Optimum Cattle Management on Utah Ranches

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The Right Thing To Do

Cattle operations employ a variety of management strategies to increase their net returns (Evans and Workman 1994). Strategies may include rangeland improvements (brush control on degraded sites), increased hay harvest efficiency (haying only the best land and grazing low productions fields), and improved herd management (more uniform livestock distribution by intensive herding and strategic salt placement).

Cattle management improvements have traditionally been analyzed on a case by case basis, even though selection should consider impacts on the "total ranch" operation and must include the best possible uses of land, time, and funds. It would be hard to over-state the importance of properly choosing among management alternatives or, as stated by White (1988), "selecting the right thing to do is more important than doing things right."

Economic analysis of improvements on a "total ranch" basis is crucial because other (unconsidered) aspects of ranch management may limit net returns even more than the "target" improvement being considered. Linear programming (LP) offers a tool to determine the optimum intensity and mix of improvements, to identify the most limiting resources, and to simultaneously measure the combined impacts on total ranch net returns (Evans and Workman 1994).

The Typical Utah Ranch

Production and economic data for the typical Utah ranch were based on detailed surveys of 96 Utah cattle ranches (Evans 1992). In 1990, the typical ranch ran 196 brood cows and replaced 14% of the cows annually (Evans and Workman 1994). Replacement heifers were bred at 14 months of age to calve as 2-year olds. Eight bulls were used, a cow to bull ratio of 27:1, and calf crop (calves weaned divided by cows in the calving herd) was 77 percent. Thirty-six of the 150 calves weaned were retained for sale as yearlings. Death loss was 3.9 percent on mature cows and 2.3 percent on replacement heifers. Private land holdings, carrying capacities, and grazing leases are shown in Table 1.

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Table 1. Typical Utah ranch private land holdings, carrying capacities, and grazing leases, 1990.

	Size	Carrying Capacity
Land holdings	(ac)	(AUM)
Desert range	30	3
Native foothill	1331	180
Low meadow pasture	111	264
Foothill crested wheatgrass	545	298
Irrigated alfalfa hay	101	987
Irrigated grass hay	15	90
Irrigated barley	31	199
Dryland wheat	46	147
Crop aftermath	193	303
Grazing leases		
U.S. Forest Service		415
Bureau of Land Management		707
State of Utah		11
Private	1835	248
	Total	3852

Net variable cash ranch incomes for various management options (Table 2) were calculated by subtracting annual variable cash costs from annual cash returns (income from sales of cattle and crops). Annual net incomes ranged from less than $17,000 for the current typical Utah ranch to over $42,000 for the same ranch after applying the O'Connor Management System.

The Optimization Method

LINGO (LINDO Systems, Inc. 1991) was the LP optimization package applied to the 16 potential cattle management options described in Table 2. In general terms, the LP model was as follows:

Objective Function:	Maximize Net Ranch Income
Subject to:	
Labor	$\leq$ 6,670 Hours
Livestock Investment	$\leq$ 196,000 Dollars
Short Term Capital	$\leq$ 137,200 Dollars
Forage and Feed	$\leq$ 3,852 AUMs

The LP objective function coefficients for the 16 management options, expressed as net variable cash ranch income/brood cow, appear in Table 3. Also shown in Table

Table 2. Linear programming cattle management options, option descriptions, and net ranch incomes.

Management Option	Description of Management Option	Net Variable Cash Ranch Income
		($)
TUCC	Typical Utah cow-calf operation.	16,543
TUCCSEF	Typical Utah cow-calf operation selling all excess feed.	31,278
SELLEXWC	Sell all weaned calves (except replacement heifers).	31,500
RETAINWC	Retain all weaned calves to be sold as yearlings.	30,365
RETAINST	Retain all steers to be sold as yearlings.	30,754
PURCHST	Purchase steers to be sold as yearlings.	27,674
PURCHTST	Purchase terminal sired steers to be sold as yearlings.	29,545
PURCHREP	Purchase all replacement heifers.	29,456
EXCESREP	Keep excess replacement heifers and cull on fertility.	29,793
EWFCH	Early wean calves from first calf heifers (at 4 or 5 months).	31,974
THREEREP	Breed replacements to calve at three years instead of two.	21,268
OMS	Apply the O'Connor Management System.	42,644
EW	Early wean calves from cows (at 4 or 5 months).	28,964
RENTB	Rent all breeding bulls.	31,114
TERMB	Terminal sires (Simmental and Charolais) on 60% of cows.	33,514
TERMBPR	Terminal sires bred to cow herd; replacements purchased.	31,439

3 are the resource requirement coefficients for labor (hr/brood cow), livestock investment ($/brood cow), and short term capital ($/brood cow), along with total quantities ("Right Hand Sides") of each resource available on the typical Utah ranch.

Forage resource requirement coefficients for each management option were expressed as AUMs/brood cow/month. Total available forage ("Right Hand Sides") were expressed as maximum AUMs available/month for the typical Utah ranch (Evans and Workman 1994). Monthly forage allocation was adjusted to maximize the amounts of forage available during the limiting months.

The Optimum Cattle Management Option

The LP analysis selected the optimum (maximum net ranch income) option from the 16 potential cattle management options. The most profitable intensity and combination of options consisted of running 208 brood cows under the O'Connor Management System compared to 196 brood cows for the typical Utah cow-calf operation. O'Connor designed his system to improve the reproductive efficiency of the cow herd as follows (Anderson et al. 1986):

1. Cows gain weight for 5 weeks starting 2 weeks prior to breeding.
2. Calves removed from cows for 48 hours at start of breeding.
3. Cows bred to tested, high fertility bulls.
4. Breeding season limited to 60 days.
5. Cows in moderate body condition at calving.

The optimum management option produced an annual net variable cash ranch income of $45,152 compared to only $31,278 for the typical Utah cow-calf operation selling all excess feed. The limiting constraint on optimum herd size and maximum net ranch income was forage available during the month of May. The LP "shadow price" for May forage was $179 per AUM, i.e., the typical rancher could afford to pay up to $179 for an additional AUM of May forage in order to expand the herd by one more brood cow. Evans and Workman (1994) describe several economically attractive rangeland improvements (seeding, prescribed burning, chemical brush control) that can alleviate this crucial May forage constraint.

Summary

Cattle management improvements have traditionally been analyzed on a case by case basis. However, selection of optimum management options should consider impacts on

Table 3. Net variable cash ranch income, labor, livestock investment, and short term capital for cattle options applied to the typical Utah ranch (196 brood cows).

Management Option	Net Variable Cash Ranch Income	Labor	Livestock Investment	Short Term Capital
	($/brood cow)	(hr/brood cow)	($/brood cow)	($/brood cow)
TUCC	84.40	27.59	854.44	279.55
TUCCSEF	159.58	27.59	854.44	279.55
SELLEXWC	160.71	27.59	838.86	279.55
RETAINWC	154.92	29.32	888.92	279.55
RETAINST	156.91	29.32	878.68	279.55
PURCHST	141.19	32.77	878.68	559.81
PURCHTST	150.74	32.77	854.44	667.38
PURCHREP	150.29	27.59	810.80	363.14
EXECSREP	152.01	27.59	891.41	279.55
EWFCH	163.13	27.59	857.76	279.55
THREEREP	108.51	28.45	923.53	279.55
OMS	217.57	28.45	941.06	280.82
EW	147.78	28.45	869.69	268.77
RENTB	158.74	26.73	816.84	278.53
TERMB	170.99	27.59	870.03	283.72
TERMBPR	160.40	27.59	833.70	369.83
Total Available		6,760[a]	196,000[b]	137,200[c]

[a](10 hours/day x 26 days/month x 26 person months) = 6,760 person hours.
[b]Maximum investment = $1000/brood cow.
[c]Maximum short term capital loan = $137,200 (70% loan on brood cow investment).

the "total ranch" operation. Linear programming offers a tool to identify optimum management options while simultaneously measuring the combined impacts on total ranch net returns.

Based on production and economic data for the typical 196 brood cow Utah cattle ranch, we conducted an LP analysis of 16 potential cattle management options. The optimum cattle management option involved running 208 brood cows under the O'Connor Management System. Net ranch income increased to $45,152 compared to only $31,278 for the typical Utah ranch. May forage was the limiting constraint on herd size and net ranch income. The high value of additional May forage ($179 per AUM) makes several range improvements economically attractive.

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