2002 Annual Report

Grassland Section

Dickinson Research Extension Center
1089 State Avenue
Dickinson, ND 58601

Pasture and Forage Costs of Management Strategies for Range Cows during the Dry Gestation Production Period

Llewellyn L. Manske PhD
Range Scientist

North Dakota State University
Dickinson Research Extension Center

Introduction

The beef production industry in the Northern Plains has a low profit margin. A logical response to this situation is the scientific evaluation of management-practice effectiveness in reducing production costs by reducing pasture and harvested-forage costs, which constitute the greatest portion of the total annual production costs for a beef cow and calf. Because the daily requirements for cows differ with production period, proper evaluation of management strategies requires two steps: evaluation of pasture and forage costs related to each production period and evaluation of the management strategies for livestock production periods as components within a complete 12-month pasture-forage management system. Achieving reductions in livestock production costs for range cows during the dry gestation production period requires an understanding of the production costs of common traditional practices and the costs of readily available alternative management practices.

This study evaluated several pasture-forage management strategies to determine the pasture-forage costs for range cows in the dry gestation production period during the fall. The pasture management strategies were native rangeland pastures reserved for late-season grazing and cropland aftermath. The harvested-forage management strategies were crested wheatgrass, forage barley hay, oat hay, pea forage hay, forage lentil hay, and oat-pea hay. The management strategy costs evaluated were pasture or land rent values per acre, production costs per acre, costs per unit of forage dry matter, costs per unit of nutrient, land area per animal unit, and forage feed costs per day, per month, or per production period.

Procedure

This study was conducted at the NDSU Dickinson Research Extension Center, located in western North Dakota. Pasture-forage costs were evaluated from data collected on projects conducted between 1983 and 1999. Native rangeland herbage weight data were collected from ungrazed plots. Forage dry matter yield per acre and percent crude protein data for perennial domesticated grass hay and annual cereal and annual legume hays were taken from a previous study (Manske and Carr 2000). Pasture rent value of $8.76 per acre was used to determine costs for native rangeland pasture. The value of $2.00 per acre was used for cropland aftermath grazing costs. Land rent values of $22.07 per acre for cropland and $14.22 per acre for domesticated grass hayland were used in the determination of forage production costs for the harvested forages. Range cow daily nutritional requirements, which change with cow size, level of milk production, and production period, were taken from NRC (1996).

Pasture and forage costs of feed to meet livestock dry matter and crude protein requirements were determined during this study. Production costs per acre were determined by adding average land rent per acre, custom farm work rates, seed costs per acre, and baling costs at per half ton rates. Costs per ton of forage dry matter (DM) were determined by dividing production costs per acre by pounds of forage dry matter yield per acre and multiplying the quotient by 2000 pounds. Costs per pound of crude protein (CP) were determined in two stages: first, pounds of forage dry matter per acre were multiplied by percentage of forage crude protein to derive pounds of crude protein per acre; then, production costs per acre were divided by pounds of crude protein per acre. Pasture land area per animal unit per month was determined in two stages: first, pounds of forage dry matter per acre were divided by pounds of forage dry matter required per animal unit per day to derive number of grazing days per acre; then, the average number of days per month was divided by the number of grazing days per acre. Harvested-forage land area per animal unit per month or per production period was determined in two stages: first, pounds of crude protein required per animal per day during a production period were divided by percentage of crude protein of forage type to derive pounds of forage dry matter to provide as feed per animal unit per day; then, pounds of forage dry matter to feed per day were divided by pounds of forage dry matter per acre, and the quotient was multiplied by 30 days per month, 30.5 days per month, or the number of days per production period. Forage feed costs per animal per day, per month, or per production period were determined in three stages: first, production costs per acre were divided by pounds of forage dry matter per acre, and that quotient was divided by percentage of forage crude protein to derive cost per pound of crude protein; next, the cost per pound of crude protein was multiplied by pounds of crude protein required per animal per day during a production period; then, the feed costs per day were multiplied by 30 days per month, 30.5 days per month, or the number of days per production period.

Treatments

Native rangeland pastures were reserved for late-season grazing and had no grazing during the growing season. Cropland aftermath pastures were grazed by dry range cows at an average stocking rate of 7.10 acres per cow per month. The crop aftermath consisted primarily of annual cereal residue of oats, barley, and/or chopped corn stubble.

Harvested forages were cut by swathing and were then rolled into large round bales. Mature crested wheatgrass hay was cut at a mature plant stage. Early crested wheatgrass hay was cut at the boot stage. Forage barley hay was cut both at the milk stage and at the hard dough stage. Oat hay was cut both at the milk stage and at the hard dough stage. Pea forage hay was cut at both early and late plant stages. Forage lentil hay was cut at both early and late plant stages. Oat-pea forage was cut for hay.

Results

Forage dry matter and crude protein costs (tables 1, 2, and 3) were determined for a 1200- pound range cow during the dry gestation production period. The cow required a daily intake of 24 lbs dry matter (DM) at 6.2% crude protein (CP) (1.5 lbs CP/day).

Native range pasture during the fall dormancy period has a crude protein content of around 4.8%. Late-season native range forage has pasture rent value or production costs of $8.76 per acre, forage dry matter costs of $97.33 per ton, and crude protein costs of $1.01 per pound. A cow grazing during the dry gestation production period requires 4.00 acres of native range pasture per month, at a cost of $1.17 per day, or $35.04 per month. The crude protein content of mature native range forage is below the requirements of a cow in the dry gestation stage, and crude protein would need to be supplemented at 0.34 lbs per day, or 10.2 lbs per month per cow.

Crop aftermath of annual cereal stubble has very low crude protein content. Crop aftermath has production costs of $2.00 per acre. A dry gestating cow grazed 7.10 acres of crop aftermath per month, at a cost of $0.47 per day, or $14.20 per month. This forage source is below the crude protein requirements of a dry gestating cow. Dry cows grazing crop aftermath lost an average of 1.14 lbs per day and lost an average of 4.82 lbs per acre; accumulated weight loss was 34.20 lbs per month.

Crested wheatgrass cut late, at a mature plant stage, has a crude protein content of around 6.4%. This low-quality perennial grass hay has production costs of $28.11 per acre, forage dry matter costs of $34.80 per ton, and crude protein costs of $0.28 per pound. Late-cut crested wheatgrass hay would be fed at 23.4 lbs DM/day to provide 1.5 lbs CP/day. An additional 0.6 lbs of roughage per day would need to be provided. Production of late-cut crested wheatgrass hay to feed a cow during the dry gestation production period requires 0.44 acres per month and costs $0.41 per day, or $12.32 per month.

Crested wheatgrass hay cut early, at the boot stage, has a crude protein content of around 14.5%. This high-quality perennial grass hay has production costs of $26.50 per acre, forage dry matter costs of $40.80 per ton, and crude protein costs of $0.14 per pound. Early cut crested wheatgrass hay would be fed at 10.3 lbs DM/day to provide 1.5 lbs CP/day. An additional 13.7 lbs of roughage per day would need to be provided. Production of early cut crested wheatgrass hay to feed a cow during the dry gestation production period requires 0.24 acres per month and costs $0.21 per day, or $6.26 per month.

Forage barley hay cut early, at the milk stage, has a crude protein content of 13.0%. This forage barley hay has production costs of $68.21 per acre, forage dry matter costs of $28.80 per ton, and crude protein costs of $0.11 per pound. Early cut forage barley hay would be fed at 11.5 lbs DM/day to provide 1.5 lbs CP/day. An additional 12.5 lbs of roughage per day would need to be provided. Production of early cut forage barley hay to feed a cow during the dry gestation production period requires 0.07 acres per month and costs $0.17 per day, or $4.95 per month.

Forage barley hay cut late, at the hard dough stage, has a crude protein content of 9.2%. This forage barley hay has production costs of $70.35 per acre, forage dry matter costs of $27.40 per ton, and crude protein costs of $0.15 per pound. Late-cut forage barley hay would be fed at 16.2 lbs DM/day to provide 1.5 lbs CP/day. An additional 7.8 lbs of roughage per day would need to be provided. Production of late-cut forage barley hay to feed a cow during the dry gestation production period requires 0.09 acres per month and costs $0.22 per day, or $6.66 per month.

Oat hay cut early, at the milk stage, has a crude protein content of 11.5%. This oat hay has production costs of $69.17 per acre, forage dry matter costs of $29.60 per ton, and crude protein costs of $0.13 per pound. Early cut oat hay would be fed at 13 lbs DM/day to provide 1.5 lbs CP/day. An additional 11 lbs of roughage per day would need to be provided. Production of early cut oat hay to feed a cow during the dry gestation production period requires 0.08 acres per month and costs $0.19 per day, or $5.76 per month.

Oat hay cut late, at the hard dough stage, has a crude protein content of 7.8%. This oat hay has production costs of $74.53 per acre, forage dry matter costs of $26.40 per ton, and crude protein costs of $0.17 per pound. Late-cut oat hay would be fed at 19.1 lbs DM/day to provide 1.5 lbs CP/day. An additional 4.9 lbs of roughage per day would need to be provided. Production of late-cut oat hay to feed a cow during the dry gestation production period requires 0.10 acres per month and costs $0.25 per day, or $7.54 per month.

Pea forage hay cut at an early plant stage has a crude protein content of 18.9%. This pea hay has production costs of $79.96 per acre, forage dry matter costs of $55.00 per ton, and crude protein costs of $0.15 per pound. Early cut pea forage hay would be fed at 7.9 lbs DM/day to provide 1.5 lbs CP/day. An additional 16.1 lbs of roughage per day would need to be provided. Production of early cut pea forage hay to feed a cow during the dry gestation production period requires 0.08 acres per month and costs $0.23 per day, or $6.75 per month.

Pea forage hay cut at a late plant stage has a crude protein content of 14.4%. This pea hay has production costs of $86.87 per acre, forage dry matter costs of $37.40 per ton, and crude protein costs of $0.13 per pound. Late-cut pea forage hay would be fed at 10.3 lbs DM/day to provide 1.5 lbs CP/day. An additional 13.7 lbs of roughage per day would need to be provided. Production of late-cut pea forage hay to feed a cow during the dry gestation production period requires 0.07 acres per month and costs $0.19 per day, or $5.80 per month.

Forage lentil hay cut at an early plant stage has a crude protein content of 21.8%. This lentil hay has production costs of $59.69 per acre, forage dry matter costs of $71.60 per ton, and crude protein costs of $0.17 per pound. Early cut lentil hay would be fed at 6.8 lbs DM/day to provide 1.5 lbs CP/day. An additional 17.2 lbs of roughage per day would need to be provided. Production of early cut forage lentil hay to feed a cow during the dry gestation production period requires 0.12 acres per month and costs $0.24 per day, or $7.34 per month.

Forage lentil hay cut at a late plant stage has a crude protein content of 14.7%. This lentil hay has production costs of $71.48 per acre, forage dry matter costs of $37.00 per ton, and crude protein costs of $0.13 per pound. Late-cut lentil hay would be fed at 10.1 lbs DM/day to provide 1.5 lbs CP/day. An additional 13.9 lbs of roughage per day would need to be provided. Production of late-cut forage lentil hay to feed a cow during the dry gestation production period requires 0.08 acres per month and costs $0.19 per day, or $5.62 per month.

Oat-pea forage hay has a crude protein content of 12.5%. This oat-pea hay has production costs of $95.52 per acre, forage dry matter costs of $37.20 per ton, and crude protein costs of $0.15 per pound. Oat-pea hay would be fed at 11.9 lbs DM/day to provide 1.5 lbs CP/day. An additional 12.1 lbs of roughage per day would need to be provided. Production of oat-pea hay to feed a cow during the dry gestation production period requires 0.07 acres per month and costs $0.23 per day, or $6.99 per month.

Pasture-Forage Costs

Pasture and forage costs of pasture and harvested-forage management strategies for range cows during the dry gestation production period are shown in table 4.

Production costs per acre for harvested forages were greater than pasture rent per acre. Production costs per acre for annual cereal and annual legume hays were considerably greater than those for perennial grass hay. Production costs per acre for harvested forages cut late were greater than production costs per acre for the same forage type cut early because the greater dry matter yield of the late-cut forages resulted in increased baling costs. The relationships of forage production costs among pastures, perennial hays, and annual hays are often interpreted to indicate that feeding livestock annual cereal and annual legume hays is more expensive than feeding livestock perennial grass hay, which in turn is more expensive than grazing livestock on perennial grass pasture. This interpretation of pasture-forage production costs per acre has been the basis for numerous management strategies for range cows during the dry gestation production period. However, neither production costs per acre nor pasture rent per acre accurately reflects livestock production costs because forage dry matter weight per acre and nutrient weight per acre captured through grazing or haying vary with forage type and plant growth stage, and the variations are not proportional to these per acre costs.

The costs per unit of forage dry matter reflect the relationships between the pasture rent per acre or production costs per acre and the amount of dry matter consumed by grazing livestock or cut for hay. Cost of harvested forage per unit of weight is commonly used to compare different forage types, but cost of pasture forage dry matter livestock consume by grazing is generally not considered by livestock producers when they compare costs of management strategies. The dry matter costs for fall forage on native range pastures were very high ($97.33/ton) and were greater than the dry matter costs for perennial grass hays ($34.80 and $40.80/ton) and annual cereal ($26.40 to $29.60/ton) and annual legume ($37.00 to $71.60/ton) hays. Forage dry matter costs per ton were greater for harvested forages cut early than for the same forage type cut late because the production costs per acre were shared by fewer pounds of forage dry matter yield for the early cut forages. Forage dry matter costs per unit of weight do not accurately reflect livestock production costs because of the variable quantity of nutrients contained within the dry matter and the resulting differences in the amount of dry matter needed to provide adequate quantities of nutrients for livestock.

Cost per unit of nutrient is an important indicator of livestock pasture-forage costs. Nutrient cost per unit of weight is related to the forage dry matter cost and the quantity of nutrients per unit of forage weight. The crude protein costs ($1.01/lb) on fall native range pastures were very high and were considerably greater than the crude protein costs per pound for harvested forages. Crude protein costs for early cut perennial grass hay ($0.14/lb) and annual cereal hays ($0.11 and $0.13/lb) were lower than the crude protein costs for the same forage types cut late ($0.28, $0.15 and $0.17/lb, respectively). Crude protein costs for late-cut annual legume hays ($0.13 and $0.13/lb) were lower than the crude protein costs for the same forage types cut early ($0.15 and $0.17/lb). High-quality forages have lower costs per unit of nutrient than low-quality forages at the same cost per unit of dry matter. Even high-quality forages with a higher cost per unit of dry matter may actually be less costly feed because less of the high quality forage is needed to meet the nutritional requirements of the livestock. Crude protein content of herbage on late-season native range and cropland aftermath pastures was below the requirements of cows during the dry gestation production period.

Land area per animal unit has not been traditionally recognized as an important factor in beef production costs. Land area per month required for a dry cow on reserved native range pastures and cropland aftermath was high (4.0 and 7.1 acres). Land area required to produce one month of forage for a dry cow ranged between 0.07 and 0.44 acres for harvested forages. Crested wheatgrass hay cut at a mature plant stage required the larger land area, and forage barley cut at the milk stage, pea forage cut late, and oat-pea hay required the smaller land areas. Costs of the land area required to provide adequate quantities of forage for a cow contribute substantially to total production costs. The greater the amount of the produced nutrients captured from a land base, the smaller the land area required by an animal unit and the lower the production costs.

Livestock forage feed costs on late-season grazed native range pastures were high ($1.17/day and $35.04/month) because the forage quantity and quality were low. Feed costs on cropland aftermath were less than $0.50 per day and $15.00 per month because the rent value of cropland aftermath was low. However, the considerable weight loss in dry cows grazing cropland aftermath should be regarded as a substantial cost. Feed costs per day and per month for early cut crested wheatgrass hay ($0.21/day and $6.26/month) were about half the feed costs for mature-cut crested wheatgrass hay ($0.41/day and $12.32/month). The feed costs for annual cereal and annual legume hays were less than $0.25 per day and $8.00 per month. The feed costs for early cut annual cereal hays ($0.17 and $0.19/day) were lower than the feed costs for late-cut annual cereal hays ($0.22 and $0.25/day). The feed costs for late-cut annual legume hays ($0.19 and $0.19/day) were lower than the feed costs for early cut annual legume hays ($0.23 and $0.24/day). The feed costs for oat-pea hay ($0.23/day) were similar to the feed costs for late-cut annual cereal hays and early cut legume hays.

Perennial grass hays yield greater pounds of crude protein per acre when harvested during early developmental stages, around the boot stage to flowering stage. Annual cereal hays yield greater pounds of crude protein per acre when harvested during early developmental stages, around the flowering stage to late milk stage. Annual legume hays generally yield greater pounds of crude protein per acre when harvested during the middle and late stages of development. Cereal-legume mixed hays have generally not produced greater quantities of forage dry matter or pounds of crude protein per acre than have annual cereals or annual legumes seeded separately, because of the differences in the optimum times to harvest annual cereals and annual legumes. Cutting forage hays at their optimum harvest times reduces livestock feed costs per day and per month because the cost per pound of crude protein is lower when greater pounds of crude protein per acre are captured during harvest. The pasture-forage management strategies with livestock forage feed costs lower than $0.20 per day and $6.00 per month were forage barley cut at the milk stage, oat hay cut at the milk stage, pea forage cut at the late stage, and forage lentil cut at the late stage. Forage barley cut at the milk stage had the lowest feed costs for range cows during the dry gestation production period.

Discussion

Grazing native rangeland during the fall is commonly accepted as a low-cost, innocuous practice; however, costs of forage dry matter and crude protein on native rangeland during the fall are extremely high, and fall grazing has the potential to degrade grassland ecosystems. The cost of grazing native rangeland during the fall is high because the weight of the herbage on fall pasture is only about half of the mid summer herbage weight and grazing livestock therefore require about twice as many acres per month during the fall as they do during the summer. The nutritional quality of mature herbage during fall is about half of the herbage nutrient content during summer: the crude protein content of mature native range forage is below the requirements of dry cows, and supplementation is needed.

Grazing mature rangeland during the fall can have negative economic consequences beyond the fall because the practice can remove or damage fall growth and other leaf material that the grass plant depends on to survive the winter and resume growth the next spring. Perennial grasses are perpetuated primarily through vegetative reproduction by tillering rather than through sexual reproduction. Very few perennial grasses grow from seed in established grasslands. Perennial grasses start growth of next year's plants in late summer or early fall, during winter hardening, the process of physiological preparation for the winter season. Warm-season grasses produce a relatively large bud but suspend additional growth until the next spring. Cool-season grasses produce tillers with one and a half to four leaves.

Fall tillers grow from axillary buds on the crowns of perennial grass species between mid August and the end of the active growing season and remain viable over the winter. These fall tillers continue growth as lead tillers the following spring, producing a high proportion of that season's herbage. After the lead tillers have flowered, secondary tillers can grow from axillary buds.

During the later portion of the growing season, the grass plant population consists of mature lead tillers, secondary tillers, and fall tillers. Mature lead tillers that are near the completion of their life cycle and secondary tillers that have developed seed heads will not overwinter but will progress through a natural aging process called senescence. During this aging process, the cell components of the aboveground structures are translocated to belowground structures. The translocation of cell contents reduces the nutritional quality and the weight of the herbage. The nutritional quality of mature herbage during fall decreases to about 4.8% crude protein. The weight of the herbage is about 40% to 60% of the herbage weight during mid summer. Secondary tillers that have not entered the sexually reproductive stage and fall tillers will overwinter. These tillers retain active leaf material until the end of the growing season, when the chlorophyll fades and the leaves lose their green color, appearing brown like the leaves of lead tillers that have completed their growth cycle.

Perennial grasses remain alive and maintain physiological processes throughout the year, even during the winter. Winter dormancy for perennial grasses is not a period of total inactivity but a period of reduced biological activity. The crown, some portions of the root system, and some leaf tissue remain active by using stored carbohydrates. Winter survival and spring regrowth of secondary tillers and fall tillers depend on the plant's having adequate carbohydrate reserves.

The quantity of carbohydrates stored during the winter hardening process is closely related to the amount of active leaf material on each tiller. Tillers with abundant leaf area during late summer and early fall can store adequate quantities of carbohydrates to survive the winter and produce robust leaves the following spring. Generally, the greater the number of active leaves on tillers during the fall, the more robust the plants will be the following spring. Heavy grazing of grasslands during August to mid October removes sufficient leaf material from secondary and fall tillers that quantities of carbohydrates stored will be low. Tillers with low carbohydrate reserves may not survive until spring. It is suspected that fall tillers with fewer than one and a half leaves may be unable to store adequate carbohydrate reserves to survive the winter. Plants that have low carbohydrate reserves and survive the dormancy period produce tillers with reduced height and weight.

The rate at which plants respire, or use, stored carbohydrates during the winter is affected by the amount of insulation standing plant material and snow provide from the cold winter air temperatures. The greater the amount of insulation, the more slowly the plant draws on its carbohydrate reserves. When the standing herbage on a grassland is grazed short and most of the snow is blown off, very rapid respiration can occur and deplete carbohydrate reserves before spring, causing plant death called "winter kill".

On tillers that have overwintered, the leaf portions with intact cell walls can regreen early in the spring. The leaf portions with ruptured cell walls remain brown. The surviving leaves, with their brown tops and green bases, are most obvious soon after the snow melts. When the current year's early leaf growth has been exposed for several hours to air temperatures below 28^{o}F, it may have large dry portions and appear similar to overwintering leaves. The green portion of the overwintered leaves provides photosynthetic products that, in combination with remaining stored carbohydrates, support the development and growth of new leaves and roots. The robustness of spring growth in plants that overwinter is dependent on the amount of surviving leaf area.

Removal of the leaf area of the overwintering tillers by grazing during fall or winter deprives developing tillers of a major source of nutrients, increases the demand on low levels of carbohydrate reserves, and results in reduced leaf production. Reductions in leaf height (Manske 2000) for the major graminoids during the succeeding growing season range from 17% to 43%, and the contribution of herbage weight to the ecosystem biomass is greatly reduced.

The common assumption that grazing perennial grasses after they turn brown following a hard frost will not harm grass plants guides numerous fall grazing practices. This popular belief is not consistent with the biology of grass growth and should not be used as a foundation for grazing management decisions because of the resulting reductions in grass production and increases in pasture-forage costs the following year. Management strategies coordinated with the biological requirements of grass plants promote vigorous growth of the plants and the efficient capture of forage dry matter and nutrients produced. These characteristics result in considerable reductions in pasture-forage costs for cows and calves.

Feeding low-cost harvested forages is an economically and ecologically sound alternative to grazing livestock on fall native range pasture. Harvested forages are usually viewed as expensive feeds because the production costs per acre are greater than pasture rent per acre and a high percentage of the harvested forage production costs consist of labor and equipment costs. Some harvested forages are expensive, but not all harvested forages are high-cost feeds. Harvested forages cut at plant stages that yield great amounts of dry matter and low amounts of crude protein per acre have high costs per unit of nutrient and are generally expensive forages that increase livestock production costs. However, harvested forages cut at plant stages that yield great amounts of crude protein per acre have lower costs per unit of nutrient and are relatively low-cost forages that help reduce livestock production costs. Early crested wheatgrass, early forage barley, early oat hay, late pea forage, late forage lentil, and oat-pea hay have crude protein costs below $0.25/lb and feed costs below $0.62/day. Use of these forages should help reduce livestock production costs so that profit margins are positive even when calves are sold at $0.70/lb.

Conclusion

The traditional pasture-forage management strategies used in the Northern Plains were developed during the era of low-performance livestock. During the past several decades the type of livestock in the region has shifted to a fast-growing, high-performance animal, but pasture-forage management strategies have not been adjusted to take full advantage of the livestock's genetic potential. The use of slightly modified low-performance pasture-forage management strategies with high-performance livestock results in calves with weaning weights below potential and in high annual expenses for cow maintenance.

Attempts to produce high-performance livestock by using traditional low-performance management strategies have led to high production costs and low profit margins. Evaluation of production costs and profit margins from total cash expenses and cash receipts or from the information included on income tax and bank loan forms may be adequate to determine the financial status of a livestock operation, but these financial records do not provide adequate information for the evaluation of the effectiveness of specific pasture-forage management strategies. Traditional comparisons of pasture or land rent values, forage production costs per acre, and forage dry matter bulk weight costs do not accurately reflect livestock production costs and the effectiveness of pasture-forage management strategies.

High-performance pasture-forage management strategies combine pasture and forage types so that herbage production curves and nutritional quality curves coordinate with the twelve-month dietary quantity and quality requirement curves of cow production periods. Such management strategies meet the nutritional requirements of high-performance livestock during the entire year at low costs per unit of saleable product. Evaluation of the effectiveness of management strategies in reducing livestock production costs can be accomplished through comparisons of costs per unit of nutrient; land area per animal unit; forage feed costs per day, per month, or per production period; and costs per pound of calf weight gain. Implementation of high-performance pasture-forage management strategies will result in improved livestock weight performance, reduced livestock production costs, and increased profit margins.

Acknowledgment

I am grateful to Amy M. Kraus for assistance in the preparation of this manuscript. I am grateful to Sheri Schneider for assistance in production of this manuscript and for development of the tables.

Literature Cited

Manske, L.L., and P.M. Carr. 2000. Determination of costs of harvested forage types to help reduce beef production costs. NDSU Dickinson Research Extension Center. Range Research Report DREC 00-1029. Dickinson, North Dakota. 18p.

Manske, L.L. 2000. Fall grazing reduces grass leaf height. NDSU Dickinson Research Extension Center. Range Management Report

DREC 00-1031. Dickinson, North Dakota. 9p.

National Research Council. 1996. Nutrient requirements of beef cattle. 7th rev. ed. National Academy Press, Washington, DC.

Tables and Graphs

Table 1. Pasture-forage costs of pasture and perennial grass harvested-forage management strategies for range cows during the dry gestation production period.

			Native Rangeland Pasture	Cropland Aftermath Pasture	Crested Wheatgrass Hay	Crested Wheatgrass Hay
Growth Stage			Dormant	Post-harvest	Mature	Boot stage
Herbage Weight		lb/ac	725		-	-
Forage DM Weight		lb/ac	180		1600	1300
Costs/Acre						
	Land Rent	$	8.76	2.00	14.22	14.22
	Custom Work	$	-		5.31	5.31
	Seed Cost	$	-		-	-
	Baling Costs	$	-		8.58	6.97
Production Costs		$/ac	8.76	2.00	28.11	26.50
Forage DM Costs		$/ton	97.33		34.80	40.80
Land Area/Month		ac	4.00	7.10	0.44	0.24
Land Cost/Month		$/month	35.04	14.20	6.26	3.37
Feed Costs/Day		$/day	1.17	0.47	0.41	0.21
Feed Costs/Month		$/month	35.04	14.20	12.32	6.26
Crude Protein		%	4.8		6.4	14.5
Crude Protein Yield		lb/ac	8.64		102	189
Crude Protein Cost		$/lb	1.01		0.28	0.14

Table 2. Forage costs of annual cereal management strategies for range cows during the dry gestation production period.					
		Forage Barley Hay	**Forage Barley Hay**	**Oat Hay**	**Oat Hay**
Growth Stage		Milk	Hard Dough	Milk	Hard Dough
Herbage Weight	lb/ac				
Forage DM Weight	lb/ac	4733	5133	4667	5667
Costs/Acre					
Land Rent	$	22.07	22.07	22.07	22.07
Custom Work	$	16.08	16.08	16.08	16.08
Seed Cost	$	4.69	4.69	6.00	6.00
Baling Costs	$	25.37	27.51	25.02	30.38
Production Costs	$/ac	68.21	70.35	69.17	74.53
Forage DM Costs	$/ton	28.80	27.40	29.60	26.40
Land Area/Month	ac	0.07	0.09	0.08	0.10
Land Cost/Month	$/month	1.60	1.99	1.77	2.21
Feed Costs/Day	$/day	0.17	0.22	0.19	0.25
Feed Costs/Month	$/month	4.95	6.66	5.76	7.54
Crude Protein	%	13.0	9.2	11.5	7.8
Crude Protein Yield	lb/ac	606	468	535	435
Crude Protein Cost	$/lb	0.11	0.15	0.13	0.17

Table 3. Forage costs of annual legume management strategies for range cows during the dry gestation production period.						
		Pea Forage Hay	**Pea Forage Hay**	**Forage Lentil Hay**	**Forage Lentil Hay**	**Oat-Pea Hay**

Growth Stage		Early	Late	Early	Late	
Herbage Weight	lb/ac					
Forage DM Weight	lb/ac	2800	4650	1667	3867	5143
Costs/Acre						
Land Rent	$	22.07	22.07	22.07	22.07	22.07
Custom Work	$	16.08	16.08	16.08	16.08	16.08
Seed Cost	$	23.80	23.80	12.60	12.60	29.80
Baling Costs	$	15.01	24.92	8.94	20.73	27.57
Production Costs	$/ac	79.96	86.87	59.69	71.48	95.52
Forage DM Costs	$/ton	55.00	37.40	71.60	37.00	37.20
Land Area/Month	ac	0.08	0.07	0.12	0.08	0.07
Land Cost/Month	$/month	1.77	1.46	2.65	1.73	1.53
Feed Costs/Day	$/day	0.23	0.19	0.24	0.19	0.23
Feed Costs/Month	$/month	6.75	5.80	7.34	5.62	6.99
Crude Protein	%	18.9	14.4	21.8	14.7	12.5
Crude Protein Yield	lb/ac	526	685	361	567	611
Crude Protein Cost	$/lb	0.15	0.13	0.17	0.13	0.15

Table 4. Pasture and forage costs of pasture and harvested-forage management strategies for range cows during the dry gestation production period.

	Production Costs	Forage Dry Matter Costs	Crude Protein Costs	Land Area per month	Feed Costs per day	Feed Costs per month
	$/ac	$/ton	$/lb	ac	$	$
Native Rangeland Reserve Pasture	8.76	97.33	1.01	4.00	1.17	35.04
Cropland Aftermath						

Cropland Aftermath Pasture	2.00			7.10	0.47	14.20
Crested Wheatgrass Mature Hay	28.11	34.80	0.28	0.44	0.41	12.32
Crested Wheatgrass Early Hay	26.50	40.80	0.14	0.24	0.21	6.26
Forage Barley Milk Stage Hay	68.21	28.80	0.11	0.07	0.17	4.95
Forage Barley Hard Dough Stage Hay	70.35	27.40	0.15	0.09	0.22	6.66
Oat Milk Stage Hay	69.17	29.60	0.13	0.08	0.19	5.76
Oat Hard Dough Stage Hay	74.53	26.40	0.17	0.10	0.25	7.54
Pea Forage Early Stage Hay	79.96	55.00	0.15	0.08	0.23	6.75
Pea Forage Late Stage hay	86.87	37.40	0.13	0.07	0.19	5.80
Forage Lentil Early Stage Hay	59.69	71.60	0.17	0.12	0.24	7.34
Forage Lentil Late Stage Hay	71.48	37.00	0.13	0.08	0.19	5.62
Oat-Pea						

Hay	95.52	37.20	0.15	0.07	0.23	6.99