Understanding and Managing Costs in Beef Cow-Calf Herds[1]

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The beef industry continues to change is response to changing consumer demands and increasing competition from other protein sources. However, the foundation of a viable beef industry is effective resource management by cattle producers. Unlike most other agricultural enterprises, beef cow owners must manage their herds to make the most profit from the available resources while ensuring the long-term productivity of the those same resources. A key to long-term profitability in the cattle business is to understand and manage production cost. This paper will examine some of the largest cost factors that managers face and discuss ways to evaluate these costs to make better decisions when managing available resources.

We have been asked specifically to address fixed costs, labor costs, and ways to reduce total cow costs as well as discuss some economic principles underlying management decisions. Most of our analysis will be based on Iowa State University Beef Cow Business Records summary for 1997 and a long-term analysis of this record series for 1988-1994.

Understanding Beef Cow Herd Costs

Following Standardized Performance Analysis (SPA) guidelines, the costs are summarized by both financial and economic costs (Table 1). Financial costs match closely to cash flow and include expenditures for debt service and hired labor. Economic costs reflect the opportunity cost of inputs used and include a charge for invested capital rather than principle and interest payments and the value of family and operator labor.

The 1997 summary includes 45 herds that averaged 99 cows, but ranged in size from 22 to over 300 cows with most having fewer than 200 head. Average cost per cow in 1997 was $331.64 on a financial basis and $433.21 on an economic basis. The greatest single financial cost is feed cost followed by operating cost. Feed and operating costs are still the two largest economic costs, and family and operator labor, capital charges and depreciation charges are similar in magnitude to each other.

The standard deviation reflects the variation across herds and highlights the nature of the beef cow business and the importance of integrated resource management. One standard deviation represents approximately 34 percent of the observations on each side of the average. For example, approximately two-thirds of the herds have economic feed costs between $155.34 and $303.48 ($229.58 + or - $74.24) and one-sixth of the herds are lower and one-sixth are higher than this range.

Feed is the largest single cow cost category and can further be divided into grazed, harvested, and purchased feedstuffs. In Iowa, pasture accounts for 45 percent of the economic cost of production (Figure 1). Harvested forages, purchased feeds, and non-forage raised feeds (grains) account for 27, 16, and 11 percent of feed cost, respectively.

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Table 1. Iowa State University Extension Beef Cow Business Record, 1997: 45 herds, summary of financial and economic cost per cow in herd on January 1.

	Financial			Economic		
	Average	Std Dev	%	Average	Std Dev	%
Number of Cows in Herd	99	70		99	70	
Total Feed Cost ($)	$208.58	$75.11	63	$229.58	$74.24	53
Operating Cost ($)	72.19	31.76	22	72.19	31.76	17
Depreciation Cost ($)	37.51	40.20	11	37.51	40.20	9
Capital Charge ($)	8.25	13.33	2	45.00	21.75	10
Hired Labor ($)	5.12	10.81	2	5.12	10.81	1
Family & Operator Labor Charge ($)	xxxx	xxxx		43.81	28.19	10
Total Cost per Cow ($)	$331.64	$110.95	100	$433.21	$123.23	100

Another key distinction in cost is variable and fixed cost (Figure 2). Variable costs are those that vary with output such as purchased feed. Fixed costs are those costs that do not change as output changes, i.e., land, fences, equipment, and structures. In Iowa cow herds fixed cost represent 46 percent of financial and 62 percent of economic total cost.

These costs decrease on a per cow basis by increasing output per unit of input. Depending on the type of fixed cost, it may be possible to capture economies of scale by increasing herd size. For example, investment in working pens, stock trailers, tractors and equipment, calving sheds, etc. can be spread over more cows to reduce these costs on a per cow basis.

Depending on how your operation is structured, certain cost may be either fixed or variable. For example, if you own pasture land or are renting an entire parcel of land, the cost of that pasture is constant regardless of the number of cattle grazing it, and the pasture cost is a fixed cost. However, if you are renting pasture on an AUM basis, the cost of the pasture is a

Figure 1. Beef Cow-Calf Economic Feed Cost per Cow, Iowa 1997: Total Feed Cost per Cow $229.58

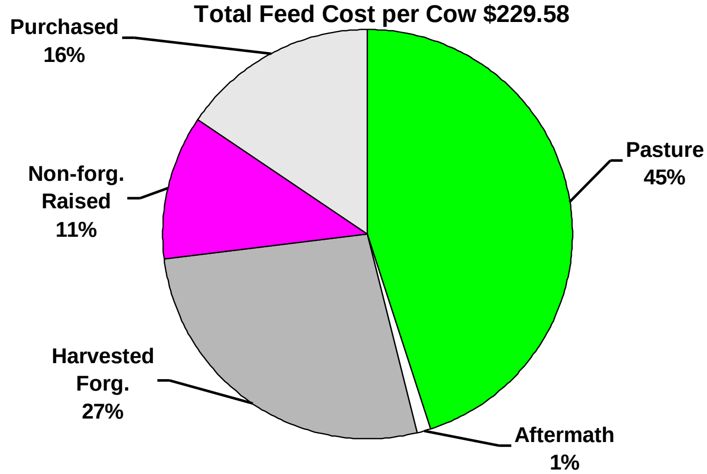
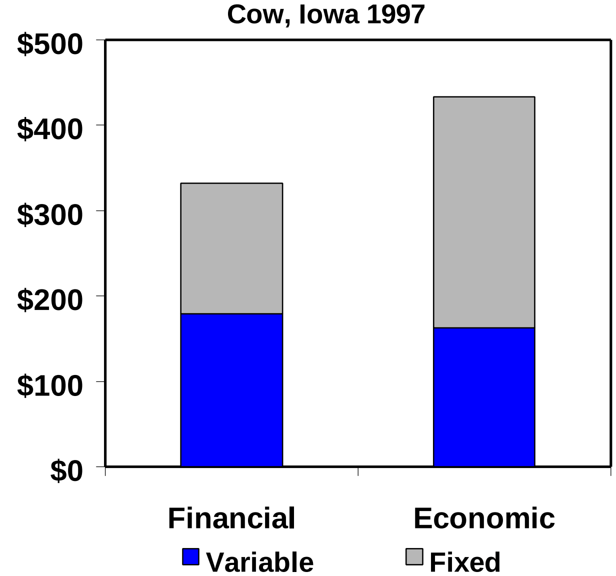


Figure 2. Beef Cow-Calf Cost per Cow, Iowa 1997

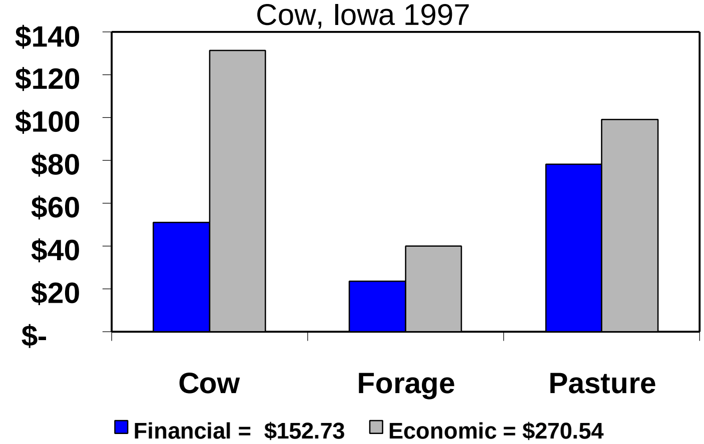


variable cost to the animal owner because the pasture cost changes with the number of animals. Labor is another cost that may be variable or fixed depending on the operation. If the amount of labor hired varies with the number of cattle raised, it is variable; if the hired labor or family living withdrawal is constant, regardless of the number of cows in the herd, it is a fixed cost. The analysis of the Iowa data in this paper will treat land as a fixed cost because land is owned and rented by the parcel. Likewise, most labor is a year-round expense or family withdrawal rather than a per cow cost.

In addition, some fixed cost can be managed differently from others. Breeding stock and land are fixed costs, but increasing herd size may not necessarily reduce these fixed costs as much as improved management can reduce them. If a given pasture is under-stocked, additional cows will reduce the fixed per acre cost per cow. However, for a given stocking rate, increasing herd size will not reduce fixed cost, but rather increase land needs. Increasing grazing efficiency will reduce land fixed cost by carrying more cows on the same amount of land. Likewise, bull cost can be reduced by better bull utilization.

As we discuss fixed cost, it is important to identify the source of the fixed cost before one can begin to manage to reduce these costs. Figure 3 shows that fixed cost per cow is the largest source of economic fixed costs, while pasture is the largest source of financial fixed cost.

Figure 3. Distribution of Fixed Cost per Cow, Iowa 1997



As noted above, the economies of scale may not be as important in beef cow herds as is in other enterprises that have highly specialized, capital intensive investments that can be used more efficiently by increasing throughput. Examples include feedlots, feed mills, and confinement hog facilities. Table 2 shows the fixed costs by size of cow herd for Iowa herds in 1997. First, note that there is little variation across size considering the amount of variation across herds in general. However, there appears to be a “wave” effect with lower and similar fixed costs for herds with 61-80 and 151-250 cows compared with other sized herds. The wave effect may indicate that there are certain herd sizes in the Iowa data that match resources more closely than other sizes. With the other higher costs herds, one or more of the inputs may not match the other available resources and costs increase. Also note that the low cost size of operation for one enterprise (cow herd) may not be the low cost operation for another enterprise (harvested forages).

There is also a slight trend to lower fixed cost in the larger herds. It is difficult to draw many conclusions with the limited number of herds and the limited range in size of herds. The longer-term study discussed later found a small (-$.10/head lower cost for each additional cow in the herd), but statistically significant decrease in total cost of production associated with larger herds.

Table 2. Average fixed cost by enterprise and size of operation ($ per cow).

# of	# of	Financial				Economic			
Cows	Herds	Cows	Forage	Pasture	Average	Cows	Forage	Pasture	Average
< 40	6	94.07	65.49	95.76	239.37	194.90	77.63	107.28	379.82
41-60	10	55.18	31.49	66.34	153.01	153.64	60.83	92.69	307.17
61-80	5	44.81	46.51	78.25	169.57	102.76	46.33	77.47	226.56
81-100	7	86.07	51.69	88.13	211.12	162.28	57.90	92.50	296.15
101-150	7	112.56	12.49	52.46	173.95	183.94	24.32	64.08	265.40
151-250	6	45.32	21.37	62.62	125.74	92.41	33.51	78.01	198.35
250+	3	83.31	6.43	27.77	87.59	137.25	35.96	84.78	246.01
Share of Total (%)		43	20	41	100	54	18	31	100

The cow economic fixed cost is dominated by operator inputs of labor and capital charge (Table 3). The largest financial fixed cost is depreciation. There is relatively little hired labor in these herds and the low non-real estate principal and interest (capital charge) suggest that there is little debt on these cows. Management strategies that reduce these costs must increase labor efficiency and reduce the investment in the cow herd. Possible strategies are addressed in greater detail later in the paper.

Land cost is the single largest fixed cost in pasture and harvested forage production. Strategies to reduce these costs should focus on productivity of the land as well as the annual cost of the land.

Table 3. Distribution of fixed cost per cow ($).

	Cow		Pasture		Harvested	
	Financial	Economic	Financial	Economic	Financial	Economic
Land			73.45	87.56	16.22	23.18
Depreciation	37.51	37.51	2.37	2.42	5.28	5.28
Capital Charge[1]	8.25	45.00	2.36		2.17	
Labor	5.12	48.93		9.18		11.47
Total	$50.87	$131.44	$78.18	$99.16	$23.67	$39.93

1/ Non-real estate

Fixed costs represent 70 and 72 percent, respectively, of the financial and economic cost of pasture identified in Table 3. Fixed costs are 53 and 66 percent, respectively, of the financial and economic cost of the harvested forages in Iowa.

Longer-Term Analysis

The Iowa Beef Cow Business Records were examined over a seven-year period, 1988-1994, to compare production cost across herds and over time (Lawrence et al. 1997). Only herds that were in the record system for at least three consecutive yeas were considered in the analysis. Prior to

1995, the Iowa Beef Cow Business Records focused only on economic cost and were not directly SPA compatible. However, they provided producers a useful process for quantifying cost of production and decision-making, and provided researchers and educators data to evaluate.

A multi-year cross-sectional regression analysis was used to model the data (Table 4). There were 420 observations, with herds counted as separate observations if they were in the data set multiple years. The model hypothesized that annual cow cost is a function of the amount of harvested forage fed, number of pasture days, operating cost, fixed costs, hours of labor, herd size, percent calf crop, and weaning weight. A combination of variables that were both quantities and costs were used for statistical purposes. Statistical problems arise if the estimated model represents an accounting identity of quantity times price. The model also included individual variables for six years to determine if costs differ from year to year for reasons other than those listed. The first year, 1988, was the base with which others were compared and was excluded from the equation.

Table 4. Regression analysis of annual beef cow cost, multiple farms in Iowa Beef Cow Business Records, 1988-1994.

Variable	Coefficient	t-ratio[a]
Constant	54.19	1.89
Harvested forages	.007	8.76
Pasture days	.115	2.23
Operating cost	1.17	18.64
Fixed costs	1.13	13.88
Labor hours	5.40	9.73
Herd size	-.10	1.93
Wean weight	.07	1.94
Percent calf crop	12.88	.68
1989	-2.84	.28
1990	17.32	1.98
1991	32.39	3.19
1992	36.24	3.03
1993	21.38	1.72
1994	40.45	2.73
Observations	420	
Adjusted r^2	.80	
F value	123.08	

a t-ratio larger than 1.96 indicates statistical significance at $p<.05$

The model explained 80 percent of the variation in annual cow cost across herd and years. The coefficients represent the change in annual cow cost for a one-unit change in the variable. For example, increasing the amount of harvested forage one pound resulted in cost increasing $.007 per cow. Increasing pasture days by one increased cost $.115 per cow. The relationship between harvested forage and pasture days is 16.4 : 1. It is doubtful that a producer can replace a pasture day with 16.4 pounds of harvested forage. Thus, extending the grazing season is still a less costly option.

Note that a $1 increase in operating and fixed cost resulted in a larger than $1 increase in total annual cost, suggesting that additional costs unaccounted for in the equation are positively correlated with these costs. As operating and fixed costs increase, other costs increase as well. Herd size and percent calf crop are significant at approximately the 94 percent confidence level. For each additional cow in the herd, annual cost per cow decreases $.10. Each additional pound in weaning weight is associated with a $.07 per cow higher cost of production. A change in the percent calf crop was not associated with a change in cost as the coefficient was not significant. Four of the years did have higher cost than did 1988, even after accounting for the variables mentioned. This cost difference may be associated with differences in feed or pasture rent prices relative to 1988, as the quantity is included in the model.

Diminishing Returns

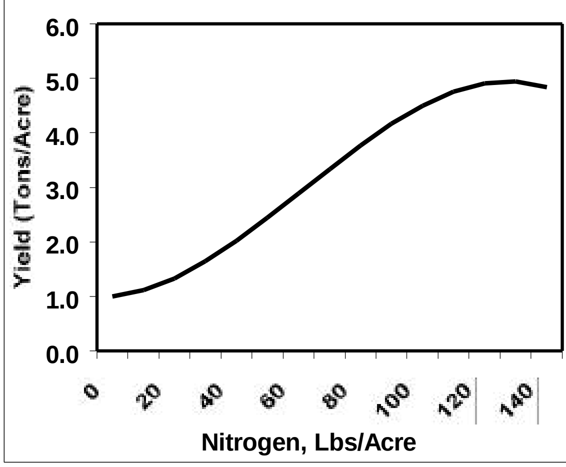
The principle of diminishing returns is fairly easy to understand. Generally stated, it says that at some point, each additional unit of input will produce less and less output. More specifically, the principle states that when one or more factors of production are held constant, the amount added to output will eventually decline by using an increasing amount of a second input. *The important management consideration is to know how to determine the most profitable level of the second input to use.*

Consider the following example of hay production (Table 4). The fixed input is an acre of land, the second input is nitrogen fertilizer, and the output is hay yield measured in tons per acre. In this example, yield is one ton per acre without fertilizer and production levels off at 4.95 tons per acre before starting to decrease. Diminishing marginal productivity (the change in output divided by the change in input) begins early. Ten pounds of fertilizer from 60-70 pounds increases yield by .45 tons, but ten pounds from 70-80 pounds only increases yields .44 tons, and 80-90 pounds results in a yield increase of .39 tons, etc. Is 70 pounds the most profitable level?

Table 5. Example of diminishingrReturns, hay yield and nitrogen fertilizer.

Nitrogen Lbs/A	Hay Ton/A	Cost of Next Input @ $.20/lbs	Value of Next Output @ $50/ton
0	1.00		
10	1.11	2.00	5.58
20	1.33	2.00	11.03
30	1.64	2.00	15.43
40	2.02	2.00	18.78
50	2.44	2.00	21.08
60	2.88	2.00	22.33
70	3.33	2.00	22.53
80	3.77	2.00	21.68
90	4.16	2.00	19.78
100	4.50	2.00	16.83
110	4.76	2.00	12.83
120	4.91	2.00	7.78
130	4.95	2.00	1.68
140	4.84	2.00	-5.47

Figure 4. Example of Diminishing Returns on Hay Yield and Fertilizer



The profit-maximizing rule for input use is to increase the use of the input until the last unit just pays for itself. In this example, fertilizer costs $.20/pound and hay is valued at $50/ton. Increasing fertilizer from 110 to 120 pounds costs $2.00/ acre. Output increased .15/ton and at $50/ton, the additional revenue was worth $7.78. However, increasing fertilizer to 130 pounds costs an additional $2.00, but income increased only $1.68. The last $2 did not pay for itself and should not have been added even though yield did increase .04 ton. Notice that this rule takes into account the price of the input, the marginal productivity of the input (how much yield changed), and the selling price of the output (.04 ton at $60/ton = $2.40 and pays for the additional $2 of fertilizer).

The principle of diminishing returns applies throughout beef production. For example, consider increasing the quantity and/or quality of winter feeding of beef cows to increase the pounds of calves sold. The fixed input is the cow herd, the variable input is feed, and the output or yield is the pounds of calves sold. At very low feed levels or quality, conception rates may suffer, or calves may be weak or have low weaning weights. As feed quantity or quality increases, the number and weight of calves also increases to the genetic potential of the herd. At extremely high feeding rates, cows may be fat enough that reproductive efficiency and milk production are reduced, resulting in reduced output. The profitable level of feeding is where the next unit of feed equals the income from the additional calf weight sold. Stocking rates are another example, with land as the fixed input, cattle as the variable, and weight gain being the output. Increased stocking density will increase production up to a point and then decline, as maintenance needs of the cattle are more than the available nutrition.

While the principle of diminishing returns is simple to grasp, it can be complicated to employ. First, seldom are there only two inputs—one fixed and one variable. Second, producers typically do not know the selling price at the time they are making the input decision. Third, beef production is a biological production process dependent on several factors from animal health to weather. These complications *increase* the need for appropriate management rather than *discount* it.

The procedure illustrated above is the same for multiple variable inputs as it is for one input. The manager considers the possible input combinations by holding all inputs except one fixed, and varying it to examine the effect on output. Next, a second input is varied while holding all others including the first input constant, and so on. The decision rule still holds. The most profitable combination of inputs is where the increase in the cost of those inputs is equal to the increase in the income they produce. Consider preparing a diet for finishing steers and varying the percentage of forage and concentrate in the diet until the additional cost of adding more concentrate is just equal to the value of the additional pounds gained.

Risk in both selling price and production is part and parcel of the cattle business. When determining the profit-maximizing level of an input to use, managers must estimate the expected selling price of the output. Price forecasts from land grant universities, private firms, or based on the futures market provide information to help managers make their own price estimates. Likewise, managers must factor in estimates of production risk when choosing input usage. Whereas the hay yield example appears to be very exact, the real world is seldom that simple. While managers can rarely predict exactly what productivity and price will be, they can, with planning, get in the right ballpark. For example, the value of the additional pounds of calves sold is different when we are at the bottom of the price cycle rather than the top. The important thing for managers to recognize is that their expectations for productivity and prices should be realistic and that these variables, which are often beyond one's control, do impact the profit maximizing decision.

Factors to Lower Cow Costs

The task of the manager is to manage the specific resources available to an operation to generate the largest sustainable return. The analysis discussed here and these results are based on Iowa beef cow herds and Iowa conditions. Most of these herds are part of a larger diversified farming operation on land that is owned or rented by the acre. The results and appropriate strategies may differ in other geographical regions; however, some general themes are likely to hold across most operations.

First, feed cost is the largest single cost factor to animal agriculture, and beef cow herds are no exception. Feed represents over half of the total economic cost, and in the Iowa herds, pasture and aftermath grazing accounted for just less than half of the feed bill. Harvested forages made up approximately a quarter of the feed cost, with the rest being purchased feeds and grain. The long-term analysis indicated that pasture days were less costly than harvested forages. An obvious strategy to cut cost is to reduce harvested forages either by less wastage or by extending the grazing season.

The largest portion of pasture and harvested forage cost is land cost. If the land is owned or rented on a parcel basis (i.e., acre), the strategy to cut cost is to increase productivity. Rotational grazing can increase carrying capacity of pastures. Fertilizer and weed control can increase productivity of pasture and hay ground. Strategies to reduce the price of the land will also reduce costs whether by the acre or the head. Possible strategies include dual purposes for the land, such as using it for recreation, either through leasing hunting rights or by partnering with a landowner who bought the land for purposes other than beef production.

The second largest economic cow cost is fixed cost of depreciation and charges to invested capital. From the data, it is not clear if these costs are expenses for structures and equipment, or for breeding stock. If the expenses are for equipment and structures, then the cost per cow can be lowered by spreading the annual cost over more cows. If the capital invested and depreciation claimed is on cows and bulls, then a larger herd won't help. There are strategies for reducing investment in cows (Lawrence and Wang, 1995). Using bulls on more cows by having a spring and a fall calving herd may reduce the investment in genetics. This strategy can work for producers in different geographic regions to share bulls, i.e., northern spring calving herds share bulls with southern fall calving herds.

The third largest expense is operating costs. These costs are dependent on the amount of input used and the price of the input. Prudent use of an input is always advised; however, the penny-wise, pound-foolish rule applies when it comes to expenses like vaccines and parasite control, ear tags, etc.

The final general cost area is labor cost representing 11 percent of economic cost in the 1997 Iowa records. The majority of this expense is for family and operator labor in the herds examined. In this case and possibly for hired labor, this expense is a fixed cost that can be reduced on a per cow basis by spreading it over more cows. However, this strategy implies that the available supply of labor can handle more cows.

Perhaps more important than reducing labor cost is recognizing the opportunity cost of the labor spent on the cow herd. The opportunity cost is the return that could have been earned if that input had been used in another activity. Most people view the opportunity cost of labor as the going wage rate at a job in town. *For resource managers, the opportunity cost of laboring is time taken away from managing*. Hours spent harvesting, storing, and feeding forages is time that is not spent studying production records, reading about new research or management practices, attending educational seminars, and interacting with peers.

Harvested forages require additional labor, equipment, and facilities for harvesting, storing and feeding, and are more costly than pasture days. Reducing harvested forages may reduce costs, but the equipment for handling harvested forages is still needed and is a fixed cost. Completely eliminating harvested forage would reduce investment and labor of feeding and hauling manure. Depending on how the cows are managed, herd health may improve by not having the cows gathered in the feeding area. The key to a “no hay system” is managing forages to extend the grazing season and managing risk such as heavy snow cover by having a reserve feed supply for the few days that grazing is impractical

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