may have more viable sperm than yearling bulls, are less likely to "fall in love" (i.e., breeding only a few select cows), and may breed more cows due to being higher in the pecking order. In Western Canada, the bull culling rate was 21%, suggesting an average bull longevity of approximately five years (WCCCS 2018).

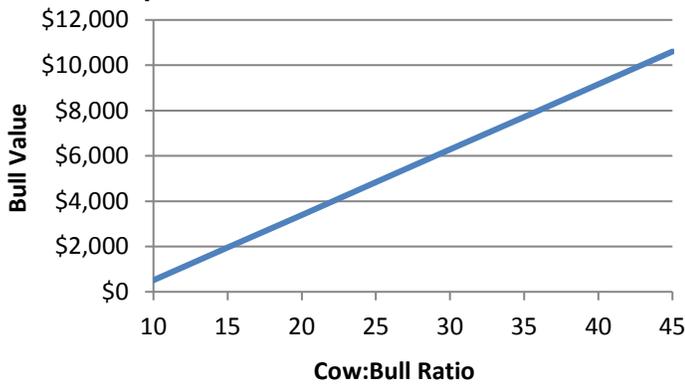
Figure 3. Effect of bull longevity on the bull breakeven price



All other variables held constant at default values

Cow to bull ratio: As the number of cows the bull services increases, the more potential calves will be born. However, if the mating capacity of the bull is exceeded, the proportion of open cows may increase, potentially reducing the weaning rate. Factors affecting the cow to bull ratio include semen quality, bull health, length of breeding season, and pasture size. The calculator predicts for every extra cow served, the bull's value increases by approximately \$280 per head.

Figure 4. Effect of cow to bull ratio on the bull breakeven price

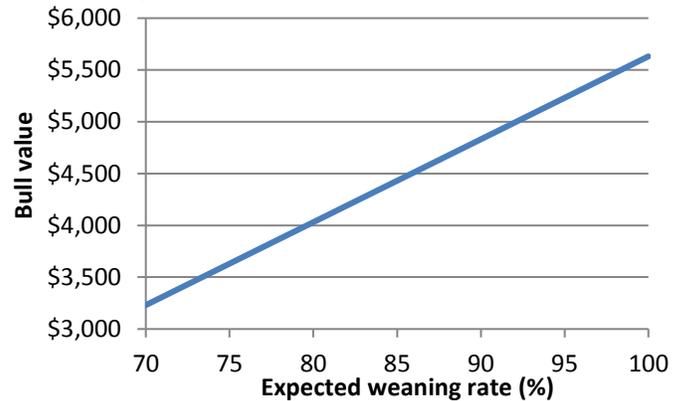


All other variables held constant at default values

In a natural service situation this relationship will plateau at some point, depending on libido which will be extremely variable from bull to bull. But if semen is being collected for sale it will only be limited by semen production.

Expected weaning rate: As weaning rates increase, the more total calf value will increase, raising the bull breakeven price. To account for losses such as miscarriages, the weaning rate enables the calculator to determine the number of weaned calves from the cow to bull ratio. Weaning rate is defined as the number of weaned calves divided the number of cows exposed. In Western Canada, an average weaning rate of 85% was reported for 2017 (WCCCS, 2018). Factors that affect weaning rate include: conception rates, calving difficulty, calving season, poor milk production or maternal health, inbreeding, and calf illness. The calculator predicts that for every 1% increase in weaning rate increases the bull price by approximately \$80 per head.

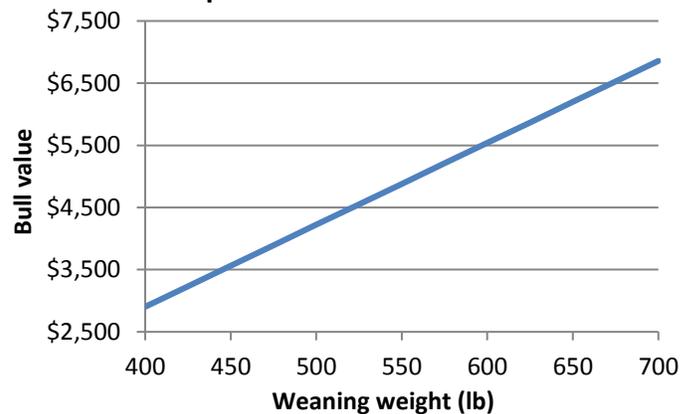
Figure 5. Effect of expected weaning rate on the bull breakeven price



All other variables held constant at default values

Expected weight of calves at weaning: As the weaning weight increases, the breakeven price is predicted to increase. Factors affecting weaning weight include milk production of the dam, genetics, calf disease prevalence, calving season, and the use of creep feeding. When keeping all other variables constant, every extra pound at weaning contributes approximately \$10 per head to the bull's value.

Figure 6. Effect of expected weaning weight on the bull breakeven price



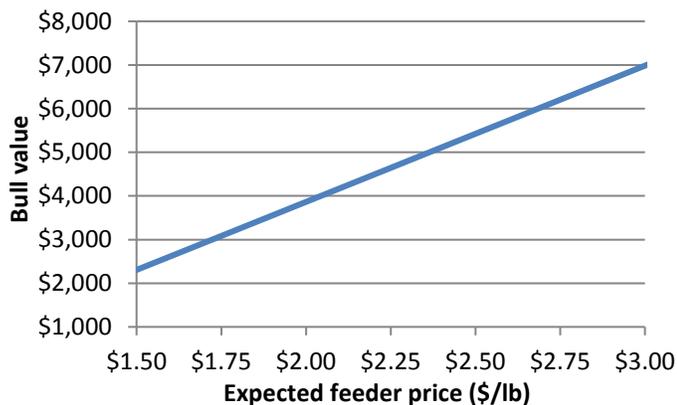
All other variables held constant at default values

Percent of calf value attributed to the bull: This parameter describes the proportion of the calf's value that can be attributed to the bull. The majority of a calf's value is attributed to the dam.

To find a default value for the percentage of calf value attributed to the bull, this formula¹ was applied to a selection of cow/calf cost of production benchmarking studies² (e.g., Forero et al 2017, Holmgren and Fenz 2015, Manitoba Agriculture 2017). The range was 3-7%, with an average of 5.5%. As this formula is quite sensitive to changes (a 0.5% increase in percentage of calf value attributed to the bull increases bull breakeven price by around \$600 per head), the suggestion is to leave this parameter steady at 5.5% unless more data is known to the producer.

PRICE FACTORS

Figure 7. Effect of expected feeder price on the bull breakeven price



All other variables held constant at default values

Expected price of calves at weaning: As the price of feeders increase, the bull breakeven price also increases. In fact, the value the bull provides is very sensitive to feeder price, where the calculator predicts that for every \$10/cwt increase in price of weaned calves, the bull breakeven price increases by

¹ To find the breakeven percentage of calf value from the bull, the following equation was derived:

$$\text{Total value} = \text{value from calves} + \text{bull salvage value}$$

$$\text{Total cost} = \text{cost of cow maintenance} + \text{other farm costs} + \text{cost of bull maintenance} + \text{bull price}$$

Combining the two equations and isolating for breakeven bull price:

$$\text{Bull price} = \text{value from calves} - \text{cost of cow maintenance} - \text{other farm costs} - \text{cost of bull maintenance} + \text{bull salvage value}$$

Abbreviating "% calf value attributed to the bull" as "A", the equation in the previous section can be written:

around \$300 per head. Feeder price is affected by factors such as the balance between calf supply and demand, weather, feed prices, and price expectations (Alberta Agriculture and Forestry 2017). Over the last five years (2014-2018) the range for Alberta 550 lb steer calves was \$176 to \$328/cwt. These price changes explain a swing of \$3,250 to \$7,500 per head in bull value, more than a twofold difference.

Salvage value: The salvage value of the bull is dependent on the mature weight and the price of butcher bulls. Over the last five years (2014-2018) Alberta bulls have ranged from \$104 to \$154/cwt with fourth quarter prices down 4% from the annual average. In 2018, Alberta butcher bull prices averaged \$104/cwt. Generally, for every extra dollar of salvage value, the bull breakeven price increases by just under a dollar. The effect of salvage value on bull value is affected by the interest rate and years of service. As these two parameters approach zero, an increase in salvage value will increase bull price by an amount that approaches the actual salvage value.

CONCLUSION

The bull valuation calculator predicts the net present value (price) which producers should not exceed if looking for a profitable purchase. Seven parameters are required: years of service for the bull, cow to bull ratio, expected weaning rate, expected calf price, expected calf weight, bull salvage value, and bull maintenance cost.

Key parameters that significantly influence bull price are the years of service, cow to bull ratio, expected price of feeders, and bull maintenance cost. Taking all

$$\text{Bull price} = A * \text{value from calves} - \text{cost of bull maintenance} + \text{bull salvage value}$$

Combining this with the equation above, it becomes:

$$\text{value from calves} - \text{cost of cow maintenance} - \text{other farm costs} - \text{cost of bull maintenance} + \text{bull salvage value} = A * \text{value from calves} - \text{cost of bull maintenance} + \text{bull salvage value}$$

Isolating for % calf value attributed to the bull:

$$A = 1 - ((\text{total cow cost} + \text{other farm costs}) / (\text{total calf value}))$$

² Due to data limitations with Canadian cow-calf studies, American studies were also used to calculate the average

the variables into account, the calculator identifies a bull value where the producer is likely to breakeven.

Bull selection depends on many factors such as farm intensity, calving season, labour availability, age where calves are marketed, heifer retention practices, and nutrition management. There is no one-size-fits-all solution or a bull that is best for all scenarios, as the right genetics depend on the individual operation and management. The purpose of this calculator is to identify a price of a bull that makes sense for an individual operation considering its unique characteristics.

To note, the bull value obtained from the calculator is only an estimate and may not reflect the true breakeven price. However, it can be used as a guide for a general bull value, and to see the effect of how changing different parameters can affect the operation's willingness to pay. Differences in bull attributes contribute to the large bull price differentials. Overall, having information on the effect of these different attributes can assist in making efficient buying decisions.

BULL VALUATION CALCULATOR

The bull breakeven price calculator predicts the price of a bull where the cost of the bull exactly offsets the value the bull provides. Purchasing a bull above the price is likely to be unprofitable, while a bull priced below the breakeven price may be considered a decent bargain. This calculator assumes calves are sold at weaning.

The calculator requires seven pieces of information:

- years of service for the bull
- cow to bull ratio
- expected weaning rate
- expected calf price
- expected calf weight
- bull salvage value
- bull maintenance cost

To find the breakeven price, a net present value (NPV) calculation is used. First, the annual net benefit (NB) is identified through subtracting the annual maintenance cost from the total annual value of the bull:

$$NB = [(cow:bull\ ratio * weaning\ rate * calf\ price * calf\ weight * \% \text{ calf attributed to bull}) - annual\ maintenance\ cost] * (1 - death\ rate)$$

With NPV, to account for the fact that we value benefits in the future less than we would in the present, each subsequent year is discounted by the interest rate (r). It provides a way to sum up a stream of benefits over time, as a bull would provide value over its lifespan of n years.

$$NPV = \frac{NB_{Year\ 1}}{(1+r)} + \frac{NB_{Year\ 2}}{(1+r)^2} + \dots + \frac{NB_{Year\ n}}{(1+r)^n} + \frac{Bull\ salvage\ value}{(1+r)^n} - purchase\ price$$

When breaking even: $NPV = 0$

As a result,

$$breakeven\ purchase\ price = \frac{NB_{Year\ 1}}{(1+r)} + \frac{NB_{Year\ 2}}{(1+r)^2} + \dots + \frac{NB_{Year\ n}}{(1+r)^n} + \frac{Bull\ salvage\ value}{(1+r)^n}$$

The calculator can be found at

<http://www.beefresearch.ca/resources/decisiontools.cfm>

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