

## ECONOMICS OF BEEF COW REPLACEMENT

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What criteria should a beef calf producer use in determining whether or not to cull a cow from his breeding herd? What is the best age to replace a mother cow?

Individual management techniques may alter the overall replacement system, but in considering the economic factors, the following information establishes a basis for replacement decisions.

It is important for the beef cow producer to keep his assets at work in producing beef calves. A good place to begin the replacement decision is to determine whether the cow is likely to produce another calf. Most ranchers try to maintain a calving interval of 12 months for their cows. By the time a calf has been weaned the cow should be palpated to check that she is pregnant again.

Pregnant cows may not be profitable if they are diseased or in poor condition. If they are unlikely to survive to the next calving date or if they are unable to forage for themselves due to problems with their teeth or feet, they are candidates for culling. Having met these two tests, the rancher should check his performance records on the cow in question. The important points at this step are to compare calving intervals and weaning weights with the herd's overall performance.

The likelihood that a cow will successfully wean a calf increases as she approaches maturity, and depending on the breed and management practices, her most fertile period is between the ages of 5 and 8 years under conditions considered in this program (Table 1). In addition to a higher fertility level in those years,

the weight of weaned calves is generally heavier. Beyond this period, both the probability of producing a calf and the expected weight of weaned calves begin to decline. Thus, the rancher spends about the same time and money on his older cows but gets fewer pounds of weaned calves from them.

Table 1. Weaned calf weight, calving percent, and mortality rates by age of cow.

Cow's age	Calf number	Weaned weight (lbs.)	Calving percent 1 <sup>a</sup> (%)	Calving percent 2 <sup>b</sup> (%)	Mortality rate <sup>a</sup> (%)
2	1	412	86	70	2.3
3	2	432	89	80	2.3
4	3	450	93	85	2.3
5	4	472	95	90	2.4
6	5	472	94	95	2.5
7	6	472	93	95	2.8
8	7	472	91	95	3.3
9	8	450	87	95	3.7
10	9	432	82	95	4.4
11	10	432	77	92	5.8
12	11	432	70	90	6.3
13	12	432	64	65	6.6
14	13	432	56	50	6.6
15	14	432	45	75	6.6

<sup>a</sup>Source: "Replacement Decisions for Commercial Beef Herds," Washington State Agricultural Experiment Station bulletin 736, 1971.

<sup>b</sup>Source: Rister, Edward and R. D. Kay, "The Effect of Capital Gain Income on Beef Cow Replacement Policy and Profit," unpublished manuscript.

From Table 1 we see that a herd of middle-aged cows is more productive than a herd of old cows. The producer must decide whether to maintain a herd at about the peak productive age to get maximum calf production per cow or to keep cows several years beyond their peak production period to spread the cost of acquiring replacements over many calves.

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## Best Replacement Age

Economic analysis suggests that the best time to replace a cow is after she has weaned between seven and eleven calves (Table 2). This is a wide range, largely because of differences in management practices, breeds and market systems. For simplicity, it was assumed that the size of the herd would remain constant in the future. Replacement heifers are obtained only when a cow reaches replacement age, dies or is culled earlier than planned because of health or fertility problems. For instance, if the cow fails to wean a calf, she is culled from the herd and a replacement is obtained, regardless of the cow's age at the time of her reproductive failure. Further, it was assumed that replacements are bred to calve at 24 months, a realistic expectation when a high level of management is attained. The longer the period of time after the heifer's second birthday before she calves, the higher the cost of the replacement that must be spread over future calves. This is because the replacement does not become a productive unit until she calves and the calf is sold.

Table 2. Value of a cow kept to various ages before replacement, two levels of productive performance.<sup>a</sup>

Replacement policy, age to replace cow	Calving percent 1	Value of cow from calving percent 1 discount rate = 10%	Calving percent 2	Value of cow from calving percent 2
<u>5</u>	95	\$ 554	90	\$-143
6	94	611	95	- 53
7	93	642	95	29
8	91	<u>650</u>	95	87
9	87	642	95	128
10	82	618	95	158
11	77	582	92	169
12	70	548	90	<u>172</u>
13	64	520	65	169
14	56	500	50	161
15	45	487	75	151

<sup>a</sup>The optimal replacement age is underlined.

The second set of calving percents used (Calving percent 2, Table 1) starts from a lower point (70 percent vs. 86 percent), rises much more rapidly and remains at the highest level longer than the first set of calving percents. The initial low values cause earnings in the early years to be low. The effects of early culling and discounting of later returns cause the value from the second set of calving percents to always be lower than the first set. The higher production in later years never offsets the lower production in early years. Nevertheless, the cow described by the second

set should be kept until she has weaned her eleventh calf, or when she is 12 years old.

## Cost and Return Considerations

The costs and returns from three classes of cattle must be considered in the replacement policy calculations. The most obvious is the feeder cattle price received for weaned steer and heifer calves. The price received for cull cows is also important since income from the sale of a cow when she has reached replacement age partially offsets the cost of acquiring her as a heifer.

Table 3. Prices used for various classes of cattle.<sup>a</sup>

Cattle class	Mean	Price level	
		High	Low
-----(\$ per cwt)-----			
Steer and heifer feeders, 200-500 lbs.	50	58	44
Replacement heifers, 200-500 lbs.	48	55	43
Slaughter heifers, 800-1100 lbs. good & choice	49	52	44
Utility cows	33	38	29

<sup>a</sup>Source: U.S.D.A., A.M.S., "Annual Livestock Detailed Quotations, San Antonio Market, 1955-74," unpublished data.

Cattle prices used in this publication are from the San Antonio Market (see Table 3). The mean price levels were adjusted from the 1955-1974 price data to represent "normal" long run expected prices when production cost levels in 1975 were considered. Of course, actual prices in 1975 were much lower than these levels. Since cattle prices tend to be cyclical, "high" and "low" prices were computed midway between the mean and the absolute high and low adjusted for the 20-year period. These computed prices were used in this study to determine the sensitivity of the replacement policy to different price levels.

Another cost that must be considered is that of a replacement heifer. Since the market for replacement heifers is generally not well defined (buyers of replacement heifers generally bid against buyers of feeder calves), the following method of estimating the cost of a replacement heifer is used. Begin with the value of a feeder heifer, add the cost of a ration adequate to raise the heifer to first calving, and then add appropriate variable and fixed costs. As an example, suppose heifers are weaned at 450 pounds and can be sold for \$48 per hundredweight. The purchase price of the replacement heifer (or income lost by not selling her) amounts to \$216.

Other costs such as forage, maintenance, etc. amount to \$132. These figures show that \$348 is the

estimated cost of adding a bred 2-year-old heifer to the cow herd (Table 4). In addition to her own direct expenses, the cow must recover this amount in order to break even in calf production.

*Table 4. Cost of a bred 2-year-old heifer.*

Income lost from sale of 450-pound heifer at \$48/cwt	\$216
Other costs	132
	\$348

The best replacement policy is determined in a manner very similar to that used in comparing the present value of various annuities. Briefly, an annuity is an investment which pays the holder a certain amount of money each year. In the present case, we are concerned with an investment in a beef cow that will pay the owner for the sale of calves. Unlike the annuity which will terminate after a number of years, the investment in cows is expected to continue in the future. When the current cow reaches replacement age, she is culled and a heifer is brought into her place. Also, in contrast to an annuity, which generally pays the same amount on the same date every year, the income from the investment in the cow is variable. It may be high in those years near the cow's peak producing age, when she has a larger probability of producing a calf and when weaned weights are relatively high, and it may be lower in other years. If she fails to produce a calf, the only income will be from her sale as a cull. If she dies there may be no income at all that year.

#### **Effect of Calving Percent on Best Replacement Age**

Two different sets of calving percent data were considered in order to demonstrate the effect that different percents have on replacement policy. Under the first set the optimal replacement policy calls for brood cows to be replaced after they have weaned their seventh calf, or when they are 8 years old. Replacing the cow a year earlier or later would reduce returns less than \$10.

The fact that a cow reaches peak production later under the second set of calving percents causes the value of the cow to always be lower than the first set. The higher production in later years never offsets the lower production in early years. Nevertheless, the cow described by the second set should be kept until she has weaned her eleventh calf, or when she is 12 years old. However, replacing her as an 11- or 13-year-old cow would reduce her value only \$3.

Alternative beef prices were evaluated in this study. However, each price change was treated as though it were a permanent change. The effect of

cyclical price fluctuations on optimal beef cow replacement is currently being researched at Texas A&M University, as are the effects of federal income tax regulations on beef cow replacement. The findings of these studies will be reported as they become available.

#### **Summary**

Beef cow replacement policy depends on the management practices used in individual herds.

In some herds a regular culling program will include open cows, slow breeders and dams of light calves. Other alternatives may be considered if this is in conflict with the individual owner's management program. It is suggested that individual herd records be used to help determine the best replacement program in an individual herd in order to increase profits.

After problem cows have been removed, attention should be given to the age for replacing remaining cows. The information presented in this publication, based on certain calving crop percent, mortality rates, weaning weights, costs and prices, indicates that an important factor in determining the best replacement age is the cow's expected calving percent in each year of her life. A pregnant cow in good health and with a strong record should not be culled. Using the indicated figures for weaning weights, calving percentage, mortality rates, costs and other prices for sale heifers involved in replacement, the best replacement age appears to be after the mother cow has weaned between seven and eleven calves.

It is important to manage the herd to obtain high calving percents. One heifer that has a higher initial expected calving percent and peaks at the same level as a second heifer may be worth several times as much in the herd.

Information in this fact sheet is adapted from "Determining Optimal Replacement Age of Beef Cows in the Presence of Stochastic Elements," Ernest Bentley, James R. Waters, and C. Richard Shumway, *Southern Journal of Agricultural Economics*, December 1976.

For further information on cost estimates, refer to "Estimates of Cow-Calf Production Cost (1976)," Tom Prater, Extension economist-management, The Texas A&M University System.

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