Economic Comparison of Grazing Systems for the Northern Great Plains

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(Workbook contribution to "Training in sustainable livestock production systems on rangelands of the western Dakotas." North Central Region (NCR), Sustainable Agriculture Research and Education (SARE) Program. PDP Project ENC00-052)

Summary: Recent grazing data provide much food for thought. Delaying the start and reducing the length of the grazing season through the use of complimentary pastures is something all grazing livestock producers should consider. Intensive management (e.g. fertilization) of at least spring complimentary pastures to increase forage production seems warranted. Nutritional supplementation may have potential for offsetting reduced livestock performance later in the grazing season in all grazing systems. Recommendations for a specific grazing strategy when utilizing native range is much less clear.

Introduction

Producers that utilize grazing livestock are continually faced with the need to develop, implement, monitor and evaluate their grazing systems. Effective and efficient grazing systems are the backbone of profitable cattle and sheep operations. For most producers in the Northern Great Plains, grazing systems revolve around a native range resource. Different grazing systems have compared both grazing strategy on native range (e.g. length of season, seasonlong vs rotational grazing) and the use of complementary pastures (e.g. crested wheatgrass, altai wildrye) with respect to biological and economic productivity (Manske, 1995; Manske and Sedivec, 1999). The worst-case scenario evaluated was a system that grazed cattle seasonlong in a single pasture for 6 months (16 May - 15 Nov). The best-case scenario incorporated a fertilized crested wheatgrass pasture in the spring (1 May - 1 Jun; 31 d), a rotational grazing strategy on native range during the summer (1 Jun - 15 Oct; 137 d) and altai wildrye pasture in the fall (15 Oct - 15 Nov; 30 d). A subset of these results is included in Table 1. Pasture cost per lb of calf gain ranged from $.64 to $.26 for different grazing strategies on native range and to $.23 for best-case grazing system. Similarly, net return per acre above pasture costs ranged from $.75 to $14.79 ($16.99 for the system). These results suggest that appropriately planned grazing strategies that combine complimentary pastures with rotational grazing on native range can be used to decrease seasonal stocking rate (ac/cow) and increase animal performance and net returns per cow and per acre. Results (1998 - 1999) from the Dickinson R/E Center (Manske, 1999a) would tend to substantiate some of these conclusions and challenge others.

Materials and Methods

This long-term grazing study is evaluating the effects of three grazing systems on herbage and cow-calf productivity. Grazing systems (Table 2) included: (1) a 6.0-month seasonlong, (2) a 4.5-month seasonlong, and (3) a 4.5-month rotational grazing strategy on native range. The 4.5 month grazing strategies also included complimentary spring and fall pastures. Spring pastures were either unfertilized or fertilized (50 lb N/ac on 1 April) crested wheatgrass and fall pastures were either crop residue/aftermath or altai wildrye for grazing systems 2 and 3, respectively.

Aboveground biomass was collected on 11 sampling dates from April to November. Samples were collected from individual pastures before, during and after they were grazed. Commercial crossbred cow and calf pairs were used on all grazing treatments. Individual animals were weighed on and off each pasture type and on each rotation date. Grazing days, stocking rate, average daily gain, gain per acre and accumulated weight gain of cows and calves was used to compare native range grazing strategy and entire grazing system. Crop acreage used to support fall grazing in system 2 was not included in the calculation of stocking rates or pasture costs in this summary. It was assumed that crop residue/aftermath is a byproduct of a cropping operation and land rental costs have been previously covered. Note that is a different approach with respect to value of crop acres for grazing than was previously used (Manske, 1995,; Manske and Sedivec, 1999). The economic comparisons included in this report are by no means complete, but offer rough comparisons on an equivalent basis. No statistical analysis was presented in the original report, thus discussion of differences among treatments are judgmental based upon magnitude of the difference and personal experience.

Results

A comparison of livestock production is presented in Table 3. Stocking rates were very similar across grazing strategies and systems. Stocking rates averaged 2.3 ac/pair across all native range grazing strategies and 2.2 across all grazing systems. System 1 required 13.3 acres of native range, while the other two systems required roughly 10.1 and 2.2 ac/pair of native range and complimentary pastures, respectively.

Individual calf gains on native range tended to reflect level of management imposed. Calves managed under system 1 gained the least per day, while those managed under system 3 gained the most. Average daily gain of calves in system 2 was intermediate. Total calf gain per cow on native range was greatest for system 1 (more total grazing days) and similar between systems 2 and 3. Calf gain per acre was similar across all native range grazing strategies.

Among grazing systems, calf average daily gain was greatest for system 3 and similar between systems 1 and 2. Accumulative calf gain per cow was greatest for system 3, lowest for system 1 and intermediate for system 2. Difference among total gain was a combination of slight differences in total grazing days (Table 2) and individual calf performance (Table 3). Seasonal calf gains per acre tended to favor the systems that employed the use complimentary pastures (systems 2 and 3).

Cow gain when grazing native range did not mirror calf gain. System 2 produced higher average daily gain and seasonal gain in cows than system 1 or 3 when grazing native range, while gains were similar between system 1 and 3. Cow gain among grazing systems was highest for system 3, lowest for system 1 and intermediate for system 2.

Standing live herbage biomass (lb/ac) for crested wheatgrass, native range and altai wildrye over the grazing season is presented in Figure 1. Fertilization (system 3 vs system 2) of crested wheatgrass increased herbage biomass at all sampling dates despite heavier stocking rates. The increase in herbage biomass allowed 50% heavier stocking rates on fertilized crested wheatgrass without compromising individual animal performance (data not shown; Manske, 1999a). Neither grazing system fully utilized the herbage produced when crested wheatgrass was grazed exclusively in the spring (May). Grazing strategy on native range had little effect on standing live herbage biomass remaining over the season. There appeared to be tendency for system 2 have more herbage biomass remaining over the season compared to the other two systems. Altai wildrye in system 3 produced a tremendous amount of herbage biomass over the season and maintained this biomass for a longer period of time than other forages. The rapid rate of decline in altai wildrye biomass during grazing (approximately 2300 lb lost during 30 d of grazing) was unexpected . This rate of disappearance is roughly twice what would be expected from animal (cows and calves) consumption alone. The rate of forage disappearance in altai wildrye pastures was not mirrored in the native range grazed during the same time period (system 1).

Pasture costs, calf return and estimated net return over pasture costs are also reported in table 3. Total pasture costs when grazing native range were greatest for system 1 reflecting the larger number of acres of native range grazed. Pasture costs when expressed as costs per pound of calf gain was also numerically greater for system 1, but the differences among grazing strategies on native range were quite small ($.019 range from greatest to least). Pasture costs among grazing systems were also greatest for system 1, lowest for system 2 and intermediate for system 3. Again the magnitude of these differences was not large. The range in total pasture costs was $12.5/cow between the systems.

When utilizing native range, total return and net return over pasture cost on a cow basis was greatest for system 1, and similar between systems 2 and 3. Net return over pasture cost on an acre basis was similar among strategies when grazing native range (range among strategies was $1.50/ac). Total return to grazing system and net return over pasture cost was greatest for system 3, least for system 1 and intermediate for system 2 (range was $28.30 and $33.60 for total and net return per cow). When net return over pasture cost was expressed on per acre basis, return was least for system 1 and similar between systems 2 and 3 (range was $3.80/ac).

Discussion

Although recent calf performance (Table 3) was greater than long term averages (Table 1), differences in individual calf performance among grazing strategies on native range remained similar. Reducing the grazing of native range from 6 months to 4.5 months by the grazing of complimentary forages increased individual calf gain approximately .25 lb/d. Employing a 4.5-month rotational grazing strategy further increased calf gain by approximately .15 lb/d. This similarity among differences in individual calf performance was unexpected given a substantial decrease in stocking rate (ac/cow/mo) within seasonlong grazing strategies in recent years. The change in stocking rate on native range was -1.75, -.60 and +.42 ac/cow/mo for systems 1, 2 and 3, respectively.

Long term and recent production and estimated pasture costs and returns for a 4.5-month rotational grazing strategy on native range (strategy 3 in table 1 and native range 3 in table 3, respectively) and for a grazing system that combines rotational grazing of native range with complimentary spring and fall pastures (strategy 4 in table 1 and system 3 in table 3, respectively) are similar. The major deviations were a slight increase in stocking rate in recent years and an overall increase in individual calf performance (.5 lb/d). This difference was the result of a shift toward larger cows in recent years (Manske, 1999a). Seasonal calf gain (lb/ac), unit pasture costs ($/lb of calf gain) and net return above pasture costs ($/ac) varied little between the two time periods.

There is substantial variation between long term and recent production and estimated pasture costs and returns for seasonlong grazing strategies on native range. Decreases in stocking rate and maintenance of animal performance generally account for most of the variation. Despite a substantial advantage in terms of seasonal calf production, overall and unit pasture costs and net returns with grazing systems that involve rotational grazing of native range in long term averages (Table 1), recent data (Table 3) suggest these differences are not constant and not nearly as large as previously suggested. Long term averages suggested rotational grazing of native range for 4.5 months with beef cows and calves increased calf gain by 20 lb/ac and net returns over pasture cost by $115/animal unit (cow) and $14/ac, while reducing pasture cost by $.38/lb of calf gain, over a seasonlong grazing for 6.0 months. Seasonlong grazing for 4.5 months was roughly intermediate between the other two grazing strategies. Comparatively, recent results suggest rotational grazing increased calf gain by 1.4 lb/ac and net returns per acre over pasture costs by $1.1, while unit pasture costs were reduced $.01/lb of calf gain when compared to seasonlong grazing of native range for 6 months. Net returns per cow over pasture costs were actually decreased $22 by rotational grazing.

Conventional wisdom and historical data would suggest that appropriately planned grazing systems that combine rotational grazing strategies on native range with the use of complimentary grazing in the spring and fall are advantageous to livestock operations. These systems are expected to increase seasonal stocking rate, animal performance and net returns per cow and per acre. Recent data would support this hypothesis, particularly with respect to the utilization of complimentary pastures. However, the magnitude of these differences for the grazing system seems questionable. For example when comparing an intensively managed grazing system with 6 months of grazing with a system that involves seasonlong grazing of native range, historical data suggests a difference of $171/cow and $16.2/ac in favor of the intensively managed system. Recent data suggest these differences to be much smaller ($34/cow and $4.3/ac; a reduction of approximately 75% of historical data). Nonetheless, there appears to be some economic incentive to increasing the level of management in grazing systems of the Northern Great Plains.

Comparing recent data regarding grazing strategies on native range with conventional wisdom and historical data is much less clear. An evaluation of long-term trials at Dickinson (Manske, 1999b) indicates that a 6.0 month seasonlong grazing strategy (similar to strategy 1 in this report) causes a reduction in stocking rate, animal performance and net return per cow and per acre when compared to 4.5 month grazing strategies (similar to strategies 2 and 3). Furthermore, using a rotational grazing strategy (strategy 3) improves animal performance with increased stocking rate, calf average daily gain and calf gain per acre and results in an improved financial status for the operation. Recent data would concur that increasing grazing management (e.g. decreasing length of grazing season, rotational grazing) on native range increases individual animal performance. Conventional wisdom would suggest that this increase in animal performance with increasing grazing management would also increase seasonal livestock gain per acre by increasing forage availability and/or quality. However, recent data suggest seasonal calf gain per acre and live standing biomass of native range was similar across all grazing strategies. An economic comparison of recent data regarding grazing strategies on native range suggests only a slight advantage (+ $1.5/ac) to decreasing the length of the grazing season and no advantage to rotational grazing.

Conclusion

Recent grazing data provide much food for thought. Delaying the start and reducing the length of the grazing season through the use of complimentary pastures is something all grazing livestock producers should consider. Intensive management (e.g. fertilization) of at least spring complimentary pastures to increase forage production seems warranted. Nutritional supplementation may have potential for offsetting reduced livestock performance later in the grazing season in all grazing systems. Recommendations for a specific grazing strategy when utilizing native range is much less clear. A reduced grazing season (4.5 months versus 6 months) seems advantageous, if spring and fall complementary pastures can be developed. Rotational grazing strategies seem to improve individual calf performance. However, this increase seems to come at the expense of total grazing days. These offsetting effects when grazing native range seems to result in similar seasonal performance between seasonlong and rotational grazing strategies.

Literature Cited

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Table 1. Comparisons of long-term average production and estimated cost and net returns of three grazing strategies on native range.[a]

Item	unit	Grazing Strategy[b] 1 (6.0 m Seasonlong)	2 (4.5 m Seasonlong)	3 (4.5 m Rotational)	4 (strategy 3 plus)
Stocking rate	ac/AUM[c]	4.04	2.86	2.04	1.72
Calf gain					
daily	lb/d	1.80	2.09	2.21	2.14
seasonal	lb/ac	13.59	22.55	33.64	37.98
Pasture cost ($8.76/ac)					
per animal unit	$/AU[c]	212.34	111.25	78.84	97.59
per lb of calf gain	$/lb	.64	.39	.26	0.23
Net return ($70/cwt)					
per animal unit	$/AU	18.24	89.18	133.10	189.22
per acre	$/ac	.75	7.08	14.79	16.99

[a] Adapted from two sources: 1) Manske and Sedivec.1999. Early grazing strategies. *In:* 1999 Annual report Dickinson R/E Center, North Dakota State University. pp 53-56 and 2) Manske. 1995. Economic returns as affected by grazing strategies. *In:* 1995 Annual report Dickinson R/E Center, North Dakota State University. pp 58-77.

[b] Native range grazing strategies 1 (6.0 m seasonlong), 2 (4.5 m seasonlong) and 3 (4.5 m rotational) labeled seasonlong starting (grazing) prior to or after 3rd leaf or twice-over rotation starting after 3rd leaf, respectively, in the first reference. Strategy 4 (strategy 3 plus) labeled 4.5 M TOR in the second reference includes a 4.5 m rotational grazing on native range combined with a spring pasture of fertilized crested wheatgrass and a fall pasture of altai wildrye.

[c] AUM and AU refer to animal unit month and animal unit, respectively. An AU is assumed to be equivalent to a 1000-lb cow and accompanying calf. An animal unit month is roughly the amount of forage consumed by one AU in one month.

Table 2. Grazing dates and days for three seasonal grazing systems in western North Dakota (1998 - 1999).[a]

Grazing System[b]	Spring pasture[c]	Native range	Fall pasture[c]	Total
1	--	12 May - 11 Nov[c] (182.5 d)[e]	--	12 May - 11 Nov[c] (182.5 d)
2	5 May - 2 Jun (28 d)	2 Jun - 15 Oct[c] (134.5 d)	15 Oct[c] - 11 Nov[c] (27 d)	5 May - 11 Nov[c] (189.5 d)
3	5 May - 2 Jun (28 d)	2 Jun - 7 Oct (127 d)	7 Oct - 7 Nov[c] (30.5 d)	5 May - 7 Nov[c] (185.5 d)

[a] Adapted from Manske.1999. Defoliation effects on the structure and dynamics of grassland ecosystems. *In:* 1999 Annual report Dickinson R/E Center, North Dakota State University. pp 26-39.
[b] Systems 1, 2 and 3 were labeled 6.0-month seasonlong (6.0 SL), 4.5-month seasonlong (4.5 SL) and 4.5-month twice-over rotation (4.5 TOR), respectively, in the original report.
[c] Spring and fall pastures were unfertilized crested wheatgrass and crop aftermath for System 2 and fertilized (50 lbs N/ac on 1 Apr) crested wheatgrass and altai wildrye for System 3, respectively.
[d] Actual dates varied slightly between years.
[e] Numbers in parenthesis reflect average grazing days across years.

Table 3. Comparisons of production and estimated cost and net returns of three grazing strategies on native range and three seasonal grazing systems in western North Dakota (1998 - 1999).[a]

		Native Range[b]			System[b]		
Item	unit	1	2	3	1	2[c]	3
Performance							
Stocking rate	ac/COWM[d]	2.24	2.27	2.46	2.24	2.23	2.10
Required land base	ac/COW[d]	13.3	10.0	10.2	13.3	11.9	12.7
Calf gain							
daily	lb/d	2.36	2.57	2.73	2.36	2.37	2.54
seasonal	lb/COW	430.7	345.7	346.7	430.7	449.1	471.2
	lb/ac	32.5	34.6	33.9	32.5	37.8	36.9
Cow gain							
daily	lb/d	.19	.55	.28	.19	.43	.53
seasonal	lb/COW	34.7	74.0	35.6	34.7	81.5	98.3
	lb/ac	2.8	7.3	3.5	2.8	6.9	7.6
Pasture cost ($8.76/ac)							
Total	$/COW	116.5	87.6	89.4	116.5	104.0	111.3
per lb of calf gain	$/lb	0.27	0.25	0.26	0.27	0.23	0.24
Returns ($70/cwt)							
Total	$/COW	301.5	242.0	242.7	301.5	314.4	329.8
Net over pasture cost							
per cow	$/COW	185.0	154.4	153.3	185.0	210.4	218.6
per acre	$/ac	13.9	15.4	15.0	13.9	17.7	17.2

[a] Adapted from Manske.1999. Defoliation effects on the structure and dynamics of grassland ecosystems. *In:* 1999 Annual report Dickinson R/E Center, North Dakota State University. pp 26-39.

[b] Systems 1, 2 and 3 were labeled 6.0-month seasonlong (6.0 SL), 4.5-month seasonlong (4.5 SL) and 4.5-month twice-over rotation (4.5 TOR), respectively, in the original report.

[c] Stocking rates and required land base would be 2.98 and 18.5 including grazing provided by crop acres. Numbers in table do not reflect these acres or costs assuming that available grazing is a byproduct of a cropping operation. Production and returns do, however, reflect livestock productivity from these crop acres.

[d] COWM and COW refer to a cow-month and base animal. The base animal is equivalent to one cow on this study and accompanying calf. A cow-month is roughly the amount of forage consumed by one COW in one month. COW is also equivalent to roughly 1.26 animal-unit equivalents, where one animal-unit is assumed to be equivalent to a 1000-lb cow and accompanying calf.

(a)

(b)

(c)

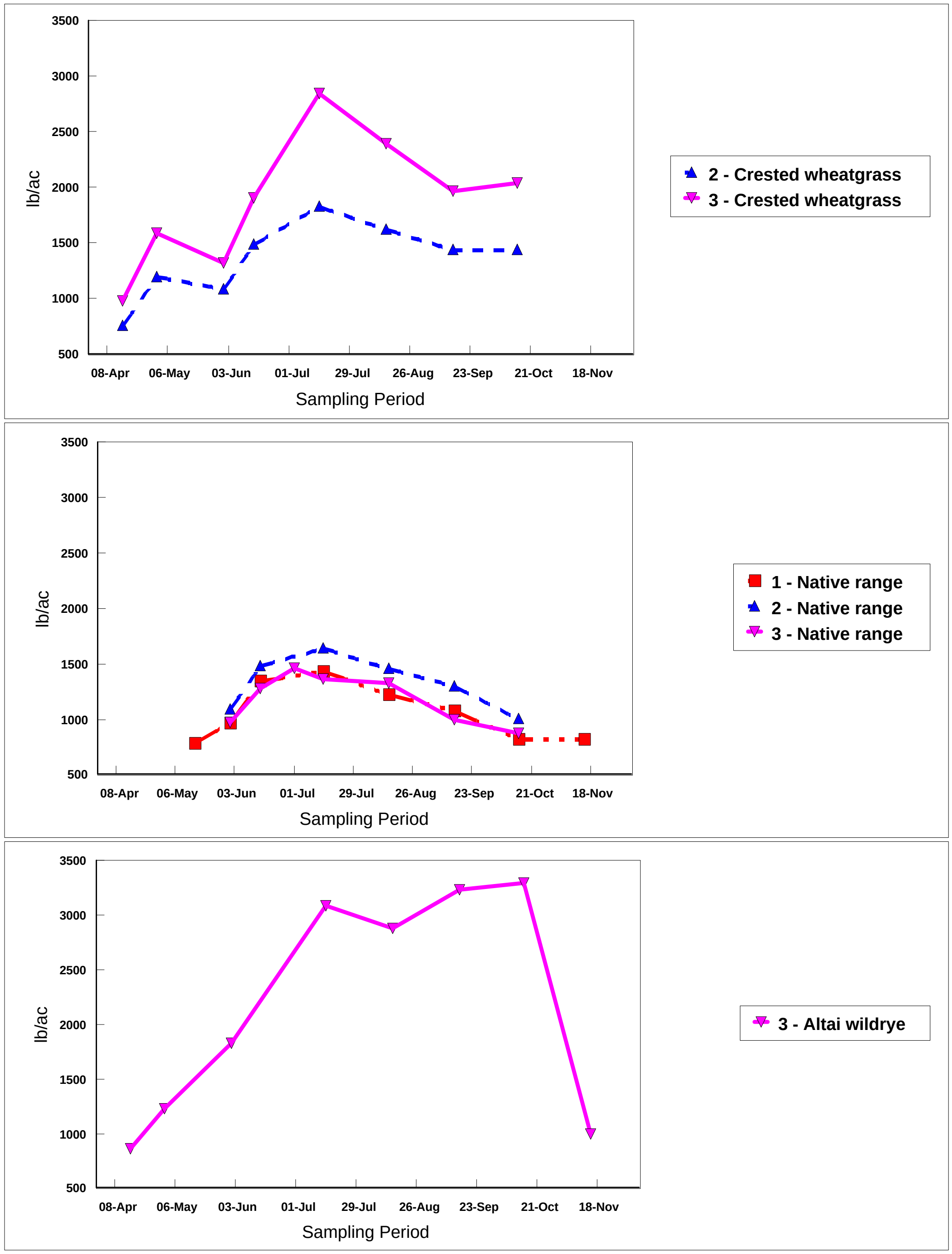

Figure 1. Standing live herbage biomass (lb/ac) for (a) crested wheatgrass, (b) native range and (c) altai wildrye over the grazing season for three grazing systems. Grazing systems (Table 2) included: (1) a 6.0-month seasonlong, (2) a 4.5-month seasonlong, and (3) a 4.5-month rotational grazing strategy on native range. The 4.5 month grazing strategies also included complimentary spring and fall pastures. Spring pastures were either unfertilized or fertilized crested wheatgrass and fall pastures were either crop residue/aftermath or altai wildrye for grazing systems 2 and 3, respectively.