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Beef Cattle Management During Drouth

TEXAS A&M UNIVERSITY
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Beef Cattle Management During a Drouth

THIS PUBLICATION presents a broad scope of information on drouths, including history, economic consequences, financial strategy, cattle management, feeding suggestions, range management, pasture management and some relationships between cattle production, cattle numbers and forage production.

This approach to drouth problems on a cow and calf operation should help the owner or manager of ranches make more intelligent decisions and to understand all of the consequences of each decision.

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Chapter 1
TEXAS DROUTHS DURING THE 20th CENTURY

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WEATHER RECORDS support the contention that drouths are nothing new to Texans. Drouth is defined as any year or sequence of years when the annual rainfall is 75 percent or less than the average annual rainfall.

Table 1 shows that in 30 of the past 70 years, a drouth has occurred in one or more of the ten regions of Texas. This table gives the percentage of normal rainfall actually received during a drouth year, and allows both a comparison of regions involved in any specific drouth and the duration of each drouth.

Table 2 shows the duration of drouths by regions and can be used to develop probabilities that drouths will last more than one year. Notice that the Upper Coast had eight 1-year drouths, but only one 2-year and no 3-year drouths. The probability of having a drouth the next year in that region is low, about 10 percent.

By comparison, in the Trans-Pecos region only three 1-year drouths occurred while four 2-year and one 3-year were recorded. Historically, the chances seem better for back-to-back drouth years than for a 1-year drouth. This affects drouth planning strategy for culling rates, calf weights and feed purchases.

The Edwards Plateau has an almost equal probability of a 2-year drouth once it is in the first year of a drouth. There, drouths of 1 year's duration have occurred six times, and of 2 years' duration, four times during this century.

Table 3 presents these data in percentages where a limited form of probabilities can be read directly. It is apparent that most of the drouths in Texas are of 1-year duration. Drouth strategy would depend greatly upon the expected duration of any drouth as it affects range forage production.

Forage production in the range areas of Texas generally parallels the rainfall pattern, but lags behind one year. That is, heavy or above-average rainfall during one year is associated with heavy forage production during both the current and following year. This leads to another method of describing a drouth called the "range feed condition index" as published by the U. S. Department of Agriculture.

The range feed condition index has been published for Texas since 1923, and has averaged 78 during a 48-year period, 1923-1970. Figure 1 graphically portrays the movement of this index over the 48-year period with the straight line at 78 indicating the average. Using 49 or less as very bad, 50-59 as bad, 60-69 as poor, 70-79 as fair, 80-89 as good and 90-99 as very good, it can be seen that conditions were listed as bad only 1 year (1956), poor in 3 years (1934, 1952, 1954), fair in 23 years, good in 20 years and very good in only 1 year (1926).

Some observers feel that the range feed condition index is a better indicator of drouth than annual rainfall data. This is because other factors such as wind, temperature, humidity and soil and range condition determine the effectiveness of rainfall. The reader may use the indicator of his choice to review the history of Texas' drouths.

What is important is to realize that drouths are continuously recurring phenomena in Texas; that they likely will last more than 1 year in the western half of the state; that reserves must be accumulated during average or better years to carry the ranching operation through drouth years and that strategies for handling drouths vary by regions of the state and by the financial position of each operator.

Table 1. Rainfall in Texas during drouth years by regions, Twentieth Century, as percentage of long-run average.[1]

Year	High Plains %	Low Rolling Plains %	North Central %	East Texas %	Trans Pecos %	Edwards Plateau %	South Central %	Upper Coast %	South Texas %	Lower Valley %
1901		71	70			60	62	70	44	
1902									65	73
1907										65
1909			72	68	67	74	70			
1910	59	59	64	69	43	65	69	74	59	
1911										70
1916		73		74	70		73	69		
1917	58	50	63	59	44	46	42	50	32	48
1920										71
1921					72					73
1922					68					
1924			73	73		71		72		
1925			72				72			
1927								74		74
1933	72				62	68				
1934	66				46	69				
1937									72	
1939							69			72
1943			72							
1948			73	74	62		73	67		
1950							68		74	64
1951					61	53				
1952	68	66			73				56	70
1953	69				49	73				
1954	70	71	68	73		50	50	57	71	
1956	51	57	61	68	44	43	55	62	53	53
1962						68			67	65
1963			63	68		65	61	73		
1964	74				69					63
1970	65	63				72				

[1]Long-run average annual rainfall (1931-1960) in inches:
18.51 22.99 32.93 45.96 12.03 25.91 33.24 46.19 22.33 24.27

Blanks indicate 75% of normal rainfall or greater.

Table 2. Drouth frequency and duration in Texas by regions, Twentieth Century

Years	High Plains	Low Rolling Plains	North Central	East Texas	Trans Pecos	Edwards Plateau	South Central	Upper Coast	South Texas	Lower Valley
					Number of drouths					
One	5	6	7	5	3	6	8	8	8	11
Two	1	1	2	2	4	4	2	1	1	1
Three	1				1					
Total drouths	7	7	9	7	8	10	10	9	9	12
Drouth years	10	8	11	9	12	14	12	10	10	13

Table 3. Percentage of Texas drouths of one or more years' duration by region, Twentieth Century

Years	High Plains	Low Rolling Plains	North Central	East Texas	Trans Pecos	Edwards Plateau	South Central	Upper Coast	South Texas	Lower Valley
					Percentage of all drouths					
One only	71	86	78	71	37	60	80	89	89	92
Two or more	29	14	22	29	63	40	20	11	11	8
Three	14				13					

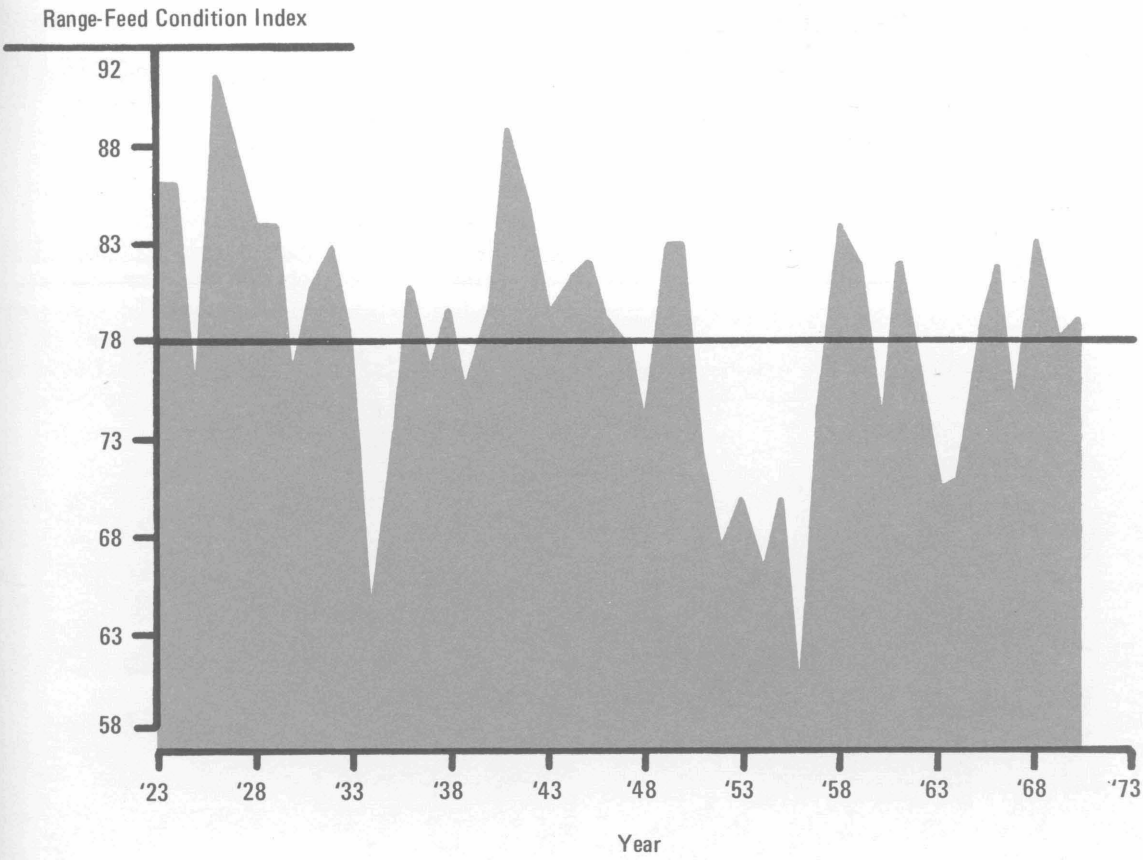

Fig. 1. Range feed condition in Texas, 1923-70, related to average.

A dry lot cow and calf operation for a part of the year may be the most economical way to preserve some of the breeding herd.

Chapter 2

FINANCIAL STRATEGY DURING A DROUTH

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THE REAL ISSUE is, "Once in a drouth, what are my strategies and how do I decide on the best one?" Several possibilities exist, each influenced by the financial condition of the operator and his desire to remain in the livestock business. Some of the strategies are:

1. Sell out entirely
2. Sell the herd only
3. Gradually reduce the herd (and possibly the leased acreage)
4. Maintain herd through feed purchases.

In this Chapter, we will take strategy No. 3 as our base. This assumes that the operator wants to stay in business, that he feels the drouth will last at the most 3 years, and that his lender will go with him on maintaining his notes.

Strategy 3 includes several decisions and actions from the time the drouth is first recognized until it has broken.

1. Cull borderline and old cows that probably would be culled at or near the end of the drouth because of age or other reasons.

2. Curtail replacement heifer development, keeping only cows that are proven and still young enough to continue producing after the drouth breaks.

3. Sell light calves, or at least remove calves from cows earlier than normal. Calves removed at 3½ months of age and 300 pounds would be the same as reducing the stocking rate by 18 percent or 18 cows out of each 100. Creep feeding up to weaning weight and feeding calves to higher weights are separate economic decisions, outside the range of this discussion.

4. Determine the maximum amount of money that can be spent per cow per year for feed purchases.

5. Estimate the difference between the value of a productive cow sold now and the replacement cost when the drouth breaks.

After agreeing to cull old and borderline cows and replacement heifers and to remove calves at lighter weights, each producer must determine his *unavoidable* out-of-pocket expenses. That is, costs he *must* pay to stay in business during the drouth period. Let us assume 300 pound calves sell at $33.50 per hundredweight and close culling results in a 90 percent calf crop. This produces $90.45 gross income per cow per year. The *unavoidable* operating costs per cow per year are estimated in Table 1.

Table 1. Estimated unavoidable operating costs per cow

Item	Estimates for East Texas (30 inches rainfall or more)	Estimates for West Texas (Less than 30 inches)	Your ranch
Veterinary	$ 1.50	$ 1.50	_____
Salt & mineral	1.50	1.50	_____
Repairs	1.00	2.00	_____
Transportation	1.00	1.50	_____
Marketing	3.00	3.00	_____
Taxes (personal & property)	1.50	1.50	_____
Credit life (cow note)	1.56	1.56	_____
Interest (operating)	.34	.44	_____
TOTAL	$11.40	$13.00	

Table 2 shows the amount which can be used to purchase feed from the annual income per cow in the herd which remains after paying the above unavoidable costs and paying the interest only on both the herd and land debt.

Table 2. Annual income per cow available for feed purchase at three herd equity and three land equity positions

	Herd equity[1]					
Land equity	100%[4]	Your Ranch	50%[4]	Your Ranch	25%[4]	Your Ranch
East Texas[2]						
100%	$79.05	———	$69.05	———	$64.05	———
75%	71.55	———	61.55	———	56.55	———
50%	64.05	———	54.05	———	49.05	———
West Texas[3]						
100%	$77.45	———	$67.45	———	$62.45	———
75%	59.45	———	49.45	———	44.45	———
50%	41.45	———	31.45	———	26.45	———

[1]Cows valued @ $250 each @ 8 percent interest on note.
[2]Assumes $500 land investment per animal unit @ 6 percent interest.
[3]Assumes $1,200 land investment per animal unit @ 6 percent interest.
[4]Estimates equal gross sales per cow less unavoidable annual costs and interest on herd and land debt.

Three-herd equity and three-land equity positions are analyzed. Values in Table 2 show the amount that can be spent on feed per cow before there is a zero profit from annual income. No charges have been made for overhead costs, such as taxes, insurance or utilities, nor any for family living. The assumption was that the operator was going to stay in

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business, as best he could, until the drouth breaks.

Assume that you have calculated Table 2 for your ranch situation which indicates that up to $50 per cow per year above unavoidable operating costs can be spent for feed, and that you can pay living expenses and overhead from miscellaneous income or personal loans. If the drouth continues after this amount has been spent for feed, you face the decision of further reduction in the cow herd or increased borrowing. Note that break-even feed expenditures vary widely with the equity position of the ranch.

The decision now involves a comparison of additional feed costs (losses over current income) with losses incurred from replacing further reduction in the cow herd. Table 3 shows losses associated with different selling and replacement prices during and after the drouth. This assumes you can sell and buy about *equal quality* cattle.

Table 3. Losses associated with different selling and purchase prices per cow.

	Expected purchase price per cow after drouth breaks				
Expected sale value of cow during drouth	$150	$200	$250	$300	$350
$150	0	50	100	150	200
200	0	0	50	100	150
250	0	0	0	50	100
300	0	0	0	0	50
350	0	0	0	0	0

Assume that you are a West Texas cattleman in the Low Rolling Plains, and own 75 percent of your land. Your lender has a note on 50 percent of your herd. This puts you in the 75 percent land equity and 50 percent herd equity position, where from Table 2 you can spend about $50 per cow per year in feed. Suppose you already have spent this much, but it is only September; from Chapter 1 you see that you have about an 86 percent chance that the drouth will break before the end of next year. Therefore, you go to Table 3 in Chapter 2, figuring you now can sell your cows for $200 per head, but pay $250 per head when you buy back next year. This Table suggests the maximum amount you might borrow to purchase feed and maintain your herd size.

Another method to estimate more closely the breakeven on borrowing to buy feed or on selling cows to purchase feed requires that you estimate the additional feed costs above expected income for next year; we will estimate this at $35 per head for this example. Now, evaluate the consequences of borrowing for feed purchases compared with selling cows just sufficient to cover feed costs as they are incurred by the remainder of the herd. Let us use an example with a 100-cow herd, as in Table 4.

Table 4. Comparison of financing feed purchases with timely cow sales versus borrowing

1. Borrowing for feed purchases:	
Feed costs @ $35 per head × 100 head	$3,500.00
Interest on purchased feed	140.00
Total annual costs	$3,640.00
2. Cows sold for feed purchases:	
Cows fed per cow sold @ $200 sale value equals $200 ÷ $35 = 5.7 head	
Percent of herd sales necessary to feed remaining herd equals $\frac{1}{1+5.7} = 15\%$	
Cows sold = 15% × 100 head	15 head
3. Replacement costs:	
15 cows @ $250 per head	$3,750.00

Each operator must decide whether to borrow and buy feed or to reduce the herd to buy feed. The previous example shows that borrowing to buy feed costs $3,640 to end up with the 100-cow herd, or $3,750 would be required for replacements to increase the herd back to 100 head when herd sales are used to purchase feed.

The strategy of selling cows when feed is needed is really a postponement of borrowing during a period of high uncertainty (in a drouth) to one of greater certainty (after it rains). For each year the drouth continues, interest will be compounded on loans in previous years for feed purchases.

During drouths in the four high annual rainfall regions of 30 inches or more, which includes North Central, South Central, East Texas and Upper Coast (Table 5), significant precipitation usually occurs during the two primary growing periods of April through June, and September through November (Table 6). Furthermore, the lowest total rainfall since 1901 for three of these areas was about 20 inches and in only 3 years the annual total rainfall was below 20 inches in the South Central region.

This situation leads to an initial strategy similar to that for other regions; that is, cull closely, curtail replacements and wean at an early age.

Because of the high likelihood of significant spring and fall rainfall, the secondary strategy includes minimizing feed purchases and increasing fertilizer *during the primary growing periods*. Fertilizer rates should be increased about 50 percent above the usual rate for the initial spring application in April and the fall application in September. If the drouth breaks, the additional production will replenish hay reserves. If the drouth continues, the added production will maintain the basic herd. Any excess production can be sold at substantially higher prices, up to double normal hay prices.

Income Tax Considerations

In general, livestock held for breeding or dairy purposes that are sold because of drouth are consid-

Table 5. Long-term average precipitation by months for selected regions, Texas

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
North Central	2.18	2.40	2.21	3.69	4.75	3.23	2.22	1.99	2.74	2.84	2.28	2.41	32.93
South Central	2.34	2.37	2.10	3.04	3.78	3.13	2.68	2.57	3.61	2.86	2.21	2.56	33.75
East Texas	4.22	3.82	3.58	4.56	5.12	3.35	3.42	2.91	2.95	3.15	4.26	4.62	45.96
Upper Coast	3.62	3.57	2.83	3.35	4.09	3.61	4.70	4.48	4.57	3.65	3.55	4.17	46.19

Table 6. Rainfall by months during the 1963 drouth year[1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
North Central	.43	.47	.95	3.96	3.64	2.01	1.44	1.16	1.50	.94	3.03	1.28	20.81
South Central	.74	2.41	.28	1.51	1.17	3.04	1.12	1.15	2.26	1.45	3.42	1.79	20.34
East Texas	1.78	2.12	1.67	4.03	2.42	2.92	3.30	1.31	3.43	.28	4.74	3.31	31.33
Upper Coast	2.35	2.68	.42	.99	1.50	5.42	2.58	1.87	6.14	.75	5.53	3.38	33.61

Source: Climatological Data, Texas, U.S. Department of Commerce.
[1]1963 was the last drouth reported in these regions.

ered "involuntarily converted" property. This means a rancher may postpone paying taxes on any gain received if he buys replacement livestock within the specified replacement period. A loss on a drouth sale does not differ from normal tax reporting. For example, consider a rancher who owns 100 cows which he originally purchased and who normally sells 10 old cows a year; but because of the drouth, he sells 40. Assume cows have an undepreciated cost basis of $100 per head and they sell for $175 per head. This means the rancher has a gain of $75 per head.

For tax purposes, he will be required to consider in the year of sale a capital gain of $750 (10 cows at $75 each). The additional 30 cows (or $2,250 gain at $75 each) that are sold because of drouth qualify as "involuntary conversions," and tax on the gain can be postponed.

Livestock that are *raised* have a *zero cost basis* (cash basis taxpayer); thus, the same situation discussed earlier would result in $1,750 gain (10 cows at $175) reported in the year of sale and $5,250 gain (30 head at $175) which could be postponed.

Information which a rancher must file with his tax return the year of sale (if he is going to postpone reporting his gain) includes:

1. Evidence that a drouth exists.
2. Computation of the amount of gain realized on the sale.
3. Number and kind of livestock sold.
4. Number and kind of livestock which would have been sold under normal circumstances.

The year the livestock are replaced, the tax return should contain the following information:

1. Date replacement livestock were purchased.
2. Cost of the replacement livestock.
3. Number and kind of replacement livestock.

The livestock must be replaced with similar livestock within 2 years after the close of the first tax year in which all or part of the gain occurred. An extension can be granted. Additional details are covered in the 1971 edition of the IRS Publication 225, "The Farmer's Tax Guide."

In summary, the steps recommended to cope with the drouth with the goal of conserving capital are:

1. Cull wisely and rigorously, using cow sales to purchase feed. Maintain good records on all sales. Keep only the middle aged, proven producers.
2. Sell replacement heifers next.
3. Wean calves at 3 to 4 months.
4. Feed cows so long as income covers variable costs, or
5. Feed as long as losses are minimized by keeping the present herd as opposed to further culling and buying back later.
6. Attempt to live within your income.

Possible Income from Wildlife

Intensive harvest of forage-consuming wildlife is also good drouth strategy. Reduced wildlife populations will reduce the incidence of starvation, and associated diseases, and will help maintain the remaining wildlife in a more desirable condition for recovery when the drouth breaks.

Materials on income tax management were provided by Robert Whitson, Extension area farm management specialist, Gonzales.

Inventory your wildlife resources. Do you have big game? Many big game leases bring 10 cents to $5 per acre, depending on quality of hunting, available facilities and proximity to large towns. How about quail? Returns vary from 10 cents to $3.00 per acre again depending upon the number and quality of other items included within the hunting lease. Dove hunting may be very good during drouth periods because of concentrations of birds around water facilities, fallow fields and other sources of feed. Also, the dove season does not conflict with quail or big game. Charges from $3 to $10 per hunter per day are common. In many counties, the javalina is a neglected game animal which offers opportunities for hunting at times other than the big game seasons.

There is a market for your wildlife crops, and the economic return is worthy of your consideration. More than a million hunters in Texas are interested in a place to hunt.

Publications Containing Additional Information

L-761, *Leases for Hunting,* C. W. Ramsey, Texas Agricultural Extension Service, 1970.

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L-761, *Leases for Hunting,* C. W. Ramsey, Texas Agricultural Extension Service, 1970.

Chapter 3
PRODUCTION LEVELS, CATTLE NUMBERS AND FORAGE PRODUCTION DURING A DROUTH

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THE MOST COMPLICATED decisions facing ranchers are those associated with reasonably matching forage production and supplemental feeding with cow numbers and levels of production during drouth years. These decisions are difficult because the rancher tries to lose as little money as possible during each year of the drouth while retaining enough cattle to have a quick financial recovery when rainfall returns to normal. Most ranchers, optimistic by nature, are reluctant to reduce cow numbers because of the possibility or hope of rain within the next 2 to 4 weeks.

A small 100-cow ranch with an average cow weight of 1,000 pounds and an average production level of 500-pound calves at 7 months of age must produce 1.3 to 1.5 million pounds of forage each year. Generally increases or decreases of 20 percent in forage production are considered normal because of the annual variation in rainfall. A short-term drouth is reasonably serious because it can reduce forage production to 60 to 70 percent of normal or average, which will reduce cow weights by 75 to 100 pounds, and calf weight by 75 to 125 pounds. If the most severe part of the drouth is when cows are expected to rebreed, percentage calf crop may be reduced more than 20 percent.

On well-managed ranges, the first 6 to 12 months of a drouth may not seriously reduce the feed supply because of old forage on the ground and drouth-resistant forage plants that will continue to grow on subsoil moisture. A small addition in a supplemental feeding program under these conditions allows a rancher to maintain normal cow numbers with some reduction in cow weight and weaning weight.

When ranchers enter the second or third drouth year with poor cows, no subsoil moisture, no reserve feed supply and ranges and pastures without any organic matter to slow down run-off, the forage available for a cow and her calf will be reduced drastically. During these periods, actual forage production may be as little as 10 to 20 percent of normal or average. With such reduced feed supply, it is necessary to reduce cow numbers, sell lightweight calves and spend more money for supplemental feed.

In the past, most of the emphasis during a drouth was on emergency feeding of livestock. Since most of the information reaching the producer stresses how to feed cattle under drouth situations, he may fail to see that a sizable reduction in cow numbers would greatly reduce his problems. During the drouth in the 1930's and in the 1950's, many ranchers kept twice as many cows as they should have, trying to retain some of their above-average breeding stock and to have enough cattle for a quick financial recovery at the end of the drouth. The extremely high feed cost for 2 or more years plus the deterioration in their ranges probably lengthened by several years the time necessary to make a financial recovery.

These energy requirements are calculated on cow weight and calf weight and leave the area of reproduction for a later discussion. Long periods of low forage production mean that excellent management of the available feed supply is necessary to provide the proper nutritional level when it is most important to maintain a reasonable percentage calf crop with the cow and calf at the weight suggested.

In this section, five different management systems are suggested, each relating to different:

- Energy levels for the cow and calf
- Supplemental feeding levels
- Energy levels needed from pasture forages
- Forage production levels from pastures

These five systems are shown in Table 1 and illustrated in figure 1.

System 1 was considered normal or average and the digestible energy requirements for the cow and calf from pasture forages and the total pasture forage production were assigned a value of 100 percent. In this management system, a 1,000-pound cow that produces a 500-pound calf at about 7 months of age was considered average for years of normal rainfall. The megacalories of digestible energy (D.E.) required for this level of production would be 8,820 annually.

When 200 pounds of a concentrate (grain, oil meal or some combination) are fed as a supplement, they would replace 270 megacalories of digestible energy. This would reduce the digestible energy requirement that must come from pasture forages to 8,550. Estimating that air-dry pasture forages contain an average of one megacalorie of digestible energy, we change our terminology from megacalories of digestible energy to pounds of air-dry pasture forage.

With only 60 percent of the pasture forages actually consumed by the cow and calf, forage produc-

tion should be at least 14,250 pounds for each cow and calf on the ranch.

System 2 was designed to reduce the energy requirements from pasture forages to 85 percent of normal and pasture forage production to 78 percent of normal. The energy requirement from pasture forages for each cow and calf was reduced by lowering cow weight by 7.5 percent or 75 pounds, lowering calf weight at weaning time by 20 percent or 100 pounds and by increasing supplemental feeding by 75 percent to 350 pounds of concentrate or its hay equivalent. Under this system of management, the cow weight would be 925 pounds, and the weaning calf 400 pounds. The same number of cows and calves on less pasture would result in an increase in pasture utilization by the cattle to about 65 percent.

System 3 describes rather severe drouth conditions where energy requirements from pasture forage are reduced to 70 percent of normal and pasture forage production required is only 60 percent of normal. Energy requirement is reduced by increasing supplemental feeding by 150 percent to 500 pounds of concentrate per year, reducing cow weight by 17.5 percent or 175 pounds and by reducing calf weight by 40 percent or 200 pounds. Cows and calves fed at this level would weigh about 825 and 300 pounds respectively. Under such poor feed conditions, the cows and calves would consume about 70 percent of the pasture forages produced.

System 4 describes a severe drouth situation where calves are weaned at 5 months of age to reduce the energy drain on the cow caused by milk production. Under this system, the energy required from pasture forages is reduced to 60 percent of normal and the amount of forage produced by the pasture to 48 percent of normal. Supplemental feeding has been increased by 220 percent to 640 pounds of concentrate. Cow weight has been reduced by 20 percent to 800 pounds, and calf weight at weaning time (5 months) reduced to 240 pounds or 52 percent of normal. Cows and calves under these poor feed conditions would consume at least 75 percent of the forage grown in the pastures.

System 5 deals with a situation about as extreme as cattle can be expected to live in while maintaining good reproduction rates. The system is devised to keep near-normal reproduction rates while cows are maintained at or near maintenance. Energy requirements from pastures are reduced to 50 percent of normal by increasing supplemental feeding by 350 percent to 900 pounds of concentrate or hay equivalent, maintaining cow weight at 800 pounds or 20 percent below normal and weaning 170-pound calves at 3 months of age. This is a reduction of 66 percent in weaning weight but should help maintain good rates of reproduction. Under such drouth conditions, the cows and calves should consume at least 75 percent of the forage produced in pasture.

For most ranches, a time arrives in a long-term drouth when there is no way to maintain the usual cow numbers without buying most of the feed for their care. Under these circumstances, the combination of increased supplemental feeding cost reduced productivity of the breeding herd and reduced cow numbers must be considered. Table 2 and figure 2 illustrate these points and should give guidelines as to the most appropriate combination for that ranch on a given year.

Table 2 and figure 2 illustrate the reduction in forage production for normal or 100 percent to 10 percent of the average or normal. As pasture forage production is reduced, the rancher must determine the production level, amount of supplemental feeding and the number of cows that can be kept on the ranch.

Table 2 and figure 2 show the relationship of cattle numbers to levels of forage production under the five systems. In this and in other tables, percent calf crop has not been specified because this is determined by the nutritional levels just before and during the breeding season. In this table, we have suggested that with 60 percent of normal forage production you might maintain the production levels in System 1 by reducing cow numbers to 60 percent of normal. If you would be satisfied with a reduction of 75 pounds in cow weight and 100 pounds in calf weight, you could continue with 76 percent of normal cow numbers.

When forage production is reduced to 30 percent of normal, a rancher probably could not maintain the 1,000-pound cow with a 500-pound calf at any reduction in cow numbers, but he might produce 400-pound calves from 925-pound cows if the stocking rates were reduced to 38 percent of normal or average; 50 percent of the cow numbers would result in cows weighing about 825-pounds producing 300-pound calves. Removing part of the stress of milk production by weaning 240-pound calves at 5 months off of 800-pound cows should allow a rancher to continue a stocking rate of about 63 percent of normal. A rancher should be able to maintain near 75 percent of the average or normal cow numbers by weaning calves at 3 months of age. Early weaning should stimulate rebreeding of the cows and maintain a high percent calf crop with 800-pound cows and 900 pounds of concentrates or its equivalent in hay fed to supplement the poor pastures.

Forage production can be reduced to 10 percent of normal and a small breeding herd can still be maintained. Under Systems 3, 4 or 5, a small group of 17, 21 or 25 head, respectively, of breeding cows can be kept at a light cow weight. The calves will average about 1.1 pounds gain per day and can be weaned at 7, 5 or 3 months according to the system used.

If a rancher follows recommendation in Table 2 and figure 2, he will end up with severely damaged ranges that will take several years or normal rainfall to recover. Under Systems 4 and 5, the cows and calves will have to consume at least 75 percent of the forage produced. Under range conditions when the cows and calves consume 75 percent of the forage, the other 25 percent generally is lost to insects, pounding rains, hail storms and trampling by livestock. This means little forage left above ground to maintain healthy grass plants or to slow down run-off. This means most of the rainfall ends up in the streams and rivers and the ranchland is eroded severely with little moisture penetration.

Table 3 and figure 3 also show the reduction in cow numbers as forage production is reduced under the different management systems. In this table, an attempt has been made to protect pastures by maintaining use of forage at 60 percent by the cow and calf. Under these circumstances, cow numbers must be reduced more than suggested in Table 2. This practice of matching cow numbers to forage production probably will enhance profit because of:

1. Less cost for supplemental feeding
2. Heavier calves at weaning time
3. Higher percent calf crop
4. More production from forage plants after rains
5. Quicker recovery of pastures and ranges after rainfall returns to normal.

In this table, we suggest the production levels for System 1 with pasture forage production at 60 percent of normal. The cow numbers should remain the same because utilization by the cows and calves has not changed. Under System 2, 71 percent of the normal cow number should maintain cow weight at 7.5 percent of normal or 925 pounds, and weaning weight at 400 pounds. With cow weight reduced 17.5 percent to 825 and calf weight reduced 40 percent to 300 pounds, about 86 percent of the normal cow numbers could be maintained with an increase of 150 percent in the supplemental feed to 500 pounds of concentrate per cow per year.

When forage production is reduced to 30 percent of normal in Systems 2, 3, 4 and 5, it should support 35, 43, 50 and 60 cows and calves, respectively, at the production levels suggested with the suggested supplemental feed.

A drouth that would reduce pasture forage production to 10 percent of normal would support 14, 17 and 20 cows under production levels and supplemental feeding rates suggested in Systems no. 3, 4 and 5, respectively.

The information in Table 4 can be used to work out the protein and energy requirements for production levels most common during drouth situations.

Table 1. Energy requirements of a cow and calf at different production levels and management systems under drouth conditions

	System number				
	1	2	3	4	5
	1000-lb. cows 500-lb. calves at 7 mo.	925-lb. cows 400-lb. calves at 7 mo.	825-lb. cows 300-lb. calves at 7 mo.	800-lb. cows 240-lb. calves at 5 mo.	800-lb. cows 170-lb. calves at 3 mo.
1. Energy requirements for a cow and her calf	8820	7750	6650	5990	5480
2. Energy in supplemental feeds. (lb. concentrate) concentrates × 1.5 = hay	270 (200)	480 (350)	670 (500)	860 (640)	1200 (900)
3. Energy needed from pastures. Forages in lb. of annual production	8550	7270	5980	5130	4280
4. Energy needed from pasture. Forages as a % of normal or average	100%	85%	70%	60%	50%
5. Probable pasture utilization. Energy actually used by cow and her calf	55-65%	60-70%	65-75%	70-80%	70-80%
6. Pound of pasture forage produced per cow. Over-grazed pastures at lower production levels	14250	11190	8540	6840	5710
7. Percentage of normal or average pasture forage production	100%	78%	60%	48%	40%
8. Pounds of pasture forage that should be produced for proper stocking rate. (60% used by cow and calf)	14250	12120	9970	8550	7130

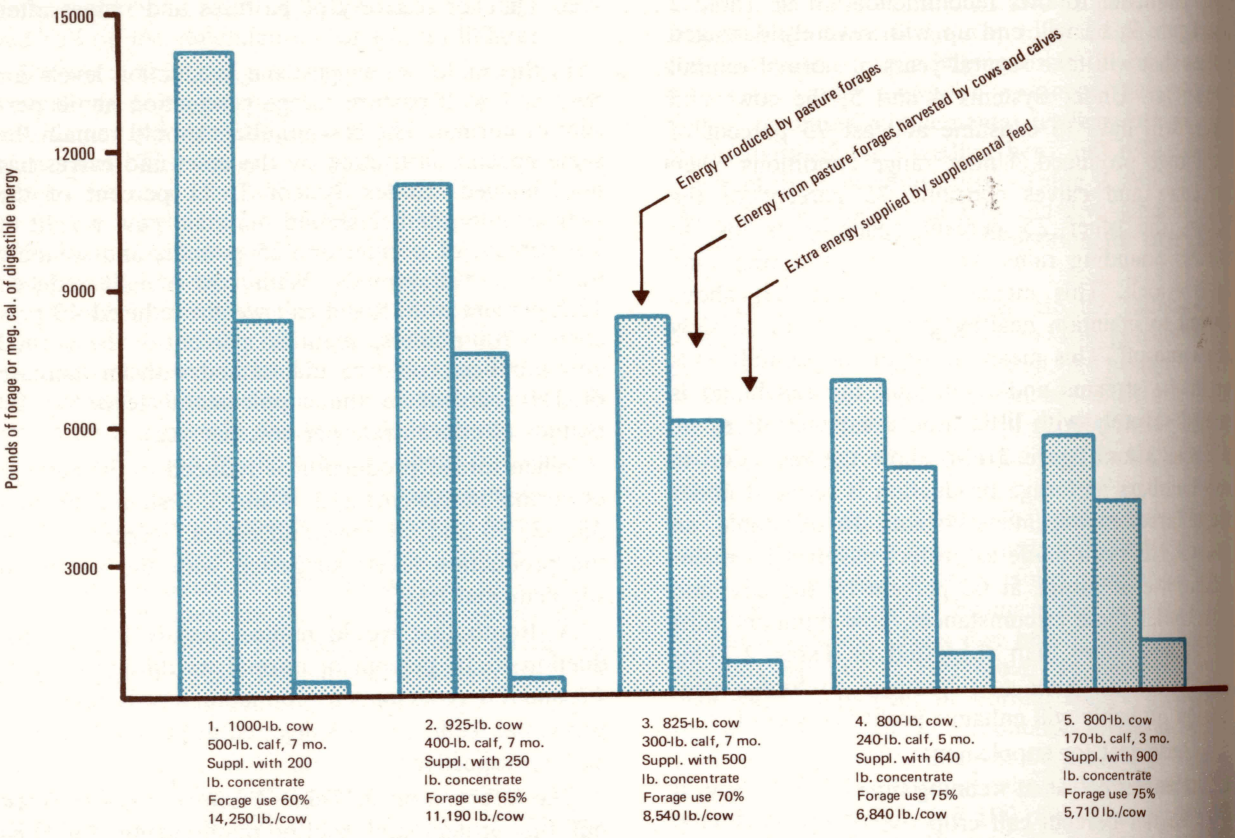

Fig. 1. Changes in production levels and management systems as forage production is reduced because of drouth.

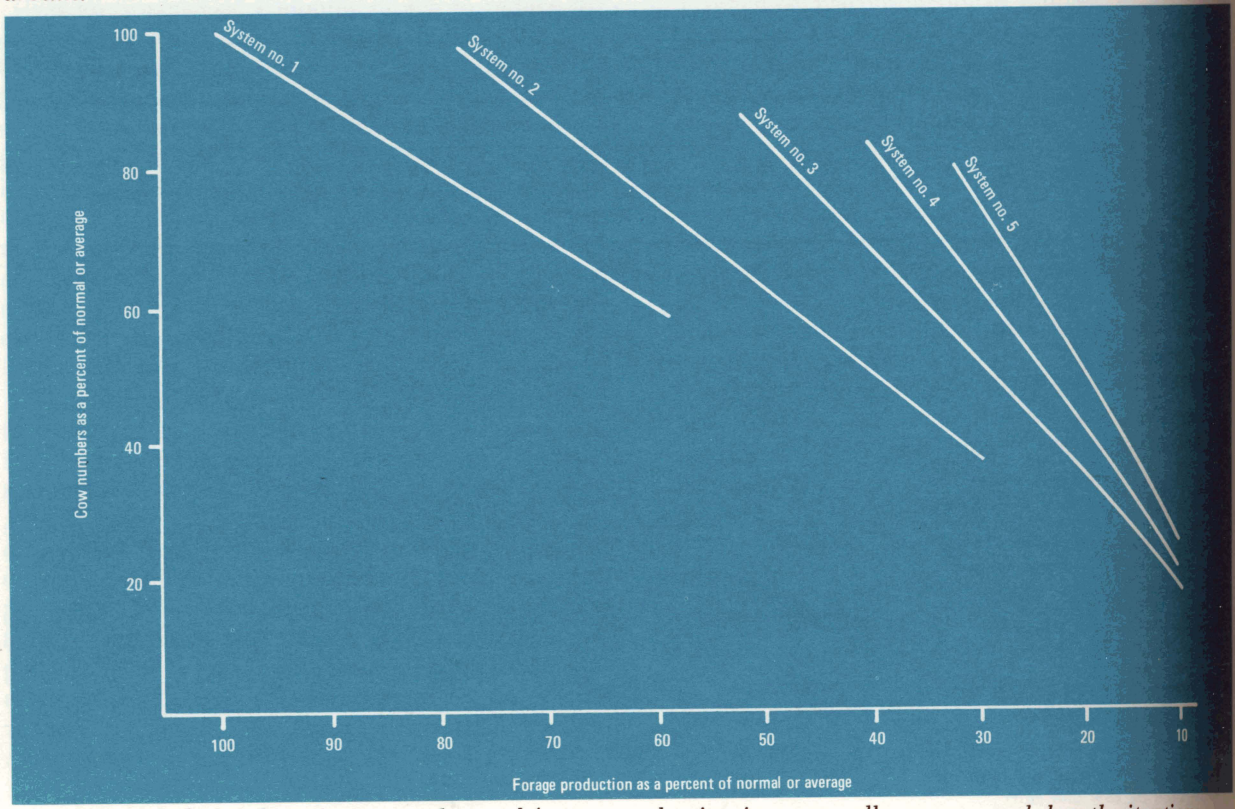

Fig. 2. Relationship of cow number and forage production in a normally over-grazed drouth situation.

Table 2. Percentage of normal or average cow numbers that can be maintained during a drouth under different mangement systems.
Severe overgrazing — up to 75% of forage by cows and calves

	Pasture forage production						
Percent normal or average	100%	80%	60%	40%	30%	20%	10%
Pounds per year (100 cows)	1,425,000	1,140,000	855,000	570,000	427,500	285,000	142,500
1. 1000-lb. cow—500-lb calf @ 7 mo. Supplemented with 200-lb. concentrate 60% use of forage 14,250 lb. per cow	100	80	60	40	—	—	—
2. 925-lb. cow—400-lb. calf @ 7 mo. Supplemented with 350-lb. concentrate 65% use of forage 11,190 lb. per cow	—	—	76	51	38	—	—
3. 825-lb. cow—300-lb. calf Supplemented with 500-lb. concentrate 70% use of forage 8450 lb. per cow	—	—	—	68	50	33	17
4. 800-lb. cow—240-lb. calf @ 5 mo. Supplemented with 640-lb. concentrate 75% use of forage 6840 lb. per cow	—	—	—	83	63	42	21
5. 800-lb. cow—170-lb. calf @ 3 mo. Supplemented with 900-lb. concentrate 75% use of forage 5710 lb. per cow	—	—	—	—	75	50	25

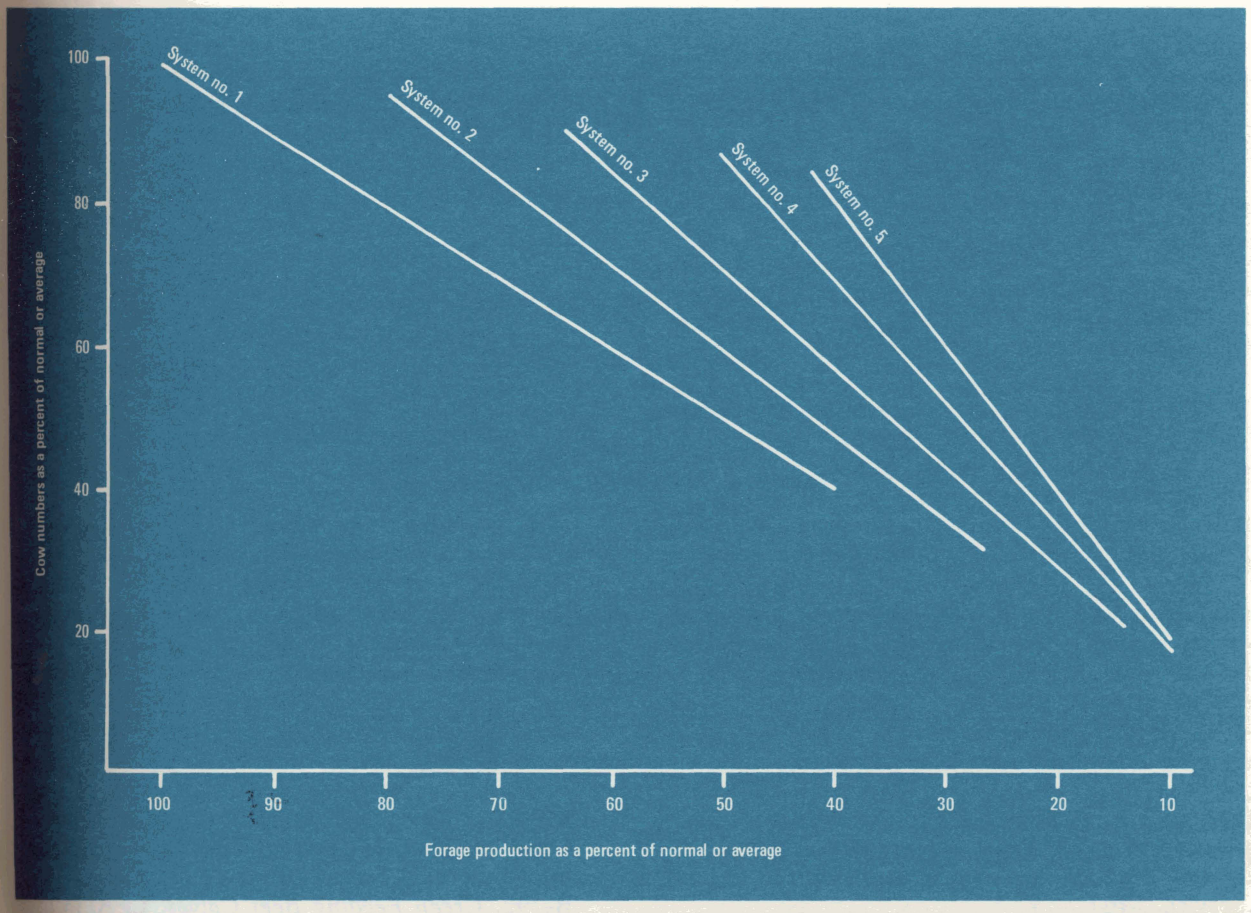

Fig. 3. Relationship of cow numbers and forage production in an attempt to practice reasonably good range management.

Table 3. Percentage of normal or average cow numbers that can be maintained during a drouth under different management systems
An attempt to maintain reasonably good pasture conditions — 60% use of forage by cows and calves

	Pasture forage production						
Percent normal or average	100%	80%	60%	40%	30%	20%	10%
Pounds per year (100 cows)	1,425,000	1,140,000	855,000	570,000	427,000	285,000	142,500
1. 1000-lb. cow—500-lb. calf @ 7 mo. Supplemented with 200-lb. concentrate 14,250 lb. per cow	100	80	60	40	—	—	—
2. 925-lb. cow—400-lb. calf @ 7 mo. Supplemented with 350 lb. concentrate 12,120 lb. per cow	—	94	71	47	35	—	—
3. 825-lb. cow—300-lb. calf @ 7 mo. Supplemented with 500-lb. concentrate 9,970 lb. per cow	—	—	86	57	43	29	14
4. 800-lb. cow—240-lb. calf @ 5 mo. Supplemented with 640 lb. concentrate 8,550 lb. per cow	—	—	—	67	50	33	17
5. 800-lb. cow—170-lb. calf @ 3 mo. Supplemented with 900 lb. concentrate 7,130 lb. per cow	—	—	—	80	60	40	20

Table 4. Daily nutrient requirements and nutrient composition of rations for mature beef cows and their calves. (Based upon air-dry feed containing 90 percent dry matter)

Daily nutrient requirements			Minimum amounts and qualities of feed		
Body weight lb.	Digestible protein lb.	Digestible energy megcals.	Daily feed per animal lb.	Digestible protein %	Digestible energy megcal./lb.
Feed requirements for maintenance of body weight					
800	0.51	11.21	12.0	4.3	0.95
900	0.56	12.24	13.0	4.3	0.95
1000	0.60	13.25	14.0	4.3	0.95
1100	0.64	14.23	15.0	4.3	0.95
1200	0.69	15.19	16.0	4.3	0.95
1300	0.73	16.13	17.0	4.3	0.95
Av. Age and wt. Mo. Lb.		**Feed requirements for milk production and calf growth**			
		1.11 lb. per day — 300 lb. calf at 7 mo. of age			
1 87	0.43	5.02	5.2	7.0	0.95
2 120	0.48	6.24	6.6	7.0	0.95
3 153	0.53	7.38	7.8	7.0	0.95
4 187	0.56	8.25	8.7	7.0	0.95
5 220	0.57	8.56	9.0	7.0	0.95
6 253	0.59	8.84	9.3	7.0	0.95
7 286	0.59	9.10	9.6	7.0	0.95
		1.57 lb. per day — 400 lb. calf at 7 mo. of age			
1 94	0.53	6.59	6.6	7.0	1.00
2 141	0.61	8.39	8.4	7.0	1.00
3 188	0.69	10.23	10.2	7.0	1.00
4 235	0.73	11.39	11.4	7.0	1.00
5 282	0.76	12.15	12.2	7.0	1.00
6 329	0.76	12.67	12.7	7.0	1.00
7 376	0.76	13.04	13.0	7.0	1.00
		2.05 lb. per day — 500 lb. calf at 7 mo. of age			
1 101	0.64	8.26	7.9	7.0	1.05
2 162	0.74	10.75	10.2	7.0	1.05
3 224	0.85	13.06	12.2	7.0	1.05
4 285	0.91	14.95	14.2	7.0	1.05
5 347	0.95	16.52	15.7	7.0	1.05
6 408	0.96	17.48	16.7	7.0	1.05
7 470	0.96	18.16	17.3	7.0	1.05
		Feed requirements for 1 mile travel, fetal development and gain			
Per 1000 lb. of body wt.	—	1.05	1.1	—	0.95
8th-9th mo. of pregnancy	0.10	2.00	2.1	4.5	0.95
For each one lb. gain	0.20	4.2	4.4	4.5	0.95

Source: B-1044 Nutritional Requirements of the Cow and Calf.

Publications Containing Additional Information

B-1044, *Nutrient Requirements of the Cow and Calf,* L. A. Maddox, Jr. Texas Agricultural Extension Service, 1967.

B-1043, *Feeding the Cow and Calf,* L. A. Maddox, Jr. Texas Agricultural Extension Service, 1967.

MP-956, *Keys to Profitable Cow-Calf Operation,* L. A. Maddox, Jr., and co-workers. Texas Agricultural Extension Service, 1970.

B-792, *Creep Feeding Beef Calves,* L. A. Maddox, Jr. and U. D. Thompson. Texas Agricultural Extension Service, 1969.

Chapter 4
MANAGEMENT FOR GOOD REPRODUCTION RATES DURING A DROUTH

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DURING DROUTH PERIODS, green natural forages, the most economical feedstuffs for livestock, are unavailable. In their place, sparse range grasses must be supplemented or animals must be fed entirely on harvested feeds. During such periods, feed costs rise and in so doing may dictate modifying routine production practices.

In the absence of sufficient nutrients, particularly energy, cows lose considerable weight. When such weight losses occur, milk production decreases and reproductive activity may cease. The end result is light-weight calves and unbred cows. To prevent such undesirable effects, cows either must be provided sufficient nutrients to avoid weight losses and maintain production requirements or they must be relieved totally or partially from body stresses.

Unavailability of feeds or their unusually high cost often prohibits feeding lactating cows the nutrients necessary for lactation and rebreeding. Production requirements of the mature cow for which nutrients are needed include body maintenance, lactation and rebreeding. First-calf heifers and young cows must have additional nutrients for growth. To reduce stress and lessen the total feed necessary, the only production requirement that can be removed is lactation. Lactation stress may be removed from cows or heifers by weaning calves after 60 to 80 days of age, or partially removed by creep feeding and holding the calf off of the cow for part of the day. In so doing, nutrient requirements are lessened and reproductive activity is more likely to commence or be maintained.

The cow herd must be gaining weight before a large percentage will show heat, breed and conceive. If healthy cows are losing weight, it is probably because they are receiving inadequate energy. Females in moderate flesh following calving should gain ¼ to ½ pound per day while cows in poor condition should gain up to ¾ pound daily for adequate calf weight and breeding success. Since energy is one of the most critical nutrients limiting reproductive efficiency, cows must receive adequate energy and should be handled to perform as described. Weaning calves from cows or limiting nursing time of calves lessens body stresses and makes such weight increases possible. Tables 1 and 2 show the effects of early weaning calves on subsequent calf performance and reproductive performance of their dams. It is recognized that the number of experimental animals is low.

Table 1. Effect of early weaning and creep feeding on breeding efficiency in young heifers.[1]

	Control heifers	Heifers-calves creeped	Heifers-calves[2] weaned
No. animals	7	7	7
Calf wt. @ 60 days	114 lb.	99 lb.	134 lb.
Calf wt. @ 7 mo.	352 lb.	378 lb.	376 lb.
Gain to weaning	1.54 lb.	1.80 lb.	1.55 lb.
Percent heifers pregnant	29	57	100

[1]90-day breeding season
[2]Calves weaned at 60 days of age
Source: Texas Agricultural Experiment Station, Overton.

Table 2. Effect of early weaning and creep feeding on breeding efficiency in mature cows[1]

	Control Cows	Cows-Calves Creeped	Cows-Calves Weaned
No. Animals	10	10	10
Calf wt. @ 60 days	156 lb.	150 lb.	156 lb.
Calf wt. @ 7 mo.	352 lb.	378 lb.	420 lb.
Gain to weaning	1.54 lb.	1.98 lb.	1.69 lb.
Percent cows pregnant	90	80	100

[1]90-day breeding season
Source: Texas Agricultural Experiment Station, Overton.

The tables show that creep feeding in young cows (2- and 3-year olds) partially reduces lactation stress and aids in rebreeding. Complete removal of lactation stress in young heifers and older cows shows a marked increase in breeding efficiency. Work at the University of Arizona on rebreeding first-calf heifers supports these data. Arizona work showed 79 percent pregnancy rates in heifers with calves weaned early and 46 percent pregnancy rates in normally weaned groups. The main limitation to breeding performance was absence of heat or failure to cycle.

Early weaning of calves overcomes the inefficiency of converting feed into milk and milk into gain. Cows on good pasture convert only about 30 percent of the digestible organic matter of their feed into milk and on poorer pastures this conversion may be even less. Then it takes about 12 pounds of milk for a pound of calf gain.

If cows have been with bulls before calves are weaned, the herd may be pregnancy tested. Pregnancy can be determined by expert rectal palpation as early as 40 days after conception. Females that are unbred can then be fed to gain in body weight. Feeding open females in this manner should provide enough energy to stimulate reproductive activities. Such females should be fed until most have cycled and rebred (about 45 to 60 days). Females pregnant at the time of early weaning can be put on a maintenance diet. The extra feed or feed saved then can be used to maintain other cows or fed directly to their

calves. This means more cows can be carried per acre of pasture and better use made of the lower quality forages that do not promote high milk production.

The success of early weaning depends somewhat on the diet calves are receiving. According to various studies, the rumen will be fully developed in 8-week-old calves that have been allowed roughages and grain, but not in calves that have received milk only. Calves that are to be early weaned (particularly those less than 80 days of age) should be provided feed 2 weeks to one month before weaning. Such feeding stimulates rumen development and helps insure maximum performance of calves. One way to start calves on feed is to pen them and allow nursing twice daily. Putting calves in a relatively small pen with a palatable feed available will stimulate early eating. One or two older calves that eat well will "show the way." After a week or two, once-a-day nursing can be allowed for 2 or 3 days. When all calves are eating, they can be weaned.

Following are rations used for early weaning at Texas A&M University, the University of Illinois and the University of Arizona. The feed mixture used at Texas A&M has been used extensively in the rearing of dairy calves and also has proven to be of value in raising young beef calves. Beef calves fed this mixture should gain about 2 pounds daily. The A&M ration is designed to be fed with additional hay while the Arizona and Illinois mixtures have hay incorporated in the premix. Most feed stores carry premix feeds of high nutritive value normally used by dairymen for feeding calves. Many of these commercial mixtures may be used for feeding early weaned beef calves. Buying commercial premixes or custom mixing rations then depends on cost and availability of feedstuffs.

Table 3. Composition of postweaning mixture[1]

Ingredient	Pounds of feed[2]
Milo	1000
Cottonseed meal	500
Oats	500
Salt	20
Dicalcium phosphate	20
Aurofac	10
Total digestible nutrients, %	75
Digestible protein, %	15

[1]Ration should be fed with average quality hay.
[2]Ration should have added 1000 international units of vitamin A and 200 international units of vitamin D per pound of feed.
Source: Texas A&M University data.

Table 4. Composition of four postweaning diets.

	Diet[1]			
Ingredient	1	2	3	4
Corn, shelled cracked, lb.	685	588	491	394
Soybean meal, 50% C.P., lb.	40	137	234	331
Hay, ground, 15.75% C.P., lb.	250	250	250	250
Bonemeal, steamed, lb.	10	10	10	10
Limestone, ground, lb.	10	10	10	10
Salt, trace-mineralized, lb.	5	5	5	5
Crude protein, %	12.3	15.9	20.2	24.1

[1]All diets contained 1,000 international units of vitamin A, 200 I.U. of vitamin D and 10 milligrams of aureomycin per pound of feed.
Source: University of Illinois data.

Table 5. Summary of results from the four diets[1]

	Diet				
Ingredient	1	2	3	4	Average
Weaning age, days	81.0	79.0	79.7	82.7	80.6
Weaning weight, lb.	191.5	200.2	196.3	212.8	200.2
Average daily gain, lb.	2.08	2.13	2.14	2.24	2.14
Feed per lb. gain, lb.	4.55	4.44	4.21	4.33	4.38

[1]Calves in all treatment groups were fed for a period of 70 days.
Source: University of Illinois data.

Table 6. Composition of creep mixture

Ingredient	% ration
Milo, steam flaked	47.00
Alfalfa hay, ground	20.00
Cottonseed hulls	12.20
Cottonseed pellets	13.00
Molasses	5.00
Tallow	1.50
Dicalcium phosphate	0.40
Salt	0.65
Trace minerals	0.05
Antibiotic	0.15
Vitamin A-10-P	0.05
Total digestible nutrient, %	100.00
Crude protein, %	65.00
	13.50

Source: University of Arizona data

Table 7. Performance of early weaned and normal weaned calves and their dams

Data	Performance of Early weaned calves (93 days)	Control calves—milk fed to 203 days
Number of cow-calf pairs	14	13
Initial calf weight, lb.	257	262
Final weight, lb.	511	539
Gain, lb.	254	277
Daily gain, lb.	2.31	2.52
205-day weaning weight, lb.	512	544
Calf creep, lb./day	13.4	7.1
Cow feed, lb./day	16.6	26.7
Calf + cow feed, lb./day	30.0	33.8
Feed/lb. calf gain, lb.	13.0	13.4
Feed cost/lb. calf gain, $	0.24	0.24
Cows		
Initial weight, lb.	773	806
Final weight, lb.	819	811
Gain, lb.	46	5

Source: University of Arizona data

Publications Containing Additional Information

B-1107, *Ways to Increase Percent Calf Crop in Beef Cattle,* J. R. Beverly, Texas Agricultural Extension Service, 1971.

B-1077, *Determining Pregnancy in Cattle,* A. M. Sorensen, Jr. and J. R. Beverly, Texas Agricultural Extension Service, 1970.

B-924, *Testing Bulls for Fertility,* L. A. Maddox, Jr., A. M. Sorensen and Dale Burnett, Texas Agricultural Experiment Station—Texas Agricultural Extension Service, 1964.

Chapter 5

FEEDING SUGGESTIONS DURING A DROUTH

U. D. THOMPSON
L. A. MADDOX, JR.*

Protein Feeding

PROTEIN in the ration of a cow eating mature grass is important because it affects the amount of forage a cow can consume in 24 hours. Cows without adequate protein will have lowered rumen activity, which reduces forage consumption and, in turn, reduces availability of all nutrients to the animal.

Oil seed protein meals such as cottonseed, guar, peanut, soybean and linseed, if equal in percentage of crude protein, have much the same feeding value in cattle maintenance feeding. Mixtures of different meals have no feeding advantage over the single source since ruminants balance dietary protein through ruminal amino acid synthesis. Crude protein in the oil seeds is about 80 percent digestible compared to about 50 per cent for most dry roughages. Protein feed's chief function is to supplement grain and roughage, both comparatively low in protein. Protein provides balance and improves ration efficiency.

Individual preference determines form of protein supplements. Blocks, cakes, cubes and pellets can be fed directly on the ground, but meals, crumbles and liquids require equipment. Therefore, form plays an economic role since labor and equipment costs affect supplement selection.

Urea, Grain and Oil Seed Meals

Urea is a nitrogenous compound through which bacterial action in the rumen and in presence of sufficient amounts of carbohydrate feed is converted into protein. Use this nitrogenous material to lower protein cost. It contains no energy. Feed the feed-grade or fertilizer-grade (281 or 282). Mixtures containing urea require thorough mechanical mixing with molasses and ground grain. The grain to urea ratio should be no less than 8 pounds grain to 1 pound urea. Combinations of the grains and/or oil seed meals may be fed. Prepare these mixes with salt or feed-grade gypsum (calcium sulfate) to control intake. Feed stocker cattle a mixture of 90 percent concentrates and 10 percent salt to control the intake to 1 percent of body weight permitting growth gain on fair pasturage. Control dusty, ground grains with 5 percent molasses. Feed such mixes in weather-protected troughs. They also may be pelleted.

Allow cattle an adjustment period when starting on feeds containing urea. If 4 pounds of supplement is to be fed daily, provide 2 pounds daily for the first week and begin the 4-pound ration at the beginning of the second week. Toxic symptoms may occur when feeds containing urea are fed to starved animals or upon rapid consumption. Urea toxicity causes a staggering or wobbly gait in animals. If such is observed, administer orally ½ to 1 gallon of a 5 percent acetic acid solution or household vinegar.

Frequency of Feeding Protein

Three groups of wintering Hereford heifers and cows were supplementally fed cottonseed cake on pasture in the Davis Mountain area of Texas during four winters, 1958-62. The accompanying feeding schedules were used.

- Two pounds per head daily the first year and 3 pounds daily the last 3 years.
- Seven pounds per head on Tuesdays and Saturdays during the first year and 10.5 pounds the last 3 years.
- Four and two-thirds pounds per head on Tuesdays, Thursdays and Saturdays the first year and 7 pounds the last 3 years.

The three groups were rotated among the pastures during the winter to minimize pasture differences as much as possible. All cattle were pastured together during the balance of the year.

Although slight but nonsignificant differences in weight changes were observed among the three groups of cows, the difference in frequency of feeding cottonseed cake had no significant effect upon percent calf crop weaned, weaning weight of calves or weaned calf weight produced per cow. At the end of the fourth year the females fed twice weekly showed slight advantage in weight and in percent calf crop weaned. They also tended to graze more widely over the pasture without waiting for supplemental feed than did those fed more frequently.

Feeding twice per week was as satisfactory as

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more frequent feeding and resulted in savings of about 60 percent in labor and travel compared with daily feeding.

Quality and quantity of forage being consumed influences performance. Cattle receiving low-quality forage and insufficient amounts need both protein and energy more frequently.

Controlling Feed Consumption

Use salt or gypsum to limit feed consumption, reduce labor costs and permit each animal a more equitable share. Harmful results from salt feeding seldom occur with ample water and adequate forage. Salt-feed mixtures may range from 10 to 50 percent salt. The salt amount in the mixture regulates consumption level. Consumption will be lessened when there is enough high-quality forage available. Mixtures of salt and ground grain and/or oil seed meals, ground grain and/or urea may be fed satisfactorily. Percentage of each feed or combination in the mixture depends on feed prices and pasture conditions. With an ample supply of low-protein, fair-energy forage feed only salt and oil seed meals. Where the forage is low and limited in both protein and energy, add grain to the meal and salt mixture. In such cases feed more supplement.

Feed-grade gypsum (calcium sulfate) controls feed consumption similarly to salt. The previously suggested mixtures should contain half the gypsum as called for in the mix's salt portion. A ratio of six parts feed by weight to one part gypsum is suggested for mature cattle. Feed yearling cattle an eight to one ratio.

Energy Feeding

Lack of sufficient total feed (mainly energy) probably is the most common deficiency in the wintering of Texas beef breeding cattle. Low total feed intake can cause excessive losses of cow weight, improper fetus development, low tolerance to cold weather and lowered resistance to parasites and diseases.

When native pastures are mature and cured in the winter, they have 0.8 to 0.9 megacalories of digestible energy (40 to 45 percent TDN) per pound. Because this cured forage is high in crude fiber which slows down passage through the first stomach, cattle can consume only limited cured forage. When South and West Texas ranches are stocked properly, there usually is enough digestible energy provided they are supplemented with other essential nutrients. Most Texas ranchers overgraze their pastures, thus causing shortage of energy available to the cow during midwinter. Under these conditions, supplementation with 20 percent crude protein feeds at a higher daily rate is recommended. Consider feeding sorghum grain as an energy supplement.

Trap or Drylot Feeding

Maintaining livestock in feedlots or traps near water and shelter conserves animal energy. Hays can be used as the sole feed, but without a small amount of legume hay, a protein supplement should be supplied. With as much as 4 pounds of alfalfa hay daily per head for cattle fed with sorghums, prairie or johnsongrass hay, the protein supplement is not necessary. Four pounds of alfalfa hay supply about as much protein as 1 pound of cottonseed meal.

Dry cows or cows and calves can be maintained in drylot on an all-concentrate ration for several months during a drouth. Dry cows can be maintained on 8 to 10 pounds of an all-concentrate ration with 7 percent of digestible protein properly fortified with minerals and Vitamin A. The cow and calf would need a daily feed of 14 to 16 pounds of all-concentrate feed containing 8 to 9 percent digestible protein for both cows and calves to remain reasonably healthy.

Creep Feeding Calves

Creep feeding young animals results in increases in weight and flesh and insures higher condition in the dams at weaning time. Creepfed calves tend to grow out uniformly and shrink little at weaning if continued on the creeps or placed on drylot feed.

Farm grains, such as oats, corn, wheat, and milo, and pellets or cubes are good feeds for creep feeding. Wheat and milo should be ground for calves. Shelled corn and oats may be fed unground. Ground ear corn and home mixtures of ground ear corn, 85 to 90 percent, and cottonseed meal, 10 to 15 percent, may be used. Self-feeding any of the concentrate feeds in creeps is safe as long as the young animals get even a small amount of milk.

Concentrate feeds ordinarily are used in creep feeding, but concentrate and roughage mixtures in various combinations may be used, particularly if pastures are short.

Vitamin A

Vitamin A is required for normal development of bones, maintenance of tissues and vision. Vitamin A deficiency in the early stages is characterized by night blindness. In later stages, cattle become less alert and lose their appetites. They may develop other symptoms such as watering eyes, swelling joints, rap-

id breathing and staggering gait. Or they may have a nasal discharge, suffer convulsions or develop complete blindness. Night-blind cattle bump into objects and those only partially night-blind walk about cautiously when driven after dark. Other symptoms previously mentioned may vary in order of occurrence, but watering eyes with some swelling joints may be noted soon after night-blindness occurs. Some watering at the eyes, however, may result from conditions other than Vitamin A deficiency. Sluggishness is characteristic, as is appetite loss. Staggering gait also has been noted while the animals still had sufficient energy to pitch and frolic when out of the lot. If the condition is not remedied, the cattle will become unmarketable and eventually die.

Vitamin A deficiency in bulls of breeding age results in decreased breeding efficiency. Spermatozoa decrease in numbers and motility, and there is marked increase of abnormal forms.

In Vitamin A-deficient breeding cows, estrus may continue, but fewer cows become pregnant. Deficiency in the pregnant animal, if severe enough, may cause abortion and birth of dead, weak or blind calves.

Cattle can store vitamin A and use this reserve when needed. The time in which cattle become vitamin A deficient varies. Young animals become affected in less time than older ones. There are marked differences also among individuals of the same age who receive the same treatment.

Calves weighing 250 to 400 pounds on a ration deficient in carotene may show symptoms of deficiency in 40 to 80 days. Those above 400 pounds show symptoms of deficiency in 80 to 140 days, and older cattle in 100 to 150 days.

Calves at birth have practically no body storage of vitamin A and depend on a supply from the colostrum or milk. If the cows are depleted and are on a carotene-deficient ration, calves will be affected by vitamin A deficiency. To save the calves, cows must have good green hay, ample silage or vitamin A fortified concentrates or supply synthetic vitamin A.

Synthetic vitamin A may be mixed with feed, injected intramuscularly and/or administered in controlled drinking water. Cows require 40,000; yearling cattle, 15,000; and calves, 5,000 international units daily per head. Vitamin A loses its potency when exposed to sunlight, air and heat. Use a dark, cool place for storing products containing vitamin A. It is available in different strengths. Administer according to manufacturer's recommendations.

Alfalfa hay is one of the better natural feed sources for supplying this vitamin. Any hay, however, may or may not contain carotene (vitamin A), depending upon age, time exposed to sunlight and air and the amount of heat created in the curing process and storage. Bright, pea-green color is an indicator of vitamin A potency in hay, but is not 100 percent reliable. Hays which contain mold from the result of heating have lost some or all of their vitamin A potency. Chemical testing is the most reliable method for determining this essential nutrient. Silage is considered a good source of vitamin A.

Minerals

Have granular salt available as a lick at all times, except when salt is fed to limit feed consumption. In most instances, it is preferable to feed as a separate mineral supplement except where it is used in combination with bonemeal to control blowing.

Phosphorus is the major mineral deficiency. Keep supplements available at all times. Bonemeal, spent bone black, dicalcium phosphate or monosodium phosphate are good free-choice phosphorous supplements. Monosodium phosphate may be added to the drinking water and is an excellent method of supplying this mineral. Commercial mixtures containing no more than ratios of one or two parts calcium to one part phosphorus are considered good supplements.

Stock Water

Drouth also means water problems in areas where livestock must depend on surface water. When a pasture still provides feed after the stock water has disappeared, the rancher may need to haul water to the cattle.

Water requirements of beef cattle are based on feed consumption (pounds of dry matter) and average daily temperature. The amount of water includes the moisture contained in the forage plants.

At an average temperature of 40 degrees, 0.37 gallons of water is needed for each pound of dry matter consumed. As the temperature rises, the water required per pound of dry matter intake increases by the following amounts: 50 degrees, 0.40 gallons; 60 degrees, 0.46 gallons; 70 degrees, 0.54 gallons; 80 degrees, 0.62 gallons; and 90 degrees, 0.88 gallons.

An 800- to 1,000-pound dry cow consumes 12 to 14 pounds of dry matter while on a maintenance ration. A cow in the same weight range and her 3- to 4-month-old calf consumes 20 to 24 pounds of dry matter per day.

Composition of Feeds

The protein and energy in common and unusual feed that may be used in a drouth are shown in Table 1. A comparison of the composition of the unusual or unfamiliar feed with those commonly used will give an indication of their relative feeding values.

Table 1. Composition of various feeding materials

Feed	Protein		Digestible Energy
	Crude	Digestible	
	%	%	Megcal/lb.
Alfalfa hay	15.2	10.6	.99
Beargrass, Yucca	6.6	2.4	1.02
Bermudagrass hay	8.1	4.1	.88
Bonemeal	25.3		
Corn, grain	8.9	6.9	1.60
Corn cob	2.9	—0.7	.92
Corn husks	3.4	0.4	.78
Corn grain and cob	7.4	5.4	1.46
Corn silage	2.3	1.5	.40
Cottonseed	23.1	17.1	1.81
Cotton gin trash	7.7		
Cottonseed hulls	3.9	0.2	.88
Cottonseed meal, solvent	41.1	32.5	1.26
Digester tankage	59.8	50.8	1.32
Guar meal	35.0		
Johnsongrass hay	7.0	3.1	1.00
Liveoak acorns	2.7		.47
Liveoak leaves	9.2	2.7	.34
Mesquite beans and pod	13.0	11.7	14.30
Mesquite, ground wood	5.9		
Mistletoe	9.0		
Molasses, blackstrap	3.0		1.07
Oats	11.8	8.8	1.30
Oat hay	6.4	3.8	.90
Peanut hay, good	10.0	5.4	.94
Peanut hulls	6.7	1.6	.37
Peanut hay, with nuts	13.4	10.2	1.43
Prairie hay	5.1	2.0	.91
Prickly pear	0.8	0.4	.19
Pear, finger	2.6		
Rice, rough	7.9	6.0	1.40
Rice bran	13.5	8.5	1.36
Rice, hulls	3.0	.1	.20
Rice straw	3.9	.6	.83
Salt, cord grass	4.3		
Sesame, meal	43.3	39.4	1.42
Spanish moss	1.9		.48
Sorghum grain	11.0	8.6	1.42
Sotol heads	2.2	.9	.49
Soybean meal, solvent	45.8	43.1	1.56
Sorghum hay	8.0		
Sorghum silage	2.3	0.6	.30
Sudangrass hay	11.3	4.3	.98
Wheat grain	11.1	8.3	1.56
Wheat bran	16.0	12.2	1.16

Source: L-916, *Supplemental Feeding of Beef Cattle.*

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Chapter 6
LIVING IN DROUTH WITH GOOD RANGE MANAGEMENT

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DROUTH is a "way of life" for Texas ranchers. Dry periods must be considered in long-range programs as one of many production factors. Range management balances livestock use to plant growth and insures a continuous forage supply. A good range management program provides for stored feed such as hay and silage, as well as the forage reserve resulting from wise grazing use. Proper range management also conserves soil and water and provides for better wildlife habitat.

Grasses must replace 25 to 50 percent of their roots each year, mostly at the expense of reserve plant food. A healthy range plant needs roots to produce top growth, but it also needs the food-producing foliage to insure a strong root system.

What About Drouth?

Three-fourths or more of average rainfall is necessary for maintaining range forage production. A shortage of precipitation averages about 1 year out of 5 in the eastern portion of Texas. Reporting stations in the western part of the State average 2 years out of 5 in which precipitation is less than three-fourths average. On a statewide basis, rainfall is below average more years than it is above.

Occasional dry years are not so critical, particularly if they are followed by an unusually favorable year. A crisis arises when two or more dry years occur in succession.

The following factors should be considered in determining the effectiveness of rainfall:

1. *Varying seasonal distribution across Texas.*

Central and East Texas have two characteristic wet periods; one around May and another about September. Summers are usually hot and dry and little forage production can be expected from native pastures. About two-thirds to three-fourths of the forage is produced during April, May and June, and most of the remainder during September and October. If rains are lacking during these periods, forage production will be lowered accordingly. Good rains in July and August can mean extra forage production.

In far West Texas, normally the one wet period begins about July and continues through September. Forage is produced principally during July, August, September and October. Other areas of the state have their own rainfall and forage production characteristics. Range management plans should be made to take full advantage of these periods of highest rainfall.

2. *Rainfall during the previous year.*

3. *Intensity and duration of individual storms.*

4. *Temperature, wind and other associated climatic factors.*

5. *Topography and soils.*

6. *Range condition* (amount and effectiveness of desirable forage cover). Only the sixth factor can be controlled, but we can take advantage of seasonal distribution. A good vegetative cover makes light rainfall more effective, and prevents soil loss during intense storms and periods of high winds.

Management During Drouth

Forage Plant Reaction

Drouth damages plants and this hurts the livestock operator. First, some of the buds at the base of perennial grass plants which normally grow into leaves and seed heads may not develop. Second, the height growth of the plant is less during drier years. These two plant reactions, alone or together, lower forage production.

Third, death of part or all of the plant's base or root crown during continued drouth further reduces plant density, and the amount of top growth; so forage production declines. Less food is stored for use by plant roots and for reserve energy to begin growth the next season. Unless stocking rates are adjusted to compensate for these reductions, range deterioration will be severe. Plants weakened by continual close grazing are more easily damaged than vigorous plants in properly stocked or deferred pastures. Perennial forbs may become fewer. Thus green forage that normally provides phosphorus, protein and carotene for deer and livestock may be absent for long periods. Woody plants may show some dieback in the top, and those growing on wetter soils may be damaged severely or killed. During extended drouths, even mesquite, hardier oaks and junipers may die.

Management Following Drouth

Plant Condition

Range improvement, which is slow at best, may begin with the arrival of favorable growing conditions if proper range management is applied. Seeds which have lain dormant in the soil germinate in large numbers. The plants still alive use their remaining food reserve to begin growth. Further plant development depends on food manufactured in the newly formed plant leaves. Treatment of individual forage plants and ranges is more important immediately following than during drouth. Plants should be grazed lightly, if at all, following the "one good rain" which breaks the drouth if they are to recover sufficiently for maximum yield.

A good height growth indicates vigorous plants, but does not assure high forage yield. Total forage production frequently is reduced by the decrease in plant density and size of the root crown. The better forage plants may make a good height growth but lack the vigor to produce much volume immediately. Annual plants such as tallow weed, filaree and rescuegrass should be utilized efficiently. Annual weeds not utilized by grazing animals should be controlled with herbicides to allow forage plants to make full use of available soil moisture.

Livestock Management

The ranchman's greatest hazard may be his optimism! He tends to stock too heavily too quickly. Execessive early use of desirable forage plants consumes growth made at the expense of the small food reserves in the roots. Plants must be given a chance to make and store food if they are to survive and reproduce. The foliage is the food-making part of the plant, and it should be allowed to develop and function if the range is to regain its original grazing capacity. Forage grasses can be grazed after they reach the boot stage.

Management problems of proper stocking, grazing systems and improvement practices following drouth vary according to locality, range condition and type of stock, but the following should be considered.

1. Experience and research show that a well-designed deferred rotation grazing system results in more rapid range recovery than continuous grazing with a proper stocking rate. The critical period in grass development is during active growth and seed production. Part of the range should be rested during this period to allow seedlings to become established and the older plants to gain strength. Deferred rotation-grazed pastures at Sonora improved in range condition during the drouth of the 1950's while pastures grazed yearlong declined and produced less livestock products.

2. The degree of grazing use should be regulated to prevent damage to grazed plants in a weakened condition. Greater stubble height should be maintained for at least 2 years following drouth. See MP-965, Keys to Profitable Range Management in Texas, for details.

3. Increased losses may occur from poisonous plants before the better forage plants make much growth. Drouth-weakened ranges are susceptible to invasion by poisonous and low-value weeds and brush, and may require treatment, either mechanically or with chemicals, to eliminate hazardous areas.

4. Maximum use of temporary pastures will allow range plants to make needed growth before being grazed.

5. Seed depleted areas with adapted species.

Preparation for Future Drouths

Prepare for a drouth during favorable years. Ranges should be used moderately during years of high forage production. Moderate use gives a reserve feed supply which can be utilized during drier years.

Management practices for range improvement following drouth should be modified as conditions change. Several years of careful treatment may be necessary to overcome the effects of serious drouths on vegetation. The management program should be aimed at the production and improvement of high-quality perennial range plants. Low-quality perennial and annual plants produce less usable forage, are short-lived and give little or no reserve feed.

A period of good conditions for plant growth is the time to overhaul your range management program. Consider the following:

1. *Balance the stocking rate with forage production.* Range forage production is more stable if livestock are permitted to graze 50 to 60 percent (the usable forage) of the total average forage production.

Ranchmen should base their stocking rate on 75 percent of the average usable forage production over a period of years. During good years, they can graze steers, lease their forage or use less severe culling. In drouth years, the range will not be overstocked.

2. *Organize a grazing management program.* Experience and research show that deferred rotation grazing permits maximum livestock production and results in steady range improvement. Studies at Sonora have shown moderately stocked, deferred rotation pastures produce better gains on cattle, and improve in condition as quickly as lightly-stocked pastures. Grazing systems which include temporary pastures or take advantage of local terrain or vegetation differences are desirable.

3. *Make range improvements.* Cross fencing helps obtain more uniform forage use. Permanent water facilities should be developed. A few large tanks

rather than numerous small ones should be constructed, and existing tanks deepened and other water developments made. New tanks should be deep with minimal surface to reduce evaporation losses.

4. Distribute livestock to use existing forage uniformly by separating salting and watering places.

5. Set up a systematic program for brush, weed and poisonous plant control. Mechanical or chemical treatment may be necessary to encourage an increase of desirable plants.

Control of dense brush, combined with deferment, results in easier livestock handling and improvement in the quantity and quality of forage. Increased forage production with brush control is especially noticeable during dry years.

Control brush first on the most productive areas. All of a pasture should be treated in a single operation since livestock prefer to graze the cleared areas. In areas where goats are used for sprout control, the acreage treated should be adjusted to the numbers of goats available.

6. Rains during the warm season produce grass. Below-average rainfall during the growing season warns of less forage production for later use. The ranchman who adjusts his stocking rate early will receive a better market price and will not face a loss from severe culling later.

7. Store silage, hay and other feeds while plentiful and not too expensive.

8. Seed abandoned fields and barren ranges to adapted forage plants. Many can be used later for hay production.

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This is the kind of forage cattlemen dream about during a drouth.

Chapter 7

PASTURE, HAY AND SILAGE MANAGEMENT FOR DROUTH

J. N. PRATT

ALBERT C. NOVOSAD*

SHORTAGES of hay, silage and grazing are less severe for the beef cattle producer who adopts and continues favorable practices for high production and quality forage. Certain practices are fundamental to a profitable long-term pasture program, although drouth may occur in local areas annually and in wider areas periodically: 1. fertilization, 2. utilization when forage is high quality, 3. planting drouth resistant forage species and 4. storing forage reserves as hay or silage.

Drouth Practices

The beef cattle producer experiencing *moderate* to *severe* drouth should continue or implement the following practices to enhance maximum efficiency from pasture, hay and silage production.

Fertilization

Although the total amount of plant food needed will be less than during normal years, amounts of fertilizer recommended by a soil test should be applied to match rainfall which occurs. Forage production *without* fertilization will be limited even in years of normal rainfall, and *extremely deficient* in drouth seasons.

Because forage quality is higher when pastures are fertilized, less forage may be needed to supply the animals' requirements.

Roots can obtain moisture at greater depths, and leaves conserve more moisture when pastures are fertilized. Regrowth after grazing is rapid in adequately fertilized pastures, but otherwise is slow.

Higher rates of fertilization should be applied to the more productive species, and on soil sites with greater capacity to store and provide moisture. Fertilizer should be applied ahead of effective rainfall to enhance efficient uptake and utilization.

Apply fertilizer according to soil test recommendations. In most soils, little loss of fertilizer is experienced during dry weather, but returns for fertilizer investment still can be expected to be a profitable production input. Limited forage growth and extremely low quality and palatability can be expected if adequate fertilizer is not available to utilize rainfall which occurs.

Utilize forage efficiently.

Efficient utilization during drouth is of utmost importance. Management practices should include every reasonable effort to conserve quality and prevent wastage. Leaves have two to three times more nutrients than stems. When the specified number of leaves of any particular species are produced, additional growth and tonnage result from stems and seedhead production. Thus, as plants mature, increased forage production is primarily of low quality and adds little to the grazing value of the forage. Protein content, digestibility, palatability and other quality factors deteriorate rapidly.

The following practices will be helpful in maximum use of available forage:

1. *Group cattle and graze pastures according to nutritive requirements.* For example, highest quality forage could be grazed by beef cows with young calves, since the nutritive requirements for these animals are higher than for dry cows. Supplements, if needed, also can be fed more economically if cattle are grouped.

2. *Limit grazing.*

Limit grazing to the time required for cattle to obtain nutritive requirements. For example, cows nursing calves usually can obtain their nutritive requirements in 2 or 3 hours each day when grazing high-quality forage. The cattle can be permitted to graze for this time, then be removed to an adjoining area. This system of limiting grazing reduces spoilage from tramping, droppings and other contaminants. Limited grazing also enhances hay harvest from excess forage growth.

3. *Conserve excess forage as hay.*

When rainfall occurs, fresh growth usually is much higher quality and leafier than older forage. Frequently, the immediate nutritive supply far exceeds the demand of the cattle. A cow nursing a calf requires less than ½ ton during a 4-week period, and more forage may be grown than is required.

This excess forage should be harvested as hay to conserve forage quality and production. If not har-

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vested, quality will decline rapidly as the forage becomes coarse, stemmy and less palatable. Hay can be stacked loose economically in the field if desired.

4. *Cross-fence and practice rotation.*

Cross-fencing of pastures and rotation of cattle facilitate grouping cattle, harvesting, fertilization and promote effective utilization of high-quality forage.

5. *Plant summer annual forages to supplement permanent pastures.* Summer annual forages, such as sudan and sorghum-sudan hybrids, millet and other warm-season annual forages, offer opportunities for the beef cow producer to reduce hazards of drouth where cultivated land is available for planting.

Although summer temporary forage crops often are not feasible during years of normal rainfall, their use during drouth may be more economical than other alternatives for supplying nutrients to the beef cow herd.

Summer annual pasture species usually are highly drouth tolerant. They usually can be established on most cultivated soils when some moisture is available. Summer forages grow satisfactorily under limited rainfall conditions and, with fertilizer, can provide fast, high-quality growth.

Because of their comparative high quality and expense of production, these pastures should be used by beef cattle having high nutritive requirements. For example, stocker calves and nursing calves need higher quality forage than cows, and especially dry cows. Nursing calves can be permitted to "creep graze." Summer annual forages also can be used to encourage rebreeding and maintain a high percent calf crop for the following season.

When rainfall occurs and more forage is produced than can be grazed, the excess can be harvested as hay or silage to be fed later in the summer or winter.

Precautions should be observed when grazing certain summer annuals. Young plants and leaves of sorghum, sudan and johnsongrass contain a glucoside, which breaks down to release a toxic material known as prussic acid or hydrocyanic acid (HCN). Sorghum generally has a higher prussic acid potential than sudan. Silage and cured plants, such as hay, have not been a problem. Usually, there is little danger of prussic acid poisoning in grazing the sudan hybrids and varieties. Allow plants to grow at least 18 inches high before grazing is initiated. Avoid grazing the young growth, such as that which follows clipping, drouth or frost. Frosted or frozen leaves should be avoided until they are dry.

Sudan hybrids, varieties and sudan-johnsongrass types have been linked to the horse disease "cystitis syndrome." It has occurred only when horses have eaten the green forage; however, when cured as hay no problem existed. Avoid grazing or feeding greenchop from these plants to horses. No such problems have been reported with other classes of livestock.

6. *Plant Winter pastures for stocker calves.*

In most beef cow-calf enterprises, a certain number of light-weight, late-spring and summer-born calves should be weaned during the fall. The number of light-weight calves may be considerably higher during drouth than in normal years.

Winter annual pastures can be a profitable way to increase value and weight of the light-weight calf. Winter pastures should be grown on soil sites which have been clean-tilled during late summer. Incorporate fertilizer during seedbed preparation. Plant in late summer to utilize early fall rains. Late-planted fall pastures mean restricted forage growth, grazing and livestock profits.

Fertilizer is essential for early growth, drouth resistance and sustained forage growth through the late fall. Nitrogen is one of the major nutrients, but phosphorus and potassium also are essential and often deficient.

Winter pastures are of extremely high quality and should be utilized efficiently. Grazing of stocker calves should be limited to the time needed for them to acquire their nutritive requirements. Then cattle should be removed to an adjoining area where good-quality hay is available free choice.

Winter pastures can be effective for the beef cow herd in maintaining breeding dates, stimulating milk flow for young calves and improving the general health and nutrition of the herd. Because of the high-quality forage, winter pastures should not be used continuously for dry cows.

7. *Test hay to determine quality.*

Quality in hay crops depends largely on: 1. the amount of fertilization, and 2. the maturity when harvested. Generally, quality is improved by fertilization and by harvesting when the hay crop is immature. But, quality of hays varies more than among most other crops. The value of a specific grass hay may be $7 or more per ton greater than a similar hay of the same species, depending on its protein and other nutritive components. A forage analysis permits an accurate knowledge of any supplements which may need to be fed to supply nutritive requirements for a cow-calf herd.

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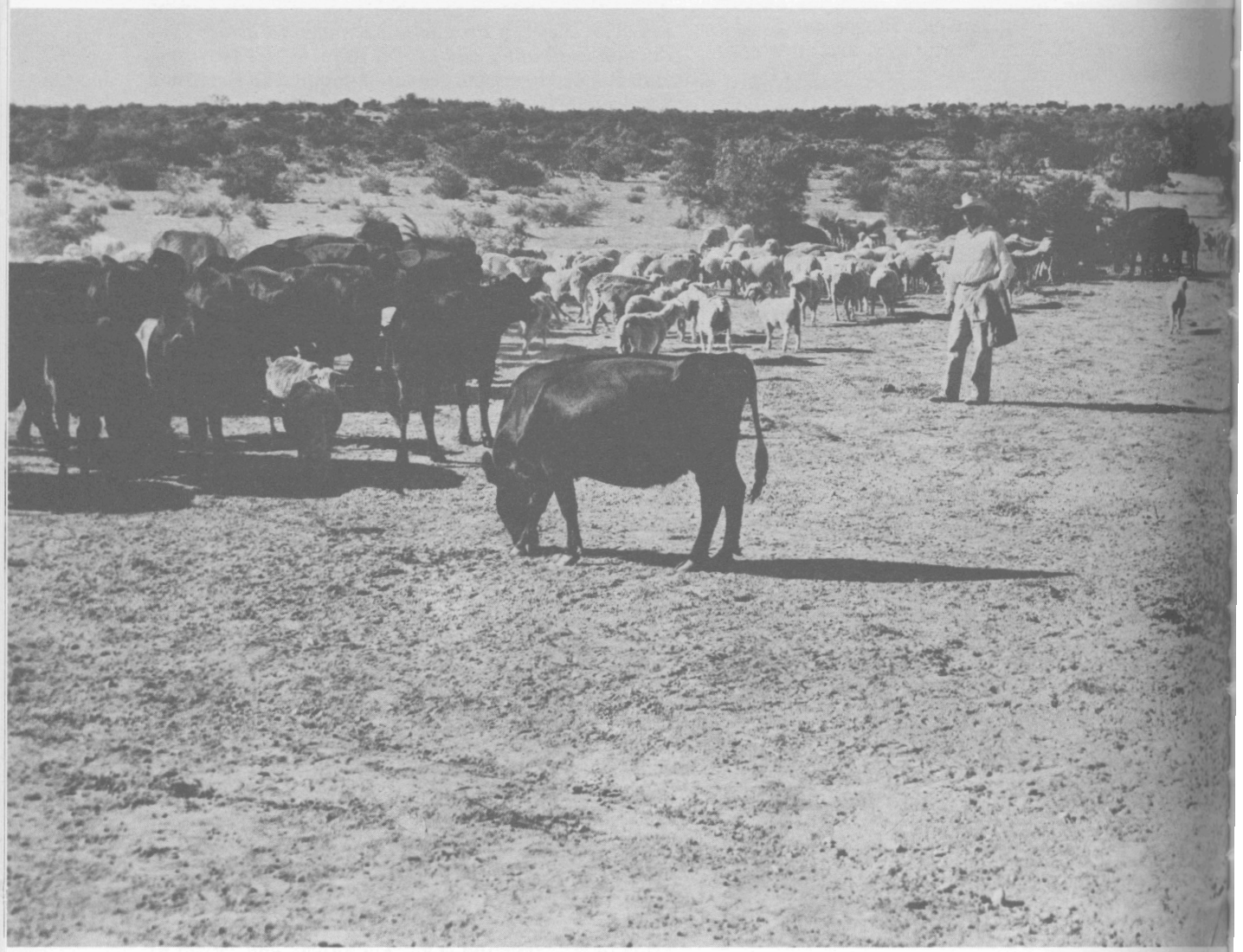

Overgrazed ranges such as this will require several years of normal rainfall and proper management to return to normal productivity.

COMMON AND EMERGENCY FEEDS FOR BEEF CATTLE*

In addition to the ordinary feeds, numerous materials are used as emergency feeds. Many are coarse, fibrous, unpalatable and require special preparation for feeding. Their worth compared with the common hays or roughages is debatable.

Roughages

Cottonseed hulls form a standard, widely-used roughage, about 45 percent in crude fiber; but low in protein and productive value. Hulls have high utility value, mix readily with ground grains, cottonseed meal and ground alfalfa hay and are palatable. The hulls should be free of dirt, low in moisture content and carry enough lint to mix easily with cottonseed meal.

Ground cotton burs and cotton stalks have not been used successfully as the only roughage in rations for cattle, although they may show higher values for protein and a lower content of crude fiber than cottonseed hulls. These materials are unpalatable.

Ground cotton gin trash, including leaf trash, a small percentage of immature seed, lint and burs, can replace cottonseed hulls in roughage mixture with ground alfalfa hay. It may contain from 5 to 8 percent crude protein and no more than 30 percent crude fiber. Supplemented with cottonseed meal and molasses or ground sorghum grain, it has been used as the only roughage in maintenance rations. It lacks the palatability of cotton seed hulls and should not be used if it contains much lint.

Peanut hulls are extremely high in crude fiber, varying from 55 to 65 percent. Finely ground peanut hulls may be used as bulk in rations for cattle, but are better in combination with alfalfa. If used as the only roughage at the start of feeding, they may cause impaction. They are less palatable in mixtures than cottonseed hulls and have little productive value.

Rice hulls, sometimes finely ground and used in mixed rations, contain less crude fiber than cottonseed hulls, but are extremely high in total ash, principally silica. While they may be used as a source of bulk in complete rations, they have no productive value.

Corncobs contain little protein, but are high in energy for maintenance. They are much lower in crude fiber than cottonseed hulls, but are less palatable when forming a large percentage of the ration. They should be ground finely if included in mixed rations with ground grain and cottonseed meal. When used with ground earcorn, they are a satisfactory source of bulk.

Straws from small grain, such as oats, wheat, barley and rye, are low in protein and comparatively high in crude fiber. Oat straw is preferred, but all may be used as bulk when supplemented with cottonseed meal. Hay from the small grain crops harvested in the dough stage may be of excellent quality and sufficient for maintenance. Barley hay and straw are the least desirable because of possible trouble from the beards.

Forage crops, whether cured dry or stored as silage, have much the same value. In most cases, the quality of the particular forage is more important than the kind or variety; but preferences are based on quality or utility. Forage sorghum stover, for example, is preferred to grain sorghum stover, and North Texas prairie hay is preferred to South Texas prairie hay. All sorghum hays require additional protein for balance and more efficient use; yet if fed liberally, they have sufficient quality for the maintenance of cattle.

Silage is a good feed for drouthy livestock. An advantage of silos is that bulk forage crops can be preserved in palatable condition for long periods. The dry matter in silage and the dry matter in a good quality dry roughage from the same crop, have about equal feeding value. Silage may not provide dry matter at low cost. Most sorghum silages contain 70 to 75 percent water. Dry roughages contain about 10 percent water. As with the sorghum and grass hays, sorghum silages should be supplemented with protein concentrates for most efficient use. In addition to bulk and energy, silage supplies sufficient carotene for the maintenance of body reserves of Vitamin A potency.

Singed prickly pear and finger pear, often used in drouth maintenance feeding, are succulent roughage high in moisture and minerals and low in protein. Comparatively large amounts are required daily unless additional roughage is fed. Cows may consume up to 60 pounds daily if available. As with other low protein feeds, results are improved by the addition of protein concentrates.

Sotol, chopped or ground, is good for the maintenance of cattle, particularly if fed with a supplement high in protein and phosphorus. Livestock losses have been reported with the feeding of sotol, but the plant apparently is not poisonous. Cattle allowed 2 pounds of cottonseed cake daily do well when full-fed sotol.

Ground mesquite sapwood branches 3 inches in diameter or less have been fed as part of the roughage in steer fattening rations without ill effect. Its value has not been determined as a replacement for feeds such as cottonseed hulls and silage. It may be used as part of the bulk in rations if it should be lower in price than cottonseed hulls.

Concentrates

Sorghum grain usually supplies feed energy at lower cost than any other Texas farm grain. It should be ground or rolled for feeding and used in mixtures with cottonseed meal, cottonseed hulls, sorghum silage and ground roughages. It is used widely in range cubes or cakes and drouth feed mixtures containing approximately 20 percent crude protein. A 20 percent protein feed mixture may be prepared by combining approximately 33 pounds of 41 percent protein cottonseed meal and 67 percent ground sorghum grain.

Ground earcorn is a common energy feed in Central Texas and is well adapted to a variety of uses. It contains about 25 percent roughage, making it comparatively safe to use in either maintenance or fattening rations. Combinations of ground earcorn with 10 to 15 percent cottonseed meal are good as a creep feed. Shelled corn or corn chops may be the best single fattening grain because of its palatability and high productive value. Shelled corn should be ground for cattle except at the outset of creep feeding.

Oats are a well balanced grain feed, particularly valuable in the development of young breeding stock. They need not be ground for calves, but should be ground or rolled if fed to cattle. Because of high utility and high value for growing young stock, oats usually do not compete with sorghum grain as a source of energy for fattening.

Wheat is a highly nutritious grain and may be used much as corn and sorghum grain in drouth or fattening rations. If used alone, it should be hand fed in limited amounts because of danger from founder. It

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should be crushed or rolled for cattle and is used to better advantage when mixed with other ground grain.

Barley is available for feeding in some areas and has much the same value as the other feed grains. It should be ground or rolled for feeding. It usually is fed with sorghum grain or corn and in such combination as one-third barley and two-thirds sorghum grain.

Feeding molasses is a carbonaceous feed containing little protein. It is high in minerals and has about 70 percent of the energy value of sorghum grain. Beet, corn, citrus and cane or blackstrap molasses seem to have about equal feeding value. Cane or blackstrap molasses, most commonly available in Texas, contains 20 to 25 percent moisture. It varies in price and often is competitive with sorghum grain as a source of energy. It improves the ease of handling ground mixed feeds and adds palatability to ground, low-grade roughages. Its most common use is in whole mixed rations and at an 8 to 12 percent level. It may be mixed with urea, minerals, vitamins and other materials and self-fed as a liquid protein supplement.

The **oil seed protein meals** such as cottonseed meal, soybean meal, linseed meal and peanut meal, if equal in percentage of crude protein, have much the same value in maintenance feeding for cattle.

These meals provide energy and protein, and are palatable. A chief function of the protein meals is to supplement grain and roughage which are comparatively low in protein. They provide balance and improve the efficiency of rations. Prepared as cubes or pellets, these by-products of the oil seeds have high utility.

Sorghum gluten meal, 41 percent protein content, is a satisfactory source of protein for cattle, but is less palatable than the oil seed meals.

Sorghum gluten feed, about 25 percent crude protein, is comparatively high in energy and may be used as a source of both protein and energy for cattle. For example, in fattening heavy yearling steers, 5 pounds of sorghum gluten feed may be fed to replace 3 pounds of 41 percent protein cottonseed meal and 2 pounds of ground sorghum grain. It follows that if 5 pounds of gluten feed cost less than 3 pounds of cottonseed meal and 2 pounds of ground sorghum grain, gluten feed may be used in the ration. Lack of palatability limits the use of the sorghum gluten feed as the only concentrate in full feeding.

Cottonseed is a medium protein feed comparatively high in energy. It contains approximately 20 percent crude protein and about 77 therms of energy per 100 pounds. Subject to some lack of palatability, if fed in large amounts in fattening rations, it can be used to supply both protein and energy. It also can be fed for maintenance, subject to comparative cost of feed nutrients as may be supplied by cottonseed meal and the grains. Light cottonseed from the planting seed delinting plants are lower in protein and fat than heavier cottonseed, but may be used satisfactorily in livestock feeding.

The **20 percent protein commercially mixed** cubes, pellets or meals are usually high in energy. Most of these mixtures are fortified with vitamin A and trace minerals. Unless the stock being fed have definite need for the vitamins and minerals in the feed, costs of the protein and productive energy supplied should be considered.

Rice bran, which contains more protein than sorghum grain, is high in energy because of a high fat content. It may become rancid in storage and in warm weather, is not very palatable and if fed in large amounts may cause scouring. However, price often favors its use, and a small amount may be used as a replacement for sorghum grain in maintenance and fattening rations.

Converted rice bran and polishings with added calcium carbonate may contain 25 percent limestone flour. It does not become rancid, but lacks palatability because of a high mineral content. It may be used in combination with other feeds in maintenance rations, but mineral content and cost of protein and energy are to be kept in mind.

Meat and bone scraps, 50 percent protein and 60 percent digestible tankage, may be used to supply a part of the protein in rations for cattle. These products are high in calcium and phosphorus and supply good amounts of energy. They lack palatability and perhaps should form only 3 or 4 percent of full-fed rations. Since the animal proteins are probably less efficient than the vegetable proteins for cattle, their use is not recommended unless protein is supplied at low cost.

The composition of these and other feed materials that may be used in drouth feeding is shown in table 1 on page 22. The percent chemical compositions of the different feeds indicate possibilities of use and supplements needed for good feeding results.

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