Improving the Competitiveness of Beef Production in the Northern Contiguous United States and Canada

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Abstract

Beef cow-calf operations in many northerly regions of North America traditionally calve in the winter (February-March), feed stored feeds in confinement from October through mid-May, and sell offspring as weaned calves. We investigated the alternative management practices of calving in summer (June-July), extending the grazing season into the autumn using stockpiled pasture, and selling offspring as yearlings, feeders or heavy feeders, and compared them with the traditional practices for cost-effectiveness and profitability. Our findings indicated that it was unequivocally more profitable to extend the grazing season into the fall, rather than feed in confinement, because of lower costs of pasture feeding. Summer calving was more cost-effective than winter calving because of savings in bedding, labor, veterinary treatments, and barn amortization, but generated lower revenues and was less profitable than traditional winter calving when offspring were sold as weaned calves. When offspring were retained to heavier marketing weights, summer calving in general became more profitable than winter calving, but only for the case of confinement feeding. Retaining offspring to higher marketing weights did not generally pay. For winter calving, under either confinement feeding or extended fall grazing, it was more profitable to sell offspring as weaned calves. For summer calving with confinement feeding, selling offspring as feeders was "most profitable" (i.e. generated the least net loss), but with extended fall grazing, selling offspring as weaned calves was most profitable. The most profitable combination across all three sets of management practices was winter calving with extended fall grazing with offspring sold as weaned calves.

Problems for North American Beef Producers

The beef production industry in North America is unlikely to benefit from any market price increases for the foreseeable future. On the contrary, real (inflation-adjusted) prices are likely to decline further in the face of greater competition from other meats and from low-cost countries such as Brazil and New Zealand as international trading becomes less restricted. This behooves North American beef producers to reduce production costs in order to remain competitive. Two possibilities for cost reductions present themselves. One is through technological progress, such as genetic engineering, embryo transplants, breeding synchronization, etc. The other is through finding more productive and efficient management practices, such as increasing calving rates, reducing the costs of stored feeds, labor and other inputs, or obtaining added value by marketing progeny at higher liveweights. This study focused on the second of these two possibilities, and in particular on examining combinations of management practices that offer alternatives to traditional production procedures.

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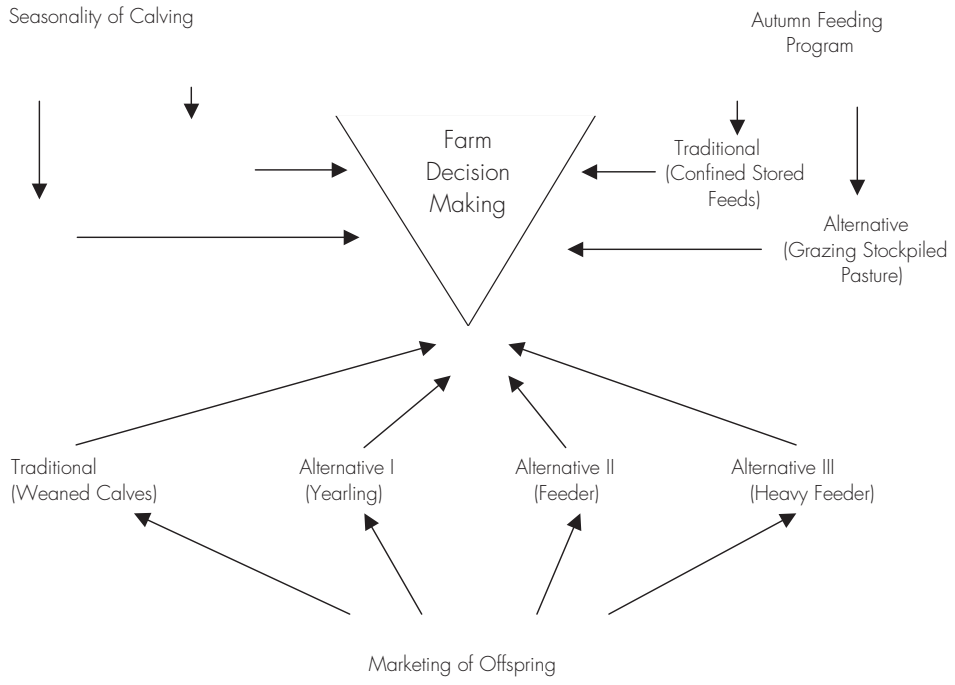
Traditionally, in northern regions of North America, beef cow-calf operators have bred their cows for calving in winter in confinement, grazed their herds from mid-May to mid-October, and sold their progeny as weaned calves. Previous research has indicated the potential for alternative management practices to improve beef cow-calf enterprise profitability. For example, summer calving has been shown to reduce feed, labor and health treatment costs, and to improve calving rates compared with winter calving in the U.S. Great Plains (Lardy et al. 1998a), in Alberta (Alberta Agriculture, 1998), and in Ontario (Hamilton, 1996; Hamilton and Giessen, 1997). Extending the grazing season into the late fall using stockpiled pasture was found to reduce feed costs over traditional confinement practices in the U.S. Great Plains (Adams, et al., 1994), in the U.S. Mid-West (Olson, 1997; Hitz and Russel, 1998), and in Ontario (Buchanan-Smith, et al., 1998; Wand et al., 1998). Retaining weaned calves for marketing at higher liveweights has been revealed to be profitable in the U.S. Great Plains (Adams et al., 1994; Lardy et al., 1998b) and in Ontario (Stonehouse, 1983; Stonehouse et al., 1992).

However, comparisons of combinations of production practices have not been conducted so far. This poses a decision problem for beef farmers, as depicted in Figure 1. The objective of this study was to compare various combinations of traditional with alternative management practices for a) seasonality of calving (winter vs. summer); b) fall feeding (stored feeds in confinement vs. extended grazing on stockpiled pasture); and c) progeny retention (to yearling, feeder or heavy feeder status vs. disposal as weaned calves). Sixteen possible combinations of practices were then set up for comparison.

Materials and Methods

The original intention was to combine data for both traditional and alternative management practices from primary (commercial farm) and secondary (research station and publication) sources. However, very few farmers were found to be using the alternative management practices, especially in combination with one another, so that data for both traditional and alternative practices were obtained from University of Guelph research station experiments. Where possible, these data were supplemented by those from commercial farms.

Figure 1: Traditional and alternative management practices for beef cow-calf enterprises.



For seasonality of calving, bio-physical data were collected for five years from a 150-cow herd at the New Liskeard Agricultural Research Station, where the winter-calving group (traditional) was calved February - April. in naturally ventilated barns, while the summer-calving group (alternative) was calved on pasture June - August. Both groups were bred to the same sires and received the same general husbandry including health and production management such as castration and dehorning. For both confinement and extended grazing options, the emphasis was on extensive, low-cost feeding systems. Medium-quality hay formed the core of the confinement program, with minimal concentrate feed offered, while no supplemental concentrate feed was offered during fall extended grazing. Data regarding both fall stockpile grazing and confinement feeding were collected for three years from the New Liskeard herd. Data on progeny retention options were collected from progeny from this herd which were managed at the Elora Beef Research Station. In each case, cattle were blocked for appropriate characteristics such as body weight, body condition, parity, and sex, and then randomized among treatments. Some twenty-seven commercial farmers using one or more of the three alternative management practices were identified. These farmers were requested to fill out and return a questionnaire detailing bio-physical findings plus unit prices for products and unit costs for inputs. Twelve questionnaires were returned, and the bio-physical data, while incomplete, were helpful in indicating whether commercial farm experience paralleled research station findings.

For financial data for market prices for outputs, published sources were preferred over primary sources. The latter were felt to be less representative, being site-specific, whereas the former are based on averages from large samples of regional populations. Livestock market prices, for all liveweight categories from weaned calves through heavy feeders to culled cows, were averages of twelve years' worth of monthly data. The twelve-year period was chosen so as to capture the periodicity of a beef cattle price cycle.

For financial data for costs of inputs, a blend of published sources and research station costs were used. Research station data were found to be similar to published costs data for feeds, bedding, pasture, and health treatments. Averages were compiled from five years of observations. However, published

Table 1: Livestock reproduction performance, by seasonality of calving.

	Winter Calving (75 - cow herd)	Summer Calving (75 - cow herd)	Probability
Body Condition[a] at Breeding - Cows	2.68	2.99	p<.05
- Heifers	2.22	2.60	p<.05
Pregnancy Rate (%) – Cows	85.4	88.0	Ns
- Heifers	75.5	81.2	p<.05
Culling[b] Rate (%) - Cows	16.4	17.1	Ns
- Heifers	34.4	22.3	p<.05
Calving Ease Score[c]	1.4	1.1	p<.05
Assisted Births (%) - Cows	18	3	p<.05
- Heifers	63	17	p<.05
Calf Birth Weight (lb)	106	100	p<.05
(kg)	48	45	p<.05
Calf Survival Rate (%)	93	92.3	Ns
Calf Health Treatments Rate (%)	33	14	p<.05
Health Treatments per Calf Born	2.8	0.6	p<.05
Calf Weaning Rate[d] (%)	78	80	Ns

[a] Ranked from 1 (thin)to 5 (obese)
[b] Culling reasons include: open at final pregnancy check; failed to raise calf to weaning; severe functional or behavioral problems
[c] Ranked from 1 to 4; 1 unassisted; 2 easy pull; 3 hard pull; 4 surgical
[d] # cows weaning calf/# pregnant cows retained.
Ns - not significantly different statistically.

data were used for labor unit costs and beef barns, the latter amortized at current market interest rates over the expected useful lifetime.

From the livestock performance data plus market prices for outputs, gross revenue figures were compiled. Bio-physical data combined with unit cost data were used to profile the expenses, which, when deducted from revenues, gave a net returns figure. The net returns were set up on a per-cow-exposed-to-breeding basis to account fully for those indirect costs of maintaining cows that do not become pregnant for each of the sixteen alternative management practices combinations.

Results and Discussion

Livestock Performance

Two broad areas of livestock performance were measured across the three experiments: reproductive performance (Table 1) and growth performance of the offspring (Table 2). Summer-calving cows and heifers were found to have superior body condition at breeding time than their winter-calving counterparts (Table 1). For cows, season had no effect on pregnancy rate. However, pregnancy rate for summer-calving heifers was significantly higher than that of winter-calving heifers at (81.2% vs. 75.5%). This advantage for summer-calving heifers may be explained in part by their superior level of body condition at breeding; in general, better body condition is associated with increased body energy store and is positively associated with reproduction. Herd culling policy was directed toward retaining only those cows and heifers that were confirmed to be pregnant, that successfully raised a calf to weaning, and that did not suffer any functional or behavioral problems. While no difference was found between winter-calving and summer-calving cows, the culling rate for winter-calving heifers was significantly higher at 34.4% than the

Table 2: Livestock growth performance, by seasonality of calving and by marketing category for offspring.

	Winter Calvings	Summer Calvings
Birth to Weaning		
Birth weight (lb)	106	100
(kg)	48	45
Weaned calf weight (lb)	558	531
(kg)	253	241
Time period	Feb 15 - Oct 5	June 15 - Jan 15
# days	232	216
Daily liveweight gain (lb)	1.95	2.0
(kg)	0.88	0.91
Weaning to Yearling		
Yearling weight (lb)	690	653
(kg)	313	296
Time period	Oct 6 - Feb 14	Jan 16 - May 15
# days	132	122
Daily liveweight gain (lb)	1.0	1.0
(kg)	0.45	0.45
Yearling to Feeder		
Feeder weight (lb)	779	963
kg)	353	437
Time Period	Feb 15 - May 15	May 16 - Sep 15
# days	89	124
Daily liveweight gain (lb)	1.0	2.5
(kg)	0.45	1.13
Feeder to Heavy Feeder		
Heavy feeder weight (lb)	1 089	1 055
	494	479
Time Period	May 16 - Sep 15	Sep 16 - Dec 15
# days	124	92
Daily liveweight gain (lb)	2.5	1.0
(kg)	1.13	0.45
Total days offspring retained to Heavy Feeder	577	554

22.3% rate for summer-calving heifers (Table 1). This difference was due in part to the lower reproductive success of winter-calving heifers, and higher death loss for the progeny of heifers prior to weaning.

Calving ease was scored using a scale of 1 for unassisted births up to 4 for dams requiring surgery. Summer calvers were found to have a significantly lower calving ease score, at 1.1, than winter calvers at 1.4 (Table 1). In particular, the proportion of cows requiring assistance of any kind at birth averaged 18 percent for winter-calvers, significantly greater than the 3 percent for summer calvers. Winter-calving heifers required significantly more assistance at 63 percent percent than did summer-calving heifers at 17%.

One of the reasons contributing to more assisted births for winter calving may have been the significantly higher average birth weight of these calves. Winter calvers produced calves averaging 106 lb (48 kg) compared with summer calvings, averaging 100 lb (45 kg) (Table 1). Increased birth weight is known to be a major risk factor in calving. The increased rates of calving assistance with winter calvings is also likely due in part to increased opportunity to observe cows in labor and offer assistance in the confinement situation. Similarly, the higher average calving ease score with the winter group is likely a reflection, in part, of the increased opportunity to intervene with confined animals. However, since calf survival was similar between seasonal management groups, there appeared to be no negative impact resulting from the lower assistance rates with summer-calving cows.

While there was no significant difference between winter and summer calvings in calf survival rate, calf treatments required to realize the survival rates were significantly higher for winter calvings (averaging 33%, or 2.8 treatments per calf born) than for summer calvings (averaging 14%, or 0.6 treatments per calf born) (Table 1). The major disease symptom in both groups was diarrhea (calf scours). Winter-born calves were likely exposed to more pathogens via increased manure contamination characteristic of high animal density housing, compared with the relatively uncontaminated environment experienced by calves born on pasture. There was no difference found between winter and summer calvings in calf weaning rate (Table 1).

For growth performance of the offspring, more could be attributed to season of year and whether animals were at pasture or being confinement-fed than to either seasonality of calving or use of stockpiled pasture to extend the grazing season in the fall. Offspring grew fastest while grazing pasture during the flush pasture growth period (from mid-May to mid-July) regardless of season of birth, stage of growth between weaning and heavy feeder status, and prior (confinement vs. grazing) treatment (Table 2). Consequently, calves born in winter with higher average birth weights than summer-born calves maintained their higher liveweights through weaning and yearling stages to heavy feeder status, not because of their season of birth but because of their advantage gained from two seasons at pasture. On the other hand, summer-born calves exhibited superior growth rates during the yearling-to-feeder growth stage when they were at pasture, with feeder weights significantly higher at 963 lb. (437 kg) than for winter-born calves at 779 lb. (353 kg) (Table 2). No significant differences were found in growth rates between winter-born and summer-born offspring during either the grazing or the confinement feeding periods.

The emphasis on feeding management, pasture availability, and feed cost minimization throughout this study led to the discrepancy in terms of retention times and final liveweights for heavy feeders between winter-born calves (1.089 lb.) and summer-born calves (1.055 lb.) (Table 2). There was no attempt made to equalize liveweights reached, nor to equalize total days offspring born in either season were retained to heavy feeder status.

Whether the heavy feeders could be considered ready for slaughter depends on desired degree of finish. It was assumed that heavy feeders would require some additional finishing, hence were referred to as heavy feeders rather than finishers.

Livestock Stored Feed Consumption

Overall consumption by the breeding herd and suckling calves of stored forage and mineral was found to be similar between seasonal groups. With confinement fall feeding, winter-calving cows consumed more concentrates (fed to cows as needed to maintain body condition) and required more straw bedding than

summer-calving cows. However, summer-born calves consumed more creep feed concentrate than winter-born calves in the fall confinement feeding situation. Extending the grazing season into fall reduced consumption of all stored feeds and bedding (Table 3).

Stored feed consumption by offspring beyond the weaning stage was found to be higher for calves born in summer by virtue of the greater nutritional requirements at higher growth stages when in confinement, i.e. during the yearling-to-feeder and heavy feeder stages (Table 3, Fall Confinement Feeding). This difference in favor of winter-born calves was found to be accentuated when an extended fall grazing season was implemented (Table 3, Fall Extended Grazing). Total feed consumption data were found to be reasonably close to feed requirements according to NRC standards.

Livestock Grazing Requirements

Somewhat greater pasture acreage was found to be needed for cows calving in summer on pasture, whether on the fall confinement feeding or extended pasture grazing program (Table 4). This was primarily due to a trade-off between pasture utilization efficiency and ease of management of calving on pasture. The same was found for the offspring pasture requirements. As would be expected, greater pasture acreage was required for both cows and offspring on the fall extended grazing program compared with the fall confinement feeding program. Total pasture requirements for cow and offspring combined were highest at 2.75 ac (1.12 ha) for summer-calvers on fall extended pasture, compared with summer-calvers with fall confinement feeding at 2.43 ac (0.98 ha), winter-calvers on fall extended pasture at 2.39 ac (0.97 ha), and winter-calves on fall confinement feeding at 2.03 ac (0.82 ha) (Table 4).

Table 3: Livestock stored feeds consumption per annum.

	Winter Calving Group				Summer Calving Group			
	Hay	Concentrates	Straw	Mineral Supplement	Hay	Concentrates	Straw	Mineral Supplement
Fall Confinement Feeding Program								
Cow (lb/head)	9 050	132	1 985	30.6	9 168	33.4	1 589	30.4
(kg/head)	4 105	60	900	13.9	4 159	15.2	721	13.8
Calf (lb/head)	-	18.9	-	-	-	54	-	-
(kg/head)	-	8.6	-	-	-	24.5	-	-
Post-weaning								
Yearling (lb/head)	1 932	824	278	3.6	1 830	717	543	3.3
(kg/head)	876	374	126	1.6	830	325	246	1.5
Feeder (lb/head)	1 474	630	891	2.4	-	-	-	4.5
(kg/head)	669	286	404	1.1	-	-	-	2
Heavy Feeder (lb/head)	-	-	-	4.5	2 252	331	543	4
(kg/head)	-	-	-	2	1 022	150	246	1.8
Total, All Animals[a] (lb)	12 456	1 605	3 154	41.1	13 250	1 135	2 675	42.2
(kg)	5 650	728	1 431	18.6	6 010	515	1 213	19.1
Fall Extended Grazing Program								
Cow (lb/head)	5 611	44	1 152	27	5 325	49	929	29
(kg/head)	2 545	20	523	12	2 415	22	421	13
Calf (lb/head)	-	-	-	2.5	-	-	-	-
(kg/head)	-	-	-	1.1		-	-	-
Post-weaning								
Yearling (lb/head)	893	381	143	1.2	1 830	717	543	3.3
(kg/head)	405	173	65	0.5	830	325	246	1.5
Feeder (lb/head)	1 474	630	891	2.4	-	-	-	4.5
(kg/head)	669	286	404	1.1	-	-	-	2
Heavy Feeder (lb/head)	-	-	-	4.5	2 252	331	543	3.4
(kg/head)	-	-	-	2	1 022	150	246	1.5
Total, All Animals[a] (lb)	7 978	1 055	2 186	37.6	9 407	1 097	2 015	40.2
(kg)	3 619	479	992	17.1	4 267	498	914	18.2

Labor Requirements

Labor inputs were recorded as hours per head spent on observing, treating, cleaning, feeding, and moving pastures for cows and offspring by growth stage from birth to weaning to yearling (11 months for summer-born) to feeder to heavy feeder (Table 5), conforming to the time periods in Table 2.

In general, there was a lower labor requirement found for summer-calving cows and their offspring through to heavy feeder weight than for winter-calving cows and offspring (Table 5). The sole exception was the somewhat higher labor requirement for summer-born calves between birth and weaning. Most labor savings occurred during the calving season, with summer calvers on pasture requiring less attention and assistance at calving.

No significant difference was found in labor requirements between fall confinement feeding and fall extended grazing programs. Saving in feed handling and distribution labor for the extended grazing options were largely absorbed by field monitoring, fence maintenance, and moving livestock across pasture subdivisions.

Economic Performance - Revenues

Market prices, based on 12-year averages for the months in which offspring were sold as weaned calves, yearlings (11-month old for summer-born), feeders, or heavy feeders, did not differ greatly between summer-calving and winter-calving herds. Prices were somewhat higher for winter-born calves sold as either weaned calves or feeders, but were somewhat lower for winter-born calves sold as either yearlings or heavy feeders

Table 4: Pasture land requirements per annum.

	Winter-Calving Group	Summer-Calving Group
Fall Confinement Feeding Program		
Cow (ac/head)	1.13	1.35
(ha/head)	0.46	0.55
Offspring (ac/head) [a]	0.90	1.08
(ha/head)	0.36	0.44
Total, Cow + Offspring (ac/head)	2.03	2.43
(ha/head)	0.82	0.98
Fall Extended Grazing Program		
Cow (ac/head)	1.33	1.53
(ha/head)	0.54	0.62
Offspring (ac/head) [a]	1.06	1.22
(ha/head)	0.43	0.50
Total, Cow + Offspring (ac/head)	2.39	2.75
(ha/head)	0.97	1.12

[a] Assumes offspring retained to heavy feeder weight.

Table 5: Labor requirements.

	Winter Calving Groups	Summer Calving Groups
	(hr/head)	
Cow - calving season	4.04	3.08
- remainder of year	6.19	6.19
Calf - birth to weaning	4.26	4.41
- weaning to yearling/11 mon.	1.68	1.56
- yearling/11 mon. to feeder	2.82	1.95
- feeder to heavy feeder	3.22	3.12
Total[a]	22.21	20.31

[a] Assumes offspring retained to heavy feeder stage.

(compare Table 6, winter-calving herds, with Table 7, summer-calving herds). In addition, there was a liveweight advantage to winter-born calves sold as weaned calves (558 lb.; 253 kg.), yearlings (690 lb.; 313 kg.) or heavy feeders (1,089 lb.; 494 kg.) (Table 6) compared with summer-born calves sold as weaned calves (531lb.; 241 kg.), 11-month olds (653 lb.; 296 kg.) or heavy feeders (1,055 lb.; 479 kg.) (Table 7). Only in the case of feeders did summer-born calves average a higher market liveweight at 963 lb. (437 kg.) than winter-born calves at 779 lb. (353 kg.).

Combining average market prices with average weaning rates and average market liveweights, and netting out herd replacement needs, gross revenues were found to be higher for winter-born calves sold as weaned calves ($353.55/cow exposed to breeding (Table 6), than for summer-born calves sold as weaned calves ($315.25, Table 7). Similarly, gross revenues were higher for winter-born calves sold as yearlings ($407.38, Table 6 vs. $405.90, Table 7), and as heavy feeders ($563.17, Table 6 vs. $556.91, Table 7). Only in the case of offspring sold as feeders did gross revenue average higher (at $495.06/cow exposed to breeding) for summer-born calves (Table 7) than $447.55 for winter-born calves (Table 6). Generally, a gross revenue advantage lay with winter-calving herds.

Economic Performance - Expenses

The two most important expense items for beef production are feeds and labor. Averaging $70 per acre per year, pasture costs included establishment expenses amortized over the expected useful life plus annual fertilizer treatment and maintenance costs. Land costs were not included (see below under Net Returns). Pasture costs were consistently higher for summer calvers than winter calvers, with the exception of higher pasture costs for winter calvers on extended grazing with offspring sold as yearlings (compare $149.34 per cow, Table 6, with $147.91 per cow, Table 7). Stored feed costs were higher for the winter-calving group, for feeder and heavy feeder categories for the fall confinement feeding option. These were based on charges of 2.2¢ per lb for hay, $.02 per lb. for straw, $.07 per lb for concentrates, and $.38 per lb. for mineral supplement. For the extended grazing option, stored feed costs were higher for the summer-calving group for offspring marketed as yearlings and as heavy feeders, but lower for the other two marketing categories. Although not great, these differences in pasture and

Table 6: Gross revenues, expenses and net returns for winter-calving herds, by feeding system & offspring marketing option.

	Winter-Calving + Confined Feeding				Winter-Calving + Stockpiled Grazing			
	558 lb Calf @$1.06	690 lb Yearling @ $0.98	779 lb Feeder @ $0.96	1,089 lb Heavy Feeder @ $0.86	558 lb Calf @ $1.06	690 lb Yearling @ $0.98	779 lb Feeder @ $0.96	1,089 lb Heavy Feeder @ $0.86
	($ per Beef Cow Exposed to Breeding)							
Revenue								
Offspring (liveweight x unit price x 0.6)[a]	353.55	407.38	447.55	563.17	353.55	407.38	447.55	563.17
Culled Cow (1,515 lb x 20% @ $0.5431)	164.56	164.56	164.56	164.56	164.56	164.56	164.56	164.56
Total Revenue	518.11	571.94	612.11	727.73	518.11	571.94	612.11	727.73
Expenses								
Pasture (production & utilization)	109.74	109.74	109.74	133.22	128.83	149.34	149.34	172.88
Stored Feeds - Forages	199.10	241.60	274.03	274.03	123.44	143.09	175.52	175.52
- Concentrates	10.56	68.24	112.34	112.34	3.08	29.75	73.85	73.85
- Mineral Supplement	11.63	13.00	13.91	15.62	11.21	11.67	12.58	14.29
Sub-total Stored Feeds	221.29	322.84	400.28	401.99	137.73	184.51	261.94	263.65
Straw Bedding	39.70	45.26	63.08	63.08	23.04	25.90	43.72	43.72
Labor	144.90	161.70	189.90	221.10	144.90	161.70	189.90	222.10
Animal Treatments	6.47	6.52	6.56	6.58	6.47	6.52	6.56	6.58
Barn Amortization	66.67	66.67	66.67	66.67	66.67	66.67	66.67	66.67
Total Expenses	588.77	712.73	836.23	893.64	507.64	594.64	718.13	775.60
Net Return (to Other Costs[b], Equity[c] and Management)	(70.66)	(140.79)	(224.12)	(165.91)	10.47	(22.70)	(106.02)	(47.87)

[a] Each beef cow exposed to breeding produces 0.6 offspring for sale per year (80% calving rate less 20% retention rate for herd replacements).
[b] Includes animal marketing, manure handling, utilities, banking, accounting, legal, insurance, building and fence maintenance.
[c] Equity capital invested in land, fixtures (e.g., tile drains), machinery and equipment, and buildings other than beef barn.

stored feed costs helped to render overall expenses higher for winter calving options with the exception of summer-born calves with stockpiled grazing and offspring sold as yearlings (compare $594.64 per cow, Table 6, with $594.70 per cow, Table 7), and offspring sold as heavy feeders (compare $775.60, Table 6, with $776.09, Table 7). Much of the difference at the heavy feeder stage was due to feeding the summer-born offspring in confinement while winter-born offspring were at summer pasture.

Labor costs, at $10.00 per hour, were found to be lower for summer-born calves unequivocally for all offspring sales and fall feeding options. As previously noted, this was due mainly to lower supervision and assistance inputs for cows at birth.

In other expense categories, animal treatment expenses were higher for winter-born calves at between $6 and $7 per cow exposed to breeding (Table 6) compared with between $1 and $2 per cow exposed to breeding for summer-born calves (Table 7). Barn amortization was also higher at $66.67 per cow for winter-born calves (Table 6) than $40.00 per cow for summer-born calves (Table 7).

Overall expenses for winter-born calves ranged from a low of $507.64 per cow exposed to breeding for stockpiled grazing and offspring sold as weaned calves to a high of $893.64 per cow for fall confinement with offspring sold as heavy feeders (Table 6). This compares with a range for summer-born calves of from $476.51 per cow on extended fall grazing with offspring sold as weaned calves to $727.56 per cow in fall confinement with offspring sold as heavy feeders (Table 7). For all but two of the feeding and offspring marketing options, winter calvings exhibited higher expense totals than summer calvings, and confinement feeding options carried higher totals than those for fall stockpiled grazing. Necessarily, total expenses rose the longer offspring were retained on the farm between weaned calf and heavy feeder status.

Table 7: Gross revenues, expenses and net returns for summer-calving herds, by feeding system & offspring marketing option.

	Summer-Calving + Confined Feeding				Summer-Calving + Stockpiled Grazing			
	531 lb Calf @$0.99	653 lb Yearling @ $1.04	963 lb Feeder @ $0.86	1,055 lb Heavy Feeder @ $0.88	531 lb Calf @$0.99	653 lb Yearling @ $1.04	963 lb Feeder @ $0.86	1,055 lb Heavy Feeder @ $0.88
	($ per Beef Cow Exposed to Breeding)							
Revenue								
Offspring (liveweight x unit price x 0.6)[a]	315.25	405.90	495.06	556.91	315.25	405.90	495.06	556.91
Culled Cow (1,515 lb x 20% @ $0.5431)	164.56	164.56	164.56	164.56	164.56	164.56	164.56	164.56
Total Revenue	479.81	570.46	659.62	721.47	479.81	570.46	659.62	721.47
Expenses								
Pasture (production & utilization)	131.21	131.21	154.75	154.75	147.91	147.91	191.97	191.97
Stored Feeds - Forages	201.70	241.96	241.96	291.50	117.15	157.41	157.41	206.95
- Concentrates	6.12	56.31	56.31	79.48	3.43	53.62	53.62	76.79
- Mineral Supplement	11.55	12.81	14.52	16.04	11.02	12.27	13.98	15.28
Sub-total Stored Feeds	219.37	311.08	312.79	387.02	131.60	223.30	225.01	299.02
Straw Bedding	31.78	42.64	42.64	53.50	18.58	29.44	29.44	40.30
Labor	136.80	152.40	171.90	203.10	136.80	152.40	171.90	203.10
Animal Treatments	1.62	1.65	1.68	1.70	1.62	1.65	1.68	1.70
Barn Amortization	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Total Expenses	560.78	678.98	723.76	840.07	476.51	594.70	660.00	776.09
Net Return (to Other Costs[b], Equity[c] and Management)	(80.97)	(108.52)	(64.14)	(118.60)	3.30	(24.24)	(0.38)	(54.62)

[a] Each beef cow exposed to breeding produces 0.6 offspring for sale per year (80% calving rate less 20% retention rate for herd replacements).
[b] Includes animal marketing, manure handling, utilities, banking, accounting, legal, insurance, building and fence maintenance.
[c] Equity capital invested in land, fixtures (e.g., tile drains), machinery and equipment, and buildings other than beef barn.

Economic Performance - Net Returns

Net returns are defined here as gross revenues less total (recorded) expenses, the residue being required to cover all non-recorded expenses such as animal marketing, manure handling, utilities, banking, insurance, accounting and legal fees, and building and fence repairs and maintenance. Any remaining residue after covering these non-recorded expenses would be available to provide the farmer with a return to equity capital invested in land, machinery, buildings other than beef barns, and management.

As recorded in Tables 6 and 7, most of the management combination options were found to produce negative net returns, meaning that not all expenses were covered by gross revenues and there would be no return to equity capital and management. This was particularly true of both winter-calving and summer-calving herds operating under confinement feeding in the fall. The most unattractive management combination on a net returns basis was winter calving with confined feeding and offspring marketed as feeders, at -$224.12 per cow exposed to breeding (Table 6).

Summer calvings were, by and large, found to generate superior net returns, across the confinement feeding options, and were unequivocally lower cost than their winter-calving counterparts. Despite lower costs, summer calvings were not more profitable than winter calvings across all offspring marketing options for extended fall grazing. Generally, fall extended grazing was found to give higher net returns than confined feeding, and higher marketing liveweight categories gave inferior net returns to lower. Overall, the best combination was winter-calving with fall extended grazing and offspring marketed as weaned calves, at $10.47 per cow exposed to breeding (Table 6).

Conclusions

From the study findings, it is concluded that:

1. Reductions in labor, bedding, and animal treatment inputs and costs and in barn amortization are possible by moving from a traditional winter-calving program in confinement to a summer-calving program on pasture, while animal performance and revenues earned remain reasonably comparable;

2. For fall confinement feeding operations, stored feed inputs and costs can be reduced by selecting summer-calving over winter-calving, generally the more so by retaining offspring to higher marketing weight categories;

3. For fall extended grazing operations, stored feed inputs and costs can be reduced for both summer- and winter-calvings, and animal and gross revenue performance will not be adversely affected, so that extended grazing is judged to be more profitable than confinement feeding;

4. Higher feed, labor and inputs of all kinds will be required to take offspring to greater marketing liveweight categories, and the higher costs incurred will generally not be fully compensated by the higher revenues earned, so that calf retention options are considered not to be as profitable as the traditional marketing of offspring as weaned calves; and

5. The best overall management combination would be to have the herd calve in winter, to extend the pasture grazing season into the fall for as long as weather and pasture conditions allow, and to dispose of offspring at the traditional weaned calf stage.

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