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# Balancing Forage Demand with Forage Supply

Larry D. White and Tom R. Troxel*

One of the first priorities for proper management of range resources is balancing animal numbers with forage supply. A balance between stocking rate and range utilization is necessary for the effective conversion of range forage to animal production plus maintaining future range production capabilities. To achieve this balance, ranchers need more information on current forage conditions. With timely forage inventories, planned stock flow information, and knowledge of ranch growing conditions, the amount of forage required to support livestock can be calculated and compared to the amount of forage available.

Often only past experience is used to establish or adjust stocking rates. This may result in an overstocked ranch that is forced to sell under crisis conditions or buy expensive feed and hope for rainfall. Better planning and more information on forage demand and supply can reduce the risk and allow more effective use of ranch resources.

Forage inventories and analysis of the forage supply/demand balance are needed because forage production can vary as much as 100 percent between years. This analysis should be done each March, July, and November to evaluate grazing plans. This information allows consideration of alternatives before crises develop. The stock flow and the forage inventory provide the baseline information for these analyses.

The approximate date can be predicted (unless regrowth occurs) when the forage supply will be reduced to the level where animal and range production will be adversely affected.

## Proper Stocking Rate

Many ranchers have used the same approximate stocking rate for years with adjustment only when forage supplies are depleted and feed costs prevent maintaining the current herd/flock size. This has damaged the resource and reduced the forage production available to livestock and wildlife as well as other resources (Figure 1). Because forage production varies significantly from year to year, the proper stocking rate should differ as well. Stocking rate is the

Continued overuse by an excessive stocking rate has depleted the range resource, increased the occurrence of forage shortages, decreased animal performance, and lost valuable topsoil from erosion.

*Extension Range Specialist, Texas AgriLife Extension Service, College Station, Texas, and Extension Beef Cattle Specialist, Arkansas Cooperative Extension Service, Little Rock, Arkansas.

area of land alloted per animal-unit for the entire grazable period of the year. However, the stocking rate is proper only when the number of animals grazed on a given area results in maintaining or improving the range resource consistent with the conservation of other natural resources.

By adjusting stocking rate to current forage production during the year, a rancher can ensure that the number of animals grazed will not harm the range resource. Adjustments are necessary only if you are overstocked or can add additional animals when excess forage is produced. Ranchers who only adjust stocking rates annually should be conservative, resulting in forage shortages only in drought years; hence, in normal and wet years forage is "underutilized," allowing faster range improvement, drought reserve, or accumulation of fuel for more effective use of prescribed fire. Ranchers who do not graze conservatively or adjust stocking rates in relation to current forage production will continue to damage their range, animal, and financial resources increasing risk of survival and violation of environmental regulations.

## Balance Animal Numbers with Forage Supply

The quantity of forage produced determines the number of animals that can effectively be supported: "coordination of forage utilization with forage growth through control of animal numbers usually determines the success or failure of other range practices and the economic stability of the operation" (Heady, 1975). At best, animal numbers, and more specifically daily dry matter intake (DDMI) of managed animal herds, should be regulated to harvest the current year's forage production without damaging future growth and quality.

DDMI is the actual forage intake required (forage demand) by an animal, while total forage requirement is the forage needed to meet both animal and range requirements. Until successful methods for predicting future forage production are developed, forage demand must be balanced with supply after forage growth has occurred.

## Match Animal Nutrient Demand and Supply Cycles

The key to successful animal production on most rangelands is selective grazing by animals with sufficient daily intake to meet nutritional requirements; i.e., maintenance, growth, and lactation. The capability of the range resource to supply the necessary nutrients in relation to animal requirements must be understood. Deficiencies must be corrected through supplementation if animal performance is to be adequate. Supplementation supplies deficient nutrients rather than feeding to meet deficits in the forage supply.

Seasonal changes in forage quality and quantity greatly determine if animal nutrient requirements are met. Diet quality may be adequate, but shortages in forage supply limit total daily nutrient intake. This often happens when spring growth is slow and animals graze short green growth but "refuse" to fill up on last year's remaining forage. Seasonal quality variations can be overcome by supplementation. Shortages in forage supply are more likely during the late fall and winter period, except during drought. Adjusting the livestock production cycle to best coincide with the seasonal forage cycle more effectively utilizes the resources for animal performance and reduces purchases of supplemental feeds.

## Stock Unit Equivalent for Cattle

The range must supply enough forage for animals to meet daily forage intake requirements (both quantity and quality) if animals are to be productive. Animal gains during one season that are lost during another season (over-wintering) produce no net increase. The daily forage demand (from pasture or other sources) differs for different kinds of animals, size (and age) of animal, physiological needs, and management objectives.

A stock unit equivalent (S.U.E.) table was constructed using a non-lactating 1,000-pound cow in the last third of pregnancy as a standard.

This animal requires 17.3 mega calories (NRC, 1984) of metabolizable energy which converts to a daily forage demand of 19.6 pounds of 53.6 percent digestible forage. All other animals were expressed in relation to this standard animal metabolizable energy requirement (Table 1).

Example 1 illustrates how the stock unit equivalent is calculated:

**Example 1.**

| Type of Animal | Requirement Metabolizable Energy | Standard | Stock Unit Equivalent |
|---|---|---|---|
| 1,100-lb. lactating cow | 19.9 | ÷ 17.3 Mcal = | 1.15 |
| 800-lb. lactating cow | 16.6 | ÷ 17.3 Mcal = | 0.96 |
| 500-lb. steer (gaining 1 lb./day) | 11.8 | ÷ 17.3 Mcal = | 0.68 |
| 700-lb. steer (gaining 0.5 lb./day) | 13.1 | ÷ 17.3 Mcal = | 0.76 |
| 2,000-lb. bull | 24.9 | ÷ 17.3 Mcal = | 1.44 |

## Table 1. Stock Unit Equivalent (S.U.E.).

[Based on NRC Daily Metabolizable Energy Requirement for 1,000-lb. Dry Pregnant Cow in the Last Third of Pregnancy]

**CATTLE**

**Mature Cows**

| Body Weight [lb.] | S.U.E. for Lactating Cow 3-4 Months | S.U.E. for Dry Cow Mid-Third Pregnancy | S.U.E. for Dry Cow Last-Third Pregnancy |
|---|---|---|---|
| 800 | 0.96 | 0.71 | 0.87 |
| 900 | 1.02 | 0.77 | 0.94 |
| 1,000 | 1.09 | 0.84 | 1.00 |
| 1,100 | 1.15 | 0.90 | 1.05 |

**Heifers (Medium Frame)**

| Body Weight [lb.] | S.U.E. For Different Grains Daily Gain (lb.) 0.5 | 1.0 | 1.5 | 2.0 | Lactating Two year-3-4 Month (0.5 gain) |
|---|---|---|---|---|---|
| 300 | 0.40 | 0.47 | 0.054 | 0.58 | ___ |
| 400 | 0.49 | 0.58 | 0.67 | 0.73 | ___ |
| 500 | 0.58 | 0.70 | 0.79 | 0.86 | ___ |
| 600 | 0.67 | 0.80 | 0.90 | 0.98 | ___ |
| 700 | 0.75 | 0.89 | 1.10 | 1.11 | 0.98 |
| 800 | 0.83 | 0.98 | 1.12 | 1.22 | 1.06 |
| 900 | 0.91 | 1.08 | 1.23 | 1.33 | 1.14 |
| 1,000 | 0.98 | 1.17 | 1.33 | 1.44 | 1.22 |

**Steers (Medium Frame)**

| Body Weight [lb.] | S.U.E. For Different Gains Daily Gain (lb.) 0.5 | 1.0 | 1.5 | 2.0 | 2.5 |
|---|---|---|---|---|---|
| 300 | 0.040 | 0.47 | 0.52 | 0.57 | 0.62 |
| 400 | 0.59 | 0.50 | 0.65 | 0.71 | 0.77 |
| 500 | 0.59 | 0.68 | 0.77 | 0.84 | 0.91 |
| 600 | 0.68 | 0.78 | 0.88 | 0.96 | 1.04 |
| 700 | 0.76 | 0.88 | 0.99 | 1.17 | |

The stock unit equivalent measure is similar to the animal unit in purpose. However, the standard animal unit is considered a mature cow with or without a calf consuming 26 pounds of forage per day. The stock unit relationship is based on energy requirements and allows changes as animal requirements change. This is necessary for month-to-month planning. The S.U.E. allows estimation of forage quantity needs by multiplying S.U.E. by 19.6 pounds of dry matter per day (53.6 percent digestibility) for the animal in question. Daily forage intake can be more accurately estimated if forage digestibility is known.

Example 2 illustrates how S.U.E. is used to determine daily forage demand.

**Example 2.**

| Type of Animal | S.U.E. | Daily Forage Demand |
|---|---|---|
| 1,100-lb. lactating cow | 1.15 x 19.6 = | 22.5 lb. |
| 800-lb. lactating cow | 0.96 x 19.6 = | 18.8 lb. |
| 500-lb. steer (1 lb./day) | 0.68 x 19.6 = | 13.3 lb. |
| 700-lb. steer (0.5 lb./day) | 0.76 x 19.6 = | 14.9 lb. |
| 2,000-lb. bull | 1.44 x 19.6 = | 28.2 lb. |

# Stock Flow Plan

The purpose of the stock flow plan is to project and monitor the number, performance, changes in inventory, and types of livestock by month. The stock flow plan should assist in projecting the amount of forage needed for animal performance. This will assist in the evaluation of adjusting animal numbers with forage availability for each grazing unit and for the entire ranch.

Table 2 is an example of a completed stock flow plan for a mature cow herd.

**Table 2. Example of a Completed Stock Flow Plan for a Mature Cow Herd.**

**Total Ranch Management Stock Flow**

Ranch =
Division =
Year =
Acres = 1,500

Class of Livestock: Mature Cows — Number of Bulls: 3

| | January 31 | February 28 | March 31 | April 30 | May 31 | June 30 | July 31 | August 31 | September 30 | October 31 | November 30 | December 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 |
| Weight | 1,155 | 1,078 | 1,008 | 981 | 1,000 | 1,025 | 1,025 | 1,025 | 1,050 | 1,080 | 1,155 | 1,155 |
| Prod. Stage | Calving | Calving | Calving | Lact-Brd | Lact-Brd | Lact-Preg | Lact-Preg | Lact-Preg | Wean | Preg | Preg | |
| A.D.G. | (2.50) | (2.50) | (0.87) | 0.65 | 0.81 | 0.00 | 0.00 | 0.81 | 1.00 | 2.40 | 0.00 | 0.00 |
| S.U.E. | 1.15 | 1.15 | 1.09 | 1.09 | 1.09 | 1.05 | 1.05 | 1.03 | 1.02 | 1.00 | 1.06 | 1.06 |
| Tot. S.U./Day | 84.0 | 84.0 | 79.6 | 83.8 | 83.8 | 80.9 | 76.7 | 75.2 | 74.5 | 73.0 | 77.4 | 77.4 |
| Forage Req./Day | 1,645 | 1,645 | 1,560 | 1,642 | 1,642 | 1,585 | 1,502 | 1,474 | 1,459 | 1,431 | 1,517 | 1,517 |
| Forage Req./Month | 51,008 | 46,072 | 48,347 | 49,257 | 50,899 | 47,540 | 46,573 | 44,212 | 43,782 | 44,355 | 45,499 | 47,016 |
| Bull S.U. | 0.00 | 0.00 | 0.00 | 1.40 | 1.40 | 1.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Forage Demand Per Year = 564,559 lb.
Forage Demand Per Acre = 376 lb.

| Changes in Inventory | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Death | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sold: Cows | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 |
| Steers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 | 0 | 0 |
| Heifers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 0 | 0 |
| Purchased: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Transfer: In | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 |
| Transfer: Out | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 | 0 |

## How to Prepare a Stock Flow Plan

- **Class of Livestock**: Record under "Class of Livestock" what type of livestock is entered into the stock flow plan (mature cows, bulls, stockers). Months of the year are also listed with numbers of days. Monthly information on the number of head, weight, production stage, A.D.G., S.U.E., and Total S.U./Day may be most conveniently recorded as it stands on the first day of the month.
- **Number**: The total number of the specific class of livestock. Because of the way many classes of livestock are managed, a monthly recount may not be practical. A recount should be completed every time livestock are gathered.
- **Weight**: Monthly livestock weights are to be recorded on this line if this information can be obtained. Body condition scores could be recorded on this line instead, with a scale of 1 to 9. Thin, moderate, or good scores or even arrows as an indication of body condition change could also be used. An arrow pointing up(↑) would indicate an improvement in body condition; an arrow pointing down (↓) would indicate a decrease in body condition; and an arrow pointing across (→) would indicate maintaining body condition.
- **A.D.G.**: The expected average daily gain is reported here. Once again, if the average daily gain is not known, use arrows (↑ increasing A.D.G., ↓ decreasing A.D.G., or → no A.D.G.).
- **S.U.E.**: Stock Unit Equivalent. The daily forage requirements differ for different kinds of animals, various sizes and ages, physiological needs, and management objectives. The S.U.E. is based on daily metabolizable energy requirement of a 1,000-pound cow in the last third of pregnancy (17.3 Mcal). Stock units change as production stages change throughout the production cycle. Enter the correct S.U.E. for the class of livestock.
- **Tot. S. U./Day**: Total Stock Units Per Day. Multiply the number of head times the S.U.E. If bulls are grazing with the cow herd, for example, multiply the number of bulls times their S.U.E. and add that number to the cow total S.U./ day.
- **Forage Demand/Day**: Take the Total Stock Units/Day and multiply by 19.6 pounds. This will estimate the daily forage demand for this group of livestock.
- **Forage Demand/Month**: To determine the forage demand for each month, multiply the Forage Demand/Day by the number of days in a given month.
- **Change in Inventory**: This is to assist with the transfer of livestock.
- **Death**: The number of animals lost each month may not be known. However, every time livestock are gathered, the number that died should be determined.
- **Sold**: The number of livestock sold during any given month should be recorded on this line.
- **Purchased**: The number of livestock purchased during any given month should be recorded on this line.
- **Transfer (in/out)**: This is to record the number of livestock transferred in or out of the specific classification of livestock. For example, weaned heifers may be transferred out to the growing heifer enterprise.

The stock flows of all livestock grazing the same pasture must be combined to determine the total forage demand. A grazing plan helps to identify when and where the forage demand will be obtained so that needed forage production by pasture can be determined.

As the year progresses, record what actually happens. By comparing planned events with actual events, future crisis situations may be forecast. This is very true in predicting when forage will be depleted. Actual records will also improve future plans.

## Determine Forage Demand

A complete mature cow stock flow plan is illustrated in Table 2. This stock flow plan starts in January with 73 mature cows. It identifies the breeding season (April, May, and June); calving season (January, February, and March), and weaning (October). During the breeding season months (April, May, and June) the addition of three bulls must be included with the

mature cow forage demand to obtain the forage demand for the entire herd (cows and bulls). Calves until weaning are considered in the S.U.E. for the cow.

The total annual forage demand for the example cow herd is 564,559 pounds of forage or 376 pounds per acre. Range research has determined that, on a year-long average, properly stocked livestock harvest only 25 percent of the forage produced, commonly referred to as a "harvest efficiency" of 25 percent. This means that 25 percent of the forage is consumed by livestock, 25 percent is lost to natural disappearance, and 50 percent must remain in the pasture for soil protection and future forage production. Therefore, the example cow herd requires 1,504 pounds (376 ÷ 0.25) of annual forage production per acre. If the pastures are capable of this annual production, then the planned stocking rate of 73 cows plus 3 bulls is appropriate, but adjustments may be necessary if seasonal rainfall is inadequate.

## How Long Will the Forage Last?

The planned stocking rate assumes a minimum level of annual forage production of 1,504 pounds per acre; however, actual production is seldom the same as expected. Current conditions are better evaluated by inventorying forage supply in March, July, and November and comparing with future forage demand, thus reducing a potential crisis. The example stock flow (Table 2) can be used to determine how long a standing crop of forage will last. For example, a July 1 inventory of pastures planned to be grazed through November 1 estimates a forage standing crop of 600 pounds per acre. Is 600 pounds per acre enough forage to meet projected forage demand? By adding the forage demand per month for the months of July, August, September, and October and dividing that total by 0.25, the total forage requirement for the cow herd can be determined (Example 1).

**Example 3. Total amount of forage required during July, August, September, and October.**

$$\frac{(46{,}573 + 44{,}212 + 43{,}782 + 44{,}355)}{0.25} = \frac{178{,}922}{0.25} = 715{,}688 \text{ total lb. of forage required}$$

If the cow herd is grazing 1,500 acres with a standing crop of 600 pounds per acre, 900,000 pounds of forage are available. With a total forage requirement of 715,688 pounds and a supply of 900,000 pounds, the ranch does have enough forage for this cattle herd until November 1. In fact, the short-term stocking rate could be increased by 19 S.U.E. throughout this planning period. To make this estimation, first determine the amount of excess forage (900,000 lb.—715,688 = 184,312 lb. of total forage available). Multiply the total forage available by 25 percent harvest efficiency (184,312 × 0.25 = 46,078 lb. available for forage intake). Stock unit days of grazing can be determined by dividing the available forage for intake by 19.6 pounds (46,078 lb. ÷ 19.6 lb./day = 2,351 stock unit days of grazing). Since there are 123 days from July 1 to November 1, divide the stock unit days by 123 days, which results in 19 S.U.E.

How long will the forage last if only 450,000 pounds of forage are available for this herd (300 lb./acre)? One way to answer this question is to determine the total forage demand per month and subtract this from the forage available for grazing.

The total amount of forage available for intake is 450,000 pounds multiplied by 25 percent, or 112,500 pounds on July 1. The amount remaining on August 1 can be determined by subtracting 46,573 (forage demand for July) from 112,500, which equals 65,927 pounds, and so on until the forage supply is depleted or regrowth occurs (Example 4).

**Example 4.**

| Month | Forage available | Forage demand for intake | Forage remaining |
|---|---|---|---|
| July | 112,500 lb. | 46,573 lb. | 65,927 lb. |
| August | 65,927 lb. | 44,212 lb. | 21,715 lb. |
| September | 21,715 lb. | 43,782 lb. | –22,067 lb. |
| October | –22,067 lb. | 44,355 lb. | –66,422 lb. |

This example indicates the herd will run out of forage during the month of September. The day in September when the herd will be out of forage can be estimated. After determining the September forage demand per day (1,459 lb.), divide it into 21,715 pounds of forage remaining after August (21,715 ÷ 1,459 = 15 days, or September 15). The forage inventory should represent grazeable plants. Some plants should

not be considered usable forage, since animals will starve before eating them readily. Forage demand and forage supply information can now be used to review management options in July before a September forage crisis actually occurs.

This example assumes regrowth due to September and October rainfall will provide forage to carry the herd or flock through the winter. In many cases, forage produced in the spring and summer plus full regrowth is needed for winter forage supplies.

## Conclusion

An effective total ranch operation requires careful planning, evaluation, organization, implementation, and control to maintain a balance among ranch resources. The ranch should operate as a natural ecosystem and, therefore, must have continual feedback for selective mechanisms to maintain stability and diversity for long-term survival.

Allocating all of the forage resource to the forage demand results in very little flexibility. Unused or underused resources offer opportunity to change or meet unforeseen circumstances. A planned drought reserve forage supply may be critical to survival. As flexibility decreases, usually risks increase, and capital expenditures to cover prior poor management decisions may be necessary.

When a resource becomes limited, it may become overutilized. The ranch then has less flexibility, even though other resources may be underutilized. Forced use of those underutilized but less preferred resources often results in deterioration of the preferred resources. Resource flow plans help pinpoint when, how much, where, and what resources are available for use throughout the year.

Balancing forage demand and supply can be accomplished by using the described procedures. This should improve management decisions and help identify important dates for implementing alternatives. Operating within the resources available reduces risk. Success requires careful planning and selection of the right things to do for investment of limited resources. As Allison (1988) stated, there is no-one poorer than a rancher always out of grass.

## References


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