Financial Benefits of Range Management Practices in the Chihuahuan desert

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Over the last 50 years various management practices to improve cattle production efficiency in the Chihuahuan desert of southern New Mexico have been evaluated at the College Experimental Ranch operated by the Department of Animal and Range Sciences of New Mexico State University, and at the adjacent Jornada Experimental Range operated by the Agricultural Research Service-United States Department of Agriculture. These management practices have been both active (high monetary inputs) and passive (low monetary inputs). Research on active management practices has involved primarily brush control and grazing systems while passive management research has been oriented toward stocking rates, cattle breeding improvement, supplemental feeding, watering point spacing, and replacement heifer management.

The management strategy that has proven most effective based on these various studies is to use a conservative stocking rate (30 to 35% use of forage), a continuous grazing system, a maximum watering point spacing of 2 to 3 miles apart, an intensive replacement heifer management program, an intensive breeding program, almost no supplemental feed inputs other than a salt/mineral mix on the mature cow herd, and partial confinement of the herd during periods of severe drought. Performance measures comparing the average 1978 to 1984 Chihuahuan desert ranch, the average 1986 to 1991 Chihuahuan desert ranch, and the NMSU College Ranch with full application of the available technology are given in Table 1.

I will consider in detail the financial effectiveness of four rangeland oriented practices—stocking rate, water development, grazing systems, brush control—that have been most widely used on Chihuahuan desert ranges. The basis for my analysis comes from a series of reports by agricultural economists at New Mexico State University and exercises I've performed using a computer model developed by Allen Torell, agricultural economist, NMSU. This model permits comparison of financial outcomes from various management practices through altering cattle prices, ranching costs, and ranch financial structure. The financial structure of the average Chihuahuan desert ranch given in Tables 2 and 3 is based on rancher interviews and range surveys directed by Allen Torell and the author (Torell et al. 1990, Torell and Word 1991). Special thanks is given to Dr. Torell for his help in the development of this paper.

Management Practices and Financial Returns

Stocking Rate

The conservative stocking rate is a critical factor in the superior vegetation, livestock, and economic performance on the College Ranch compared to surrounding ranges. Early long-term studies by Paulsen and Ares (1962) on the Jornada Experimental Range and by Valentine (1970) on the College Ranch showed Chihuahuan desert upland ranges had superior forage productivity under 30 to 40% use levels compared to those that were heavier. Over a 24-year period a combination of continuous grazing and conservative stocking on the College Ranch has tripled forage production, increased range condition from low fair to high good, improved wildlife habitat, and given superior cattle performance (Beck et al. 1987, Saiwana 1990, Tembo 1990). Under this strategy a stocking rate increase of 40% (165 to 120 ac/AU) has been possible with no sacrifice in cattle performance or increase in degree of forage plant use.

The key question is what are the initial financial consequences of the 20 percent reduction in stocking rate that is required to lower forage use from 45 to 50% to 35 to 40% for the average ranch in Tables 2 and 3? Under a worst case scenario of no improvement in cattle performance, no reduction in supplemental feed cost and the present cost-price structure, a rancher destocking from 250 AU's to 200 AU's would receive about $25,000 from sale of cattle ($500/AU) and his ranch income would be reduced from $13,003 to $6,802.

On the other hand if the 20% stocking rate reduction increased calf crop by 5%, calf weaning weights by 30 lbs, lowered cattle death losses from 4% to 2% and reduced supplemental feed costs from $30 to $15 per AU, income from the cattle would increase from $13,000 to $16,555. Our research program at the College Ranch indicates the favorable scenario just described is much more probable than the worst case scenario. However, I recognize the need for research to better compare livestock production under different stocking rates.

Three other considerations regarding the decision on whether or not to partially destock would be recent climatic conditions, recent cattle prices, and taxes. During the last six years in southern New Mexico, cattlemen have had both favorable precipitation conditions and high cattle prices. Based on historic trends (Fowler and Torell 1985) the probability is now high for both drought and a decline in cattle prices. The old Wall Street adage of buy low and sell high applies just as well to livestock as common stock.

Under present tax laws the rancher that decided to partially destock would be subject to taxes on all income from the sale of the 50 animal units because the cost of raising and keeping the animals is allowed as a deduction against gross income during the life of the cattle. The rancher would be taxed at 28% of the $25,000 for a total tax of $7,000. For most ranchers a gradual destocking would be better for tax purposes than to sell all the anim-

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Table 1. Production and efficiency characteristics for average medium sized-Chihuahuan desert ranches in southern New Mexico in the 1978 to 1984 period and the 1986 to 1991 period and for the NMSU College Experimental Ranch using the best available technology.

Characteristic	Average ranch (1978 to 1984)	Average ranch (1986 to 1991)	College Ranch (best technology)[2]
Ranch size (Acre)	40,000	40,000	40,000
Number of AUY	235	250	333
Number of mature cows	179	190	253
Replacement rate (%)	13	13	13
Bull to cow ratio	1:15	1:15	1:15
Calf crop %	74	75	87
Calf death loss	4.0	4.0	<0.5
Steer calf weight	425.0	420.0	490
Beef product/Ac	1.35	1.44	3.53
Supplement feed cost/AUY (%)	26.95	30.00	10.63
Health care cost/AUY ($)	2.66	4.85	9.50
Replace heifer mgmt cost/AUY ($)	—	—	10.05
Total variable cost/AUY ($)	—	117.24	116.85
Total fixed cost/AUY ($)	—	72.02	54.02
Total cost/AUY ($)	165.88	189.27	170.87
Total return ($)	8,084	13,003	49,487
Return/AUY ($)	34.40	51.99	148.61
Return/Ac ($)	0.21	0.33	1.24
Stocking rate (Ac/AUY)	170	160	120
Forage product (lbs/ac)	125	150	250
Forage use (%)	45-50	45-50	30-35
Range condition[1]	Mid-Fair	High-Fair	High-Good

[1]Soil Conservation Service approach is the basis for range condition ratings.
[2]Standardized to 40,000 acres.

Table 2. Financial structure of the average medium sized (250 animal unit) cow-calf ranch in the Chihuahuan desert of southern New Mexico in the 1986 to 1991 period.

Item identification	Unit	Quantity	Value/Unit/$	Total Value/$
Land:				
Owned rangeland	Acres	8,400	25.77	216,468
State lease rangeland	Acres	8,000	6.44	51,520
Federal lease rangeland	Acres	23,600	—	—
Federal lease rangeland	AUM's	1,780	42.96	76,468
Subtotal		40,000		344,456
Dwellings:	—	—	—	55,000
Other buildings:	—	—	—	36,000
Watering facilities:				
Wells	Number	4	10,000	40,000
Pipelines	Miles	2	2,100	4,200
Tanks & Reservoirs	Number	3	2,500	7,500
Subtotal				51,500
Barbed wire fence	Miles	38	1,500	57,000
Other range facilities	—	—	—	4,000
Machinery	—	—	—	39,300
Cattle:				
Cows	Number	190	600	114,000
Heifers 1-2	Number	25	600	15,000
Heifer calves	Number	25	374	9,345
Bulls	Number	13	688	8,944
Horses	Number	4	1,000	4,000
Subtotal				$151,289
Total Value				$738,545

als in one year. It is doubtful that any monetary benefits would result from destocking below a 30% level of forage use.

Water Development

Better watering point placement and spacing is one of the surest and safest ways to increase economic returns and improve range condition in the Chihuahuan desert. Surveys by the author show watering point spacings average around 4 to 4 1/2 miles apart on southern New Mexico ranges. Studies from the College Ranch indicate that changing spacings to 2 to 3 miles apart could increase grazing capacity by 25 to 35% on many ranches

(Valentine 1947, Tembo 1990). Watering point spacings closer than 2 to 3 miles apart are of questionable benefit to livestock and vegetation, and cost may be excessive. This, however, needs to be better researched. If the rancher (Tables 2 and 3) reduced watering point spacing from 4 miles apart to 2 1/2 miles apart he should be able to gain a 25% increase in grazing capacity at a cost of around $18,800 (1 well, 3 pipelines, 1 tank), or $0.47 acre. Another $0.78 per acre can be added to these costs for additional cattle ($500/animal unit) for a cost of $1.25 per acre ($50,000 total). Under the present cost-price structure with no interest on the $50,000 required for this practice, an extra $7,752 per year return could be expected. This amounts to a 15.50% return on investment and 6.45 years for investment recovery. If the rancher borrowed the $50,000 at a 10 percent interest rate for 10 years, his annual payment would be $7,929 against $7,752 expected increased income from the practice which gives an annual loss of $177. A rancher with cash flow problems would be wise to avoid this investment although it might be suitable for a well-capitalized rancher.

A major benefit of water development is to improve range condition and cattle performance. In this situation the rancher would sustain only the $18,800 ($0.47/acre) cost of the watering points. If calf crops improved by 5%, calf weaning weights increased by 20 lbs, and cattle death losses were reduced from 4 to 2%, the rancher's total return would increase by $7,115 ($0.18/acre). Here 2.64 years would be required to pay off the investment and annual return on investment would be 38%. If the rancher took out a 5-year loan at 10% interest, the annual payment would be $4,754, which is well below the $7,115 expected added income. Any Wall Street analyst would like this investment.

Specialized Grazing Systems

Athough specialized grazing systems have received a lot of attention by researchers on desert areas of Arizona and New Mexico, the results generally have been disappointing. The Santa Rita rest rotation grazing system was compared to season long grazing using moderate stocking rates in southeastern Arizona. After a 12 year period,

Table 3. Annual average budgeted costs and returns for the average medium sized (250 AU) cow-calf ranch in the Chihuahuan Desert of southern New Mexico (1986 to 1991).

	Gross returns			
Livestock type	$/CWT	Sale weight (CWT)*	Total ($)	Guideline value ($/AUY)
137 calves	89.00	4.2	51,217	204.84
2 cull bulls	55.00	12.5	1,375	5.50
23 cull cows	42.00	8.0	7,728	30.91
Total ($)			60,320	241.25

	Production costs				
Cost type	Unit	$/Unit	Tax deduction	Total ($)	Guideline value ($/AUY)
A. Variable costs					
1. Grazing fees					
State lease	Acre (8,000)	0.59	x	4,720	18.88
BLM	AUM (1780)	1.86	x	3,311	13.24
2. Supplemental feed			x	7,500	30.00
3. Livestock expenses					
2 purchased bulls	Head	1,300	x	2,600	10.40
Fuel & repairs			x	4,500	18.00
Veterinary & medicine			x	1,200	4.80
Property taxes (livestock)			x	1,024	4.10
Maintenance			x	2,700	10.80
Other			x	1,756	7.02
4. Hired labor			x	0	0
Total variable costs			x	29,311	117.24
B. Fixed costs					
Electricity			x	1,700	6.80
Telephone			x	720	2.88
Butane & Heating			x	1,030	4.12
Insurance			x	4,200	16.80
Depreciation			x	9,346	37.38
Property taxes			x	1,010	4.04
Total fixed costs			x	18,006	72.02
Total cash costs			x	47,317	189.27
C. Net ranch income** ($)				$13,003	51.99

*Sale weights include 3% shrink.
**No value is subtracted for operator labor and management.

grass densities and forage yields showed no difference between the two strategies (Martin and Sieverson 1988). The ranges studied were in good condition and the authors speculated that the outcome of their study might have been different on poor or fair condition ranges.

On the College Ranch in southcentral New Mexico, a best pasture rotation scheme was compared to continuous grazing over a 24-year period. The best pasture scheme involved three pastures and one herd of cattle. Annually each pasture was used when its suitability for grazing was considered to be highest relative to the other pastures. Both climatic conditions and forage resources in the pastures were used to make grazing decisions. The ranges studied were generally in low fair to poor condition at the beginning of the study and were conservatively stocked (Beck 1978, Beck et al. 1987). As previously mentioned, impressive results were obtained with continuous-conservatively stocked grazing strategy. Both vegetation and cattle performance were highest under the continuous compared to the best pasture rotation scheme.

The most effective specialized grazing strategy for desert ranges that has been experimentally tested is a modified best pasture system developed by Martin and Ward (1970). This strategy involves controlling where cattle graze by regulating access to water. This system involves little extra labor or fence and it nearly doubled forage production around the watering points over an eight-year period compared to a continuously grazed control.

Presently there is considerable interest in short-duration type grazing schemes developed by Allan Savory. Much of the interest in these schemes has to do with the impressive claims that stocking rates can be increased by at least 50 percent and in some cases doubled or tripled (Savory and Parsons 1980). Although research comparing vegetation, livestock, and financial performance under short-duration and continuous schemes in the Chihuahuan desert is unavailable, some assessment can be made of the potential monetary benefits using a best case scenario.

A report by Graham et al. (1991) indicates that water development and fence cost for short duration grazing systems in northeastern New Mexico have averaged about $3.20 per acre and extra livestock costs are about $500 per AU. On this basis total costs will be around $6.32, $4.76, and $3.98 per acre for 100, 50, and 25% stocking rate increases, respectively, on Chihuahuan desert. On the 40,000-acre ranch in Tables 1 and 2 this means total investments of $252,800, $190,400, and $159,200, respectively, to put the entire ranch under short-duration grazing. Under a best case scenario with no decline in cattle performance, no increase in total fixed costs, or no interest rate cost for borrowed capital, the rancher in Tables 2 and 3 would increase his total return by $31,009, $15,505, and $7,752 for 100, 50 and 25% stocking rate increases, respectively. Recovery of investment would require 8.2, 12.3, and 20.5 years. Returns on investment would be 12.3%, 8.1%, and 4.9%. If the rancher borrowed the money at 10% interest for 15 years, annual payments would be $32,599, $24,350, and $20,529, which are all above the expected increased returns.

Under a worst case scenario the price of cattle might fall 30%, and severe drought could reduce forage production by 40% and cattle performance (calf crop and weaning weights) by 20%. Under these conditions in one year the rancher could easily lose 25% of his investment. Although ranchers with a strong financial balance might survive this scenario, the leveraged rancher would quickly be put out of business. The all-important question becomes Could it happen?

A rancher considering implementation of a short-duration grazing system would have the highest probability for success if he made his investment under conditions of low cattle prices and low interest rates after recovery from the last drought. Ranges in good condition would be more likely to sustain the heavier stocking rates needed to pay for the short duration grazing system than those with depleted forage supplies. Research available from both the Great Plains (USA) and Africa indicate that if the rancher increased his stocking rate much more over 40% beyond what would normally be considered moderate, both financial and ecological failure would be likely within 15 years (Gammon 1984, Skovlin 1987, Heitschmidt 1986, Willms et al. 1990). In New Mexico the average stocking rate increase for short-duration grazing systems has been about 60% (Graham et al. 1991). Nearly all these systems were implemented within the last 10 years, which have been characterized by highly favorable precipitation conditions.

It is rather interesting that the rancher would do just about as well by investing in 30-year government insured bonds (7.5% yield) as under the short-duration grazing/50% stocking rate increase best case scenario. Most would agree short-duration grazing systems on desert lands are risky, uncertain investments with only moderate reward under the best of conditions. However, at moderate stocking rates they may have potential to improve vegetation and wildlife resources for those ranchers and government agencies who consider financial risks and returns unimportant.

Brush Control

Brush control has received much more emphasis than grazing management as a means to increase livestock productivity and economic returns in the Chihuahuan desert. Generally herbicidal control is the only feasible means of brush control on degraded sites with a sparse understory. On mesquite areas which show the most response to herbicidal control, a doubling of forage production from 120 to 240 lbs at a per acre cost of $8 for herbicide and $3.13 for livestock to make use of the extra forage ($11.13/AC total) would be reasonable best case scenario. Using the financial structure in Tables 2 and 3, the rancher who controlled brush on 25 percent of his land and doubled forage could expect an extra total return of $7,752 or $0.78/acre. In 14.4 years he would recover his $111,300 investment. The annual return on investment would be 7.0%. If the rancher borrowed the money at 10% interest, annual payments, for 10- and 20-year loans would be $17,650 and $12,889, respectively, which are both well above his annual $8,198 return.

In the above best case scenario the returns (7.0%) are above bank passbook (3.0%) savings accounts and below long-term government bond yields (7.5%). A serious downside is the probability for success with a single herbicide application is no more than 50 to 70%. Then there's also the possibility of drought and lower cattle prices. Under these conditions a rancher could easily lose half or all of his investment in a few years. Presently I conclude brush control is a risky and costly management practice for ranchers and government agencies in the Chihuahuan desert. The big question is, Will higher cattle prices and development of cheaper, more effective herbicides change this situation?

Minimization of Infrastructure

Some ranches in the Chihuahuan desert have high amounts of fence, watering points, buildings, corrals, roads, and machinery relative to others. These assets generally have an annual depreciation cost, a maintenance cost, or both. The tax code of the 1970's and early 1980's permitted generous deductions for depreciation associated with these assets. However, the 1986 tax code lengthened depreciation schedules and eliminated certain deductions. Under the present tax code, keeping infrastructure at the minimum level required to efficiently stock and operate the ranch is essential to controlling fixed costs and avoiding debt. Keep in mind that the high fixed costs are an important drawback of Chihuahuan desert ranching compared to the Great Plains. A disadvantage of active range improvements such as brush control or specialized grazing systems on private land is that ranches with high levels of infrastructure and grazing capacity per unit area tend to sell for less per animal unit than ranches larger in size but less developed (Torell and Doll 1989). This is because ranch buyers perceive owning more land as advantageous over the lower management costs associated with developed ranges (Torell and Doll 1989).

Conclusions

Specialized grazing systems, stocking rate adjustments, brush control and water development have been the traditional approaches to improving range condition and financial returns in the Chihuahuan desert. Under present conditions, specialized grazing systems and brush control involve high monetary inputs and great uncertainty regarding their influences on forage and cattle productivity.

Generally, ranchers have had an aversion to stocking rate reductions as a range improvement tool in the Chihuahuan desert and on other rangelands. This is because they associate lower gross income and higher fixed costs per animal unit with lower livestock numbers. However, research indicates that even on a short-term basis (1 to 5 years), higher individual livestock productivity and lower supplemental feed costs can more than compensate for this loss of income when stocking rates are reduced from heavy to moderate (30 to 40% forage use). On a long-term basis major increases in carrying capacity can be expected from this adjustment on most Chihuahuan desert ranges.

Water development is one of the safest and most profitable investments a rancher can make. The important criteria for successful water development are that areas producing at least 120 lbs/acre of forage exist in the zone two miles and more from water. Most ranchers will benefit financially more by using water development as a tool to improve range condition and cattle performance rather than to increase grazing capacity.

Low intensity range management coupled with high technology cattle management is a contrary approach from the viewpoint of many ranchers and range conservationists. However, this technology shows considerable potential for increasing the sustainability and profitably of cattle grazing in the Chihuahuan desert with low risk to the operator. Soil stability and excellent wildlife habitat are added benefits associated with this approach. Research is needed to better evaluate livestock productivity under this approach compared to more intensive strategies.

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Rayless Goldenrod Toxicity in Livestock

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Rayless goldenrod, commonly referred to as jimmy weed or alkaliweed *(Haplopappus heterophyllus)*, is a toxic range plant of the southwestern United States. Losses to livestock have been reported in western Texas, New Mexico, Arizona, and southern Colorado (Kingsbury 1964). The disease has been referred to as "alkali disease" because it was thought to be associated with drinking of alkali water. It is currently referred to as "milk sickness" or "trembles" because the toxin is excreted in the milk of lactating animals and results in the poisoning of humans and young nursing animals. Cases of "milk sickness" in humans occurred in the Pecos Valley of New Mexico and were also identified with the disease in animals. "Trembles" refers to the clinical syndrome which is manifest by muscular weakness, muscle fasciculation, and collapse. This toxic syndrome of livestock, caused in the southwestern United States by rayless goldenrod, appears the same as white snakeroot *(Eupatorium rugosum)* poisoning in the midwestern and eastern United States. The same toxins are believed to be involved in both. Rayless poisoning in livestock is usually a result of bad management and occurs in pastures where good quality forage is not available, thus forcing animals to graze less desirable plants.

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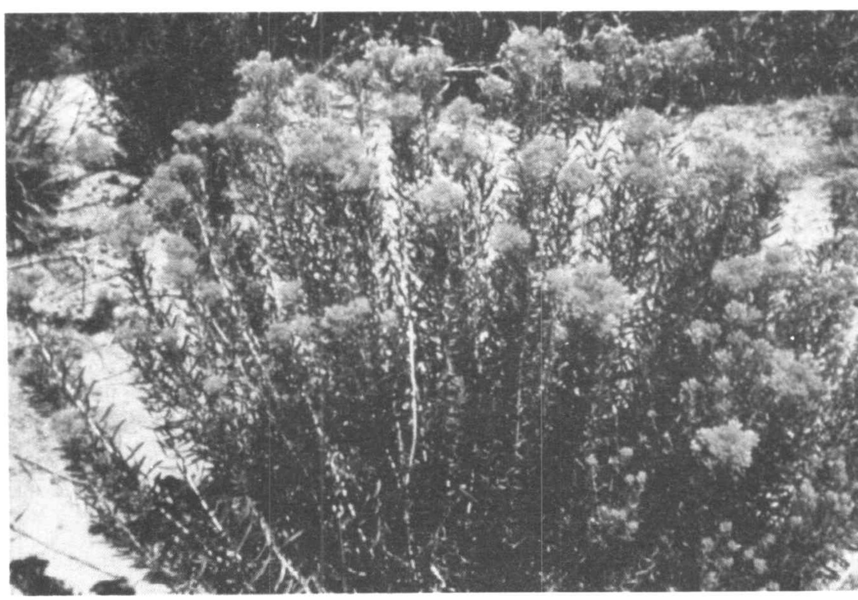

Fig. 1 *Rayless goldenrod.*

Description, Habitat and Geographical Distribution

Rayless goldenrod is an erect, bushy, unbranched perennial shrub growing from 2.0 to 4.0 ft in height. The base is woody. The leaves are alternate, linear, entire or toothed (Figure 1). Heads are numerous, small, and clustered at the top of the stem with 7–15 tabular flowers; corolla yellow, achene silky-hairy, with bristly hairs at the apex (Kingsbury 1964).

This plant is commonly found in riparian zones along river valleys and drainages or dry plains, grasslands, or open woodlands from southern Colorado to western Texas, New Mexico, Arizona, and southward into Mexico. The plant grows abundantly