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WINTERING COW: AN EXCEL SPREADSHEET TO BALANCE WINTER BEEF COW RATIONS, AND EVALUATE WINTER FEEDING PROGRAMS ON ANNUAL COW COST AND CALF BREAK-EVEN PRICE

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Summary

An Excel (v 7.0) spreadsheet was created to simplify balancing winter diets (energy and protein), estimating feed needs and evaluating the impact of winter feeding programs on annual cow cost and calf break-even price by using inputs readily found on the farm (e.g., forage test results, accounting and production records). The spreadsheet operates on the substitution method and requires the following inputs: cow energy (TDN) and protein (CP) requirements, body condition score (1 = thin, 9 = fat), average effective temperature for the period in question, forage, energy and protein supplement dry matter (DM), TDN and CP concentration, feeding period length and feed delivery method, other yearly feed costs (pasture, and mineral and vitamin supplements), yearly direct and indirect costs, number of cows in the group, group weaning weight and percentage, and projected calf price. A special feature permits economic evaluation of alternative calving date scenarios (30 days earlier or later than actual). Adjustments based on BCS, effective temperature, feed quality and delivery method, weaning weight and percentage, and calving date permit economic evaluation of various scenarios the user may encounter or wish to simulate. The spreadsheet was used to simulate the impact of BCS 4 vs 5 at the beginning of the winter feeding period, feeding forage with vs without a bale feeder, or calving February 15 vs March 15 (same weaning date) on annual cow cost. One unit drop in BCS, feeding without a bale feeder or calving 30 days before March 15 represented increases in annual cow costs of 2%, 6% and 4%, respectively.

Introduction

Winter feeding costs comprise 50 to 60% of total annual beef cow enterprise costs. Cow-calf producers that recognize this fact are demanding a simple approach to balance wintering cow diets. In addition, it is essential that this approach integrates other economic and production concepts to develop winter feeding programs that achieve least production cost. Therefore, an Excel (v 7.0) spreadsheet was created to simplify balancing winter diets (energy and protein), to estimate feed needs, and to evaluate the impact of winter feeding programs on annual cow cost and calf break-even price. Balancing cow rations and projecting feed needs with this spreadsheet requires results of forage tests and nutrient analyses of supplement ingredients.

Availability of production and financial records further permits evaluation of economic impact of the winter feeding program on annual cow costs and projected break-even price.

Design

Balancing method. The spreadsheet uses the substitution method to balance energy and protein. This maximizes forage use and keeps it simple. However, in contrast to the standard substitution method, when both the energy and protein supplements are required, protein supplement DM replaces forage DM, not energy supplement DM. This usually reduces trial and error runs and reduces the number of energy deficient diets yielded by this method. Estimates of DM consumption by beef cows were based on research observations conducted at the University of Minnesota with mature pregnant cows fed forage in confinement during the winter. Dry matter intakes averaged 1.8%, 2.0% and 2.2% of the cow's BW for poor (< 53% TDN), average (53% to 58% TDN) and high (> 58% TDN) quality forages.

Adjustments to energy requirements. Adjustments to energy requirements are made based on condition score and ambient temperature. Data from various university research trials indicate that cows should calve in a body condition score (BCS) of at least 5 (1 = thin; 9 = fat). Recent work at the University of Minnesota (Cassady et al., 1996) demonstrated that keeping females in BCS >5 (but not obese) delays effects of energy restriction on reproductive cyclicity. Thus, the spreadsheet is built so that energy requirements of cows in pre-calving BCS < 5 are increased (10%/unit BCS) to permit weight and condition gain before calving. Similarly, if pre-calving BCS is >5, energy requirements are increased (2.5%/unit BCS) to maintain higher condition pre-calving. Based on these pre-calving strategies, the spreadsheet is built so that it maintains BCS 5 post-calving if cows calve in BCS 5; otherwise, for cows in BCS > 5, energy needs are reduced 10%/unit BCS to take advantage of the additional body reserves. When balancing diets for post-calving cows with BCS < 5, energy requirement is increased 18%/unit BCS to permit weight gain post-calving. Body condition score units should be entered as whole numbers in the range from 3 to 7. The authors believe that application of the principles discussed herein is limited to this range of BCS.

Energy requirements are adjusted for cold exposure by the relationship suggested by Ames (1978). This adjustment changes the energy requirement by 1% for every degree of coldness below the lower critical temperature (defined in the program at 20° F).

Adjustment to forage delivery method. Adjustments to determine forage needs are made based on hay feeding method. Data from university trials indicate that feeding hay with no hay feeder increases wastage to 35% (Wheaton, 1980; Anderson and Mader, 1985). Estimates of hay wastage when rolling out bales or using feeders are 15% and 10%, respectively (Wheaton, 1980; Anderson and Mader, 1985).

Simulation of alternative calving dates. The spreadsheet was designed so that feed needs, annual cow cost and break-even price for alternative calving dates could be projected. The program permits a single alternative evaluation per run. This alternative can either be 30 days sooner or later than the current calving date. Although energy and protein requirements for gestation or lactation do not change, the proportion of days cows are fed for late trimester gestation or lactation does change. Depending on feed quality and price, this may have a positive or negative impact on cow costs. Additionally, because calving date impacts weaning weight (Minyard and Dinkel, 1965), weaning weight is adjusted by 55 lb for every 30-day difference in calving date.

Inputs

Cow and the environment. The basic cow and environment inputs needed to balance energy and protein requirements of wintering beef cows are: body weight (in lb or kg), crude protein and TDN requirements (in lb or kg), cow BCS in the range of 3 to 7 (1 = thin; 9 = fat; enter whole units), and average effective temperature (in degrees Fahrenheit) during the feeding period (pre- or post-calving). Body weight may be obtained directly, or estimated from the weight of cows in BCS 5 using the cow's BCS and estimates from Table 1 (Herd and Sprott, 1986). Energy and protein requirements may be obtained from the NRC publications (1984 or 1996, standard tables), or from a table of requirements (NRC, 1996 Table Generator) adjusted to local conditions (such as Table 2). Effective temperature is ambient temperature adjusted for wind and humidity factors. A wind-chill table is included in this publication to correct ambient temperature for the wind-chill factor (Table 3).

Table 1. Relationship between body condition score and fat content or cover, weight or height.

	Fat, %					
BCS	Empty body	Carcass	Carcass fat cover, in	Wt/ht, lb/in	Ratio of weight	BW to change BCS as % of BCS at BCS 5
1	0	.7	0	15.7	.740	
						5.8
2	4	5.0	0	16.9	.798	
						6.2
3	8	9.3	.05	18.3	.860	
						6.7
4	12	13.7	.11	19.7	.927	
						7.3
5	16	18.0	.19	21.3	1.000	
						8.0
6	20	22.3	.29	23.0	1.080	
						8.7
7	24	26.7	.41	24.8	1.167	
						9.1
8	28	31.0	.54	26.7	1.258	
						10.2
9	32	35.3	.68	28.9	1.360	

Adapted from Herd and Sprott, 1986.

Feed nutrient values. The basic feed nutrient value inputs needed to balance energy and protein requirements of wintering beef cows are: dry matter (DM), crude protein (CP) and energy (TDN) values of forage, energy and protein supplements. Because this program is limited by single entries in each of these feed categories (forage, energy or protein supplement), the user is encouraged to weigh average of pre-defined blends of forages (e.g., first- and second-cut hay fed on alternative days, or alfalfa hay fed at 3 lb/day along with ad libitum access to grass hay) or supplements (e.g., corn and bakery waste byproduct blended at 50:50 ratio) to be fed. Some prior knowledge of forage or supplement inventories, prices and associative effects in the feed mix or in the digestive tract is required to optimize these mixes.

Table 2. Beef cow energy and protein requirements[a] (1996)[b].

Mature Beef Cows

Weight	Weaned		Late pregnant		Low lactation		High lactation	
lb	CP, lb	TDN, lb	CP, lb	TDN, lb	CP, lb	TDN, lb	CP, lb	TDN, lb
1400	1.67	10.6	2.07	13.3	2.45	15.6	3.00	17.9
1300	1.59	10.1	1.98	12.7	2.36	15.0	2.92	17.3
1200	1.50	9.5	1.90	12.2	2.28	14.3	2.83	16.6
1100	1.41	9.0	1.81	11.6	2.19	13.7	2.74	16.0

First Calf Heifers

Weight	Weaned		Late pregnant		Low lactation		High lactation	
lb	CP, lb	TDN, lb	CP, lb	TDN, lb	CP, lb	TDN, lb	CP, lb	TDN, lb
1200	1.71	11.1	2.09	13.7	2.24	14.8	2.62	16.2
1100	1.62	10.5	1.99	13.1	2.15	14.1	2.53	15.1
1000	1.53	9.9	1.90	12.5	2.06	13.4	2.44	14.9

Bred Heifers

Weight		Late pregnant			
lb		CP, lb	TDN, lb		
950		1.8	13.0		
900		1.7	12.5		
850		1.7	12.1		

[a] Nutrient recommendations are based on British bred females in BCS 5 exposed to temperatures ≥ 20° F. Increase energy recommendations 1% for each degree drop below 20° F. These are only guidelines; additionally animals should be receiving adequate vitamin and mineral nutrition.

[b] Adapted from NRC, 1996.

Costs and production record inputs. Although feed costs are not needed to balance energy and protein requirements of wintering beef cows using this spreadsheet, economic evaluation of the winter feeding program is not possible without this information. Thus, the user is encouraged to at least obtain feed prices which, in conjunction with cow and environment and feed nutrient value information, permit a least cost approach to balancing wintering cow diets. Additionally, the spreadsheet is designed to project annual cow costs and calf break-even price. Therefore, information commonly provided by record keeping (e.g., CHAPS) and financial management programs (e.g., SPA or FINPACK) is required. Annual pasture costs (pasture maintenance charges such as fences, water, etc. or rental charges), other direct (veterinary, breeding fees, livestock supplies, etc.) and indirect costs (taxes, depreciation, interest, etc.) are required (listed in FINPACK Livestock Enterprise Analysis Sheet) to estimate, along with the feed cost output, annual cow cost. Additionally, weaning weight and weaning percentage (calves weaned/cow exposed; obtained from FINPACK Livestock Enterprise Analysis Sheet or CHAPS Herd Summary Sheet) is required to calculate production/cow.

Other. The program is designed to project feed needs as close to reality as possible. Therefore, the user is required to enter forage feeding method and average weight (as is) of bales used. The program will project feed needs according to feed delivery method and present feed needs as kg or lb and number of bales (if bale weight was entered). Also, the program is designed to balance rations or project costs for a herd or groups of cows within a herd. Herd groups or herds can be named within the spreadsheet. This name is printed on output sheets to keep reports separate. Projected calf price information ($/cwt) is used by the program to estimate projected net returns/cow or herd in the user-defined group.

Table 3. Wind-chill values for cattle.[a]

Wind speed, mph	Temperature, °F						
	-10	-5	0	5	10	15	20
0	-10	-5	0	5	10	15	20
5	-16	-11	-6	-1	3	8	13
10	-21	-16	-11	-6	-1	3	8
15	-25	-20	-15	-10	-5	0	4
20	-30	-25	-20	-15	-10	-5	0
25	-37	-32	-27	-22	-17	-12	-7
30	-46	-41	-36	-31	-26	-21	-16
35	-60	-55	-50	-45	-40	-35	-30
40	-78	-73	-68	-63	-58	-53	-48

[a] From Better Beef Business (1981).

Outputs

Ration balancing. Results of ration balancing procedures for pre- and/or post-calving periods are clearly presented in output sheets as daily feed in DM and as fed basis. A separate column showing daily feed to offer takes into account projected forage waste estimated from the entry in feed delivery method. Also, a separate column lists total and required (adjusted for cold or BCS) TDN and CP requirements for comparison.

Cow and herd feed needs. Entries into group size and bale weight are used to calculate feed needs as forage and supplement needs/cow or group/period. Separate columns for output in kg or lb and number of bales (if bale weight was entered) are provided. The column for feed needs in kg or lb/cow can be used to compare to feed usage output sheets computed by FINPACK (Livestock Enterprise Analysis sheet) or SPA software.

Profit projection. When cost and production information is entered, the program computes annual feed and non-feed costs, total annual cost/cow or herd and calf break-even price. Also, when the user defines a projected calf price, the program computes expected net return/cow or herd.

Sample Scenarios

Sample scenarios were computed with the aid of the spreadsheet to simulate effects of initial BCS (at beginning of winter), feeding hay with or without a hay rack or moving calving date one month earlier on annual cow cost and calf break-even price. The reference scenario was that of a 100 head, 1200-lb cow herd with an initial BCS of 5, maintained in a 15° and 25° F environment (pre- and post-calving; see attached input sheet). Forage and supplements available were grass hay (85% DM with 56% TDN priced at $40/ton), corn (88% DM with 90% TDN and 8.5% CP priced at $2.50/bu) and soybean meal (88% DM with 88% TDN and 50% CP priced at $300/ton). Pre- and post-calving periods were 90 days long. Pasture, and salt and mineral costs were $25 and $15/cow/year, respectively. Yearly non-feed and indirect costs were $65 and $120/cow, respectively. Cows were expected to wean a 90% calf crop weighing 550 lb. Calf price was projected at $76/cwt.

Table 4 lists results of the simulation on annual cow costs and calf break-even price. The reference costs simulated here were $370.10/cow (winter feed costs represented 39% of total cow costs), which resulted in a break-even cost of $74.77/cwt. A unit drop in initial BCS increased cow cost $6.88/cow; the result of an increase in supplementation costs. Under this scenario, winter feeding costs were 40% of total cow costs. Feeding without a feeder increased annual cow cost $22.49/cow; winter feeding costs represented 43% of total cow costs. Moving calving date to February 15 increased cow cost $12.82/cow but reduced break-even $4.44/cwt because calves were heavier at weaning.

Table 4. Simulated[a] effects of changing initial BCS, feed delivery method or calving date on annual winter feed and cow costs, calf break-even price and profitability.

	Reference	BCS 4	No feeder	Calving on Feb. 15
Winter feed cost, $/cow/yr	145.12	152.00	167.61	157.94
Forage	99.07	97.21	121.56	96.54
Supplement	46.05	54.79	46.05	61.40
Annual cow cost, $/cow/yr	370.10	377.00	392.61	382.94
Winter feed cost, % of annual	39.21	40.31	42.69	41.24
Calf break-even price, $/cwt	74.77	76.16	79.32	70.33
Profit, $/cow	6.10	-0.80	-16.41	30.88
Cost of one less unit BCS		**6.88**		
Cost of no feeder			**22.49**	
Cost of calving 30 days earlier				**12.82**

[a] See Input sheet for details of reference scenario.

Thus, one could summarize from this simulation that thin cows cost $7/unit BCS and feeders are worth $22/cow. Also, switching to an earlier calving date would cost $13/cow more, but would yield $25/cow more (a net benefit of $12/cow).

The features of this spreadsheet permit evaluation of various considerations singly or combined to represent real life situations. The spreadsheet has been used to evaluate the economic impact of matching forage quality with nutrient needs, the economic impact of

various forage systems (i.e., hay vs silage) and the impact of cold exposure on annual cow cost (e.g., to determine how much to spend on shelter).

Conclusions

This spreadsheet provides a simple and fast method to balance wintering cow rations, estimate feed needs and evaluate the impact of winter feeding program on annual cow cost and calf break-even price. Built-in adjustments for cow condition, temperature, feed delivery method and calving date permit user-driven simulations, which can be used for educational purposes or decision-making. The spreadsheet is limited to single entries into forage, energy or protein feed categories; thus, it requires some previous nutrition knowledge to optimize feed offerings. It balances only energy and protein needs of wintering cows in spring-calving herds.

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If you would like a copy of this Update and the Excel Spreadsheet, please send your name, affiliation, address, phone and e-mail address to: A. DiCostanzo, University of Minnesota, Department of Animal Science, 205 Haecker Hall, 1364 Eckles Avenue, St. Paul, MN 55108-6118.