

Impact of Cow Size on Economic Profitability in Cow-Calf and Feedlot Production Systems

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Summary with Implications

This study retrospectively evaluated the effect of cow size on profitability in the cow-calf segment and retained ownership of steer calves in the feedlot. Data were collected between 2005 to 2017 from the cowherd at Gudmundsen Sandhills Laboratory. From these data, two separate herds were assumed, one consisting of small-sized (1,000 lb) cows and another consisting of large-sized cows (1,220 lb) for the GSL cowherd. Larger cows weaned larger calves and produced heavier carcass weights of steers at slaughter. However, smaller cows generated more total pounds of output throughout the entire production system based on more calves retained in feedlots and more cull cows. Regardless of the pricing method used (i.e., live, carcass, grid), cow-calf producers in the Nebraska Sandhills maximized the highest amount of profit by selecting smaller cows.

Introduction

Cow-calf producers have placed heavy selection pressure on growth traits to increase weaning and yearling weights to increase revenue. The influence of cow size on calf weaning weights is known to vary depending on the production environment, management decisions, breed, and forage resources. Previous research has suggested smaller-framed cows that mature at an earlier age and lighter body weight may be more favorable in limited-resource environments. Increasing cow size increases forage

intake requirements, which decreases the number of livestock that can be maintained on a fixed land base. This study hypothesized that increased cow size in a semi-arid environment could decrease the economic net returns of a cow-calf operation that sells non-replacement heifers at weaning and retains ownership of all steers through the finishing phase. Therefore, the objective of this research was to quantify the net return differences between a cow-calf operation that used either small or large mature weight cows.

Procedure

A hypothetical partial budget was built to evaluate the producer net-return impacts of increasing cow size using data generated from the Gudmundsen Sandhills Laboratory between 2005 to 2017. Performance data were previously reported in the 2019 *Nebraska Beef Cattle Report* (pp. 18–20). From these data, two separate herds were assumed, one consisting of small-sized (1,000 lb.) cows and the other consisting of large-sized cows (1,220 lb.) from the GSL cowherd. A hypothetical partial budget compared small and large cows on a 5,000-acre ranch in the Nebraska Sandhills providing 0.6 AUM/acre for annual grazing. Thus, a total of 156 and 136 cow-calf pairs could be maintained in the assumed ranch by small and large-sized cow herds, respectively. The total number of cows were derived to maximize the number of cows with a given land and resource. The sex of calf distribution of the calf crop was estimated at 50% for each sex. A 15% heifer replacement rate was assumed to maintain herd numbers.

A representative Nebraska Sandhills cow-calf producer was assumed to be trying to maximize profit by choosing dam size subject to fixed production costs and input and output price uncertainty. We assume that the cow-calf producer has two options: they can either 1) sell all calves at weaning or 2) sell all non-replacement heifers at

weaning and retain steer calves into feedlots. Revenue for the cow-calf operation is generated by selling weaned calves and cull cows. Primary costs are pasture rent, other feed costs, and other cow costs. Calf prices were estimated using an average price for steers and heifers over a 10-yr period combined from auctions in Nebraska. Pasture lease rates were obtained from the University of Nebraska Farm Real Estate Market Survey for the North region of Nebraska on average quality pastures and averaged over 5 yr (\$24.40/acre). A bull-to-cow ratio of 1:25 was assumed for both herds and bull purchase price was assumed at \$3,000/bull. All assumptions used for the hypothetical operation are listed in Table 1.

The producer has the option to retain ownership of unsold weaned calves into the feedlot and sell fat cattle either live or on a grid. Retained calves in the feedlot are subject to daily per head yardage costs, feed costs, and other miscellaneous costs. Thus, operation net profit is the combination of both cow-calf and feedlot retention decisions and written as:

$$\pi_{(\text{dam weight})} = \sum_{p=1}^P (\sum_{k=1}^K TR_k^p - TC_k^p + \sum_{m=1}^M TR_m^p - TC_m^p)$$

where p is the number of operational phases where $P=\{\text{cow-calf, feedlot}\}$, TR_k^p and TR_m^p is total revenue associated with output k and output m in production phase cow-calf and feedlot respectively, TC_k^p and TC_m^p is the total cost associated with output k and output m in production phase cow-calf and feedlot respectively, $TR_k^p - TC_k^p$ is net profit from cow-calf production for k outputs where $K=\{\text{heifers, cull cows}\}$, and $TR_m^p - TC_m^p$ is the net profit from feedlot production for outputs m where $M=\{\text{steers}\}$. The analysis assumed all heifers not retained are sold in the cash market at weaning, 10% cow culling rate in herds with smaller cows, and 4% cow culling rate in herds with larger cows, which was calculated by pregnancy rates of those herds. All steer calves are assumed to be weaned and retained into feedlots and sold as fat cattle.

Table 1. Total output (lb) estimated using small (1,000 lb) and large (1220 lb) cows using recommended stocking rates for a 5,000-acre ranch in the Nebraska Sandhills

Measurement	Small Cow	Large Cow	Source
Cow-calf production			
<i>Calf-crop</i>			
Cow-calf pairs, n	156	136	Stocking density is given at 5,000 acre
Cow pregnancy rate, %	90	96	2019 Nebraska Beef Cattle Report, pp. 18–20
Total calves, n	156	136	Assumed from stocking density
Heifer retention rate, %	15	15	Average retention rate
Heifers sold at weaning	55	58	N heifers × retention rate
Heifer weaning weight, lb.	449	480	2019 Nebraska Beef Cattle Report, pp. 18–20
Steers to retain into a feedlot, n	78	68	Half of the calf crop
Steer weaning weight, lb	475	508	2019 Nebraska Beef Cattle Report, pp. 18–20
<i>Total heifer output, lb</i>	24,684	27,817	N heifers sold × heifer weaning weight
<i>Total steer output, lb</i>	37,066	34,558	N steers sold × steer weaning weight
<i>Cull cows</i>			
Cull cow rate, %	10	4	% open cows
Cull cows sold	16	5	Cow-calf pairs × cull cow rate
Cull cow weight, lb.	1,000	1,220	Assumed dam weight in each herd
<i>Total cull cow output, lb.</i>	15,981	5,995	Cull cows sold × cull weight
<i>Total cow-calf output, lb.</i>	77,730	68,369	steer output + heifer output + cull cow output
<i>Total cow-calf output sold¹, lb.</i>	40,665	33,812	heifer output + cull cow output
Feedlot production			
<i>Retaining ownership¹</i>			
Steer HCW, lb.	961	977	2019 Nebraska Beef Cattle Report, pp. 18–20
<i>Total feedlot output, lb</i>	74,989	66,422	HCW × N steers sold

¹ Assumes all steers progeny are held for retained ownership into feedlots

Results

All findings and calculations are displayed in Table 2. When considering the total offspring BW and cull cow BW, the total output at weaning was 9,361 lb greater in the small-sized cow herd compared with the large-sized cow herd. If steer calves were retained post-weaning through the finishing phase, the number of steers produced in the small-sized cow herd produced an additional 8,567 lb of steer HCW compared with the large-size cowherd. The increase in total pounds produced at weaning and after the feedlot phase is driven by increased carrying capacity in smaller-sized cows resulting in more weaned calves.

Herds with smaller cows produce more calves that are lighter resulting in lower gross revenue from heifer sales compared to herds with larger cows. In this data, herds

with smaller cows cull a larger share of the herd each year resulting in \$6,843 more cull cow gross revenue. Total costs to run a smaller cow were larger due to added fixed costs of running another cow-calf pair (i.e., veterinary costs, labor, interest etc.). If only heifers and cull cows were sold in the cash market, smaller cows were relatively more profitable than larger cows, on a per cow basis. Cow-calf operators would lose approximately \$811 per small cow and \$897 per large cow. If steers were also sold in the cash market at weaning, then cow-calf operators would lose approximately \$393 per small cow and \$468 per large cow. Total costs for only the cow-calf production segment were larger for herds with smaller cows, but those costs were spread across more cow-calf pairs.

Total feedlot costs were larger for herds

with smaller cows due to more days on feed and more steers being finished. Grid pricing captures the relative carcass performance of each finished steer by assigning premiums and discounts to a set base (dressed wt.) price. If a cow-calf producer were to sell on the grid, the net profit would be approximately \$1,196 per steer for steers from smaller cows and \$1,229 from larger cows. More steers were finished from herds that have smaller cows. Overall, the net profit difference between herds with small and large cows was \$9,720 under grid pricing. Finished cattle in Nebraska are generally sold either on a negotiated cash live weight basis or formula/grid dressed basis. If finished steers were sold on a live weight basis then the overall profit would be lower regardless of cow size. The overall net profit

Table 2. Partial budget analysis used to evaluate net revenue generated from small (1,000 lb) and large (1,220 lb) cows using recommended stocking rates in the Nebraska Sandhills

Measurement	Small Cow	Large Cow	Source
Cow-calf production			
<i>Revenue</i>			
Total heifer output, lb	24,684	27,817	Table 1
Heifer cash price ¹ , \$/lb	1.68	1.61	Average NE prices from 2005–2017, LMIC (2020)
<i>Total heifer revenue, \$</i>	41,556	44,879	Heifer output × heifer price
Cull cow output, lb	15,981	5,995	Table 1
Cull cow price, \$/lb	0.69	0.70	Average cull cow prices from 2005–2017, LMIC (2020)
<i>Total cull cow revenue, \$</i>	11,027	4,184	Cull cow output × cull cow price
<i>Total cow-calf revenue, \$</i>	52,584	49,063	Heifer revenue + cow-calf revenue
<i>Costs</i>			
Number of bulls, n	6	5	~25:1 cow:bull ratio
Price per bull, \$	3,000	3,000	The average price paid for bulls at GSL
<i>Total bull cost, \$</i>	18,000	15,000	N bulls × price per bull
Pasture ³ , \$/acre	24.40	24.40	Nebraska Farm Real Estate Reports
Pasture, acre	5,000	5,000	Average ranch size in Nebraska
<i>Total grazing/feed cost, \$</i>	121,967	121,967	Pasture land × rental rate
Misc. cow costs, \$/cow	251	251	Total cow costs per year—feed & pasture costs, FINBIN (2020)
<i>Total misc. costs, \$</i>	39,156	34,136	Cow-calf pairs × misc.cow costs
<i>Total cow-calf costs, \$</i>	179,123	171,103	Bull cost + grazing cost + misc. cost
<i>Net profit cow-calf production</i>			
Profit, \$	-126,539	-122,040	Cow-calf revenue—cow-calf costs
Profit, \$/cow	-811.15	-897.35	Profit/cow-calf pair
Feedlot production			
<i>Revenue</i>			
HCW, lb	961	977	Table 1
YG, 1–5	2.800	2.800	2019 Nebraska Beef Cattle Report, pp. 18–20
Marbling	500.230	500.350	2019 Nebraska Beef Cattle Report, pp. 18–20
QG	Choice	Choice	2019 Nebraska Beef Cattle Report, pp. 18–20
Grid Premiums, \$/lb	0.022	0.022	Average premiums from 2005–2017, LMIC (2020)
Grid Discounts, \$/lb	0.002	0.002	Average discounts from 2005–2017, LMIC (2020)
Price dressed wt., \$/lb	1.769	1.769	Average dressed wt. price from 2005–2017, LMIC (2020)
Price live wt., \$/lb	1.116	1.116	Average live wt. price from 2005–2017, LMIC (2020)
<i>Total steer revenue (grid), \$</i>	134,114.28	118,793.00	(Price dressed + Premiums-Discounts) × HCW × N Steers
<i>Total steer revenue (live wt.), \$</i>	114,234.37	101,184.19	Price live × HCW × 1.37 × N steers

difference between herds with small and large cows was \$7,449.

Total operational profit is obtained by combining net profit from the cow-calf and feedlot operation, either live or grid. Regardless of the pricing method used, cow-calf producers maximize the highest amount of profit by selecting smaller cows. Overall net profit for a cow-calf producer

using grid (live) pricing was -\$340 for operations with smaller cows and -\$412 for operations with larger cows.

Conclusion

Cow size can have a large impact on cow-calf productivity and profitability from weaning throughout the finishing phase.

The increase in total pounds produced at weaning and after the feedlot phase with the smaller-sized cowherd is driven by increased carrying capacity, which reflects forage intake differences. Along with decreased total pounds produced with larger cows, net returns declined in both the cow-calf and feedlot sectors of progeny from larger cows. While the cost and revenue

Table 2. Continued

Measurement	Small Cow	Large Cow	Source
<i>Costs</i>			
Yardage costs, \$/hd/d	0.5	0.5	The industry average in Nebraska
Days on feed, d	240	237	(HCW×1.37-Steer weaning weight) / average daily gain
<i>Total yardage costs, \$</i>	9360	8058	N steers × DOF× yardage cost
Average daily gain, lb/d	3.612	3.612	2019 Nebraska Beef Cattle Report, pp. 18–20
Feed conversion, lb of feed: lb of gain	6.0	6.0	Industry Average in Nebraska
Feed intake, lb/hd	5,201.88	5,150.82	Feed conversion× average daily gain× days on feed
Ration costs, \$/lb	0.08	0.08	Industry Average in Nebraska
<i>Total feed costs, \$</i>	30,494.88	26,325.49	Feed intake× ration cost× N steers
Misc. costs, \$/hd/day	0.05	0.05	Accounts for vet costs, labor, interest, etc., (Expert opinion)
<i>Total misc. costs, \$</i>	936.00	805.80	Misc.costs × N steers
<i>Total feedlot costs, \$</i>	40,790.88	35,189.29	Yardage cost + feed cost + misc. cost
<i>Net profit feedlot production</i>			
Profit (live), \$	73,443.49	65,994.90	Total steer revenue (live)—total feedlot costs
Profit (live), \$/hd.	941.58	970.51	Profit (live) / N steers
Profit (grid), \$	93,323.40	83,603.71	Total steer revenue (grid)—total feedlot costs
Profit (grid), \$/hd.	1,196.45	1,229.47	Profit (grid) / N steers
Operational Net Profit			
Net profit (live), \$	-53,095.48	-56,044.99	Cow-calf net profit + feedlot net profit (live)
Net profit (live), \$/cow	-340.36	-412.10	(Net profit (live)) / cow-calf pairs
Net profit (grid), \$	-33,215.58	-38,436.17	Cow-calf net profit + feedlot net profit (grid)
Net profit (grid), \$/cow	-212.92	-282.62	(Net profit (grid)) / cow-calf pairs
Net profit (no feedlot), \$	-61,393.10	-63,656.88	Cow-calf net profit + (N steers × weaning weight × 3.86)
Net profit (no feedlot), \$/cow	-393.55	-468.07	Net profit (no feedlot) / cow-calf pairs

estimates are specific to the timeframe and location used in this study, producers can use the framework and operational-specific costs to determine the benefits or drawbacks of using smaller-framed cows. The tradeoff in production parameters between cow sizes should be evaluated in a wide variety of production segments and environments within beef production to optimize net returns to cow-calf operations.

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