MATCHING FORAGE RESOURCES WITH COW HERD SUPPLEMENTATION

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INTRODUCTION

In any supplementation program, it is essential that forage resources be stocked such that there is adequate forage quantity available per animal unit. If forage quantity is insufficient, then the supplementation program will be ineffective. The object of supplementation programs (usually protein supplements) is to make-up deficiencies in forage quality to increase passage rate of forage and thus increase forage intake of the cow.

Forage intake of the cow declines with decreased forage quality. Cellulose content in mature forage increases and requires increased rumen residence time for rumen microbes to break down chemical bonds. Also, protein content of mature forage decreases, allowing less protein to be available for making new rumen microbes. The net effect is for the passage rate of forage and forage intake to decline (Table 1).

A general rule is for daily protein supplementation to be limited to around 2 lbs. a day in order to avoid forage substitution effects. If energy supplements are fed, then it is generally expected that negative forage substitution effects will occur.

COW NUTRITIONAL REQUIREMENTS

An animal unit day (AUD) is defined as 26 lbs. of forage per day for a 1000 lb. cow and her calf. If the forage is not green and actively growing, protein, phosphorus, and sometimes energy content of the forage may be deficient. In order to meet the dietary protein requirements of the cow herd, the forage needs to contain 7% protein or 1.6 lbs. per day for a nonlactating and 9.6% or 2.0 lbs. per day for a 1000 lb. lactating cow milking 10 lbs. a day. Calcium and phosphorus requirements for a nonlactating 1000 lb. cow in the last trimester of pregnancy are .26% calcium or .81 oz. per day and .20% phosphorus or .63 oz. per day. For a lactating 1000 lb. cow, .28% calcium or .88 oz. per day and .22% phosphorus or .70 oz. per day are required.

As mentioned above, protein requirements increase with lactation. For early lactation (18 lbs. of milk), protein requirements are 2.14 to 2.24 lbs for a 1000 lb. cow. For late lactation (7 lbs. of milk), protein requirements are 1.8 to 1.9 lbs. for a 1000 lb. cow. Protein requirements are lowest for nonlactating cattle during mid-pregnancy, or only 1.4 lbs.

Table 1. Forage Intake of Lactating Cattle at Different Forage Digestibilities[a]

Forage Digestibility or TDN %	Amount Required to Eat to Meet Maintenance Requirements, % of Body Weight[b]	Amount Can Eat at the Forage Digestibility Listed, % of Body Weight[c]
43	3.2	1.2 to 1.3
45	3.1	1.7 to 2.0
50	2.8	1.9 to 2.1
55	2.6	1.7 to 2.1
58	2.4	1.9 to 2.5
60	2.3	2.0 to 2.5
62	2.3	2.3 to 2.8
64	2.2	2.6 to 3.2
Greater then 64		2.6 to 3.2

[a]For a 1000 lb. cow milking 10 lbs. / day.
[b]The point of intersect for mainintenance requirements and what the animal can eat is around 56% digestibility for lactating animals and about 52% digestibility for nonlactating animals.
[c]Research from various sources including Kronberg et al., 1986. *J. Range Manage.* 39:421; Wagner et al., 1986. *J. Anim. Sci.* 63:1484; Havstad and Doornbos, 1987. Proc. West. Sec. Amer. Soc. Anim Sci. p. 9; Sprinkle, 1992. M.S. Thesis, Montana State University.

Table 2. Maintenance Requirements for Range Cattle

Cow weight, lbs.	Protein required, lbs., nonlactating range cow	Mcal of ME required, nonlactating range cow[a]
800	1.4	15.1
900	1.5	16.5
1000	1.6	18.0
1100	1.6	19.2
1200	1.7	20.5
1300	1.8	21.8
1400	1.9	23.0
1500	2.0	24.2
1600	2.1	25.4
1700	2.2	26.6
1800	2.3	27.8
Additional requirements for milk production: Add to the above maintenance requirements if cow is lactating.		
Estimated lbs. of milk production/day	**Additional lbs. of protein required/day**	**Mcal of ME required for milk**
5	.15	2.4
8	.24	3.8
10 (late lactation; 100 days or more)	.30	4.8
12	.36	5.8
14	.42	6.7
16	.48	7.7
18 (peak lactation; 60 to 70 days; most beef breeds)	.54	8.6
20	.60	9.6
22 (peak lactation; more typical of breeds such as Simmental)	.66	10.6

[a]ME = metabolizable energy; Mcal = megacalories (1,000,000 calories). Increase maintenance requirements by 10% if Charolais, Simmental, or other large framed breed crosses; increase by 15% for dairy crosses; reduce by 10% for Brahman crosses. If daytime temperatures exceed 95˚ F, increase maintenance requirements 25%.

Human energy needs are specified in calories. Human calories are actually equal to 1000 calories, so an average male diet of 3000 calories per day is equal to 3,000,000 calories. Since cattle are much larger than humans, energy needs for cattle are listed in megacalories of metabolizable energy. A megacalorie (Mcal) is equal to 1,000,000 calories. Metabolizable energy (ME) is that amount of energy in feed or forage thatis available to be metabolized or used by the body for maintenance, production, work, and heat regulation. The energy requirement for a 1000 lb. nonlactating cow is 18,000,000 calories or 18 Mcal of ME per day. To maintain a 1000 lb. range cow milking 10 lbs. per day requires approximately 23,000,000 calories or 23 Mcal of ME per day. Energy requirements for cows with greater milk production are increased by .48 Mcal of ME per lb. of milk (1 gallon of milk = 8.62 lbs.). Table 2 lists maintenance requirements for different sizes of cattle.

Energy is used to produce milk with about the same efficiency as energy is used to maintain essential body functions. Energy for body weight gain is used less efficiently than energy for milk production with a greater portion of the metabolizable energy being lost as heat as body tissue is formed. Poor quality forages promote very little body weight gains while the energy density of grain for body weight gain can be up to 7 times greater than that of inferior quality forage. Because of the variability in available energy for body weight gain among different feedstuffs and the accompanying inefficiency of gain, a different system of specifying energy requirements for gain (net energy for gain or NE_g) is recommended by the National Research Council. Net energy for gain or NE_g in a particular feed or forage is always less than ME (see Table 3). Table 3 lists ME and NE_g values for known digestiblities or total digestible nutrients (TDN) of forages or feeds.

The energy costs of NE_g required for body weight gain has been determined by research. Energy costs are dependent upon fat content of the gain, but for most range cows, each 1 lb. of live weight gain requires approximately 2.1 Mcal of NE_g. Live weight gain can only occur after the cow's maintenance and lactation requirements are met. If a 1000 lb. lactating cow milking 10 lbs. per day consumed 24 lbs. of forage with a digestibility of 60%, then 23.5 lbs. of the forage would satisfy her maintenance requirements of 23 Mcal (see calculation below).

23 Mcal ME required per day for maintenance and lactation

$$\div \frac{.98 \text{ Mcal ME}}{\text{lb. forage}} = 23.5 \text{ lbs. forage}$$

This would leave .5 lbs. of forage for gain, which would supply .17 Mcal of NE_g. The cow should be able to gain .08 lbs. per day with this level of milk production and forage quality.

.5 lbs. of forage remaining

$$\bullet \frac{.34 \text{ Mcal } NE_g}{\text{lb. of forage}} = .17 \text{ Mcal } NE_g$$

$$.17 \text{ Mcal } NE_g \div \frac{2.1 \text{ Mcal } NE_g}{\text{lb. of gain}}$$

= .08 lbs. average daily gain

COW HERD ASSESSMENT

The easiest way to monitor cattle is to use the body condition scoring system displayed in Table 4. Briefly, if the transverse processes of the lumbar vertebrae (between hip bones [hooks] and the ribs) are readily visible, the cow is probably a body condition score (BCS) of 3 and may not rebreed. Research has shown that reproduction will suffer when cows have a body condition score less than 4. Each 1 unit increase in body condition is approximately 80 pounds, so to increase a cow from a BCS of 3 to 4 would require a live weight gain of 80 lbs. Before a cow can gain weight, maintenance and lactation energy requirements must be met. It is practically impossible and very costly for cows to gain weight during early lactation. Most cows will mobilize fat to support milk production for the first 40 to 60 days of lactation. A good management practice is to monitor body condition 3 months before calving and supplement accordingly to maintain desired body condition. If possible, cattle should be at a BCS of 5 or greater at calving to allow for weight loss during the first 60 days of lactation. Young growing cattle that will be producing their first calf at calving, large frame size cows, and cows with greater milk production potential are all at risk for becoming thin and failing to rebreed. If the grazing management plan will allow it, young or thin cattle should be separated from the rest of the herd into a different pasture and supplemented as necessary to maintain body condition

Table 3. Energy Content of Forages or Feeds at Different Digestibilities

	Dry Matter Basis	
Digestibility	Mcal ME/lb. of feed or forage	Mcal NE_g/lb. of feed or forage
40	.66	.04
42	.69	.07
44	.72	.10
46	.75	.13
48	.79	.16
50	.82	.19
52	.85	.22
54	.88	.25
56	.92	.28
58	.95	.31
60	.98	.34
62	1.02	.37
64	1.05	.40

TDN = Total Digestible Nutrients; ME = metabolizable energy; NE_g = net energy for gain; Mcal = megacalories or 1,000,000 calories.

Table 4. System of Body Condition Scoring (BCS) for Beef Cattle

Group	BCS	Description
Thin Condition	1	EMACIATED - Cow is extremely emaciated with no palpable fat detectable over spinous processes, transverse processes, hip bones or ribs. Tail-head and ribs project quite prominently, as do shoulders, hooks, backbone, and pins. Looks like C.M. Russell's "Waiting for a Chinook" or "Last of the 5000."
	2	POOR - Cow still appears somewhat emaciated, but tail-head and ribs are less prominent. Individual spinous processes are visible and sharply defined and are still rather sharp to the touch, but some tissue cover exists along the spine. Spaces between spinous processes are visible.
	3	THIN - Ribs are still individually identifiable but not quite as sharp to the touch. There is obvious palpable fat along spine and over tail-head with some tissue cover over ribs, transverse processes, and hip bones. Backbone is still visible but not so sharp in appearance. Transverse processes of lumbar vertebrae (between hooks and ribs) are readily visible. Hindquarters are angular in appearance and not fleshy.
Borderline Condition	4	BORDERLINE - Individual ribs are no longer visually obvious. Foreribs are not visible, but 12th and 13th ribs (last ribs) are. The spinous processes can be identified individually on palpation, but feel rounded rather than sharp. Some fat cover over ribs, transverse processes, and hip bones. Transverse processes are no longer obvious. Spine is covered with some fat, but it is still possible to detect individual vertebrae. Full, but straight, muscling in hindquarters.
Optimum Moderate Condition	5	MODERATE - Cow has generally good overall appearance. Upon palpation, fat cover over ribs feels spongy and areas on either side of tail-head now have palpable fat cover. The 12th and 13th ribs not visible unless the animal has been shrunk. Areas on each side of tailhead are beginning to fill with fat, but are not mounded.
	6	HIGH MODERATE - Firm pressure now needs to be applied to feel spinous processes. A high degree of fat is palpable over ribs and around tail-head. Back appears rounded. Hindquarters are plump and full. Noticeable sponginess over foreribs and small mounds of fat are beginning to appear beside tailhead.
	7	GOOD - Cow appears fleshy and obviously carries considerable fat. Very spongy fat cover over ribs and around tail-head. In fact, "rounds" or "pones" or "love handles" beginning to be obvious. Some fat around vulva and in crotch. Brisket is full. Spine is covered with fat and spinous processes can barely be distinguished. Back has a square appearance.
Fat Condition	8	FAT - Cow very fleshy and over-conditioned. Spinous processes almost impossible to palpate. Cow has large fat deposits over ribs, around tail-head, and below vulva. "Rounds" or "pones" are obvious. Very full brisket.
	9	EXTREMELY FAT - Cow obviously extremely wasty and patchy and looks blocky. Tail-head and hips buried in fatty tissue and "rounds" or "pones" of fat are protruding. Bone structure no longer visible and barely palpable. Animal's motility may even be impaired by large fatty deposits. Heavy deposits of udder fat.

Adapted from Richards et al., 1986; *Journal of Animal Science* Vol. 62:300.

at a score of 4 or greater prior to calving. Many producers also breed heifers to calve 30 days before the cow herd to allow them additional time to recover from the stresses of lactation prior to rebreeding. A producer should consider implementing a supplementation program if the forage is such that cattle are consistently at less than a BCS of 4 at breeding and conception rates are 10 to 15% lower than desired.

EXAMPLE OF COST OF BODY WEIGHT GAIN BEFORE CALVING

It is determined that several cattle are at a body condition score of 3, ninety days before calving. The grazing management plan does not allow separation of thin cattle into a separate pasture. The permittee desires to evaluate the economics of supplementing all 100 cattle. To increase body weight 80 lbs. (1 condition score) over 90 days requires an average daily gain of .88 lbs. It is assumed that at 55% digestibility, the forage is currently meeting maintenance requirements if cattle have daily forage intakes equal to 2% of their body weight. The NE_g content of the cottonseed meal supplement to be fed is .50 Mcal of NE_g per lb. If cottonseed meal was $180 per ton and 90% dry matter (DM), to gain .88 lbs. per day would require feeding 4.11 lbs. of protein supplement per day at a cost of $0.37 a day.

$$\frac{.88 \text{ lbs gain}}{\text{day}} \cdot \frac{2.1 \text{ Mcal } NE_g}{\text{lb. gain}}$$

$$= \frac{1.85 \text{ Mcal } NE_g \text{ required}}{\text{day}}$$

$$\frac{1.85 \text{ Mcal } NE_g}{\text{day}} \div \frac{.50 \text{ Mcal } NE_g}{\text{lb. cottonseed meal}}$$

= 3.7 lbs DM cottonseed meal

$$3.7 \text{ lbs. DM cottonseed meal} \div \frac{.90 \text{ dry matter}}{\text{lb. as fed cottonseed meal}}$$

= 4.11 lbs. as fed cottonseed meal

- $\frac{\$0.09}{\text{lb.}}$ = $ .37 per day

The 90 day cost per cow would be $33.30, or $3330 for 100 cows. If conception rates increased only 10% by increasing body condition by 1 unit, the value added for calves would be $3000 if calves weighed 400 lbs. at weaning and sold for $0.75 per lb. If labor is factored in at $20 per day to feed the supplement and supplement was fed three times per week (9.59 lbs. per cow per feeding), net loss would be $930.

[$3330 supplement cost + $600 labor and gas (3 times/ week feeding)] - ($3000 value from calves) = $930 loss

In order to break even on the cost of supplement + labor and gas in the above scenario, two-thirds of the cow herd would need to be at a body condition of 3.

$3930 total cost of supplementation ÷ $300 per calf = 13.1 calves

13.1 calves ÷ 20% conservative estimate of increased conception with cow BCS of 4 vs. 3 during breeding = 65.5 cows

It is much more cost effective to separate thin cows from fat cows 3 to 4 months before calving, and to supplement them to be at a BCS of 5 or greater at calving. Ideally, cattle should go into winter with a BCS of 5 or greater. This allows for a cushion for weight loss when forage quality and availability decline. Thin cows, especially first calf heifers, could possibly benefit from weaning calves 1 or 2 months early to take advantage of lower cow maintenance requirements and the opportunity for gain before forage quality and availability drop in late fall. If first calf heifers have calved two weeks to a month before the cow herd, this can offset some of the reduced weaning

weight. Also, late summer calf prices are often slightly higher than autumn calf prices. Producers can benefit by evaluating forage as described below in order to match cow nutritional requirements to forage quality. This will allow for forward planning of weight loss in the cow herd and enable designing a cost effective supplementation program.

FORAGE ASSESSMENT

*Forage Quality***.** In order to match cow requirements to the available forage, lab analyses of forage samples representative of the cow herd diet are encouraged. By matching cow nutritional requirements with forage contributions, a cost effective supplement program can be developed. When forage is green and actively growing, forage quality should be sufficient to meet a cow's nutritional requirements. As forage matures, forage quality is reduced substantially. At a minimum, the forage should be analyzed for protein and TDN, and, if possible, calcium and phosphorus. Local Cooperative Extension offices can furnish addresses and phone numbers of laboratories which can provide this service.

Another option to plant testing is to analyze fecal samples from a cross section of the herd (approximately 10 cows) using a new technique called near infrared spectroscopy (NIRS). This technique uses reflected infrared light to estimate digestibility, protein, and phosphorus content of the forage diet. Unless the cow's diet contains 30% or greater brush content, NIRS can be a rapid and easy method to determine nutrient content of the diet. Currently, Texas A & M University (Department of Rangeland Ecology and Management, Grazingland Animal Nutrition Lab, College Station, TX 77843-2126) is doing this procedure. The phone number for more information is (409) 845-5838.

Currently, the cost for protein and TDN plant analyses is approximately $18, and the cost for NIRS is around $24 with shipping costs included. The NIRS procedure may more accurately estimate energy and protein content of the selected diet, but is not recommended when diets consist of large quantities of brush. If plant analysis is practiced, it is important to select a representative sample similar to what the cows are actually eating by plant species and percentage.

Benefits are not usually realized in nonlactating cattle for protein supplementation unless the forage has less than 6.25% protein. Protein supplementation when protein content of the forage is below this level will increase microbial synthesis of protein in the rumen and also increase passage rate and intake of poor quality forage. If forage has less than .28% calcium and .22% phosphorus as a percentage of dry matter, then lactating cattle (1000 lbs.) should have a free choice calcium and phosphorus mineral mix provided in addition to trace mineral salt. The TDN or digestibility content of the forage for lactating cattle is marginal at around 56%. For nonlactating cattle, TDN is marginal at around 52%. As digestibility of the forage drops, residence time in the rumen increases and forage intake decreases to levels inadequate to maintain production and reproductive success.

*Additional Considerations for Forage Quality***.** Let us assume a cow herd consists of 1200 lb. cows milking 16 lbs. per day and that forage quantity is no problem. The cows' maintenance and lactation energy requirements would be equal to 20.5 + 7.7 Mcal or 28.2 Mcal of ME per day (Table 2). If the forage digestibility is 60% (green and actively growing), then the energy concentration for maintenance would be .98 Mcal of ME per lb. of forage (Table 3). This would equal 29 lbs. of forage per day that needs to be eaten to maintain body weight, or 2.4% of body weight. This level of intake is possible with forage quality this good. If

forage quality dropped to 54% digestibility, then forage intake would need to be 2.7% of body weight, which is probably not possible with forage of this quality. In this instance, the cow would need to reduce milk production or lose body weight, or both. If the cow had a body condition score of 6, then weight loss would probably not be a problem. However, if the cow had a body condition score of 4, then potential problems could exist for rebreeding.

Because minimal cheap harvested feed or crop aftermath exists in Arizona, it is probably advantageous to match yearly forage resources to the calving season to reduce supplemental feeding. If a sufficient quantity of nutritious green spring forage is available, then traditional spring calving is practical. On the other hand, if forage quantity is limiting and often of poor quality during early spring, then it may be advantageous to move the calving season forward to synchronize with summer monsoon rains. Nonlactating cattle will consume about 30% less forage than lactating cattle and forage quality of dormant forage will more closely match nutrient requirements for nonlactating cattle.

SUPPLEMENTATION DECISIONS

Once the cow requirements are defined and forage quality determined, a decision can be made to supplement protein or energy or both. Usually, the best practice is to satisfy protein requirements first. This gives the best chance for increasing forage intake and increasing energy intake. After protein requirements are met, additional protein and energy may need to be supplemented in order to meet energy requirements or for weight gain. If the allotment is accessible, supplementation may have positive economic benefits in subsequent calving percentages. Supplemented cattle should be monitored frequently for body condition to evaluate the success of the supplementation program.

*Energy Supplementation***.** If the energy content of the forage is deficient, supplementation of energy will decrease forage intake and possibly forage digestibility. This may sometimes be an advantage in stretching forage supplies. Some of the negative forage substitution effects of energy supplementation upon forage intake can be overcome by including greater proportions of feed byproducts high in fiber such as corn gluten feed in the energy supplement. Energy supplements also have the disadvantage of needing to be supplemented at least every other day, and preferably every day. This may be impractical for many range operations. Boss cows may overload with energy when supplemented at less frequent intervals. Salt-limited supplements are also an option, but oftentimes cost discounts are not applied to the commercial supplement for the 20% salt included. Another solution may be to feed molasses based blocks, but an economic analysis should be conducted to determine costs and benefits of this type of energy supplement.

Protein Supplementation. Due to its positive effects upon forage intake, protein supplementation is the most frequently practiced of all supplementation regimes. Research in west Texas has shown that cattle may be effectively supplemented with protein as infrequently as once a week (seven times daily rate of supplementation of 2 lbs. per day). As mentioned earlier, protein supplementation may increase forage intake, allowing for greater intake of nutrients. Since protein supplements are costly, forage evaluation is recommended to determine if protein supplementation is necessary. For nonlactating cattle, the forage should contain less than 6.25% protein. Lactating cattle may benefit from protein supplementation if forage is below their requirements (9.6% for 1000 lb. cow), but they should be able to tolerate a slight deficiency since they can select a diet higher in protein than random pasture clippings. If forage

availability is inadequate, protein supplementation may be inefficient. If forage utilization in a pasture is already at 50%, then don't expect protein supplementation to enhance forage intake. Managers who use protein supplementation effectively with dormant forages often do so by establishing ungrazed forage "banks" or pastures to use in conjunction with protein supplementation. By doing so, the manager ensures adequate forage availability. If forage availability is inadequate, feeding larger quantities of a protein-energy supplement would be a better choice to attempt to minimize weight loss.

*Bypass Protein Supplementation***.** If the cow herd has been experiencing pronounced loss of body condition and the energy content of the forage is adequate, supplementation with a ruminally undegradeable protein supplement or bypass protein may be advantageous. Research in Montana on dormant winter range has shown that the feeding of bypass protein supplements may reduce weight loss in stressed cows. Also, earlier estrus activity following calving may exist in cows fed bypass protein. Feedstuffs high in bypass protein include feather meal, blood meal, corn gluten meal, and fish meal. Due to palatability problems, rendered animal products are usually limited to 25 to 30% of the total supplement and are combined with grain products to increase palatability. The effectiveness of bypass protein is influenced by the type of forage. For instance, research in Texas reported that cottonseed meal contains 50% bypass protein when fed with cool season forages, but only 23% with warm season forages. The disadvantage with feeding bypass protein is cost. Bypass protein supplements may cost twice as much as normal protein supplements.

*Supplement of Indecision***.** Sometimes a producer is unsure whether to supplement protein or energy. Usually, when forages are low in energy, they are also low in protein. Cool season forages tend to have greater digestibility than warm season grasses. Dormant Tobosa grass can be very low in both digestibility and protein. The "supplement of indecision" combines both protein and energy. An example supplement would contain 40% natural protein, 50% grain products, trace mineral salt, vitamins A and D, dicalcium phosphate, and potassium chloride. Fed at a rate of 2 pounds a day the 90 days preceding calving, there would probably be a slight decrease in BCS if the forage was low in protein and forage availability was adequate.

Table 5. Protein and Energy Content of Some Supplements

	Dry Matter Basis		
Feedstuff	% Protein	ME, Mcal/ lb.[a]	NE_g, Mcal/ lb.[a]
Corn	10.0	1.49	.67
Milo	12.4	1.30	.58
Cottonseed Meal	44.8	1.23	.50
Alfalfa Hay, full bloom	15.9	.85	.22

[a]ME = metabolizable energy; Mcal = megacalories (1,000,000 calories); NE_g = net energy for gain.

EXAMPLE CASE STUDIES OF SUPPLEMENTATION

As mentioned previously, supplementation of cattle should occur before calving. Minimal results will be achieved through supplementation the first 45 to 60 days after calving, and attempting to restore body condition after this time will be twice as costly as supplementing for weight gains before calving.

Two examples are presented at the end of this section: I. Maintaining a cow at a BCS of 5, ninety days before calving when forage quality is inadequate; and, II. Increasing BCS from 4 to 5, seventy days before calving when forage quality is adequate.

Table 5 provides nutrient content of some feedstuffs. Other values can be obtained from National Research Council tables for feedstuffs or from your feed company. Least cost computer programs are also available to calculate the least expensive supplements to feed.

SUMMARY

Ideally, body condition of cattle should be 5 or greater for maximum reproductive success. If BCS drops below a score of 4 at breeding, calving percentages will decrease sharply. Producers should manage their herds through supplementation regimes to obtain at least a BCS of 5 at calving. The least costly and most effective time to supplement is before calving. If cattle are still thin at calving, they should be placed on a higher plane of nutrition at least 60 to 90 days to increase conception rates. This may be accomplished with higher quality pastures if available or supplementation or both. Forage which is not green and actively growing should be analyzed to determine what type of supplementation to practice and at what level.

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Example I. Maintaining a Cow at BCS of 5 with Inadequate Forage Quality

1. **Determine Forage Quality.**
   Forage digestibility is 50% and protein is 6.2%.

2. **Determine Cow Maintenance Requirements (Table 2).**
   For a 1000 lb. nonlactating cow in the last trimester of pregnancy, 18 Mcal of ME and 1.6 lbs. protein are required.

3. **Estimate Forage Intake (Table 1).**
   Forage intake is estimated at 1.8% of body weight (a little less since cow is nonlactating).

4. **Determine if Maintenance Requirements are Being Met.**
   Protein: 18 lbs. forage intake • .062 protein in forage = 1.116 lbs. The forage is deficient in protein by .484 lbs. (1.6 - 1.116 = .484 lbs.) Using cottonseed meal as a supplement would require 1.08 lbs. of cottonseed meal per day (Table 5, dry matter basis). (.484 ÷ .448 protein/lb. cottonseed meal = 1.08 lbs.)

   Energy: 18 lbs. forage intake • .82 Mcal ME per lb. (see Table 3 to convert TDN to ME) = 14.76 Mcal. The forage is deficient by 3.24 Mcal. (18 - 14.76 = 3.24 Mcal). Using cottonseed meal as supplement would require 2.63 lbs. of cottonseed meal per day (Table 5, dry matter basis). (3.24 ÷ 1.23 Mcal ME/lb. cottonseed meal = 2.63 lbs.)

   So, to satisfy the maintenance requirements of this cow would require about 2.9 lbs. of cottonseed meal per day. (Must convert dry matter to as fed basis: 2.63 ÷ .90 dry matter = 2.9 lbs.)

5. **Supplement for Maintenance if Necessary.**
   To supplement this cow at this level for 90 days preceding calving would require 2.9 lbs. of protein supplement per day for a cost of $ .25 per day or $22.50 for 3 months ($9.00 per cwt. for cottonseed meal).

6. **Determine if Body Condition is Adequate.**
   Adequate.

7. **Supplement for Weight Gain if Needed.**
   Not needed.

8. **Financial Analysis.**
   If a 10% increase in conception occurs as a result of supplementation and calves are born on an average 20 days earlier, then the net profit excluding labor and gas is $19.50 (400 lb. weaning weights; 1.5 lbs. average daily gain on calves).

20 days • 1.5 ADG • .60/lb. =	$ 18.00
10% increase in conception:	24.00
(400 lbs. • .60/lb • .10)	
	42.00
less supplement cost	- 22.50
profit exc. labor and gas	$ 19.50

Example II. Increasing Cow Condition from 4 to 5 with Adequate Forage Quality

1. **Determine Forage Quality.**
   Forage digestibility is 55% and protein is 8.5%.

2. **Determine Cow Maintenance Requirements (Table 2).**
   For a 1000 lb. nonlactating cow in the last trimester of pregnancy, 18 Mcal of ME and 1.6 lbs. protein are required.

3. **Estimate Forage Intake (Table 1).**
   Forage intake is estimated at 2.0 % of body weight.

4. **Determine if Maintenance Requirements are Being Met.**
   Protein: 20 lbs. forage intake • .085 protein in forage = 1.7 lbs. The forage is adequate in protein.

   Energy: 20 lbs. forage intake • .90 Mcal ME per lb. (see Table 3 to convert TDN to ME) = 18 Mcal. The forage is adequate in energy.

5. **Supplement for Maintenance if Necessary.**
   Not necessary.

6. **Determine if Body Condition is Adequate.**
   Inadequate. Needs to increase by 1 condition score before calving, or by 80 lbs.

7. **Supplement for Weight Gain if Needed.**
   Average daily gain needed over 70 days is 1.14 lbs. (80 lbs. ÷ 70 days = 1.14 lbs.) This requires 5.3 lbs. of cottonseed meal per day (as fed basis). (1.14 lbs. ADG • 2.1 Mcal NE_g required per lb. of gain = 2.394 Mcal NE_g; 2.394 Mcal NE_g required ÷ .50 Mcal NE_g per lb. of cottonseed meal (Table 5) = 4.788 lbs. cottonseed meal (dry matter basis); 4.788 lbs. ÷ .90 dry matter = 5.3 lbs. cottonseed meal per day.

8. **Financial Analysis.**
   In this example, weight gain is expensive using a protein supplement. If a cheaper protein supplement could be obtained with a higher NE_g concentration per lb. of supplement, then it would cheapen things somewhat. Also, a judgment call is required here. In most years, the substitution of grain products could cheapen the cost of gain by about 1/2. There may be some decline in forage intake (possibly up to 15%), but this can be alleviated somewhat by feeding the grain supplement during the early afternoon (around 1 PM). Unless the weather is cold, cattle should not be grazing as actively during this time period, so there will be less substitution of energy obtained from the grain for energy obtained from grazing. If the protein supplement was fed, then the gross profit before discounting labor and gas would only be $8.50 per cow. This may be marginal in profitability. If corn were fed, 4 lbs. of corn would be required per day to achieve the same weight gains. At a corn price of $7.50/cwt, the cost per day for corn would be around $0.25 to $0.30 per day or $17.50 to $21.00 for the feeding period.

For Protein Supplement		**For Grain Supplement**	
20 days • 1.5 ADG • .60/lb. =	$ 18.00	20 days • 1.5 ADG • .60/lb. =	$ 18.00
10% increase in conception:	24.00	10% increase in conception:	24.00
(400 lbs. • .60/lb • .10)		(400 lbs. • .60/lb • .10)	
	42.00		42.00
less protein supplement cost	- 33.60	less grain supplement cost	- 21.00
profit exc. labor and gas	$ 8.40	profit exc. labor and gas	$ 21.00

FROM:

Arizona Ranchers' Management Guide
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Arizona Cooperative Extension