# Should I Purchase Replacement Females?

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The cows that make up the cow herd are the factories that produce the primary product of the ranch. These cows, like factories, have a limited life and have to be replaced over time. When investing in replacement bred cows or bred heifers, a producer is faced with two options; raise the replacements on the ranch or purchase the replacements. In this paper, we will outline the process by which the investment alternatives can be analyzed and the best decision made.

In analyzing the costs of raising versus purchasing a bred replacement heifer, we will use a Net Present Value (NPV) approach. This approach allows us to examine the bred heifer for her investment potential by discounting the stream of cash flows to a value that can be translated to a simple dollar figure in the present. This NPV figure will help determine if the heifer costs too much or not. We are then able to benchmark the market value for a bred heifer and the cost of raising the same against the NPV.

The analysis we will conduct in this paper will use Alabama and Southeast data over the 1990-2000 time period. The advantage to using historical data is that the numbers are clearly defined, and we can see what would have happened had we employed the different investment strategies. The results then can be extrapolated into the future using the budget and valuation framework established over the predefined time period.

## Evaluating the Cost of a Bred Replacement

Understanding and budgeting the costs of developing a bred heifer is key to effectively analyzing the decision to raise or purchase your bred replacement heifers. In outlining this process, we will develop a budget situation based on the averages for the 1990 to 2001 time period. Keep in mind that these prices will vary with the cattle cycle — see Figure 1 for an illustration.

The data we will use in examining the cost of the bred replacement will be based on the previously mentioned Alabama and Southeast data. We will assume 550-pound September heifer prices, medium and large frame, number one muscle score (Alabama Auctions) and high-end bred beef replacement heifers prices (CattleFax). In examining this data, we find that the average September weaned heifer from 1989 to 1998 sold for an average $385/head. Likewise, the same heifers sold a year later as bred beef replacements during 1990-1999 would have sold for an average $653/head. Thus, the market has placed an average value of $268/head for developing a September bred replacement heifer.

The first assumption we will make in developing the cost budget for developing our own bred heifer is that the initial cost of the weaned heifer is the foregone revenue from not selling her as a weaned calf. Until that point, all costs of her production were borne by her mother. This is an accounting transfer essentially from one asset to another. In this case, we will assume the average market price of the 550-pound weaned heifers, $385/head. In our calculations, we will then adjust this value per head at the end of the year to reflect the costs of culled and dead heifers where the adjusted cost per replacement heifer is $476 in year one.

Table 1 shows the costs for developing a bred heifer from a 550-pound weaned heifer. This table shows a $383/head development cost. When summed up with the outlay cost of the heifers, we have a total cost of a bred heifer being $859/head. This is $206 ($859-$653) above the average cost of purchasing a bred heifer in the Southeast over the time period being examined.

In our budgeting analysis, we include values for labor (which includes operator labor), land, and fixed or sunk costs. These costs are an important part of the equation from an economist's point of view, but let us examine what happens when these values are omitted (Table 2). We can see that the cost of developing the heifer falls to $265 which is $3 below the average value the market puts on the development of a bred heifer from weaned heifer. Still, our total cost of the raised bred heifer is $741 which is $88 ($741-$653) higher than the average the market put on a bred heifer in the Southeast.

## Using Net Present Value

Net Present Value is a process where all cash flows — both inflows and outflows — are summed using their present values (Table 3). The present value approach is a means to adjust future dollar earnings and costs to reflect their value in today's dollars. This technique uses a discount rate to adjust those future earnings or costs to attain their value in today's dollars. The discount rate may be viewed as our desired rate of return. For example, I have $1 today. If I select an investment that provides a 5% rate of return, my $1 investment in one year will be worth $1.05. Alternatively, another way to think of this is that $1.05 in one year would be the same to me as $1 today. Thus, by bringing all future earnings back to today's value, we can determine if this investment meets our desired rate of return. The NPV coefficient is simply the sum of the stream of present values. A NPV of greater than or equal to zero is necessary to indicate that this investment attains our desired rate of return. A NPV of greater than zero means that we have attained a higher rate of return than we desired.

In a related concept, we can determine the Internal Rate of Return (IRR) in a reverse fashion. The IRR is simply the rate of return – discount rate – that makes NPV equal to zero. This allows direct comparison of the returns provided by alternative investments.

In determining the NPV of a bred replacement, we considered the bred replacement heifer at two years of age with calf. We considered all monies in the heifer to that point as the investment layout (this figure will be discussed in comparing the purchase and raise options). Cash flows for the future were discounted on two categories. First, we used a discount rate for determining a rate of return. Additionally, we accounted for the probability that any given heifer might not calve and thereby be culled in any given year during the expected 12-year production period developing a stream of expected cash flows. This process provides us with an expected NPV (E[NPV]).

The E[NPV] accounts for the risk factor inherent in cow production, the risk a cow will not calve. The calculation of the E[NPV] will be dependent on the initial outlay for the heifer.

## Net Present Value Analysis

In our budgeting example, we found that we might be better off by purchasing bred replacements. Even though the cash flows will be the same for the investment choices once the first calf is born, an NPV analysis is helpful in illustrating the investment decision. We will be able to see the differences in the NPV and in the internal rate of return (IRR) between the two options.

As discussed earlier, a key component of the NPV calculation is the discount rate. We will assume a 2% discount rate. This rate

is used based on a sense of the next best alternative investment. In this case, we used current Treasury Bill rates rounded to the nearest whole percent. Additionally, it is generally accepted that returns to agricultural enterprises is in the vicinity of 2% as well.

In Table 4, we present the present value (PV) cash flows for a raised replacement cow through an eleven calf lifespan. We can see that the net present value — assuming a 2% discount rate and 550-pound calves — of this heifer at time period zero is $329. Table 5 shows the PV cash flows for a purchased replacement cow weaning the same 550-pound calves. This animal has a NPV of $540. This assumes that the heifer will indeed produce eleven calves. Tables 6 and 7 show the changes when we sell calves at 650 pounds – NPV's increase to $792 and $1,003 respectively.

If we examine the IRR's of the same investment choices, we see that the rankings will remain the same. The raised replacement cow weaning 550-pound calves provides an IRR of 5.74% while the purchased replacement cow with the same calves provides an IRR of 9.75%. Similarly, the raised replacement weaning 650-pound calves provides an IRR of 10.70% and her purchased counterpart provides an IRR of 16.50%.

We can clearly see a difference between the decision to purchase or raise as well as the decision to wean at 550 pounds or 650 pounds. However, a further analysis will show that there is really only a 7% chance of realizing these afore mentioned outcomes. So, we will examine the case further.

Using data reported by Kunkle et al. 2002, we can compute the likelihood that a cow will have been culled in a given year (Tables 8 and 9). From this information, we can then calculate the probabilities of realizing any given outcome. This determines the expected return. In Tables 10 and 11, we show the present value of the expected returns in each year. The result for a raised cow weaning 550-pound calves was an E[NPV] of -$283. Shifting to a 650-pound calf changes this E[NPV] to -$112. In contrast, the purchased cow weaning 550-pound calves provided an E[NPV] of -$72.20 while the same cow weaning a 650-pound calf would have an E[NPV] of $99.28.

A similar analysis of the individual expected internal rates of return (E[IRR]'s) shows the same ranking for the four alternatives with -4.88% return for the raised cow weaning 550-pound calves, -0.40% return for the purchased cow weaning 550-pound calves, -0.66% return for the raised cow weaning 650-pound calves, and 5.32% return for the purchased cow weaning 650-pound calves. In both the case of the E[NPV] and the E[IRR], a purchased replacement weaning a 550-pound calf provided better returns than a raised replacement weaning 650-pound calves.

When accounting for the risk factor of open cows, we see that a slightly different ranking comes about. Without risk, both 650-pound strategies outperformed their 550-pound counterparts. However, when accounting for the probability of culling any given cow in any given year, we find that purchasing outperforms raising independent of calf size examined in our example. This underscores the costs of open cows on the system, and reinforces the importance of herd management techniques in keeping conception rates up and costs down.

## Summary

Here are a couple of things to keep in mind when examining the cow replacement opportunities. If replacement cows are too cheap to sell, it implies that you might be facing cattle cycle price lows, high production costs, and/or the replacement market is saturated (over supplied). If replacement cows are too expensive to buy, it implies that you might be facing cattle cycle price highs, lack

cow/calf profitability, and/or limited availability (reduced supply) of replacements.

The example we have provided is an outline of how to evaluate the decision making process using the NPV approach with known values. There are clearly some other factors to consider. Table 12 outlines some of the advantages and disadvantages of both purchasing and raising replacement heifers and raising your own. These factors will be taken into consideration when you make your management decision. The option you choose should be tied both to the financial impact on the operation and the way it fits into your operational goals.

The decision to buy or raise replacement heifers occurs at a time when there is still uncertainty about costs and prices. While our example used the averages over a historical time period, we can see from Figure 2 that there are times when one option would have been better than the other in a purely financial sense. However, in reality, we make this decision looking into the future when we can only speculate at the future costs of raising or buying replacements. The question ultimately comes down to future financial costs, future cattle market prices, future cattle performance, and individual producer herd goals. Since we can not accurately forecast these variables, cattle producers will continue to make the replacement decision with insufficient information. Therefore, when cattle producers breed a heifer, they are clearly assuming that future costs, cattle market prices, and cattle performance will be sufficient to achieve their desired rate of return.

Our analysis suggests that over the 1990-2000 time horizon it would have been better financially to have purchased replacement heifers. This outcome was expected since our budgeted cost to develop a bred replacement heifer was greater that the value the market placed on developing a bred replacement heifer. However, this analysis is flawed by the fact that it was done on a historical time. Obviously, when attempting to look forward into the future to make this decision, a producer will not have perfect knowledge of the time period ahead. The decision must be made with all of the previously mentioned factors taken into account. Therefore, the replacement heifer decision can be made with assumptions (heifer development costs, costs of production, calf and reproductive performance, market prices, etc.) about the future. Using the framework outlined in this paper will allow one to answer the question; should I purchase replacement females?

## References

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Figure 1. High-end September bred heifer prices and September weaned heifer prices, 500-pound, Medium and Large, Number 1, Alabama, 1989-1999.

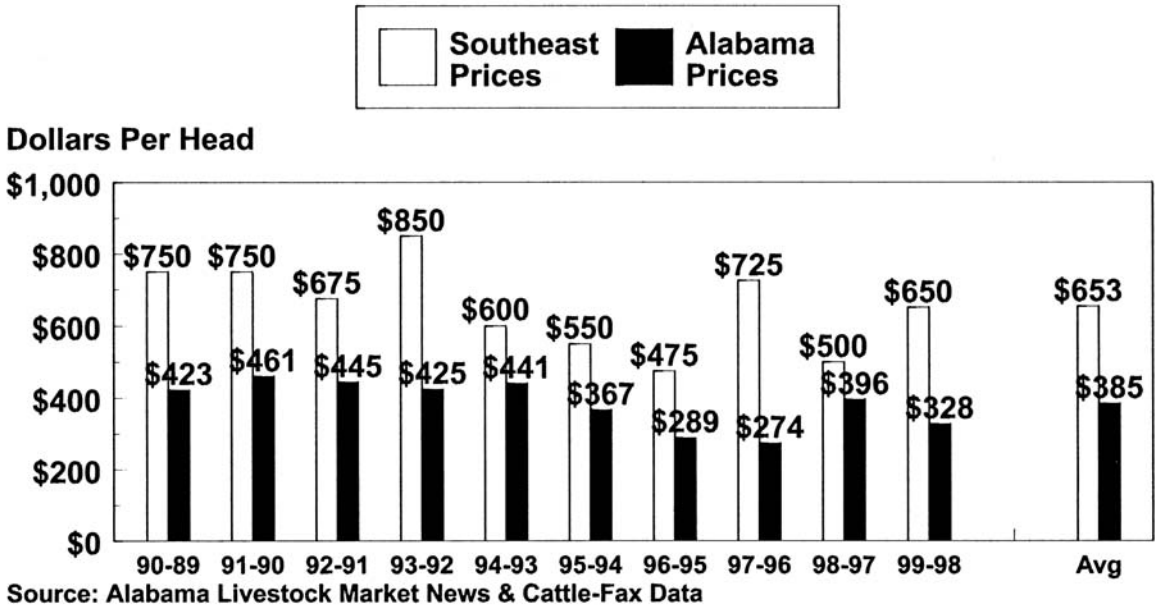


Figure 2. Value the market places on developing a September bred beef replacement heifer, 1989-1999.

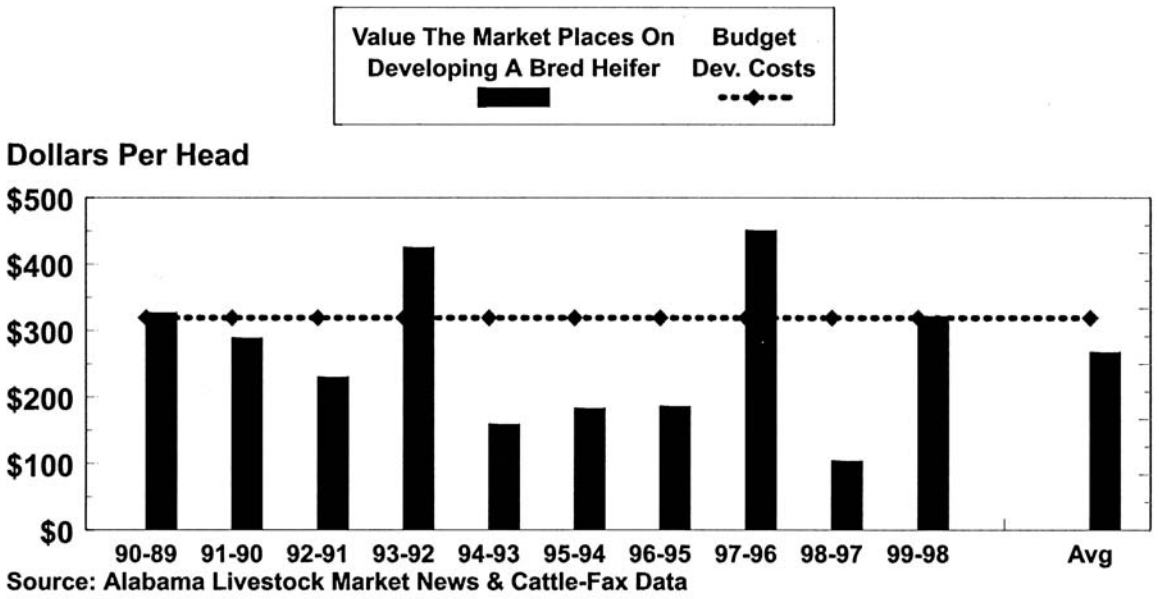

Table 1. Estimated total cost per beef cow replacement, 1990-1992.

| Item | Year 1 ($/head) | Year 2 ($/head) |
|---|---|---|
| Replacement heifer/cow | 476 * | 939 * |
| Grazing | 84 | 127 |
| Supplement | 83 | 95 |
| Labor | 45 | 47 |
| Land | 23 | 35 |
| Breeding, AI/bull | 26 | 23 |
| Miscellaneous & supplies | 25 | 32 |
| Interest | 60 | 106 |
| Fixed cost | 37 | 38 |
| Total | 859 | 1,443 |

*Replacement heifer/cow value at the end of the year after adjusting for culled and dead animals.

Table 2. Estimated total cost per beef cow replacement without land, labor, and fixed costs, 1990-1992.

| Item | Year 1 ($/head) | Year 2 ($/head) |
|---|---|---|
| Replacement heifer/cow | 476 * | 939 * |
| Grazing | 84 | 127 |
| Supplement | 83 | 95 |
| Breeding, AI/bull | 26 | 23 |
| Miscellaneous & supplies | 25 | 32 |
| Interest | 60 | 106 |
| Total | 741 | 1,291 |

*Replacement heifer/cow value at the end of the year after adjusting for culled and dead animals.

Table 3. Example net present value valuation of cash flows.

| Price | Weight | Revenue | Cost | Net cash-flow | Present value factor | Cash flow - present value |
|---|---|---|---|---|---|---|
| 86.60 | | | 476 | -476 | 1.0000 | -476 |
| 84.23 | | | 383 | -383 | 0.9804 | -375 |
| 80.24 | 550 | 441 | 503 | -62 | 0.9612 | -60 |
| 82.95 | 550 | 456 | 300 | 156 | 0.9423 | 147 |
| 69.57 | 550 | 383 | 300 | 83 | 0.9238 | 76 |
| 56.07 | 550 | 308 | 300 | 8 | 0.9057 | 8 |
| 53.27 | 550 | 293 | 300 | -7 | 0.8880 | -6 |
| 75.95 | 550 | 418 | 300 | 118 | 0.8706 | 102 |
| 62.88 | 550 | 346 | 300 | 46 | 0.8535 | 39 |
| 76.45 | 550 | 420 | 300 | 120 | 0.8368 | 101 |
| 85.66 | 550 | 471 | 300 | 171 | 0.8203 | 140 |
| 87.15 | 550 | 479 | 300 | 179 | 0.8043 | 144 |
| 87.15 | 550 | 479 | 300 | 179 | 0.7885 | 141 |
| 40.00 | 1,100 | 440 | 0 | 440 | 0.7885 | 347 |
| Net present value of beef cow investment.* | | | | | | 329 |

*Present value factor was assumed to be 2%.

Table 4. Net present value of raised beef replacement cows, 550-pound calves, 1990-2002.

| Year | | Cash flow - present value |
|---|---|---|
| 0 | 1990 | -476 |
| 1 | 1991 | -375 |
| 2 | 1992 | -60 |
| 3 | 1993 | 147 |
| 4 | 1994 | 76 |
| 5 | 1995 | 8 |
| 6 | 1996 | -6 |
| 7 | 1997 | 102 |
| 8 | 1998 | 39 |
| 9 | 1999 | 101 |
| 10 | 2000 | 140 |
| 11 | 2001 | 144 |
| 12 | 2002 | 141 |
| 12 | Sal. value | 347 |
| Net present value* | | 329 |

*Present value factor assumed to be 2%.

**This investment produces a rate of return of 5.74%.

Table 5. Net present value of purchased beef replacement cows, 550-pound calves, 1990-2002.

| Year | | Cash flow - present value |
|---|---|---|
| 0 | 1990 | 0 |
| 1 | 1991 | -640 |
| 2 | 1992 | -60 |
| 3 | 1993 | 147 |
| 4 | 1994 | 76 |
| 5 | 1995 | 8 |
| 6 | 1996 | -6 |
| 7 | 1997 | 102 |
| 8 | 1998 | 39 |
| 9 | 1999 | 101 |
| 10 | 2000 | 140 |
| 11 | 2001 | 144 |
| 12 | 2002 | 141 |
| 12 | Sal. value | 347 |
| Net present value* | | 540 |

*Present value factor assumed to be 2%.
**This investment produces a rate of return of 9.75%.

Table 6. Net present value of raised beef replacement cows, 650-pound calves, 1990-2002.

| Year | | Cash flow - present value |
|---|---|---|
| 0 | 1990 | -476 |
| 1 | 1991 | -375 |
| 2 | 1992 | -15 |
| 3 | 1993 | 203 |
| 4 | 1994 | 120 |
| 5 | 1995 | 48 |
| 6 | 1996 | 40 |
| 7 | 1997 | 148 |
| 8 | 1998 | 74 |
| 9 | 1999 | 141 |
| 10 | 2000 | 178 |
| 11 | 2001 | 181 |
| 12 | 2002 | 178 |
| 12 | Sal. value | 347 |
| Net present value* | | 792 |

*Present value factor assumed to be 2%.
**This investment produces a rate of return of 10.80%.

Table 7. Net present value of purchased beef replacement cows, 650-pound calves, 1990-2002.

| Year | | Cash flow - present value |
|---|---|---|
| 0 | 1990 | 0 |
| 1 | 1991 | -640 |
| 2 | 1992 | -15 |
| 3 | 1993 | 203 |
| 4 | 1994 | 120 |
| 5 | 1995 | 48 |
| 6 | 1996 | 40 |
| 7 | 1997 | 148 |
| 8 | 1998 | 74 |
| 9 | 1999 | 141 |
| 10 | 2000 | 178 |
| 11 | 2001 | 181 |
| 12 | 2002 | 178 |
| 12 | Sal. value | 347 |
| Net present value* | | 1,003 |

*Present value factor assumed to be 2%.
**This investment produces a rate of return of 16.50%.

Table 8. Expected NPV of raised beef cow replacement, 550-pound calves, 1990-2002.

| Year | | Cash flow - present value | No. of calves | NPV @ each year | Conception rate | Probability will have been culled | Expected cash flow - present value |
|---|---|---|---|---|---|---|---|
| 0 | 1990 | -476 | | | | | -476 |
| 1 | 1991 | -375 | | | | | -375 |
| 2 | 1992 | -60 | 1 | -488.02 | 0.84 | 0.16 | 18 |
| 3 | 1993 | 147 | 2 | -349.10 | 0.71 | 0.40 | 189 |
| 4 | 1994 | 76 | 3 | -280.89 | 0.85 | 0.49 | 75 |
| 5 | 1995 | 8 | 4 | -281.29 | 0.87 | 0.56 | 30 |
| 6 | 1996 | -6 | 5 | -295.34 | 0.87 | 0.62 | 20 |
| 7 | 1997 | 102 | 6 | -200.51 | 0.87 | 0.67 | 53 |
| 8 | 1998 | 39 | 7 | -168.92 | 0.74 | 0.75 | 42 |
| 9 | 1999 | 101 | 8 | -75.47 | 0.74 | 0.82 | 42 |
| 10 | 2000 | 140 | 9 | 57.69 | 0.74 | 0.86 | 36 |
| 11 | 2001 | 144 | 10 | 194.82 | 0.74 | 0.90 | 27 |
| 12 | 2002 | 141 | 11 | 329.25 | 0.74 | 0.93 | 36 |
| 12 | Sal. value | 347 | | | | | |
| Net present value* | | 329 | | | Expected net present value | | -283 |

*Present value factor assumed to be 2%.
**This investment produces an expected rate of return of -4.88%.

Table 9. Expected NPV of purchased beef cow replacement, 550-pound calves, 1990-2002.

| Year | | Cash flow - present value | No. of calves | NPV @ each year | Conception rate | Probability will have been culled | Expected cash flow - present value |
|---|---|---|---|---|---|---|---|
| 0 | 1990 | 0 | | | | | 0 |
| 1 | 1991 | -640 | | | | | -640 |
| 2 | 1992 | -60 | 1 | -276.80 | 0.84 | 0.16 | 18 |
| 3 | 1993 | 147 | 2 | -137.88 | 0.71 | 0.40 | 189 |
| 4 | 1994 | 76 | 3 | -69.66 | 0.85 | 0.49 | 75 |
| 5 | 1995 | 8 | 4 | -70.07 | 0.87 | 0.56 | 30 |
| 6 | 1996 | -6 | 5 | -84.11 | 0.87 | 0.62 | 20 |
| 7 | 1997 | 102 | 6 | 10.72 | 0.87 | 0.67 | 53 |
| 8 | 1998 | 39 | 7 | 42.31 | 0.74 | 0.75 | 42 |
| 9 | 1999 | 101 | 8 | 135.75 | 0.74 | 0.82 | 42 |
| 10 | 2000 | 140 | 9 | 268.92 | 0.74 | 0.86 | 36 |
| 11 | 2001 | 144 | 10 | 406.04 | 0.74 | 0.90 | 27 |
| 12 | 2002 | 141 | 11 | 540.48 | 0.74 | 0.93 | 36 |
| 12 | Sal. value | 347 | | | | | |
| Net present value* | | 540 | | | Expected net present value | | -72.20 |

*Present value factor assumed to be 2%.

**This investment produces an expected rate of return of -0.40%.

Table 10. Expected NPV of raised beef cow replacement, 650-pound calves, 1990-2002.

| Year | | Cash flow - present value | No. of calves | NPV @ each year | Conception rate | Probability will have been culled | Expected return |
|---|---|---|---|---|---|---|---|
| 0 | 1990 | -476 | | | | | -476 |
| 1 | 1991 | -375 | | | | | -375 |
| 2 | 1992 | -15 | 1 | -443.28 | 0.84 | 0.16 | 55 |
| 3 | 1993 | 216 | 2 | -248.39 | 0.71 | 0.40 | 222 |
| 4 | 1994 | 130 | 3 | -136.02 | 0.85 | 0.49 | 97 |
| 5 | 1995 | 48 | 4 | -95.65 | 0.87 | 0.56 | 48 |
| 6 | 1996 | 40 | 5 | -63.69 | 0.87 | 0.62 | 38 |
| 7 | 1997 | 148 | 6 | 76.37 | 0.87 | 0.67 | 68 |
| 8 | 1998 | 74 | 7 | 142.37 | 0.74 | 0.75 | 51 |
| 9 | 1999 | 141 | 8 | 276.21 | 0.74 | 0.82 | 49 |
| 10 | 2000 | 178 | 9 | 447.28 | 0.74 | 0.86 | 41 |
| 11 | 2001 | 181 | 10 | 621.38 | 0.74 | 0.90 | 31 |
| 12 | 2002 | 178 | 11 | 792.06 | 0.74 | 0.93 | 39 |
| 12 | Sal. value | 347 | | | | | |
| Net present value* | | 792 | | | Expected net present value | | -112 |

*Present value factor assumed to be 2%.

**This investment produces an expected rate of return of -0.66%.

Table 11. Expected NPV of purchased beef cow replacement, 650 pound calves, 1990-2002.

| Year | | Cash flow present value | No. of calves | NPV @ each year | Conception rate | Probability will have been culled | Expected cash flow present value |
|---|---|---|---|---|---|---|---|
| 0 | 1990 | 0 | | | | | 0 |
| 1 | 1991 | -640 | | | | | -640 |
| 2 | 1992 | -15 | 1 | -232.05 | 0.84 | 0.16 | 55 |
| 3 | 1993 | 203 | 2 | -37.17 | 0.71 | 0.40 | 222 |
| 4 | 1994 | 120 | 3 | 75.20 | 0.85 | 0.49 | 97 |
| 5 | 1995 | 48 | 4 | 115.57 | 0.87 | 0.56 | 48 |
| 6 | 1996 | 40 | 5 | 147.53 | 0.87 | 0.62 | 38 |
| 7 | 1997 | 148 | 6 | 287.60 | 0.87 | 0.67 | 68 |
| 8 | 1998 | 74 | 7 | 353.60 | 0.74 | 0.75 | 51 |
| 9 | 1999 | 141 | 8 | 487.44 | 0.74 | 0.82 | 49 |
| 10 | 2000 | 178 | 9 | 658.51 | 0.74 | 0.86 | 41 |
| 11 | 2001 | 181 | 10 | 832.60 | 0.74 | 0.90 | 31 |
| 12 | 2002 | 178 | 11 | 1,003.28 | 0.74 | 0.93 | 39 |
| 12 | Sal. value | 347 | | | | | |
| Net present value* | | 1,003 | | | Expected net present value | | 99.28 |

*Present value factor assumed to be 2%.

**This investment produces an expected rate of return of 5.32%.

Table 12. Advantages and disadvantages of raising and purchasing replacement heifers.

| | Purchasing replacements | Raising replacements |
|---|---|---|
| Advantages | • Use resources in other ways to improve NFI. (labor, land [stocking rate], etc.)<br>• Added flexibility to change herd size and/or breeding program<br>• Opportunity to buy genetically superior replacements<br>• May be cheaper than raising | • Ability to know and select for factors such as temperament, calving dates, etc.<br>• Ability to maintain disease control and herd health program<br>• Opportunity to raise genetically superior replacements<br>• May be cheaper than purchasing<br>• Always available |
| Disadvantages | • Availability likely limited<br>• Uncertainty of herd health impacts and disease introduction<br>• Added transportation stress<br>• May cost more than raising | • Resources tied up in developing replacements instead of producing calves<br>• Limits herd expansion flexibility and breeding program changes<br>• May cost more than purchasing |

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