Practical On-Farm Suggestions for Managing Body Condition, Dry Matter Intake for Optimum Production, Reproduction and Health

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Take Home Message

- The ideal body condition score (BCS) is a range, varying with stage of lactation.
- Optimizing body condition positively affects milk production, reproduction and health.
- Objectives of body condition management include 1) preventing excessive body condition loss in early lactation, 2) restoration of body condition during lactation, and 3) maintenance of body condition during the dry period.
- The key to preventing excessive body condition loss in early lactation is to optimize dry matter intake (DMI).
- Restoring body condition during lactation requires strategic planning.
- Meeting the maintenance needs of the dry cow necessitates a multifaceted approach.

Introduction

Body condition scoring is a method of evaluating body fat reserves (e.g., tissue energy). Dairymen and their advisors can use changes in BCS to assess the level and change of body fat stores and as an indicator of energy balance (EB) (20).

Energy balance is simply energy intake minus energy output. EB may be negative or positive. Negative energy balance (NEB) results when energy intake is less than energy output. When in NEB, the cow will mobilize energy from fat reserves and lose weight. We see this in dairy cows the first 30 to 60 days in milk (DIM) when the energy demands of milk production exceeds the energy from feed (3). Positive energy balance (PEB) occurs anytime that energy intake is greater than energy output. When in PEB, the cow will store energy as fat and gain weight. Dairy cows are generally in PEB by 100 DIM.

Body tissues are dynamic and have two important roles: 1) During NEB they serve as reservoirs for energy mobilization. 2) During PEB they serve as stores for energy deposition. Dairymen and their advisors should use changes in body condition to assess body fat stores and energy balance. These assessments can then be the basis for feeding and management adjustments.

A routine program for BCS can help detect potential health problems before they significantly reduce milk production. The basic premise of this paper is that a herd of cattle that is in optimum BC will produce more milk, have better reproduction and be less susceptible to health disorders.

The objective of this paper is the practical application of BCS in dairy feeding and management programs. Techniques that augment the energy needs of the dairy cow are foremost for optimizing production, reproduction, and health.

▪ Scoring Systems

BCS is a method of visually appraising energy changes in the animal. It is a subjective measure of body fat reservoirs. One unit of body condition change is equivalent to 56 kg. of live tissue weight. Composition is approximately 70% lipid, 24% water, 6% protein, and 1% ash (15). Fatter cows and larger cows will lose more tissue per condition score than thinner cows and smaller cows (8).

As originally proposed by Virginia Tech workers (21), BCS is a 5-point system. It is a noninvasive way of estimating fat stores in cattle that is independent of frame size and BW. The BCS depends upon appraisal (visual and tactile) of the amount of fat covering along the animal's top line from the loin to the tailhead, including the hips, pin bones, and tailhead. A score of 1 is a very thin cow, while a 5 is an excessively fat cow. These extreme scores should be avoided. The average is a 3 and is the most desirable for the majority for the herd.

Other systems evolved that further defined body condition. California and Pennsylvania researchers (5, 7, 10) each developed refined versions to describe an animal between any of the whole number scores. This permits more specific scoring.

The California system (4) divides each score into 0.25-point increments. In this study, researchers reported the area from the hooks back to and including the tailheal region was an effective determinant of overall BCS (20). Principal descriptors are as follows:

- Spinous processes
- Spinous to transverse process
- Transverse processes
- Overhanging shelf
- Hooks and pins
- Between the hooks and pins
- Between the hooks
- Tailhead to pins

The Pennsylvania system (5, 7) uses units of 0.25 between 2.5 and 4.0, and 0.50 units in cases outside this range. Using this method, evaluators showed high repeatability between observers. Ferguson (4, 20) found that scorers gave the same score about 56% and an additional 34% of the time they gave a plus or minus quarter score. Simply put, 90% of the scores deviated by either zero or a quarter point. Also scores between observers correlated highly (0.89 to 0.93).

Following is a brief description of the Pennsylvania system (5). A principal descriptor between cows that BCS <3.0, 3.0, or >3.0 is the appearance of the rump. Cows that score 3 or less will have a “V” appearance between the hookbone, the thurlbone, and the pinbone; whereas, cows that score 3.25 or higher will have “U” appearance in this region. Further division of cows scoring 3 or less is on the appearance of the hook and pin bones as to the degree of roundness and angularity related to fat pad covering these points. Cows that become too thin are cows that drop below a 2.5 BCS. These cows have no fat pad covering the pinbone. Palpating the pinbone of these cows reveals skin covering bone. This system uses the sacral ligament and the tailhead ligament to further define BCS in cows 3.25 and higher. The sacral coccygeal ligament will be distinctly visible in cows that are in 3.25 BCS. The tailhead ligament tends to disappear before the sacral ligament as cows gain condition. Cows that are ideal condition in the dry lot are cows that have a “U” at the rump, a fairly visible coccygeal ligament, and a distinctly visible sacral ligament. As cows approach a BCS 4, the sacral ligament disappears and these cows move into the “too fat” range. Cows are profoundly “too fat” when fat buries the pelvic ligaments. Table 1 is a flowchart-like summary of this system.

Table 1. Principal descriptors of body condition score (5).

Decision 1		**Appearance of rump (hookbone, thurlbone, pinbone)**	
		"U"	
		Yes	
	BCS	**Sacral ligament**	**Coccygeal ligament**
	4.00	Buried in fat (flat)	Buried in fat
"Too Fat"	3.75	Partially visible	Invisible-buried in fat
	3.50	Visible	Partially visible
	3.25	Visible	Visible
Decision 2		**Appearance of rump (hookbone, thurlbone, pinbone)**	
		"V"	
		Yes	
	BCS	**Hook bones**	**Pin bones**
	3.00	Round (fat pad)	Round (fat pad)
	2.75	Angular	Round
	2.50	Angular	Angular (palpable fat pad)
"Too Thin"	<2.50	Angular	Angular (skin and bone)

▪ Optimum Body Condition Score

The ideal BCS is a range and is a function of stage of lactation (4, 20). There are four strategic times to score BCS. They are as follows:

- Dry-off
- Calving
- Early lactation (30-60 DIM)
- Mid-lactation (120-180 DIM)

What is the ideal BCS of a cow at these critical points in the reproduction-lactation cycle of the dairy cow? Guidelines developed by Pennsylvania workers (7) are excellent. Table 2 is a summary of their recommendations.

TABLE 2. Target body condition scores (BCS) (7).

Stage	Ideal Score	Range
Dry off	3.50	3.25 – 3.75
Calving	3.50	3.25 – 3.75
Early lactation	3.00	2.50 – 3.25
Mid-lactation	3.25	2.75 – 3.25
Late lactation	3.50	3.00 – 3.50
Growing heifers	3.00	2.75 – 3.25
Heifers at calving	3.50	3.25 – 3.75

▪ Supporting Research

BCS has been the primary spotlight of many research projects. Evaluation of BCS at calving and BCS change on the subsequent milk yield, fertility, and health of the animal are important to dairymen. The research results clearly point to a strong relationship of BCS to milk production, reproduction, and health.

Body Condition and Milk Production

Spain (20) recently reviewed several studies affecting milk yield. Details and descriptions of his reviews are as follows:

- *Biosinclair et al., 1986.* He found that cows fed high-energy diets during the dry period showed no difference in milk yield during the first 120 DIM. Cows receiving the high-energy diets had higher BCS at calving. BCS was 3.38 for 100% of energy requirement versus 3.73, or 3.99 for 131%, or 162% of energy requirement.

- *Biosinclair et al., 1986.* In a second study, cows with higher BCS at calving due to high energy feeding during late lactation or the dry period had from 2 to 3 kg more milk per day during the first 120 days.
- *Michigan State Field Study.* Michigan workers reported cows that gained body condition during the dry period produced more milk. An increase of 1 point between the beginning of the dry period and calving corresponded to 545 kg more milk the first 120 DIM. Spain (20) pointed out that the Michigan State study involved cows from 1 commercial herd with an average BCS at dry-off of 2.77 for mature cows. These cows obviously required additional BC before calving.
- *Pedron et al., 1993* (16). He reported that BCS at calving did not affect milk production. However, the pattern of BC loss after calving related to increased milk production. A net decrease of 1 unit BCS corresponded to an increase of 438 kg in mature equivalent (ME) milk production and 422 kg of 305-day milk production. These results point out the importance of having adequate BC available to support milk yield.
- Waltner et al., 1993. Investigators at Washington State University further investigated the relationships between BCS and milk production of Holsteins. They suggested a quadratic response existed between BCS at calving and FCM production during the first 90 DIM. Also, these workers reported a curvilinear response to change in BCS and 305-day fat corrected milk (FCM). These results suggest an optimal BCS at calving would be between 3 to 4. They also indicate a goal would be to have a change in BC of .50 to 1.0 from calving to 120 DIM.

Body Condition and Reproduction

Cows that had BC scores of >4.00 at drying off had more problems than cows with lesser scores. These over-conditioned cows were 2.5x more likely to experience reproductive diseases, such as dystocia, retained fetal membranes, pyometra, cystic ovarian disease and abortion (13).

Cows losing extensive BC within a short period are also candidates for reproductive inefficiencies. Butler and Smith (2) showed the following associations:

- Cows that had extreme loss of BC after calving experienced reduced fertility.
- Cows that lost >1.00 BCS during the first five weeks had 17% first service conception rates (FCR) compared with 59% for cows that lost <1.00 BCS (Table 3).
- Cows that had moderate loss of BC (i.e., 0.50 to 1.0) had normal fertility.
- The cumulative pregnancy rates were similar for all groups of cows; therefore, the infertility associated with body condition loss was temporary.

Table 3. Relationship between body condition loss during first 5 weeks postpartum and reproductive performance (2)

Item	Body Condition Loss <.50	.50 TO 1.0	>1.0
Number of cows	17	64	12
Days to first ovulation	27	64	42
Days to first heat	48	31	62
Days to first service	68	41	79
First service conception rates, %	65	67	17
Services per conception	1.8	2.3	2.3
Pregnancy rates, %	94	95	100

Table 4. Interval to first service and conception rates in postpartum cows grouped according to change in body condition score from week one to five (1).

Trait	Maintained Condition	Lost Condition
Days to first AI	84.9	82.9
First service conception rates, %	62[a]	25[b]
Third ovulation conception rate, %	61[a]	42[b]
Second ovulation conception rate, %	67	50
Fifth ovulation conception rate, %	53	44

[a,b] Values in rows with different subscripts differ (P<0.05).

In another study (1), cows that lost an average of .60 BCS units suffered reproductively versus cows that gained an average of .10 BCS units. First service conception rates was 25% for cows losing weight compared with 62% for cows gaining weight (Table 4).

Ferguson (8) concluded that loss of a half unit of BC between calving and first breeding does not impair fertility. Greater BC losses are very detrimental (Table 5).

Table 5. Relationship of fertility and body condition change between calving and first insemination (n= 516 cows) (8).

Body Condition Change	Conception Rate
+1.0	61.7
+0.5	55.9
0	50.0
-0.5	44.1
-1.0	38.3

Body Condition and Health Disorders

Ruegg and Milton (18) did not report an association between BCS and periparturient disease. These results do not agree with other research and are somewhat puzzling.

Gearhart and coworkers (13) found overconditioned cows at calving had increased risk of developing reproductive and lameness problems. Thin cows at dry-off had increased risk of lameness. Spain (20) suggests that this association may be increased grain supplementation to thin cows during the dry period that may predispose cows to feet problems.

Wisconsin researchers (9, 10) found that excess BC does predispose cows to metabolic disorders. These workers suggest that excellent management can minimize the potential adverse effects of excessive body condition.

Work by Shirley (19) showed problems after calving in over-conditioned heifers. Heifers fed to a BCS of 4 and maintained for the last 60 days before calving experienced a high incidence of subclinical ketosis and displaced abomasa. Of 35 first-lactation cows, 17 experienced a displaced abomasum within the first 30 DIM. Shirley notes that the risks associated with calving heifers at a BCS of 4.0 or more outweigh the potential benefits of increased body fat stores on early lactation performance.

▪ Feeding and Management Considerations

Proper BC is necessary throughout the life of the dairy cow (Table 2). Managing EB and BC condition for optimum performance requires strategic planning. Key management principles include the following:

- Optimize BC loss in the early postpartum period.
- Restore BC during the lactation.
- Maintain BC through the dry period.
- Use the dry period, if necessary, to replenish BC.

Body Condition Loss

Excessive mobilization of body stores is usually the result of inadequate DMI. Why do some fresh cows have poor feed intakes? This is found primarily in over conditioned cows (i.e. BC∃4.0). Jones and Garnsworthy (12) showed that over conditioned cows experienced peak DMI 10 weeks later. They reached PEB 2 weeks later than cows in good body condition. In this study, over-conditioned cows lost 1 BCS unit; control cows had a slight gain.

- *Avoid getting cows overconditioned (i.e. BC>4.0).* Fat cows have reduced appetites after calving. Though studies are not showing greater depression of DMI before calving, (7, 8) anecdotal evidence suggests that this be the case. The best way to avoid fat cows is to manage energy balance during the latter half of the lactation (3).
- *Do NOT allow fat cows to lose condition during the dry period.* Excessive mobilization of body fat sets them up for fatty liver disease. Actually, they need to gain 0.5-0.75 kg/day to support a rapidly growing fetus (17).
- *Body condition score dry cows.* Cows should not lose body condition (BC) during the dry period. Dairymen should score dry cows each week. Cows losing weight may have twins. Move these cows to a higher energy ration. Increasing BC minimally is possible (i.e. 0.25- to 0.50-point) during the dry period.
- *Reduce NEB during the transition fresh cow period.* Maximizing DMI is the only way practically to accomplish this goal. Provide feed *ad libitum* to maximize feed intake. Energy intake follows feed intake (i.e., DMI). Dry matter intake depends on many variables. They fall into three general categories: 1) environment, 2) cow, and 3) ration. Table 6 summarizes these variables.

Table 6. Variables that influence dry matter intake.

Environment	Cow	Ration
Temperature	Milk production	Physical texture
Ventilation	Body size	Palatability
Humidity	Hormonal status	Fiber content
Feedings per day	Breed	Nutrient balance
Water	Body condition	Moisture content
Sprinklers, fans, etc.	State of health	Forage quality

Body Condition Gain

- *Put additional weight on thin cows during late lactation if possible.* Cattle are energetically efficient at this time. The efficiencies are 75% and 60% (14) for the late lactation and dry period, respectively.

Table 7 shows the tissue energy associated with different BC scores. Note that the energy reserve from a BCS of 2.5 to 3.5 is 436 Mcal. Based on the following efficiency relationships published in the NRC (14), calculating the days for a BCS to change is possible:

- Conversion of ME to milk production (NEL) = 0.64
- Conversion of ME to energy reserves gain = 0.75
- Conversion of energy reserves to milk production (NEL) = 0.82

- ↑ *If NEL Is Below Requirements by 2.00 Mcal/Day.* 436 Mcal x .82/2.00 = 179 days to drop from a condition score of 3.5 to 2.5.
- ↑ *If NEL Is Above Requirements by 2.00 Mcal/Day.* 436 Mcal/ ((2/.64) X .75) = 186 days to increase from a condition score 2.5 to 3.5.

From a practical standpoint, deciding at pregnancy diagnosis how much gain a cow needs by completion of the lactation is desirable. If pregnancy diagnosis is at 45 days, then this leaves 180 days until dry off. A cow scoring 2.5 would need an additional 2 Mcal/day of NEL above requirements to score 3.5; a cow scoring 3.0 would only need an additional 1.0 Mcal/NEL to score 3.5 at the end of the lactation. These adjustments may be met by feeding an extra 1.14 kg and 0.57 kg of corn, respectively.

- *Cows still thin at dry off should receive extra feed during the first half of the dry period.* 2.0 to 2.25 kg additional corn will allow thin cows to gain approximately 0.25 kg/day. More herds are finding this necessary with higher production and the adoption of BST. This approach requires three dry cow groups: far offs, thin cows, and springers.

Table 7. Energy reserves at different body condition scores (11).

	CONDITION SCORE			
	2.5	3.0	3.5	4.0
Body Weight (kg)	**----------Mcal/body condition score----------**			
545	187	200	201	203
590	203	217	219	220
635	218	234	236	237

▪ Transition Diet and Management Considerations

Successful management of body condition requires good transition feeding and management. Following are some key principles:

- *Adapt the rumen to a more concentrated diet.* Provide 2.7 to 4.5 kg of grain daily to promote growth of the rumen papillae and allow the rumen microflora to acclimate to grains.
- *Acclimate the cow to ingredients of milk cow ration.* If the milking rations contain fermented feeds, feed some silage or haylage to allow adaptation.
- *Provide a protein balance of 15 to 16% crude protein that is 25 to 30% soluble protein and 35 to 40% rumen undegradable.* High-quality protein supplementation (e.g., blood meal, fishmeal, etc.) that provides a good supply of amino acids is critical. This is necessary to support gluconeogenesis.
- *Provide glucose precursors.* Feed 4 to 8 oz. of propylene glycol or 8 to 12 oz. of calcium propionate if ketosis is a problem. Provide fermentable carbohydrates (e.g., corn meal, high moisture corn, barley, etc.) Corn meal is the ideal choice, because it ferments slowly.
- *Promptly treat fresh cow problems.* Do not allow a fresh cow to get lost in the herd. Treat health problems promptly. Encourage fresh cows to eat. Force-feed cows that are off-feed to prevent excessive loss of body weight.

▪ Implementing a Body Condition Scoring System

BCS has several dimensions. Ferguson (5) points out three key elements:

- Change in condition with stage of lactation
- Body condition of the herd this month compared to last month
- Body condition compared between groups:

Following BCS for each individual cow from the dry period through lactation gives comprehensive information. Scoring each cow at critical stages of lactation and analyzing the changes between these points gives accurate measures of her energy balance. I believe that this is the most accurate way to monitor BCS. Some DHIA systems (i.e., Raleigh, NC) provide this option. Dairymen key in the scores and the computer program provides aggregate averages of body condition change as a function of lactation.

Another approach is to BCS all cows or a sampling of cows each month. By comparing the range distribution and mean score between months, we can assess change in herd BCS. Ferguson (5) points out that this allows us to watch changes in BCS as a function of seasonal activities. This may indicate times when management and facilities are not supporting cow performance.

A third aspect of BCS would be to look at BC based on outliers (5). We simply score the herd or groups within the herd and determine how many cows are **below** ("too thin") or **above** ("too fat") acceptable limits. Cows scoring between the two points are acceptable. Final discovery of BC of the herd or group is by calculating the percentage of outliers. I like 70-80 percent of the cows to score acceptable. If the percentage of cows above or below acceptable is over 15%, then corrective measures need to be taken.

Table 2 contains acceptable ranges for each stage of lactation. By finding cows that fall outside normal ranges we can quickly determine if there is body condition loss or body condition gain with a herd or group of cows. If there are more than 15% of cows are outliers, we know there is a problem.

▪ Troubleshooting Feeding Program Problems

Body condition scoring is an excellent indicator of the combined effects of diet formulation, feeding management, and animal husbandry. (3, 17) Consequently, it helps identify divergent feeding practices that can lead to health and performance problems.

Ultimately, the cow is the final evaluator of ration adequacy. Using the outlier method allows easy monitoring of herd BCS. Monitoring BC is one of the best means of evaluating rations and diagnosing herd nutritional problems. By monitoring BCS monthly or more frequently, we can identify problems early and promptly take corrective actions. Table 8 summarizes possible causes and preventive remedies.

▪ Summary

The underlying theme of this paper is that cows in optimum body condition give more milk, breed back sooner, and have less health disorders. Other supporting points are as follows:

- BCS is a method of evaluating body fat reserves.
- Scorers using the Pennsylvania BCS system deviated by either zero or a quarter point 90% of the time.
- The ideal BCS is a range and is a function of stage of lactation.
- Research results clearly show a strong relationship of BCS to milk yield, reproduction, and health.
- Managing energy balance and body condition for optimum performance requires strategic planning.
- A BCS system based on outliers is one where the scorer determines how many cows are below or above acceptable limits.
- Ultimately, the cow is the final evaluator of ration adequacy.
- Monitoring body condition is one of the best means of evaluating rations and diagnosing dairy feeding and management problems.
- By monitoring body condition monthly or more often, we can identify problems early and promptly take corrective actions.

Table 8. Undesirable body condition scores: possible causes and remedies (17).

Stage	Score	Possible Causes	Remedies
Calving	High (>3.75)	Cows dry off in excessive condition	! Reduce energy density of ration the last half of lactation ! Narrow energy to protein ratio of lactation ration
		Dry cows gaining excessive weight	! Reduce energy in dry cow ration
	Low (<3.25)	Cows dry off in poor condition	! Increase energy density of ration the last half of lactation ! Widen energy to protein ratio of lactation ration
		Dry cows losing weight on dry cow ration	! Increase energy density ! Increase protein content and quality (RUP)
Early lactation	High (>3.25)	Cows failing to achieve peak milk	! Increase crude protein to 17 to 18% ! Increase RUP to 35 to 40% ! Narrow energy to protein ratio to 4-4.2
		Poor genetic potential	! Cull
	Low (<2.50)	Cows too thin at calving	! Adjust condition for next lactation by keeping on high energy (>1.65 Mcal/lb.) for entire ration ! Increase energy density of dry cow ration if losing weight from dry off to calving

Table 8 (continued). Undesirable body condition scores: possible causes and remedies (17).

Stage	Score	Possible Causes	Remedies
Early lactation	Low (<2.50)	Cows lose weight excessively	! Avoid calving fat cows (4>) ! Increase energy density (1.72> Mcal/lb.) ! Widen energy to protein ratio to 4.2-4.4 ! Increase fiber to 21%> eNDF
Mid-lactation	High (>3.25)	Cows fail to milk	! Cull
		Cows on high energy diet for too long	! Balance energy to needs: reduce diet energy density (<1.67 Mcal/lb.) ! Narrow energy to protein ratio
	Low (<2.75)	Cows not recovering from loss of condition in early lactation	! Maintain energy density of ration (1.72> Mcal/lb.) ! Widen energy to protein ratio (4.4-4.6)
Dry off	High (>3.75)	Cows receiving excess energy in last half of lactation	! Balance energy density of ration to match cow's needs during last 6 mos. of lactation ! Narrow energy to protein ratio 4.2-4.4
		Cows not rebred on time (extended calving intervals)	! Consider culling ! Improve herd reproductive management

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