

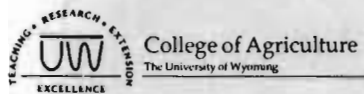
An Economic Analysis of Enterprise Combinations on Mountain Valley Cattle Ranches

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AN ECONOMIC ANALYSIS OF ENTERPRISE COMBINATIONS
ON MOUNTAIN VALLEY CATTLE RANCHES

by
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and
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INTRODUCTION

Agriculture is a very important industry to the state of Wyoming. Cash receipts for all agriculture commodities averaged \$596.9 million from 1980-84. Cash receipts from the sale of cattle and calves averaged \$413.8 million over the same time period, about 69% of total cash receipts for all commodities. The value of production of cattle and calves, which allows for resale of purchased livestock and changes in inventories, averaged \$297.6 million from 1980-84 (USDA-SRS, 1985). The number of cattle and calves on Wyoming ranches has remained fairly constant through the 1980s at about 1.4 million head.

There are many different sizes and types of cattle operations in Wyoming. A 1985 survey of Mountain Valley type ranches showed that 36% were basically cow-calf operations, 22% were cow-short yearling operations and 38% were cow-yearling operations. Some of the differences in type can be explained by the resources available to the ranch, or by managerial preferences or decisions. Four percent of the ranches surveyed did not fit any of these classifications (Kearl, et al, 1986).

Because of changing technology and market conditions, Wyoming cattle ranches use a variety of production practices. Present economic conditions require ranch managers to examine their current production practices to find ways of marketing more beef at a higher profit margin.

A major problem facing the cattle ranching industry today is a cost-price squeeze. In 1984 input prices averaged about 150% of 1978 levels while cattle

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prices were about at 1978 levels for cull cows, yearling steers and heifers and below 1978 levels for calves (Kearl, et al, 1986). Many ranch operators need more knowledge about production practices that can be adopted or changed to increase ranch profitability.

Objective

The objective of this study is to identify those factors of production, and the underlying production practices, that will have the greatest effect on ranch profitability. Calf crop percentage, death losses, weaning, and sale weights are among the most significant factors affecting net returns. The specific objectives are to:

1. show effects on ranch profitability of a change in the percent calf crop born, death loss of calves from birth to time of sale, and sale weights;
2. determine the effect on ranch profitability as a result of marketing different age and weight animals; and
3. determine the effect on ranch profitability as a result of different cropping practices.

Review of Literature

Kearl (1978a, 1978b, 1980) used budgeting to estimate costs and returns to mountain valley cattle ranches in Wyoming. Information which had been collected from previous studies was updated and used to construct typical ranch budgets. Kearl found that beef production per animal unit had increased from 1959-1973 and that generally the larger ranches were more profitable. The budgets were also used to compare cow-calf and cow-yearling operations. Although the returns to operator's labor and management and to fixed capital were minimal over the time period of the analysis, returns were slightly higher on those ranches using a cow-yearling system.

Gee and Skold (1970) used linear programming to find the optimal enterprise combination on mountain cattle ranches in Colorado with a resource base typical of a cow-calf ranch with 130 cows. The enterprises available to this typical ranch were cow-calf, cow-yearling and yearling stocker with three different levels of meadow improvement practices. The cow-yearling enterprise had the highest profit under two of the meadow management alternatives. If the ranch was allowed to use the most intensive meadow

improvement and to sell surplus hay, the cow-calf enterprise was the most profitable. Under this alternative the cow herd was decreased somewhat to allow for a substantial amount of hay sales.

Pfeiffer (1986) used budgeting to compare real returns and variability from 1975-1984 for cow-calf, cow-yearling and yearling stocker operations for the Nebraska Sandhills area. The basic cow-calf ranch consisted of 100 cows to calve, had a 90% calf crop weaned, and sold steer and heifer calves that weighed 450 and 425 pounds respectively. Half of the heifer calves were held over for replacements and those heifers not used for replacements were sold the following fall as yearlings. Fifteen percent of the cows were culled and sold each fall.

The cow-yearling and yearling stocker ranches were constrained by the forage resources available to the cow-calf ranch. The cow-yearling ranch performance was consistent with the cow-calf. The calves were fed to gain 1.0 lb. per day through the winter, and summer gains were 1.8 lb. and 1.7 lb. per day for steers and heifers respectively. The cow-yearling ranch, was reduced from 100 cows to 76 cows. Returns were slightly higher and less variable than the cow-calf ranch.

The yearling stocker operation allowed for 180 steer calves to be purchased in the fall and an additional 84 steer calves to be purchased in the spring, with feed requirements and gains similar to calves in the cow-yearling operation. The yearling stocker organization had the highest average net returns over the time period, and also the highest degree of income variability.

In 1973 and 1974, Stevens (1975) analyzed 60 Wyoming mountain valley cattle ranches in detail using a tabular presentation. It was found that 20% of the ranches with highest net incomes had sales 16.5% above the average, costs 5% below the average, and a percent return on capital of 59% above the average. The bottom 20% had sales 8% below the average, costs 27% above the average, and a percent return on capital 62% below the average. The top producers reported an average calf crop weaned of 89% compared to an 82% calf crop for the bottom producers. The study illustrates the importance of "doing a good job" in many aspects of production and cost control, in order to be successful.

Scope and Methodology

This study is specific to cattle ranches in the mountain valley type area of western Wyoming, including Uinta, Sublette, Lincoln and Teton counties. Most of the data were obtained from a sub-sample of data gathered in a 1985 survey of mountain valley ranches (Kearl, et al, 1986). A sub-sample was considered in this study, including only those operations which were full-time commercial cattle operations and had over 375 cows to calve. The data used are thought to represent better-than-average producers. The data may also be fairly representative of other higher elevation ranching areas, such as those across southern Wyoming and the higher elevation of rivers and streams draining the Wind River and Big Horn Basins. These areas are for the most part over 5,500 ft. mean sea level.

Ranch enterprise budgets were constructed to identify production relationships, resource availability, costs, sales, and relevant production practices. Given a certain resource base and average production factors, linear programming was then used to find the optimum resource allocation and appropriate ranch activities that maximize profit. Some of the production factors or resource restraints were then changed and the effect on the optimal solution determined. A description of linear programming procedures can be found in Appendix C.

RESOURCES AND ENTERPRISE BUDGETS

Land Base and Production

The owned and leased land and grazing permits for the resource base are for larger-sized ranches that were surveyed by Kearl, et al (1986). The land use and production are summarized in Table 1. The model was allowed to establish the acreages in different crops subject to the capability of the land. The land uses shown in Table 1 were the optimum in most cases, based on capability.

Production varies considerably over the mountain valley area due to differences in soil, climate, and management practices. The model ranch production is above average for the area because data were obtained from better than average producers. Two cuttings of alfalfa hay are harvested and produce 3.0 tons per acre without fertilization, or 4.0 tons per acre with fertilization. The 1980-1984 average production for alfalfa for Sublette,

Lincoln, Uinta and Teton counties was 2.25 tons per acre (USDA-SRS, 1985). This area average yield is affected by the lack of fertilizer use and only one cutting is harvested per year over some of the area.

Table 1. Resource Base and Land Production for the Model Ranch.

Item	Units	Number of Units	Production per Acre		
			Crops-- Tons or Bushels	Summer AUMs	Fall AUMs
Crop Land					
Alfalfa	acres	240	3.0-4.0 ^{a/}		1.0
Barley	acres	40	60 ^{b/}		0.4
Native meadow	acres	325	1.0		1.5
Improved meadow	acres	100	1.7-2.5 ^{a/}		1.5
Irrigated pasture	acres	235		4.0	1.5
Total		940			
Range Land					
Deeded range	acres	5,600		.25	
Leased range	acres	900		.25	
State lease ^{c/}	acres	850		.25	
Total		7,350			
Permit					
BLM	AUMs	1,572			
Forest Service	AUMs	1,126			
Total		2,698			

- ^{a/} Yield on unfertilized and fertilized land, respectively.
^{b/} Bushels per acre. Hay yields in tons.
^{c/} 850 acres, rated at 4 acres per animal-unit-month (AUM).

One ton of hay per acre is produced on native hay meadows. The improved meadow produces 1.5 tons per acre unfertilized or 2.5 tons per acre with fertilizer. These levels of production are fairly consistent with those reported in previous studies at the University of Wyoming (Hough, et al, 1965; Seamands and Roehrkasse, 1971). They are also consistent with the average production of "other" hay, 1.32 tons per acre, including fertilized and unfertilized native and improved meadow hay reported for the four counties from 1980-84 (USDA-SRS, 1985).

Barley yields, 60 bushels per acre, were based on county data for those counties in the mountain valley area.

One acre of irrigated pasture land can produce four AUMs for the summer grazing period and 1.5 AUMs for the fall period. Both the deeded and leased

range land is rated at 4 acres per AUM, or .25 of an AUM per acre for the summer season (Ross, 1986). The meadow land provides 1.5 AUMs, alfalfa land 1.0 AUM and barley land 0.4 AUMs per acre for fall aftermath. The aftermath includes crop residues, regrowth and unharvested forage on "waste" acres such as canal and ditch banks, fence rows and wet or willow and river bottom areas.

Crop Enterprise Budgets

The outputs and physical inputs used in the crop enterprise budgets are summarized in Table 2. The physical inputs consist of labor, fertilizer, chemicals, seed, etc. The seasonal labor requirements, set primarily by the production cycle for cattle, are divided into three periods--spring, summer, and fall-winter. The spring season is about two months long. It begins with the calving season and ends when the majority of the calves have been branded in the spring. On a typical mountain valley ranch this season would start in mid-March and end in mid-May. It also includes application of fertilizer, planting, starting irrigation and a few other minor labor requirements with crops. The summer season is characterized by most of the time being spent on the cropping enterprises. Some labor is involved with moving the cattle on the range and distributing salt and minerals. The fall-winter season is generally the least labor-intensive season. The main activities are gathering the cattle in the fall, weaning and shipping calves and yearlings, and feeding the livestock through the winter.

Cash costs of producing crops were obtained largely from crop budgets developed by Agee (1978). These costs were updated to 1984 levels using current prices or an index of prices paid for inputs (Kearl, 1985b). Costs of materials for each crop include fertilizer, chemicals, seed, twine, etc. (Table 3). The machinery costs include fuel, lubrication and repairs, and are shown by kinds of operations. There is also a separate charge for irrigation depending largely upon the system of irrigation used, i.e., sprinkler, flood, or sub-irrigation.

Some general overhead costs including taxes, insurance and utilities, are allocated to the different types of land, based on their productive potential as measured by AUMs. One ton of hay is equivalent to 3 AUMs and a bushel of barley equals .14 AUMs. The overhead costs were obtained from the study by Kearl, et al (1986).

Table 2. Physical Outputs and Inputs per Acre for Alfalfa, Improved Hay, Native Hay, Barley and Irrigated Pasture.

	Alfalfa Hay		Improved Hay		Native Hay Unfertilized	Barley	Irrigated Pasture
	Unfertilized	Fertilized	Unfertilized	Fertilized			
OUTPUTS							
Hay (tons)	3.0	4.0	1.5	2.5	1.0		
Barley (bushels)						60.0	4.0
Summer AUMs	1.0	1.0	1.5	1.5	1.5	0.4	1.5
Fall AUMs							
INPUTS							
Hours of labor							
Spring	0.45	0.53	0.60	0.69	0.25	1.71	0.12
Summer	4.61	4.79	3.42	3.57	1.64	1.85	0.75
Fall						1.90	
Fertilizer lb. ^{a/}							
Nitrogen				80.0			
Phosphate		30.0					
Chemicals lb. 2, 4-D						0.75	

^{a/} Lb. of actual Nitrogen (N) or Phosphate (P₂O₅).

Table 3. Cash Costs per Acre for Alfalfa, Improved Hay, Native Hay, Barley, Irrigated Pasture and Deeded Range. (Dollars)

	Alfalfa Hay		Improved Hay		Native Hay		Irrigated Pasture	Deeded Range
	Unfertilized	Fertilized	Unfertilized	Fertilized	Unfertilized	Barley		
MATERIALS								
Fertilizer								
Nitrogen		7.09		24.19				
Phosphate								
Chemicals								
2,4-D						2.69		
Seed								
Barley						12.91		
Poisoned Oats <u>a/</u>		1.22						
Twine	3.90	5.20	2.21	3.25	1.30	0.94		
MACHINERY COSTS <u>b/</u>								
Grow	11.34	11.34	11.50	11.50	5.84	50.34	5.25	
Swath	25.58	25.58	12.78	12.78	12.78			
Bale	24.58	26.08	13.16	14.66	11.72	10.56		
Stack	20.88	22.38	11.56	12.56	10.06	7.08		
Combine						26.18		
Haul grain						2.20		
IRRIGATION	22.08	22.08	1.00	1.00	0.50	11.04	0.75	
OVERHEAD COSTS <u>c/</u>								
Utilities	7.20	7.20	5.14	5.14	2.44	4.67	2.98	0.13
Insurance	7.80	7.80	5.59	5.59	2.66	5.07	3.25	0.15
Taxes	12.00	12.00	8.60	8.60	4.09	7.83	4.99	0.22
Total Cost	135.36	147.97	71.54	99.27	50.89	141.51	17.22	0.50

a/ Poisoned oats are used for rodent control

b/ Includes ownership costs for machinery

c/ Total overhead costs for the ranch distributed to the land resource in proportion to AUM productivity.

Labor and interest costs are charged through "purchasing activities" and are discussed later.

A fertilized acre of alfalfa produces 4.0 tons of alfalfa hay and 1.0 AUM of fall aftermath as previously mentioned. To produce this output requires 5.32 hours of labor and 30 pounds of available phosphate. The total machinery cost is \$85.38 and irrigation costs \$22.08 per acre based on sprinkler irrigation. The overhead costs come to \$27 bringing the total cost to produce an acre of fertilized alfalfa to \$147.97.

The improved meadows are assumed to be flood irrigated and the native hay meadows are half flood irrigated and half sub-irrigated. The costs of growing barley are based on sprinkler irrigated land. The majority of the irrigated pasture land is flood irrigated with the remainder being sub-irrigated.

Livestock Production Coefficients

For the initial model, average livestock production coefficients are used as obtained from the surveys of mountain valley ranchers (Kearl, et al, 1986). Some of these coefficients will be changed in doing the sensitivity analysis. The percent calf crop weaned is based on the number of cows on hand in the spring and expected to calve. The coefficients used in the initial model are shown below:

Calf crop weaned	90%
Death losses	
Cows and replacement heifers	2%
Calves through the winter	2%
Yearlings through the summer	1%
Replacement heifer rate	17%
Cow / bull ratio	20/1
Bull useful life (years)	3.5
Sale weights	
Heifer calves	400 lb
Steer calves	425 lb
Cull cows	1050 lb
Cull replacement heifers	725 lb.

Weights of the steer and heifer calves are less than those reported by Kearl, et al (1986). This reflects the production practices of western

Wyoming. Given the calf weight, weights for short yearlings and yearlings are dependent upon the winter rations and subsequent summer gains, which are allowed to vary. That information will be provided subsequently.

Winter Feed Requirement

The hay requirements for mature cows, replacement heifers and bulls were obtained from the ranch survey data. All requirements include an allowance for waste, in addition to that consumed. Cows and replacement heifers, coming two years old, require an average of 24 lb. of native hay per day through the winter, with less than that used prior to calving and more during and after calving. Bulls require 30 lb. of native hay per day.

The hay requirement can be filled by either alfalfa, native or improved meadow hay. To compensate for the different nutrient levels of the hay (Table 4), the requirement for alfalfa is only 90% of that for native hay and the improved meadow hay requirement is 95% of the native hay requirement. At these levels of feeding the total digestible energy supplied from the feeds remains relatively constant.

Table 4. Nutrient Content of the Feeds Available on the Model Ranch. (100% Dry Matter Basis)

Ration	Crude Protein	Total Digestible Nutrients	Net Energy Maintenance	Net Energy Gain
	Percent	Percent	(Mcal) ^{a/}	(Mcal) ^{a/}
Native meadow hay	9.4	52.0	0.47	0.22
Improved meadow hay	8.3	55.0	0.55	0.25
Alfalfa hay (midbloom)	17.0	58.0	0.56	0.31
Barley	10.9	76.8	0.78	0.52
Improved hay & barley ^{b/}	8.7	59.5	0.59	0.30
Alfalfa hay & barley ^{b/}	15.0	62.0	0.60	0.36

Source: National Research Council. 1984. Nutrient Requirements of Beef Cattle. Washington, D.C. National Academy Press.

^{a/} Million calories (Mcal) per lb. of feed.

^{b/} Based on the content of the feed used, weighted by the proportion fed.

The average winter feeding season for cows and replacement heifers coming two years old and bulls for the mountain valley ranches is about five months, for instance, the middle of December until the middle of May. The total hay

requirements for the season are 1.8 tons per cow and 2.25 tons per bull.

Four different feeding rations are available for wintering weaned calves: (1) improved meadow hay; (2) alfalfa hay; (3) improved meadow hay and 3.0 lb. of barley; and (4) alfalfa hay and 2.0 lb. of barley. A computer program (Feuz, 1985) based on the net energy system was used to calculate average daily gain (ADG) and pounds of feed required for each of the four rations (Table 5). The nutrient levels were obtained from a list of feeds and the requirements for the animal being fed were estimated using regression equations developed by Kearl and Ross (1983). Using an iterative process, the maximum attainable gain was determined from the feed supplied. The feeding season for the calves wintered was 165 days--for instance, the first of December until the middle of May.

Table 5. Winter Feed Programs for Heifers and Steers, Beginning Weight 400 and 425 Lb. Respectively: Weight Gain and Feed Requirement for 165 Day Feeding Period.

Item	Average Daily Gain (Lb)	Ending Weight (Lb)	Average Weight (Lb)	Feed Requirement	
				Daily ^{b/} (Lb)	Season ^{b/} (Ton)
Heifers					
Ration ^{a/}					
1	0.65	507	454	13.97	1.15
2	1.03	570	485	16.00	1.32
3	0.90	548	474	14.61	1.21
4	1.31	616	508	16.76	1.39
Steers					
Ration ^{a/}					
1	0.74	547	486	14.97	1.23
2	1.17	618	522	17.21	1.42
3	1.02	593	509	15.69	1.30
4	1.50	672	549	18.11	1.44

^{a/} Rations are: (1) improved meadow hay; (2) alfalfa hay; (3) improved meadow hay and 3.0 lb. of grain; and, (4) alfalfa hay and 2.0 lb. of grain.

^{b/} As fed. Includes an allowance for 10% waste; actual consumption is 91% of the requirement shown.

Heifers fed improved meadow hay gained .65 lb. per day and the average daily feed requirement was 12.7 lb. without allowance for waste. Steers on the same ration required 13.61 lb. of feed and gained .74 lb. per day. The improved meadow hay is fairly representative of grasses such as smoothbrome or

orchard grass. A mixture of alfalfa hay and native grass hay would also have close to the same nutrient levels. Because of higher energy content, gains from the alfalfa hay are better than those obtained from the improved meadow hay.

The fourth ration is the highest in energy and the gains are the highest on this ration. Heifers can gain up to 1.31 lb. per day and steers gain 1.5 lb. per day.

Although cold stress may be a problem at the lower rates of gain, it will not likely be much of a problem at gains of 1.0 lb. or more, if adequate windbreaks and/or sheds are available. At the higher rates of gain there is "heat increment" or "waste" heat generated in the digestion process. This helps to counteract any cold stress. In any case, 5-10% feed in addition to requirements plus waste has been allowed, which would help counteract stress and achieve the gains indicated.

Compensatory Gains

The four different wintering rations result in four different gains on yearlings through the summer because of effects of compensatory gain. Compensatory gain refers to the tendency for animals to make faster gains when placed on adequate feed after a period of retarded growth than if growth is normal or greater in the preceding period. Studies of compensatory gain have reported differing results. The winter treatment, stage of growth when placed on pasture or range and quality of summer forage probably contribute to the variability. Compensatory effects from 30-70% have been observed (Kearl, et al, 1986). Kercher (1982) and Ross (1983) stated that compensatory effects of 50% were reasonable, as shown in Table 6.

Table 6. Winter and Subsequent Summer Gains for Steers and Heifers Starting at 400 and 380 Lb. Respectively (Based on 50% Compensatory Gains). (Pounds)

	Steers			Heifers		
	Winter Gains	Summer Gains	Total Gains	Winter Gains	Summer Gains	Total Gains
0		288	288	0	263	263
55		260	315	55	235	290
105		235	340	105	210	315
165		205	370	165	180	345
205		185	390	205	160	365
250		165	415	250	140	390

Source: Based on relationships used by Ross, 1983.

A compensatory effect of 50% means that if steer X gains 100 lb. more than steer Y through the winter, then steer Y is expected to gain 50 lb. more than steer X through the summer. Thus, 50% of the difference in winter gain is compensated for during the summer. Assuming a compensatory effect of 30% would mean that if steer X gained 100 lb. more than steer Y on the winter ration, then steer Y would be expected to gain 30 lb. more than steer X during the summer period. So only 30% of the difference in winter gain is compensated for with the added summer gains.

Animal-Unit-Month Requirements

The kilocalories of basal metabolism can be predicted for adult animals using the regression equation:

$$\text{Kcal of Basal metabolism} = 70 (W_{\text{kg}})^{.75}$$

Nutritionists generally accept this relationship as a biological constant (Crampton and Harris, 1969).

To obtain an animal-unit-month (AUM) requirement that would be related to this basal metabolism requirement, Lewis, et al (1956) derived an equation for an animal-unit (AU) coefficient based on the specific weight of the animal in relation to a base weight as follows:

$$\text{AU coef} = \frac{W^{.75}}{1,000^{.75}} ; \text{AU coef} \times \text{months} = \text{requirement for animal}$$

W is the average weight of the animal in pounds and the denominator represents the weight of a mature cow. The AUM requirements for various classes of livestock are shown in Table 7.

Livestock Enterprise Budgets

There are three primary stages of production: cow-calf, calf wintering, and yearling summering. The livestock enterprises, or activities were specified in stages to allow the model to specify the optimum combination of production and marketing strategies under differing conditions. The outputs and the physical inputs required for various livestock in these production stages are summarized in Table 8.

Table 7. Animal-Unit-Month Requirements For All Classes of Livestock on the Model Ranch.

Class	5.5 Month Summer Season			1.5 Month Fall Season ^{a/}		
	Average Weight	AU Coeff.	AUM	Average Weight	AU Coeff.	AUM
Cow	1,000	1.00	5.5	1,000	1.00	1.50
Bulls	1,450	1.32	7.3	1,450	1.32	2.00
Replacement Heifers ^{b/}	605	0.69	3.8	725	0.79	1.20
Calves						
Heifers	250	0.35	1.9	380	0.48	0.70
Steers	260	0.36	2.0	400	0.50	0.70
Yearling Heifers ^{c/}						
Ration 1	605	0.69	3.8	710	0.78	0.39
Ration 2	660	0.73	4.0	745	0.80	0.40
Ration 3	644	0.72	4.0	735	0.79	0.40
Ration 4	693	0.76	4.2	765	0.82	0.41
Yearling Steers ^{c/}						
Ration 1	661	0.73	4.0	770	0.82	0.41
Ration 2	714	0.78	4.3	805	0.85	0.43
Ration 3	694	0.76	4.2	790	0.84	0.42
Ration 4	756	0.81	4.4	835	0.87	0.44

^{a/} .5 months for yearling.

^{b/} Yearlings.

^{c/} Rations are: (1) improved meadow hay; (2) alfalfa hay; (3) improved meadow hay and 3.0 lb. of grain; and (4) alfalfa hay and 2.0 lb. of grain.

The cow-calf stage involves carrying the cow for one year and the calf from birth to weaning at about 6 months of age. The output from this stage of production is .9 calf and .13 cull cow produced by each cow-unit of this activity. This stage of production requires 1.0 cow including the two-year-old replacement heifers, .17 weaned calf carried to yearling age for replacement heifers and .05 bull.

The calf wintering stage of production, whether for steers or heifers, requires 1.0 weaned calf and produces .98 short yearling, after allowing for death loss. The short yearlings may be sold or may enter into the third stage of production, the yearling summering activity, which requires 1.0 short yearling and produces .99 long yearling, again after allowing for death loss. The yearling summering stage of production for replacement heifers also requires .05 bull.

The main physical inputs, other than livestock, are tons of hay, AUMs of grazing, and hours of labor. Grazing is divided into a spring-summer and

Table 8. Physical Inputs and Outputs for Livestock Activities.

	Cows _{b/} 18+	Replace- ment Heifers _{b/} 6-18	Heifer _{a/} Calves _{b/} 6-12	Steer _{a/} Calves _{b/} 6-12	Year- ling Heifers _{a/} 12-18	Year- ling Steers _{a/} 12-18
Activity Level	1.00	1.00	1.00	1.00	1.00	1.00
Inputs						
Hay (tons)	1.80	1.32	1.32	1.42		
Grazing (AUMs)						
Spring	5.50	3.80			4.00	4.30
Fall	1.50	1.20			0.40	0.43
Labor (hours)						
Spring	2.12	0.24	0.24	0.30		
Summer	1.66	1.06			1.06	1.06
Winter	1.31	1.15	1.10	1.14		
Livestock (head)						
Cow	1.00					
Heifer	0.17	0.97 ^{d/}				
Bull	0.05	0.05				
Outputs/Inputs						
Heifer calf	0.28 ^{c/}		1.00 ^{d/}			
Steer calf	0.45 ^{c/}			1.00 ^{d/}		
Replacement heifer	0.17 ^{c/}	1.00 ^{d/}				
Cull cow	.13 ^{c/}					
Short yearling						
Heifer			0.98 ^{c/}		1.00 ^{d/}	
Steer				0.98 ^{c/}		1.00 ^{d/}
Yearling						
Heifer					0.99 ^{c/}	
Steer						0.99 ^{c/}

a/ Requirements shown represent those for calves wintered on ration 2, alfalfa hay. Appendix tables A1 and A2 are the enterprise budgets for steers and heifers on the other three rations.

b/ The animal's age in months; 6-12 represents the winter stage; 12-18 represents the yearling summering stage.

c/ Outputs from this stage allow for death loss.

d/ Inputs to this stage, moved by transfer activities from the previous stage.

fall season. The spring-summer season is about 5.5 months long and for simplicity will just be called summer. During this time the livestock would typically be on private or public range. During the fall season, 1.5 months, the animals are typically grazing aftermath. The seasons used for labor were explained in connection with crop enterprises.

The costs associated with each enterprise will vary somewhat but will generally consist of all cash costs that are not accounted for separately in the model (Table 9). Cows and replacement heifers are assessed a \$7 per head cost for bull replacement. This is based on an average bull replacement cost of \$500, the difference between purchase price and cull bull sale price. For the model ranch the cost per cow in the cow-calf stage of production is \$22. These costs include cash costs except for feed, grazing fees, labor and interest, and were based on budgets developed by Kearn, et al (1986).

Table 9. Livestock Enterprise Direct Cash Costs Per Head for the Model Ranch. (Dollars)

Cost	Cows 18+ ^{a/}	Replacement Heifers 6-18 ^{a/}	Calves 6-12 ^{a/}	Yearlings 12-18 ^{a/}
Vet expense	\$ 4.00	\$ 2.00	\$ 1.50	\$ 0.50
Supplies	5.00	3.00	1.75	1.25
Bull charge	7.00	7.00		
Miscellaneous	3.00	1.50	1.00	0.50
Freight & Yardage	<u>3.00</u>	_____	_____	_____
Total	\$22.00	\$13.50	\$ 4.25	\$2.25

^{a/} The age in months of the animals.

The non-feed cash costs of wintering calves and summering yearlings, without any distinction between steers and heifers, were obtained from work done by Ross (1983). These costs were indexed forward to reflect 1984 costs using current prices or a production index of prices paid for inputs. The wintering costs are \$4.25 per head and it costs \$2.25 per head to summer a yearling.

The costs for feed, labor, interest and the overhead costs associated with the land resource activities become charges, to any production stage, if appropriate, through the use of those activities or inputs.

The cost of feeding a ton of hay was calculated using a machinery budget (Agee, 1978) and data obtained from the ranches surveyed. This cost varied a great deal depending upon the feeding system used. Excluding labor and fixed cost on machinery, an average cost of \$4.50 per ton was used for the model. The cost of processing barley was \$0.50 per cwt. (Agee, 1985).

THE MODEL RANCH

Prices Paid and Received

Labor

Labor is charged to each activity as it comes into the LP solution. Hired labor costs \$5 per hour. There is no charge to owner's labor, but this labor is limited to five hours per day. This is based on the assumption that the owner spends considerable time on general overhead tasks that are not charged to any one activity in the LP model, i.e., accounting, chores, traveling to transact business or attend public meetings, etc.

Interest

Interest is both charged to and earned by the model ranch. It is assumed that the ranch is operated on a calendar year basis and there are no operating funds at the beginning of the year. There are separate accounts for money borrowed and income generated from sales and saved until needed by the ranch business. When an activity that uses funds is brought into the solution interest is charged on that activity for the remainder of the year. Interest was charged at 13% per annum, or 1.083% per month, and income from accrued interest was earned at 8% per annum or 0.667% per month. At the end of the year, total interest paid enters the model as a cash cost and interest earned comes into the model as cash income.

Crops

The prices paid and received for crops were based on the 1980-84 year-long average price (Kearl, 1985b). A purchase price slightly higher than the sale price was used for the price paid for a particular crop used as an input. The five year average price for alfalfa hay was \$61 per ton. The average price for barley was \$2.33 per bushel or \$4.85 per cwt. (Table 10).

Table 10. Average Prices Paid and Received for Crops by Wyoming Ranches - 1980-84.

Commodity	Units	Price Paid (Dollars)	Price Received (Dollars)
Alfalfa hay	ton	\$62.00	\$61.00
Native hay	ton	62.50	61.50
Improved hay	ton	63.00	62.00
Barley	bu.	2.50	2.33
State lease permit	AUM	1.65	
BLM permit	AUM	1.35	
U.S. Forest permit	AUM	1.35	
Private range	acre	2.00	1.95
Fall Pasture	AUM	5.50	5.45

Sources: Kearl, W. Gordon. 1985b. "Prices Received and Paid by Wyoming Farmers and Ranchers: 1955-1984," Division of Agricultural Economics and Agricultural Experiment Station, University of Wyoming. Bulletin 731. August.

Administrative offices provided information about the respective public grazing fees for Wyoming.

The prices paid for state land leases and public grazing fees were obtained from administrative offices in Wyoming. State land lease rates on a per acre basis are varied according to carrying capacity to achieve per animal-unit-month rates of \$1.65 for state lease. The price (grazing fees) for both Bureau of Land Management and National Forest Service permits was \$1.35 per animal-unit-month.

The price paid for private leased range land was obtained from the surveys of the mountain valley ranchers. This price varies depending upon the carrying capacity of the range and the term of the lease agreement. For this model an average price of \$2 per acre is used for the summer period. Excess deeded summer range on the ranch can be leased out for \$1.95 per acre. Additional fall pasture can be rented for \$5.50 per AUM and excess fall pasture can be leased out for \$5.45 per AUM.

Livestock

There is a considerable amount of seasonality in the time of sale of cattle, with the peak months being different for different classes of livestock. Interstate movements of cattle give a good indication of both seasonality and proportions of cattle marketed from Wyoming (Kearl, et al, 1986). Based on that data, calves, cull cows and cull replacement heifers are

sold in November, short yearling heifers and steers in April, and long yearling heifers and steers in October. In doing the sensitivity analysis, an option to sell up to 50 percent of the cull cows in August was considered.

The prices received for the different classes of cattle are based on 1980-85 average prices for the particular month (Table 11). The price for cull cows is the average for utility and cutter grades. Prices for feeder cattle are for muscle thickness number 1 grades medium and large frame cattle.

Linear interpolations were used to determine prices for the various weights of cattle sold (Table 12). The weights shown for short yearlings are the weights attained from the four calf wintering rations. Weights for long yearlings are dependent upon the winter feeding ration, and make allowance for compensatory gain effects during the summer.

Table 11. Average Prices Received for Various Classes and Weights of Cattle, Eastern Wyoming - Western Nebraska, 1980-85. (Dollars per Cwt)

Class	Weight (Lb)	Month				
		April	August	September	October	November
Steers	300-400				73.96	73.45
	400-500				71.49	71.10
	500-600	73.10			68.01	68.20
	600-700	67.90	66.12	65.06	64.91	
	700-800		64.03	63.28	63.32	64.05
	800-1000		62.21	61.65	61.31	62.35
Heifers	300-400				63.91	62.64
	400-500	67.02			62.33	61.22
	500-600	63.91				
	600-700	61.78	60.65	59.92	58.74	58.83
	700-800		59.61	58.77	57.53	58.46
Cull Cows	Utility		42.72	41.02	39.19	37.05
	Cutter		39.65	38.16	36.43	34.05
	Average		41.19	39.59	37.81	35.56

Sources: W. Gordon Karl, 1985a. "Average Prices of Cattle and Calves Eastern Wyoming - Western Nebraska, 1980-84." Department of Agricultural Economics and Cooperative Extension Service, University of Wyoming. AE 85-1. May.

U.S. Department of Agriculture, Agricultural Marketing Service. Livestock, Poultry, Grain and Seed Division. Form LPGS-214-1 (12-79).

Table 12. Prices, Weights, and Value per Head for the Model Ranch.
Calves Sold in November, Short Yearlings Sold in April, Long
Yearlings Sold in October and Cull Cows in August or November.

Class and Ration	Weight (Lb)	Price Per Cwt (Dollars)	Value Per Head ^{a/} (Dollars)
Steer Calf	425	71.69	305.00
Heifer Calf	400	61.93	248.00
Short Yearlings ^{b/}			
Steer 1	547	73.10	400.00
Steer 2	618	70.45	435.00
Steer 3	593	70.75	420.00
Steer 4	672	67.85	456.00
Heifer 1	507	65.46	332.00
Heifer 2	570	63.25	361.00
Heifer 3	548	63.91	350.00
Heifer 4	616	62.84	387.00
Long Yearlings			
Steer 1	775	63.20	490.00
Steer 2	810	62.52	506.00
Steer 3	795	62.65	498.00
Steer 4	840	62.30	523.00
Heifer 1	717	58.14	417.00
Heifer 2	750	57.53	431.00
Heifer 3	740	57.75	427.00
Heifer 4	770	57.10	440.00
August Cull Cow	1025	41.19	422.00
November Cull Cow	1050	35.56	373.00
Rep. Heifer Cull	725	57.60	418.00

^{a/} All values per head are rounded to the nearest whole dollar.

^{b/} Winter rations are: (1) improved hay; (2) alfalfa hay; (3) improved hay and 3.0 lb. of grain; and (4) alfalfa hay and 2.0 lb. of grain.

Activities

The resources available to the model ranch were indicated previously. There are four main types of activities in the model. They are: (1) crop producing; (2) livestock producing; (3) buying; and (4) selling activities. The complete LP tableau for the model ranch is in Appendix C. A much abbreviated LP tableau with only some of the activities represented from each main class of activities is shown in Table 13.

Table 13. Small LP Tableau Representing Some of the Model Ranch Activities.

Item	Alfalfa		Grazing		Cow		Sell		Winter Sell		Summer Sell		Resources
	Grow	Buy	Sell	Range	F. S. Unit	Steer Calf	Steer Calf	Steer Calf	Steer Calf	Short Yrlg. Steer	Yrlg. Steer	Yrlg. Steer	
Obj Function	-135	-62	61	-0.50	-1.35	-28.61	0	305	-11.64	435	-3.5	506	MAX
Alfalfa ground	1.0												< 240 acres
Deeded range			1.0										< 5600 acres
FS Permit					1.0								< 1126 AUMs
Alfalfa hay	3.0	1.0	-1.0			-1.8			-1.29				> 0 ton
Summer grazing				0.25	1.0	-5.5	-2.0				-4.3		> 0 AUM
Fall grazing	1.0					-1.5	-0.7				-0.43		> 0 AUM
Steer calf						0.45	-1.0						= 0 head
Weaned steer								1.0	-1.0	-1.02			= 0 head
Calf wintering										1.0	-1.0	-1.01	= 0 head
Yrlg. summering											1.0	-1.0	= 0 head

Note: The coefficients of the objective function and of the activities for calves are those for steer calves wintered on alfalfa hay.

The deeded crop land provides the resources for the crop producing activities and the fall grazing requirements of the various livestock activities. The output from the crop producing activities can be sold through hay or grain selling activities or used as inputs to the various livestock activities. If additional feed is required, then hay and/or grain can be purchased through buying activities.

The pasture land and AUMs of permit are used in grazing activities to fulfill the summer AUM requirements for the livestock activities. The deeded range land may also be leased out by use of a selling activity. BLM and Forest Service permits cannot be leased out, but can be idled in "authorized non-use." The LP algorithm allows for that through a disposal activity at zero cost. There may also be additional AUMs of summer and fall grazing purchased through a pasture leasing (buying) activity.

The cow-calf enterprise is composed of several activities. The main activity is the cow-unit. This activity requires hay resources in the winter and AUMs of grazing through the summer and fall. One cow-unit also requires .05 bull and .17 calf-to-yearling replacement heifer. The output from this activity is .13 of a cull cow to a selling activity, .45 of a steer calf and .45 of a heifer calf that move into calf activities. The .45 heifer calf is not shown in the abbreviated LP tableau.

The steer and heifer calf activities from birth to weaning are separated from the cow-unit to provide some programming advantages for changing percent calf crop, weights, and summer and fall grazing requirements. Separating the cow-unit and calf activities in this way also allows the model more flexibility in choosing the optimal enterprise combination for the model ranch.

The heifer and steer calf activities require AUMs of grazing in addition to that required of the cow-unit and produce a weaned heifer or weaned steer calf. The weaned calves can either be sold through calf selling activities or transferred to one of eight calf wintering activities.

The calf wintering activities result because of four different winter feed rations each for heifer or steer calves. The calf wintering activities require 1.02 weaned steer or heifer calf and produce 1.0 short yearling steer or heifer calf. This allows for death loss. These short yearlings will be at different weights depending upon the winter ration they were fed.

The short yearlings may be sold in the spring through selling activities or they may be used as inputs into yearling summering activities. There is a

separate summering activity for each wintering activity to allow for different weights of the short yearlings, and compensatory gain. Each summer activity requires 1.01 short yearling steer or heifer, some AUMs of summer and fall grazing, and produces 1.0 fall yearling steer or heifer.

The yearling replacement heifer activity requires 1.01 short yearling heifers and .05 bull. It also requires AUMs of summer and fall grazing. The output from this activity is 0.1 replacement heifer cull to be sold through a cull replacement heifer selling activity, and replacement heifers that satisfy the input requirement in the cow activity.

The bull activity requires hay through the winter and AUMs of grazing through the summer and fall. It provides the resources necessary to fulfill the cow and replacement heifer requirement for bulls.

The livestock activities have been divided in this manner to allow for relative ease in changing some of the coefficients. For example, to change the percent calf crop born, only two numbers must be changed, or only the requirements in the calf activities will be affected by a change in weight of calves. Dividing the livestock activities in this way also allows the model more flexibility in choosing the optimal enterprise combination for the model ranch.

Most of the crop and livestock activities also require hours of labor which are purchased through labor buying activities. Interest is charged to activities requiring capital and earned by activities generating capital through interest paid and interest earned activities.

RESULTS

Initial Solutions

An initial LP solution was obtained using the coefficients and model developed in the previous sections. The cow-long yearling organization was optimal for the basic model ranch. For comparison purposes, coefficients were changed to force the model to also complete the calculations and give results for the cow-calf and cow-short yearling organizations. The results of these initial solutions are shown in Table 14.

The model maximized net cash income or return above cash costs to the ranch. For this analysis the ranch was considered to be debt free, so no interest was charged to land. Interest on cash operating expenses was calculated as a cash expense. Net cash income ranged from \$55,778 for the

cow-calf to \$71,137 for the cow-long yearling model, a difference of about \$15,000, or 22%. Income in the cow-short yearling operation is only about \$2,000 less than the cow-long yearling model.

After the net cash income maximizing solutions were obtained, other measures of income, including net ranch income and returns to total and fixed capital, were calculated.

Net ranch income is the residual return to land, labor, capital and management. It is calculated by deducting depreciation from net cash income. Depreciation was considered fixed to all ranch types. The depreciation cost of \$24,600 was obtained from the survey of the mountain valley cattle ranches (Kearl, et al, 1986). Because there are no changes in inventory, net ranch income is obtained by subtracting depreciation from net cash income.

A return to total capital is obtained by subtracting an allowance for operator labor and management from net ranch income. Approximately 10% of income (\$20,000) was used as an allowance for operator labor and management. This allowance is obtained by averaging total sales from the cow-calf, cow-short yearling and cow-long yearling organizations and taking approximately 10% of this value. Because the same charges were used among the operations for depreciation and operators labor, the income differences were like those in net cash income.

To obtain the residual return to land or fixed capital, interest is charged on working capital, which includes investment in livestock and machinery. Returns to fixed capital are quite similar on the cow-long yearling and cow-short yearling operations which both show considerably higher returns than the cow-calf operation. Investment in livestock inventories, and hence the interest on working capital does vary among the model ranches. Interest on working capital was charged at the rate of 10%. The investment in livestock changes for each type of ranch organization and was calculated on each ranch type.

The following values were used to calculate the investment in livestock:

Cows	\$430
Replacement heifers	\$400
Heifer calves, 6-12 months	\$250
Steer calves, 6-12 months	\$305
Yearling heifers, 12-18 months	\$350
Yearling steers, 12-18 months	\$420
Bulls	\$750

Table 14. Comparisons of Returns for the Optimal Cow-Long Yearling, the Forced Cow-Calf and the Forced Cow-Short Yearling Ranches.
(Dollars)

Item	Cow-Calf	Cow-Short Yearling	Cow-Long Yearling
Livestock sales			
Cull cows	22,380	22,380	22,753
Replacement heifers	3,344	3,344	3,344
Young cattle			
Steers	63,135	88,305	101,900
Heifers	<u>31,248</u>	<u>47,988</u>	<u>54,306</u>
Total livestock	120,107	162,017	182,303
Crop sales and rent			
Hay	39,675	19,619	19,988
Barley	5,592	3,607	5,592
Range rent	10,920	10,920	0
Fall pasture rent	<u>654</u>	<u>654</u>	<u>0</u>
Total crop sales	56,841	34,800	25,580
Interest Income	2,431	8,671	3,277
Total income	179,379	205,488	211,160
Cash costs	<u>123,601</u>	<u>136,562</u>	<u>140,023</u>
Net cash income	55,778	68,926	71,137
Cash income, percent of cow-long yearling	78.41%	96.89%	100.00%
Depreciation	<u>24,600</u>	<u>24,600</u>	<u>24,600</u>
Net ranch income	31,178	44,326	46,537
Operator labor and management	<u>20,000</u>	<u>20,000</u>	<u>20,000</u>
Return to capital	11,178	24,326	26,537
Return to capital, percent of cow-long yearling	42.12%	91.67%	100.00%
Interest on:			
Livestock	24,925	29,622	31,714
Mach. & equip.	<u>24,000</u>	<u>24,000</u>	<u>24,000</u>
Return to land	(37,747) =====	(29,296) =====	(29,177) =====

Interest on the investment in calves from six to 12 months is calculated at 10% for only six months. Interest is also charged for six months on the yearlings at an effective rate of 10%. Because interest is foregone at the rate of 8% by not selling in the spring, only an additional 2% is charged on the investment in the yearlings. This avoids double accounting in favor of the short yearling ranch organization, or against the long yearling organization.

Interest on the investment in machinery and equipment (\$24,000) was obtained from the study of the mountain valley cattle ranches by Kearn, et al (1986), and remains constant for all the ranches. A return to land or fixed capital is obtained by subtracting the interest on working capital from the return to total capital. Return to fixed capital is -\$29,177 for the basic model ranch.

There is some question regarding the rate of interest which should be charged on working capital. The return on total capital in ranching is quite low. An opportunity cost for capital use in a "safe" investment is somewhat higher. Rates for short or intermediate term capital may be 10%-14%. For this study, an interest rate of 10% was charged on the investment in cattle and machinery. That rate is a compromise between the rates that might be paid to borrow and the rates that might be earned in "safe" alternative investments for operators providing their own capital.

More detailed budget statements for these three types of operation are found in Appendix Tables B1, B2 and B3.

Crop Activities

The crop producing activities were the same for all three types of ranch organization (Table 15.) The tons of hay produced and the cost of production did not change. Fertilizer was used on the alfalfa and improved meadow in all solutions. Initially, barley did not enter into the optimal solutions; but it was forced to enter to provide for the re-establishment of alfalfa. Table 15 shows total crop acres, production, cost of production and sales for the cropping activities.

All crops not sold are transferred to and used by the various livestock activities. Because of small differences in the price received for the three kinds of hay, the poorest quality hay was sold first in the models. This results in native hay being sold in several of the models.

Table 15. Cropping Activities Production, Sales and Cost of Production for the Optimal Cow-Long Yearling, the Forced Cow-Calf, and the Forced Cow-Short Yearling Ranches.

Crop Activity	Amount Produced		After-math AUMs	Cost of Production	Amount Sold			
	Acres	Per Acre ^{a/}			Total ^{a/}	Cow-Calf	Cow-Short Yearling	Cow-Long Yearling
Fertilized alfalfa hay	240	4.0	960	240	\$35,520	153	0	0
Fertilized improved hay	100	2.5	250	150	9,900	167	0	0
Native hay	325	1.0	325	488	16,575	325	319	325
Barley	40	60.0	2,400	16	5,640	2,400	1,548	2,400
Irrigated Pasture	235			353	3,995			
Total fall AUMs				1,247		120 ^{c/}	120 ^{b/}	
Deeded range ^{c/}	5,600				2,800	5,600 ^{b/}	5,600 ^{b/}	
Total cost					\$74,430			

a/ Tons of hay and bushels of barley.

b/ AUMs of fall aftermath and acres of deeded range leased out.

c/ Rangeland available included 5,600 acres of private range owned, 900 acres of private range and 850 acres of state land leased, 1,572 AUMs of BLM and 1,126 AUMs of national forest permits.

The three ranch organizations operate with very nearly the same number of cow units. The cow-calf and cow-short yearling operations utilize the state and public land permits and lease out all deeded range and some of the fall pasture. The cow-calf operation also sells 645 tons of hay and all the barley produced. The cow-short yearling operation sells 319 tons of native hay and 1,548 bushels of barley, but buys 100 tons of alfalfa, which is the limit imposed. The cow-yearling operation fully utilizes the rangeland and pasture, but sells all the barley and 325 tons of native hay and buys back the 100-ton limit of alfalfa.

There are a number of interesting implications in these solutions;

1. two organizations out of three would maximize income by leasing out as much land as they can and selling crops, except for the feed supply needed to balance the operations and allow for the use of the public lands;
2. two organizations out of three sell native hay and buy 100 tons of alfalfa hay, the limit, to take advantage of superior gains produced or reduced feed required for cows; however,
3. none of the organizations buy any grass hay or lease any range or pasture from others.

This subject will be explored a little further at a later point.

Livestock Activities

Under the optimal cow-long yearling ranch there are 472 cows to calve, 80 yearling heifers held over for replacements and 28 bulls on the ranch (Table 16). The replacement heifer calves are wintered on ration 1, improved hay. Benefits of wintering replacement heifers at higher rates of gain could include better reproductive performance as two- and three-year-old heifers. If the benefits were known and could be reflected in the coefficients of the model, then wintering the replacement heifers on alfalfa hay might be the optimum program. The remainder of the heifer calves are wintered on ration 2, alfalfa hay. Most of the steer calves are wintered on improved hay, but some are fed alfalfa hay. The short yearlings are pastured through the summer and sold as long yearlings in the fall.

The costs associated with each livestock activity are also shown in Table 16. These costs are based on the livestock enterprise budgets developed previously. The machinery costs involved in feeding hay and grain are also included in these costs. The cost of feeding bulls are included in the cost of the cow-calf activity.

Table 16. Cattle Inventories, Sales and Direct Cash Cost of Production for the Livestock Activities for the Optimal Cow-Long Yearling, the Forced Cow-Calf, and the Forced Cow-Short Yearling Ranch.^{a/}

Livestock Activity	Cow-Calf Model			Cow-Short Yearling Model			Optimal Model		
	Inven- -tory (Head)	Sold (Head)	Cost of Production ^{b/} (Dollars)	Inven- -tory (Head)	Sold (Head)	Cost of Production ^{b/} (Dollars)	Inven- -tory (Head)	Sold (Head)	Cost of Production ^{b/} (Dollars)
Cows ^{c/}	460	60	13,881	460	60	14,082	472	61	13,934
Replacement heifers	80	8 ^{d/}	1,430	80	8 ^{d/}	1,430	82	8 ^{d/}	1,467
Bull	27	8 ^{d/}	0	27	8 ^{d/}	0	28	8 ^{d/}	0
Other heifer calves	126 ^{e/}	126	0	126 ^{e/}		0	130 ^{e/}		0
Steer calves	207 ^{e/}	207	0	207 ^{e/}		0	212 ^{e/}		0
Short yearling ^{f/}									
Heifers 2				126	124	1,435	130		1,226
Heifers 4									
Steers 1									
Steers 2				207	203	2,040	62		1,366
Long yearlings ^{f/}									613
Heifers 2							127	126	283
Steers 1							147	146	329
Steers 2							61	60	135
Total Cost			15,311			18,987			19,353

a/ Sales and inventory differences between stages take death losses into account.

b/ Costs of Production are the direct cash costs associated with the livestock activities. They do not include costs of feed, grazing fees, labor, interest or the overhead costs associated with the land activities.

c/ Includes heifers two years old at calving time.

d/ Net cost of bull replacement is treated as a cost. No revenue from sales is reported.

e/ Number of calves weaned which can be sold or placed in a short yearling inventory.

f/ Numbers refer to the different rations: (1) improved hay; (2) alfalfa hay; (3) improved hay and 3.0 lb. of barley; and (4) alfalfa hay and 2.0 lb. of barley.

The livestock enterprise costs may seem low, but they do not include any feed, labor, interest, range and pasture leases which are accounted for in the specific activities and become charges to the livestock activities as they are used. Also, the general overhead costs are charged to the deeded land of the ranch, and are in fact charged to the livestock through the use of those resources.

When converting from a cow-yearling ranch to a cow-calf or a cow-short yearling ranch with the same resource base the number of cows can increase to keep the total number of animal units fairly constant. However, for the model ranch this did not occur. The cow-yearling operation made full use of the deeded range but under the cow-calf and the cow-short yearling organizations higher returns could be obtained by leasing deeded range out than by increasing the cow numbers. The number of cows actually decreased from 472 under the cow-yearling ranch to 460 for the cow-calf and the cow-short yearling ranches.

The resources purchased under each of the ranch types are shown in Table 17. All three ranch types fully utilized the public grazing permits and state lease land. Under the cow-long yearling organization a small amount of summer and fall private pasture is leased to fulfill the AUM requirements of carrying all of the yearlings through the summer.

Because the rations containing alfalfa hay are preferred to those using native or improved hay, alfalfa is purchased when the calves are wintered. Because of small differences in the price of the three kinds of hay it is advantageous to buy alfalfa hay up to the 100-ton limit and sell native hay. The price for the hay is set as though it could be purchased in the near vicinity for the ranch. If the trucking charges are more than \$4 per ton, which would probably represent 30-50 miles transportation, then no hay is purchased.

Labor and interest are also shown as purchases. The labor purchased represents the cost of hired labor, and interest is that charged on operating costs at the annual rate of 13%.

Effects of Range Leasing Restrictions and Lower Calf Crop

The cow-calf model allowed the operator to rent all of the deeded range and 120 AUMs of fall pasture to others. All of the barley and 645 tons of hay were sold. It is questionable whether leasing and crop sales of this volume

Table 17. Purchasing Activities for the Optimal Cow-Long Yearling, the Forced Cow-Calf, and the Forced Cow-Short Yearling Ranches.

Purchasing Activity	Unit	Price Per Unit (Dollars)	Cow-Calf		Cow-Short Yearling		Cow-Long Yearling		
			Number of Unit (Number)	Total Cost (Dollars)	Number of Units (Number)	Total Cost (Dollars)	Number of Units (Number)	Total Cost (Dollars)	
Summer pasture lease	acre	2.00	0	0	0	0	0	195	390
State lease	AUM	1.65	190	313	190	313	190	190	313
Bureau of Land Mgmt.	AUM	1.35	1,572	2,122	1,572	2,122	1,572	1,572	2,122
U.S. Forest Service	AUM	1.35	1,126	1,520	1,126	1,520	1,126	1,126	1,520
Fall pasture lease	AUM	5.50	0	0	0	0	0	46	253
Buy alfalfa hay	ton	62.00	0	0	100	6,200	100	100	6,200
Labor	hour	5.00	4,526	22,630	5,002	25,010	5,412	5,412	27,060
Interest				<u>7,275</u>		<u>7,980</u>			<u>8,382</u>
Total				33,860		43,145			46,240

would be a realistic alternative on a continuing basis. An additional model was run to force the sale of calves in the fall, but not allow renting out summer or fall pasture. Any pasture not used by the livestock was idled. When no rental of surplus pasture was allowed, the size of the cow herd was increased to 628 cows, 107 replacement heifers and 37 bulls. This resulted in an increase of sales from livestock, but pasture rental decreased and hay sold decreased from 645 to 417 tons. The cash costs also increased on this ranch because of the larger cow herd resulting in net cash income decreasing \$2,777 to \$53,001. The investment in livestock also increased and the return to land was -\$49,658 (Table 18).

The 90% calf crop reported from the survey by Kearn, et al (1986) is higher than that reported for the state in official statistics (SRS, USDA, 1985). Two alternative models were constructed to determine solutions for cow-calf and cow-yearling models at 80% calf crop and constrained from leasing out any rangeland. Those results are also summarized in Table 18 and the detailed budgets summaries are in Appendix B4, B5 and B6. Livestock inventories with numbers sold are shown in Table 19.

The cropping stayed the same as shown in Table 15, except for sales.

Compared with the results reported for cow-calf operation with 90% calf crop and leasing out rangelands, the cow-calf operation with 80% calf crop and restrictions on leasing had:

1. many more cows, 643 compared with 460, as the operation is changed to fully stock all rangeland.
2. about \$30,000 more in livestock sales;
3. about \$27,000 less in crop sales and land rent;
4. about \$22,000 more in cash costs;
5. about \$20,000 less each in net cash income, net ranch income and return to total capital; and,
6. about \$30,000 less return to land, as interest on the livestock component of working capital rises by about \$10,000.

Compared with the cow-yearling operation at 90% calf crop, the cow-yearling operation with 80% calf crop had:

1. a modest increase in number of cows; 494 compared with 472, as the reduced number of yearlings allows a few more cows;
2. about \$14,000 reduction in livestock sales and no change in crop sales;
3. very little change in costs; and

Table 18. Effects on Net Income of Restrictions on Range and Pasture Leasing and Reductions to 80% Calf Crop.

Item	90% Calf Crop	80% Calf Crop		Optimal
	No Range Leasing Cow-Calf	No Range Cow- Calf	Leasing Cow- Yearling	Cow-Long Yearling
Livestock sales				
Cull cows	30,586	30,959	23,872	22,753
Replacement heifers	4,598	4,598	3,344	3,344
Young cattle				
Steers	86,010	78,385	94,374	101,900
Heifers	42,904	35,960	46,548	54,306
Total livestock	<u>164,098</u>	<u>149,902</u>	<u>168,138</u>	<u>182,303</u>
Crop sales				
Hay	25,691	23,832	19,865	19,988
Barley	5,592	5,592	5,592	5,592
Total crop sales	<u>31,283</u>	<u>29,424</u>	<u>25,457</u>	<u>25,580</u>
Interest income	2,269	2,043	3,045	3,277
Total income	197,650	181,369	196,640	211,160
Cash costs	144,649	145,431	140,140	140,023
Net cash income	53,001	35,938	56,500	71,137
Cash income, percent of cow-long yearling	74.51%	50.52%	79.42%	100.00%
Depreciation	24,600	24,600	24,600	24,600
Net ranch income	28,401	11,338	31,900	46,537
Operator labor and management	20,000	20,000	20,000	20,000
Return to capital	8,401	-8,662	11,900	26,537
Return to capital, percent of cow-long yearling	31.66%	(neg)	44.84%	100.00%
Interest on:				
Livestock	34,059	34,859	32,267	31,714
Machinery and equipment	24,000	24,000	24,000	24,000
Return to land	-49,658	-67,921	-44,367	-29,177

Table 19. Cattle Inventories and Sales for Cow-Calf and Cow-Long Yearling Operations at 90% or 80% Calf Crops Without Rangeland Leasing.^{a/}

Livestock activity	90% Calf Crop		80% Calf Crop		Optimal	
	Cow-Calf Inven-tory (Head)	Sold (Head)	Cow-Calf Inven-tory (Head)	Sold (Head)	Cow-Yearling Inven-tory (Head)	Sold (Head)
Cows	628	82	643	83	494	64
Replacement heifers	109	11 ^{b/}	112	11 ^{b/}	86	8 ^{b/}
Bulls	37	11 ^{b/}	38	11 ^{b/}	29	28
Other heifer calves	173 ^{c/}	173	145 ^{c/}	145	111 ^{c/}	-
Steer calves	282 ^{c/}	282	257 ^{c/}	257	198 ^{c/}	-
Short yearlings ^{d/}						
Heifers 2						130 ^{c/}
Steers 1						212 ^{c/}
Steers 2						130
Long yearlings ^{d/}						
Heifers 2						150
Steers 1						62
Steers 2						109
						144
						50
						108
						142
						49
						61

- ^{a/} Sales and inventory differences between stages take death loss into account.
- ^{b/} Net cost of bull replacement is treated as a cost. No revenue from sales is reported.
- ^{c/} Number of calves weaned which can be sold or placed in a short yearling inventory.
- ^{d/} Numbers refer to the different rations: (1) improved hay; (2) alfalfa hay; (3) improved hay and 3.0 lb. of barley; and (4) alfalfa hay and 2.0 lb. of barley.

4. about \$14,600 reduction in net cash income, net ranch income and return to total capital, and about that in return to fixed capital, as the investment in working capital does not change.

The 10% change in calf crop produces the following percentage changes in income measures for the cow-yearling operations:

<u>Income Measure</u>	<u>Effect</u>
Cash receipts	reduced 7%
Net cash income	reduced 21%
Net ranch income	reduced 32%
Return to total capital	reduced 55%

Because of the change in rangeland renting and crop sales on the cow-calf operation, it is clear that percentage live calf crop weaned is one of the most, if not the most important element in ranch performance.

Livestock Production Practices -- Sensitivity Analysis

One of the objectives of the study by Feuz (1986) was to determine the effect of changing some of the livestock production practices and coefficients such as percent calf crop born and sale weights of livestock sold. LP models run to consider these changes were:

1. changed percent calf crop weaned;
2. decrease percent death loss on calves held through the winter;
3. early marketings of cull cows;
4. increased weaning weights of calves;
5. "best" model, which includes the features from 1, 2, 3 and 4 above;
and
6. a stocker model.

The cow-calf model was not optimal for any of these, so comparisons are with the cow-yearling model. The effects of an 80% calf crop were shown earlier. A summary of the results of the models listed in items 3-6 above is in Table 20 and detailed summaries are in Appendix B.

In Feuz' 1986 analysis, calf crop weaned was only changed from 90% to 92%. This 2% increase in calf crop weaned resulted in a 3.9% increase in net cash income and a 10.4% increase in the return to capital. Death loss was changed by 1% with an effect amounting to about half that of the 2% change in calf crop. Detailed results of those models are not shown here, but they are included in the "best practices" model.

Table 20. Comparisons of Sales, Costs and Returns of Various LP Models for Changing Management Practices, Compared with the Model Ranch. (Dollars)

	Cow-Long Yearling ^{a/}	Early Culls	Heavy Calves	"Best" Practices	Stocker
Livestock sales	182,303	183,822	208,839	220,171	650,988
Crop sales	25,580	25,580	5,762	3,903	29,373
Interest income	<u>3,277</u>	<u>3,508</u>	<u>10,099</u>	<u>9,217</u>	<u>10,985</u>
Total income	211,160	212,910	224,700	233,291	691,346
Cash costs	140,023	139,779	143,996	145,485	590,032
Net cash income	71,137	73,131	80,704	87,806	101,314
Cash income, percent of cow-long yearling	100.00%	102.80%	113.45%	123.43%	142.42%
Depreciation	<u>24,600</u>	<u>24,600</u>	<u>24,600</u>	<u>24,600</u>	<u>24,600</u>
Net ranch income	46,537	48,531	56,104	63,206	76,714
Operator labor and management	<u>20,000</u>	<u>20,000</u>	<u>20,000</u>	<u>20,000</u>	<u>20,000</u>
Return to capital	26,537	28,531	36,104	43,206	56,714
Return to capital, percent of cow-long yearling	100.00%	107.51%	136.05%	162.81%	213.72%
Interest on:					
Livestock	31,714	31,714	34,245	35,248	36,805
Machinery and equip.	<u>24,000</u>	<u>24,000</u>	<u>24,000</u>	<u>24,000</u>	<u>24,000</u>
Return to land	(29,177) =====	(27,183) =====	(22,141) =====	(16,042) =====	(4,091) =====

^{a/} Base ranch.

Changing Marketing Seasons of Cull Cows

There is a pronounced seasonal movement in the price of cull cows. Dry cows tend to reach their peak weights by August or early September under intermountain or Northern Plains conditions. After that they may gain slightly, lose slightly or about maintain that weight, depending upon feed conditions (Houston and Woodward, 1966; Klipple, 1953; Laycock and Conrad, 1981). Some cull cows are dry (not nursing a calf) in August and could

perhaps be marketed. Consequently, a model was developed to allow sales of up to half of the cull cows in August rather than November. Some of the cull cows are still nursing calves at this time and may be difficult to sell. The most important changes in assumptions were that culls sold in August would average 1,025 lb. compared with 1,050 lb. for the November sales; but they would bring \$422 per head, instead of \$373, because of the higher August prices.

The optimal solution did involve the early sale of half the culls. The early sale of culls did not release enough resources to allow expansion, so the number of cows remained the same and the same number of yearlings were sold. However, the requirement for fall grazing AUMs was reduced and 46 AUMs of additional fall pasture leased under the basic model ranch were not required. As in the previous models, crops grown and sales of crops did not change.

Net cash income was increased 2.8% from \$71,137 in the basic ranch to \$73,131 by implementing this practice. This results in a 7.5% increase in the return to capital, compared with basic model ranch (Table 20).

Increased Calf Weights

The effect of increased calf weights was also considered. An increase of about 20% in calf weaning weights was hypothesized. The steer weights were increased from 425 lb. to 510 lb. and heifer weights were increased from 400 lb. to 480 lb. The short yearling and long yearling weights were also adjusted for the different weight gains from the winter rations. Gains and winter feed requirements are shown in Table 21.

The summer weight gains are shown in Table 22. It might be noted that the summer gains are consistent with those specified previously for calves weaning at 400 and 425 lb. Calves weaning at 480 and 510 lb. may have the potential to make greater summer gains than shown. Certainly, the summer gains specified can be considered conservative.

Inventories and sales are shown in Table 23. In the optimal solution all of the steer calves and the majority of the heifers not required for replacements were fed for the highest attainable gain on the alfalfa and barley ration and sold in the spring as short yearlings. All of the ranch-grown barley was fed but no additional barley was purchased. A few

heifers were wintered on the improved meadow hay ration and held over the summer to be sold as yearlings. The replacement heifers were also fed the improved meadow hay rations.

Table 21. Gains and Feed Requirements for a 165 Day Feeding Period. Heifers and Steers, Beginning Weight 480 and 510 Lb.

Item	Average Daily Gain (Lb)	Ending Weight (Lb)	Average Weight (Lb)	Hay Requirement	
				Daily ^{b/} (Lb)	Season ^{b/} (Ton)
Heifers					
Ration ^{a/}					
1	0.72	599	539	16.61	1.37
2	1.11	663	572	18.87	1.56
3	0.98	642	561	17.27	1.42
4	1.40	711	595	19.65	1.62
Steers					
Ration ^{a/}					
1	0.82	645	578	17.79	1.47
2	1.27	720	615	20.28	1.67
3	1.11	693	602	18.52	1.53
4	1.61	776	643	21.21	1.75

a/ Rations are: (1) improved meadow hay; (2) alfalfa hay; (3) improved meadow hay and 3.0 lb. of barley; and (4) alfalfa hay and 2.0 lb. of barley.

b Includes an allowance for 10% waste.

Table 22. Average Daily Gain (ADG) and Ending Weight of Summer Yearling Heifers and Steers Fed Previously on the Four Different Rations for the Model Ranch.

Ration ^{a/}	Heifers			Steers		
	Summer ADG	Starting Weight	Ending Weight	Summer ADG	Starting Weight	Ending Weight
1	1.22	599	802	1.30	645	860
2	1.03	663	833	1.07	720	896
3	1.10	642	824	1.15	693	882
4	0.90	771	860	0.88	776	922

a/ Previous winter rations were: (1) improved meadow hay; (2) alfalfa hay; (3) improved meadow hay and 3.0 lb. of barley; and (4) alfalfa hay and 2.0 lb. of barley.

Table 23. Cattle Inventories and Sales for Ranch Organizations Producing Heavy Calves and for Those Using the Combination of "Best" Practices.^{a/}

Livestock Activity	Heavy Calves Organization		"Best" Practices Organization	
	Inventory (Head)	Sold (Head)	Inventory (Head)	Sold (Head)
Cows	523	68	524	68 ^{b/}
Replacement heifers	91	9 ^{c/}	90	9 ^{c/}
Bulls	3		31	
Other heifer calves	144 ^{d/}		151 ^{d/}	
Steer calves	235 ^{d/}		241 ^{d/}	
Short yearlings ^{e/}				
Heifers 1	24		112	
Heifers 4	120	118	39	38
Steers 4	235	231	241	239
Long yearlings ^{e/}				
Heifers 1	23	23	110	109

- ^{a/} Sales and inventory differences between years take death losses into account.
- ^{b/} Includes 34 sold early and 34 sold late.
- ^{c/} Net cost of bull replacement is treated as a cost. No revenue from sales is reported.
- ^{d/} Number of calves weaned which can be sold or placed in a short yearling inventory.
- ^{e/} Numbers refer to the different rations. (1) Improved hay; (2) alfalfa hay and 2.0 lb. of barley.

Because the majority of the calves were sold in the spring, there were additional AUMs of grazing available. Unlike the forced cow-short yearling operation with lighter-weight calves, the number of cows increased from 472 to 523. The crops produced remained the same for this model, but there were no hay or grain sales as in all previous models. All of the ranch-grown feed was used by the livestock enterprises. The amount of hay available becomes the restricting resource on this ranch model. There were 2,955 acres of deeded range leased out in the summer.

Restrictions against leasing out the rangeland would likely result in either a larger number of cows, or in keeping the calves on a roughage ration, using the range and selling long yearlings. The latter possibility is quite likely. It would also be quite likely if summer gains are significantly greater than those specified.

Net cash income increases 13%, from \$71,137 for the basic ranch to \$80,704, assuming heavy calves are produced. Return to total capital increases 36%.

"Best" Production Practices

A model was also developed to incorporate a 92% calf crop weaned, a 1% death loss of calves through the winter feeding period, weights of 480 lb. for heifers and 510 lb. for steers, and selling half of the cull cows in August. Inventories and sales for this model are also shown in Table 23.

The optimal solution for this model was to winter all of the steer calves on alfalfa and barley and to sell them in the spring as short yearlings. Most of the heifers were fed the improved hay ration, held over through the summer and sold as long yearling heifers. Twenty percent of the heifers were fed the alfalfa and barley ration and sold in the spring as short yearlings. The crop sale item includes leasing out 1,412 acres of rangeland and sales of 494 bushels of barley. If restrictions were applied against leasing it would likely result in sales of more long yearlings, or perhaps in increased numbers of cows.

Net cash income was increased by 23% over the basic model ranch, from \$71,137 to \$87,806. The return to capital increased from \$26,537 to \$43,206, or 63%.

Stocker Model

The purchase of stocker heifers or steers was also considered as another alternative. Calves could be purchased in the fall and/or the spring. The calf weights were based on the lighter weights of 400 lb. for heifers and 425 lb. for steers. It was assumed that the steer or heifer calves could be purchased from neighboring ranches so \$10 per head was assessed for freight and other purchasing costs and it is included in total costs.

Purchases are summarized as follows:

	Fall Steer Calves	Short Yearling Steers
Number purchased	1,066	270
Average weight	425	547
Total cwt. purchased	4,530.5	1,476.9
Purchase price per cwt.	\$71.69	\$73.10
Total cost	\$335,452	\$110,661

Detail on sales is shown in Appendix Table B12.

Allowing for 21 head death loss, 822 fall purchased steers were wintered on the alfalfa hay ration and 223 fed improved hay. This number of steer calves fully utilized the alfalfa and improved hay resource. All the barley and the native hay was sold.

The additional steers were purchased in the spring to best utilize the grazing resource. These steers were comparable in weight to those wintered on the improved hay ration. All of the private pasture available for lease was also leased. There were 696 AUMs of surplus fall pasture which were leased out.

The stocker model was the most profitable of all the models. Net cash income, \$101,314, was 42% more than the basic model ranch; return to total capital, \$56,714, was 114% more. The return to land was considerably higher than any of the other models, but still negative at -\$4,091.

There is also considerable risk involved with stocker operations. The purchase costs and sales were based on the 1980-85 monthly average prices. If \$1.00 per cwt. over the monthly average price was paid in purchasing the steers, then net returns would be decreased by approximately \$6,000. If the sale price was \$1.00 per cwt. below the monthly average price then net returns would decrease by \$10,375.

This model also assumed that the calves could be purchased in the vicinity of the ranch. If the calves were purchased at distances of more than 100 miles from the ranch then additional trucking charges could result in costs of more than \$10 per head, which was allowed. There is also a shrink factor of around 3% from hauling cattle 100-200 miles, which must be considered and would decrease the net returns from a stocker operation acquiring cattle from greater distances.

Crop Production Practices and Resource Use--Sensitivity Analysis

Three models were also used to test different cropping practices and resource use. They were: (1) the elimination of the improved meadow; (2) the elimination of fertilizer use; and (3) the elimination of alfalfa and barley crops. The acres of the various crops grown and the amount of crop sales from these three ranch models are shown in Table 24. Livestock inventories and sales are shown in Table 25. The costs and returns are summarized in Table 26 and detailed summaries are in Appendix B.

Table 24. Acres of Crops Grown and Sales of Crops from the Three Different Crop Resources and Practices Models.^{a/}

Item	Acres	Tons Produced		Amount Sold
		Per Acre	Total	
<u>No Improved Meadow</u>				
Fertilized alfalfa	240	4.0	960	
Native hay	425	1.0	425	425 ^{b/}
Barley	40	60 ^{b/}	2,400 ^{b/}	2,400 ^{b/}
Irrigated pasture	235			
Deeded range				4,014 ^{c/}
Rent fall pasture				218 ^{d/}
<u>No Fertilizer Use</u>				
Unfertilized alfalfa	240	3.0	720	
Unfertilized improved hay	100	1.5	150	
Native hay	325	1.0	325	325 ^{b/}
Barley	40	60 ^{b/}	2,400 ^{b/}	2,400 ^{b/}
Irrigated pasture	235			
Deeded range			5,330 ^{c/}	
Rent fall pasture				294 ^{d/}
<u>No Alfalfa or Barley</u>				
Fertilized improved hay	180	2.5	450	
Native hay	525	1.0	525	
Irrigated pasture	235			
Deeded range				4,185 ^{b/}
Rent fall pasture				380 ^{c/}

a/ Rangeland available included 5,600 acres of private range owned, 900 acres of private range and 850 acres of state land leased, 1,572 AUMs of BLM and 1,126 AUMs of national forest permits.

b/ Bushels.

c/ Acres leased out.

d/ AUMs leased out.

No Improved Meadow

On some mountain valley cattle ranches, no improvements have been made to the meadows. A model was developed to reflect this ranching practice. Alfalfa was still produced, but 100 acres of improved meadow were eliminated and the native meadow was increased by 100 acres. Because hay production was decreased, the cow numbers were reduced to 376 and number of yearlings were also decreased (Table 25). All of the native hay and barley was sold and 4,014 acres of deeded range were leased out. Net income was reduced 7.61% to \$65,722 and return to total capital was reduced 20.41% to \$21,122.

Table 25. Cattle Inventories and Sales. Cow-Yearling Ranches with Differing Resources and Crop Production Practices.^{a/}

Livestock Activity	No Improved Meadow		No Fertilizer		No Alfalfa or Barley	
	Inven- tory	Sold	Inven- tory	Sold	Inven- tory	Sold
Cows	376	49	348	45	377	49
Replacement heifers	66	6 _{b/}	60 _{b/}	6 _{b/}	66	6 _{b/}
Bulls	22	6 _{b/}	21 _{b/}	6 _{b/}	22	6 _{b/}
Other heifer calves	103 _{c/}		96 _{c/}		104 _{c/}	
Steer calves	169 _{c/}		157 _{c/}		170 _{c/}	
Long Yearling _{c/}						
Heifers 1					104	101
Heifers 2	103	100	96	93		
Steers 1			80	77	170	165
Steers 2	169	164	77	75		

- a/ Sales and inventory differences between years take death losses into account.
- b/ Net cost of bull replacement is treated as a cost. No revenue from sales is reported.
- c/ Number of calves weaned which can be sold or placed in a short yearling inventory.
- d/ Numbers refer to the different rations. (1) Improved hay; (2) alfalfa hay.

No Fertilizer

A model was also developed that eliminated the use of fertilizer on the alfalfa and improved meadow. This reduced alfalfa yields from 4.0 to 3.0 tons per acre and improved meadow hay yield from 2.5 to 1.5 tons per acre (Table 24). Although these reductions in yield resulted from eliminating the use of fertilizer, yields such as this are common.

Under these conditions, the ranch size is reduced to 348 cows (Table 25). All of the calves are held over through the winter and summer period and sold as yearlings in the fall. About half of the calves are fed the alfalfa hay ration and the remainder are fed the improved hay ration. All of the alfalfa

and improved hay is used on the ranch, but the native hay and barley is sold. Because there are fewer cows and yearlings, there is also surplus summer and fall pasture that is leased out (Table 24).

This reduction in hay production results in a decrease of net cash income of 23.6% to \$54,348. The return to capital is reduced by 63.27% and return to land is a negative \$37,548 (Table 26).

Table 26. Effects on Net Income of Variations in Cropland Resources and Production Practices. (Dollars)

Item	Basic Cow-Long Yearling	No Improved Meadow	No Fertilizer	No Alfalfa Land
Livestock sales				
Cull cows	22,753	18,277	16,785	18,277
Replacement heifers	3,344	2,508	2,508	2,508
Young cattle				
Steers	101,900	82,984	75,680	80,850
Heifers	54,306	43,100	40,083	42,117
Total livestock	<u>182,303</u>	<u>146,869</u>	<u>135,056</u>	<u>143,752</u>
Crop sales and rent				
Hay	19,988	26,137	19,988	
Barley	5,592	5,592	5,592	
Range rent	0	7,827	10,393	8,161
Fall pasture rent	0	1,188	1,602	2,071
Total crop sales	<u>25,580</u>	<u>40,744</u>	<u>37,575</u>	<u>10,232</u>
Interest income	<u>3,277</u>	<u>3,102</u>	<u>2,878</u>	<u>2,440</u>
Total income	211,160	190,715	175,509	156,424
Cash costs	<u>140,023</u>	<u>124,993</u>	<u>121,161</u>	<u>103,839</u>
Net cash income	71,137	65,722	54,348	52,585
Cash income, percent of cow-long yearling	100.00%	92.39%	76.40%	73.92%
Depreciation	<u>24,600</u>	<u>24,600</u>	<u>24,600</u>	<u>24,600</u>
Net ranch income	46,537	41,122	29,748	27,985
Operator labor and management	<u>20,000</u>	<u>20,000</u>	<u>20,000</u>	<u>20,000</u>
Return to capital	26,537	21,122	9,748	7,985
Return to capital, percent of cow-long yearling	100.00%	79.59%	36.73%	30.09%
Interest on:				
Livestock	31,714	25,153	23,296	25,315
Machinery and equip.	<u>24,000</u>	<u>24,000</u>	<u>24,000</u>	<u>24,000</u>
Return to land	(29,177)	(28,031)	(37,548)	(41,330)
	=====	=====	=====	=====

No Alfalfa or Barley

At the higher elevations of the mountain valley areas it may not be possible to grow alfalfa hay or barley, so a model was developed that excluded those crops. The acres of native and improved meadow were increased to 525 and 180 acres respectively. All of the hay resources were used by the livestock, but some surplus summer and fall pasture was leased out (Table 25).

The optimal solution was to winter the calves on the improved hay ration, hold them over through the summer and sell them as yearlings in the fall. The breeding cattle inventories were reduced to 377 cows, 64 heifers retained for replacements and 22 bulls.

Net cash income decreased by 26.08% to \$52,585. The return to land was a -\$41,330 (Table 26).

SUMMARY AND CONCLUSIONS

The cattle ranching industry in Wyoming is currently facing difficult economic conditions. Input costs have continued to rise through the 1980s while prices received for livestock have averaged about 1978 levels. This has forced many ranchers to examine more closely some of their production practices to find ways to increase profits. The objectives of this study included examining livestock management, marketing and the effect of cropping practices on ranch profitability.

An LP model was developed using a resource base and production factors representing a sample of ranches in the mountain valley area of western Wyoming. After the initial LP solution was obtained several additional LP models were run to show the effects of changing the resource base or management practices.

Results of the Linear Programming Models

The cow-yearling ranch was the optimal organization, producing net ranch income of \$46,537 compared to \$31,178 for the cow-calf ranch and \$44,326 for the cow-short yearling ranch, which were forced solutions in the model.

The forced cow-calf model leased out all of the deeded range. If it was constrained from renting, net ranch income decreased from \$31,178 in the unconstrained model to \$28,401 in the model without pasture rental.

Compared to the basic cow-yearling model:

1. If percent calf crop weaned was increased from 90% to 92%, net ranch income increased by about 6% to \$49,311.
2. If death loss of calves through the winter feeding period was decreased from 2% to 1%, net ranch income increased by slightly less than 3% to \$47,866.
3. Sale of about half of the cull cows in August rather than in November produced a net ranch income of \$48,531, a 4% increase.
4. A model which substituted 100 acres of native hay meadow for 100 acres of improved meadow resulted in net ranch income reduction of about 11% to \$41,122.
5. When Fertilizer use was eliminated, yields of alfalfa and improved meadow hay were reduced by 1.0 ton each and net ranch income was reduced by 36% to \$29,748.
6. The replacement of 240 acres of alfalfa and 40 acres of barley by 200 acres of native meadow and 80 acres of improved meadow decreased net ranch income by 40% to only \$27,985.
7. Increasing the weight of weaned calves by about 20% resulted in feeding for higher rates of gain, marketing mostly short-yearlings in the spring of the year and increased net ranch income by just over 20% to \$56,194.
8. Using all the "best" practices, steers are wintered on alfalfa and grain and sold as short yearlings and heifers are wintered on improved meadow hay, retained through the summer and sold as yearlings. Net ranch income increased almost 35% to \$63,206.
9. Allowing calves to be purchased in the fall and/or the spring resulted in complete conversion to a stocker operation. Net ranch income increased by nearly 65% to \$76,714. However, there was also more risk involved in this program.

Conclusions

The results of this study strongly suggest that ranchers should maintain ownership of their calves past the weaning stage. In all of the models, the cow-calf organization was the poorest alternative. The differences between the cow-short yearling and the cow-yearling organizations were often quite small. Ranchers should look at their own resources and market potentials to determine whether to sell their young livestock as short yearlings in the spring or as yearlings in the fall.

Throughout the 1980s there appears to have been a strong seasonal movement of feeder cattle prices with the peak prices coming in the spring of the year. Prices were generally \$3-5 higher in April than in October for the same weight and grade steer or heifer. Allowing for the price change due to seasonal movement and the change in weight, prices for 550 lb. steer calves in April were generally 14% above those for 750 lb. steers in October. For the period from 1972-79, the difference was about 11% for the same weights and sale months. If this seasonal price strength which contributes to the profitability of the cow-short yearling ranch type does not hold, then the cow-yearling ranch would be the better ranch type.

Results of this study also suggest the ranchers look seriously at a stocker organization. Profits were considerably higher under this alternative. However, there is also more risk involved with this ranch organization. As there are large numbers of cattle being bought and sold, adverse turns of the market can be disastrous. One may wish to consider a mix of a cow-yearling and a stocker organization. This type of organization may best use ranch resources, improve profits and limit risk.

Cropping practices and performance contribute much to the profitability of the ranch. One means of making ranching more profitable would be for the operators to become better farmers. Increased weaning weights and weaning percentages are important, but it is likely that if hay quality and production and grazing potential on a ranch is increased, then increased calf crop and weights will also follow.

APPENDIX A
LIVESTOCK ENTERPRISE BUDGETS
PHYSICAL INPUTS AND OUTPUTS FOR THE MODEL RANCH

Table A1. Physical Inputs and Outputs per Head for Steer and Heifer Calves on Ration 1, Improved Hay; Ration 3, Improved Hay and 3 Lb. of Barley; and Ration 4, Alfalfa Hay and 2 Lb. of Barley.

	Heifer Calves			Steer Calves		
	1	3	4	1	3	4
INPUTS						
Hay (tons)	1.15	1.21	1.39	1.23	1.30	1.44
Barley (cwt)	0.00	4.95	3.30	0.00	4.95	3.30
Labor (hours)						
Spring	0.23	0.24	0.28	0.25	0.26	0.30
Winter	0.95	0.99	1.13	1.00	1.06	1.22
Weaned Calf						
Heifer	1.0	1.0	1.0			
Steer				1.0	1.0	1.0
OUTPUTS						
Short Yearling						
Heifer	0.98	0.98	0.98			
Steer				0.98	0.98	0.98

Table A2. Physical Inputs and Outputs per Head for Yearling Steers and Heifers on the Model Ranch.

	Yearling Heifer			Yearling Steer		
	1 <u>a/</u>	3 <u>a/</u>	4 <u>a/</u>	1 <u>a/</u>	3 <u>a/</u>	4 <u>a/</u>
INPUTS						
Grazing (AUMs)						
Summer	3.8	4.0	4.2	4.0	4.2	4.4
Fall	0.39	0.40	0.41	0.41	0.42	0.44
Labor (hours)						
Summer	1.06	1.06	1.06	1.06	1.06	1.06
Short Yearling						
Heifer	1.0	1.0	1.0			
Steer				1.0	1.0	1.0
OUTPUTS						
Yearling						
Heifer	0.99	0.99	0.99			
Steer				0.99	0.99	0.99

a/ Numbers refer to previous winter ration.

APPENDIX B
STATEMENTS OF RETURNS FOR THE VARIOUS LP MODEL RANCHES

Table B1. Sales, Costs and Income for the Forced Cow-Calf Ranch.^{a/}

Item	Unit	Number of Units	Average Sale Weight	Value Per Unit	Total
		(No)	(Lb)	(Dol)	(Dol)
SALES					
Livestock					
Heifer calves	head	126	400	248	31,248
Steer calves	head	207	425	305	63,135
Cull cows	head	60	1,050	373	22,380
Cull rep. heifers	head	8	725	418	<u>3,344</u>
Total Livestock					120,107
Crops					
Alfalfa hay	ton	153		61.00	9,333
Native hay	ton	325		61.50	19,988
Improved hay	ton	167		62.00	10,354
Barley	bushel	2,400		2.33	5,592
Rent deeded range	acre	5,600		1.95	10,920
Rent fall pasture	aum	120		5.45	<u>654</u>
Total Crops					56,841
Interest Income					<u>2,431</u>
TOTAL INCOME					179,379
CASH COSTS					
Crop activities					74,430
Livestock activities					15,311
Purchasing activities					<u>33,860</u>
Total Cash Costs					<u>123,601</u>
RETURNS					
Return above cash costs					55,778
Depreciation					<u>24,600</u>
Net ranch income					31,178
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					11,178
Interest on working capital					
Livestock					24,925
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-37,747

a/ Inventories include 460 cows, 80 replacement heifer calves and 27 bulls.

Table B2. Sales, Costs and Income for the Cow-Short Yearling Ranch.^{a/}

Item	Unit	Number of Units	Average Sale Weight	Value Per Unit	Total
		(No)	(Lb)	(Dol)	(Dol)
SALES					
Livestock					
Heifer calves	head	124	616	387	47,988
Steer calves	head	203	618	435	88,305
Cull cows	head	60	1,050	373	22,380
Cull rep. heifers	head	8	725	418	<u>3,344</u>
Total Livestock					162,017
Crops					
Native hay	ton	319		61.50	19,619
Barley	bushel	1,548		2.33	3,607
Rent deeded range	acre	5,600		1.95	10,920
Rent fall pasture	aum	120		5.45	<u>654</u>
Total Crops					34,800
Interest Income					<u>8,671</u>
TOTAL INCOME					205,488
CASH COSTS					
Crop activities					74,430
Livestock activities					18,987
Purchasing activities					<u>43,145</u>
Total Cash Costs					<u>136,562</u>
RETURNS					
Return above cash costs					68,926
Depreciation					<u>24,600</u>
Net ranch income					44,326
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					24,326
Interest on working capital					
Livestock					29,622
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-29,296

^{a/} Inventories include 460 cows, 80 replacement heifer calves and 27 bulls.

Table B3. Sales, Costs and Income for the Optimal Cow-Long Yearling Ranch.^{a/}

Item	Unit	Number of Units (No)	Average Sale Weight (Lb)	Value Per Unit (Dol)	Total (Dol)
SALES					
Livestock					
Yearling heifers	head	126	750	431	54,306
Yearling steers	head	146	775	490	71,540
Yearling steers	head	60	810	506	30,360
Cull cows	head	61	1,050	373	22,753
Cull replacement heifers	head	8	725	418	<u>3,344</u>
Total Livestock					182,303
Crops					
Native hay	ton	325		61.50	19,988
Barley	bushel	2,400		2.33	<u>5,592</u>
Total Crops					25,580
Interest Income					<u>3,227</u>
TOTAL INCOME					211,160
CASH COSTS					
Crop activities					74,430
Livestock activities					19,353
Purchasing activities					<u>46,240</u>
Total Cash Costs					<u>140,023</u>
RETURNS					
Return above cash costs					71,137
Depreciation					<u>24,600</u>
Net ranch income					46,537
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					26,537
Interest on working capital					
Livestock					31,714
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-29,177

^{a/} Inventories include 472 cows, 82 replacement heifers, 130 other heifer calves, 212 steer calves and 28 bulls.

Table B4. Sales, Costs and Income for the Forced Cow-Calf with 90% Calf Crop and Without Pasture Rental.^{a/}

Item	Unit	Number of Units (No)	Average Sale Weight (Lb)	Value Per Unit (Dol)	Total (Dol)
SALES					
Livestock					
Heifer calves	head	173	400	248	42,904
Steer calves	head	282	425	305	86,010
Cull cows	head	82	1,050	373	30,586
Cull rep. heifers	head	11	725	418	<u>4,598</u>
Total Livestock					164,098
Crops					
Native hay	ton	325		61.50	19,987
Improved hay	ton	92		62.00	5,704
Barley	bushel	2,400		2.33	<u>5,592</u>
Total Crops					31,283
Interest Income					<u>2,269</u>
TOTAL INCOME					197,650
CASH COSTS					
Crop activities					74,430
Livestock activities					20,955
Purchasing activities					<u>49,264</u>
Total Cash Costs					<u>144,649</u>
RETURNS					
Return above cash costs					53,001
Depreciation					<u>24,600</u>
Net ranch income					28,401
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					8,401
Interest on working capital					
Livestock					34,059
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-49,658

^{a/} Inventories include 628 cows, 109 replacement heifer calves and 37 bulls.

Table B5. Sales, Costs and Income for the Forced Cow-Calf Ranch With 80% Calf Crop Weaned and Without Pasture Rental.^{a/}

Item	Unit	Number of Units (No)	Average Sale Weight (Lb)	Value Per Unit (Dol)	Total (Dol)
SALES					
Livestock					
Heifer calves	head	145	400	248	35,960
Steer calves	head	257	425	305	78,385
Cull cows	head	83	1,050	373	30,959
Cull rep. heifers	head	11	725	418	<u>4,598</u>
Total Livestock					149,902
Crops					
Native hay	ton	325		61.50	19,988
Improved hay	ton	62		62.00	3,844
Barley	bushel	2,400		2.33	<u>5,592</u>
Total Crops					29,424
Interest Income					<u>2,043</u>
TOTAL INCOME					181,369
CASH COSTS					
Crop activities					74,430
Livestock activities					21,232
Purchasing activities					<u>49,769</u>
Total Cash Costs					145,431
RETURNS					
Return above cash costs					35,938
Depreciation					<u>24,600</u>
Net ranch income					11,338
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					-8,662
Interest on working capital					
Livestock					34,859
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-67,921

^{a/} Inventories include 643 cows, 112 replacement heifer calves and 38 bulls.

Table B6. Sales, Costs and Income for the Cow-Yearling Model with 80% Calf Crop Weaned and Without Pasture Rental.^{a/}

Item	Unit	Number of Units (No)	Average Sale Weight (Lb)	Value Per Unit (Dol)	Total (Dol)
SALES					
Livestock					
Yearling heifers	head	108	750	431	46,548
Yearling steers	head	142	775	490	69,580
Yearling steers	head	49	810	506	24,794
Cull cows	head	64	1,080	373	23,872
Cull rep. heifers	head	8	725	418	3,344
Total Livestock					168,138
Crops					
Native hay	ton	323		61.50	19,865
Barley	bushel	2,400		2.33	5,592
					25,457
Interest Income					3,045
TOTAL INCOME					196,640
CASH COSTS					
Cropping activities					74,430
Livestock activities					19,394
Purchasing activities					46,316
Total Cash Costs					140,140
RETURNS					
Return above cash costs					56,500
Depreciation					24,600
Net Ranch Income					31,900
Allowance for operator labor and management					20,000
Return to total capital					11,900
Interest on working capital					
Livestock					32,267
Machinery and equipment					24,000
Return to Fixed Capital					-44,367

^{a/} Inventories include 494 cows, 86 replacement heifer calves, 108 other heifers, 192 steer calves and 29 bulls.

Table B7. Sales, Costs and Income for the Cow-Yearling Ranch at 92% Calf Crop.^{a/}

Item	Unit	Number of Units (No)	Average Sale Weight (Lb)	Value Per Unit (Dol)	Total (Dol)
SALES					
Livestock					
Yearling heifers	head	129	750	431	55,599
Yearling steers	head	146	775	490	71,540
Yearling steers	head	63	810	506	31,878
Cull cows	head	61	1,050	373	22,753
Cull rep. heifers	head	8	725	418	<u>3,344</u>
Total Livestock					185,114
Crops					
Native hay	ton	325		61.50	19,988
Barley	bushel	2,400		2.33	<u>5,592</u>
Total Crops					25,580
Interest Income					<u>3,321</u>
TOTAL INCOME					214,015
CASH COSTS					
Crop activities					74,430
Livestock activities					19,430
Purchasing activities					<u>46,244</u>
Total Cash Costs					<u>140,104</u>
RETURNS					
Return above cash costs					73,911
Depreciation					<u>24,600</u>
Net ranch income					49,311
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					29,311
Interest on working capital					
Livestock					31,704
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-26,393

^{a/} Inventory includes 468 cows, 82 replacement heifer calves, 135 other heifer calves, 215 steer calves and 28 bulls.

Table B8. Sales, Costs and Income for the Cow-Yearling Ranch at 1% Winter Death Loss.^{a/}

Item	Unit	Number of Units	Average Sale Weight	Value Per Unit	Total
		(No)	(Lb)	(Dol)	(Dol)
SALES					
Livestock					
Yearling heifers	head	127	750	431	54,737
Yearling steers	head	146	775	490	71,540
Yearling steers	head	61	810	506	30,866
Cull cows	head	61	1,050	373	22,753
Cull rep. heifers	head	8	725	418	<u>3,344</u>
Total Livestock					183,240
Crops					
Native hay	ton	325		61.50	19,988
Barley	bushel	2,400		2.33	<u>5,592</u>
Total Crops					25,580
Interest Income					<u>3,297</u>
TOTAL INCOME					212,117
CASH COSTS					
Crop activities					74,430
Livestock activities					19,065
Purchasing activities					<u>46,156</u>
Total Cash Costs					<u>139,651</u>
RETURNS					
Return above cash costs					72,466
Depreciation					<u>24,600</u>
Net ranch income					47,866
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					27,866
Interest on working capital					
Livestock					31,750
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-27,884

^{a/} Inventory includes 470 cows, 79 replacement heifer calves, 132 other heifer calves, 211 steer calves and 28 bulls.

Table B9. Sales, Costs and Income for the Cow-Yearling Ranch Marketing 50% of Cull Cows Early.^{a/}

Item	Unit	Number of Units (No)	Average Sale Weight (Lb)	Value Per Unit (Dol)	Total (Dol)
SALES					
Livestock					
Yearling heifers	head	126	750	431	54,306
Yearling steers	head	146	775	490	71,540
Yearling steers	head	60	810	506	30,360
Early cull cows	head	31	1,025	422	13,082
Late cull cows	head	30	1,050	373	11,190
Cull rep. heifers	head	8	725	418	<u>3,344</u>
Total Livestock					183,822
Crops					
Native hay	ton	325		61.50	19,988
Barley	bushel	2,400		2.33	<u>5,592</u>
Total Crops					25,580
Interest Income					<u>3,508</u>
TOTAL INCOME					212,910
CASH COSTS					
Crop activities					74,430
Livestock activities					19,370
Purchasing activities					<u>45,979</u>
Total Cash Costs					<u>139,779</u>
RETURNS					
Return above cash costs					73,131
Depreciation					<u>24,600</u>
Net ranch income					48,531
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					28,531
Interest on working capital					
Livestock					31,714
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-27,183

^{a/} Inventories include 472 cows, 82 replacement heifers, 130 other heifer calves, 212 steer calves and 28 bulls.

Table B10. Sales, Costs and Income for the Ranch Organization Producing Heavy Calves.^{a/}

Item	Unit	Number of Units (No)	Average Sale Weight (Lb)	Value Per Unit (Dol)	Total (Dol)
SALES					
Livestock					
Yearling heifers	head	23	802	455	10,465
Short yrlg. heifer	head	118	711	432	50,976
Short yrlg. steers	head	231	776	512	118,272
Cull cows	head	68	1,050	373	25,364
Cull rep. heifers	head	9	725	418	<u>3,762</u>
Total Livestock					208,839
Crops					
Rent deeded range	acre	2,955		1.95	<u>5,762</u>
Total Crops					5,762
Interest Income					<u>10,099</u>
TOTAL INCOME					224,700
CASH COSTS					
Crop activities					74,430
Livestock activities					22,486
Purchasing activities					<u>47,080</u>
Total Cash Costs					<u>143,996</u>
RETURNS					
Return above cash costs					80,704
Depreciation					<u>24,600</u>
Net ranch income					56,104
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					36,104
Interest on working capital					
Livestock					34,245
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-22,141

^{a/} Inventories include 523 cows, 91 replacement heifer calves, 144 other heifer calves, 235 steer calves and 31 bulls.

Table B11. Sales, Costs and Income for the "Best" Practices Model.^{a/}

Item	Unit	Number of Units (No)	Average Sale Weight (Lb)	Value Per Unit (Dol)	Total (Dol)
SALES					
Livestock					
Yearling heifers	head	109	802	455	49,595
Short yrlg. heifers	head	38	711	432	16,416
Short yrlg. steers	head	239	776	512	122,368
Early cull cows	head	34	1,025	422	14,348
Late cull cows	head	34	1,050	373	12,682
Cull rep. heifers	head	9	725	418	<u>3,762</u>
Total Livestock					220,171
Crops					
Rent deeded range	acre	1,412		1.95	2,752
Barley	bushel	494		2.33	<u>1,151</u>
Total Crops					3,903
Interest Income					<u>9,217</u>
TOTAL INCOME					233,291
CASH COSTS					
Crop activities					74,430
Livestock activities					23,478
Purchasing activities					<u>47,577</u>
Total Cash Costs					<u>145,485</u>
RETURNS					
Return above cash costs					87,806
Depreciation					<u>24,600</u>
Net ranch income					63,206
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					43,206
Interest on working capital					
Livestock					35,248
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-16,042

^{a/} Inventories include 524 cows, 90 replacement heifer calves, 151 other heifer calves, 241 steer calves and 31 bulls.

Table B12. Sales, Costs and Income for the Stocker Model Ranch.

Item	Unit	Number of Units	Average Sale Weight	Value Per Unit	Total
		(No)	(Lb)	(Do1)	(Do1)
SALES					
Livestock					
Yearling steers	head	489	775	490	239,610
Yearling steers	head	813	810	506	<u>411,378</u>
Total Livestock					650,988
Crops					
Native hay	ton	325		61.50	19,988
Barley	bushel	2,400		2.33	5,592
Rent fall pasture	aum	696		5.45	<u>3,793</u>
Total Crops					29,373
Interest Income					<u>10,985</u>
TOTAL INCOME					691,346
CASH COSTS					
Steer calves	head	1,066 ^{a/}	425 ^{a/}	315 ^{a/}	335,452 ^{a/}
Short yrlg. steers	head	270 ^{a/}	547 ^{a/}	410 ^{a/}	110,661 ^{a/}
Crop activities					74,430
Livestock activities					13,222
Purchasing activities					<u>56,267</u>
Total Cash Costs					<u>590,032</u>
RETURNS					
Return above cash costs					101,314
Depreciation					<u>24,600</u>
Net ranch income					76,714
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					56,714
Interest on working capital					
Livestock					36,805
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-4,091

^{a/} Number, purchase weight, cost per head and total cost include \$10.00 per head for trucking and purchasing costs.

Table B13. Sales, Costs and Income for the Cow-Yearling Ranch Without Improved Meadow.^{a/}

Item	Unit	Number of Units	Average Sale Weight	Value Per Unit	Total
		(No)	(Lb)	(Dol)	(Dol)
SALES					
Livestock					
Yearling heifers	head	100	750	431	43,100
Yearling steers	head	164	810	506	82,984
Cull cows	head	49	1,050	373	18,277
Cull rep. heifers	head	6	725	418	<u>2,508</u>
Total Livestock					146,869
Crops					
Native hay	ton	425		61.50	26,137
Barley	bushel	2,400		2.33	5,592
Rent deeded range	acre	4,014		1.95	7,827
Rent fall pasture	aum	218		5.45	<u>1,188</u>
Total Crops					40,744
Interest Income					<u>3,102</u>
TOTAL INCOME					190,715
CASH COSTS					
Crop activities					69,630
Livestock activities					15,476
Purchasing activities					<u>39,887</u>
Total Cash Costs					<u>124,993</u>
RETURNS					
Return above cash costs					65,772
Depreciation					<u>24,600</u>
Net ranch income					41,122
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					21,122
Interest on working capital					
Livestock					25,153
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-28,031

^{a/} Inventories include 376 cows, 66 replacement heifer calves, 103 other heifer calves, 169 steer calves and 22 bulls.

Table B14. Sales, Costs and Income for the Cow-Yearling Ranch Without Fertilizer Use.^{a/}

Item	Unit	Number of Units	Average Sale Weight	Value Per Unit	Total
		(No)	(Lb)	(Dol)	(Dol)
SALES					
Livestock					
Yearling heifers	head	93	750	431	40,083
Yearling steers	head	77	775	490	37,730
Yearling steers	head	75	810	506	37,950
Cull cows	head	45	1,050	373	16,785
Cull rep. heifers	head	6	725	418	<u>2,508</u>
Total Livestock					135,056
Crops					
Native hay	ton	325		61.50	19,988
Barley	bushel	2,400		2.33	5,592
Rent deeded range	acre	5,330		1.95	10,393
Rent fall pasture	aum	294		5.45	<u>1,602</u>
Total Crops					37,575
Interest Income					<u>2,878</u>
TOTAL INCOME					175,509
CASH COSTS					
Crop activities					68,510
Livestock activities					14,584
Purchasing activities					<u>38,067</u>
Total Cash Costs					<u>121,161</u>
RETURNS					
Return above cash costs					54,348
Depreciation					<u>24,600</u>
Net ranch income					29,748
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					9,748
Interest on working capital					
Livestock					23,296
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-37,548

^{a/} Inventories include 348 cows, 60 replacement heifer calves, 96 other heifer calves, 157 steer calves and 21 bulls.

Table B15. Sales, Costs and Income for the Cow-Yearling Ranch Without Alfalfa Production.^{a/}

Item	Unit	Number of Units	Average Sale Weight	Value Per Unit	Total
		(No)	(Lb)	(Dol)	(Dol)
SALES					
Livestock					
Yearling heifers	head	101	717	417	42,117
Yearling steers	head	165	775	490	80,850
Cull cows	head	49	1,050	373	18,277
Cull rep. heifers	head	6	725	418	<u>2,508</u>
Total Livestock					143,752
Crops					
Rent deeded range	acre	4,185		1.95	8,161
Rent fall pasture	aum	380		5.45	<u>2,071</u>
Total Crops					10,232
Interest Income					<u>2,440</u>
TOTAL INCOME					156,424
CASH COSTS					
Crop activities					51,390
Livestock activities					15,859
Purchasing activities					<u>36,590</u>
Total Cash Costs					<u>103,839</u>
RETURNS					
Return above cash costs					52,585
Depreciation					<u>24,600</u>
Net ranch income					27,985
Allowance for operator labor and management					<u>20,000</u>
Return to total capital					7,985
Interest on working capital					
Livestock					25,315
Machinery and equipment					<u>24,000</u>
Return to Fixed Capital					-41,330

^{a/} Inventories include 377 cows, 66 replacement heifer calves, 104 other heifer calves, 170 steer calves and 22 bulls.

APPENDIX C
LINEAR PROGRAMMING TABLEAU

The following column names are used for the LP tableau for the model

ranch.

<u>Name</u>	<u>Unit</u>	<u>Description</u>
galfh	acre	grow alfalfa hay
gfalfh	acre	grow fertilized alfalfa hay
gnath	acre	grow native hay
gimph	acre	grow improved hay
gfimph	acre	grow fertilized improved hay
gsmgrn	acre	grow small grain (barley)
gzirgp	acre	graze irrigated pasture
gzdrng	acre	graze deeded range
rdrange	acre	rent deeded range out
gzpvtl	acre	graze private leased range
gzstl	AUM	graze state lease
gzblm	AUM	graze Bureau of Land Management
gznfs	AUM	graze U.S. National Forest Service
lfallp	AUM	lease additional fall pasture
rfallp	AUM	rent surplus fall pasture out
balfh	ton	buy alfalfa hay
bnath	ton	buy native hay
bimph	ton	buy improved hay
bsmgrn	bushel	buy small grain (barley)
salfh	ton	sell alfalfa hay
snath	ton	sell native hay
simph	ton	sell improved hay
ssmgrn	bushel	sell small grain
alfcf	ton	alfalfa used for cow feed
natcf	ton	native hay used for cow feed
impcf	ton	improved hay used for cow feed
cowunit	head	basic cow-calf activity
hfrcalf	head	weaned heifer calf
strcalf	head	weaned steer calf
bull	head	bull
rephfr	head	yearling replacement heifer
lcull	head	cow culled in November
repcull	head	cull replacement heifer
selhfrc	head	sell a weaned heifer calf
selstrc	head	sell a weaned steer calf
slcull	head	sell a cull cow
srepcul	head	sell a replacement heifer cull
whimph	head	winter heifer calf on ration 1, improved hay
whalfh	head	winter heifer calf on ration 2, alfalfa hay
whimphg	head	winter heifer calf on ration 3, improved hay & barley

<u>Name</u>	<u>Unit</u>	<u>Description</u>
whalfhg	head	winter heifer calf on ration 4, alfalfa hay & barley
wsimph	head	winter steer calf on ration 1, improved hay
wsalfh	head	winter steer calf on ration 2, alfalfa hay
wsimphg	head	winter steer calf on ration 3, improved hay & grain
wsalfhg	head	winter steer calf on ration4, alfalfa hay & grain
sshfr1	head	sell heifer wintered on ration 1
sshfr2	head	sell heifer wintered on ration 2
sshfr3	head	sell heifer wintered on ration 3
sshfr4	head	sell heifer wintered on ration 4
ssstr1	head	sell steer wintered on ration 1
ssstr2	head	sell steer wintered on ration 2
ssstr3	head	sell steer wintered on ration 3
ssstr4	head	sell steer wintered on ration 4
yhfr1	head	summer a yearling heifer from ration 1
yhfr2	head	summer a yearling heifer from ration 2
yhfr3	head	summer a yearling heifer from ration 3
yhfr4	head	summer a yearling heifer from ration 4
ystr1	head	summer a yearling steer from ration 1
ystr2	head	summer a yearling steer from ration 2
ystr3	head	summer a yearling steer from ration 3
ystr4	head	summer a yearling steer from ration 4
syhfr1	head	sell a yearling heifer from ration 1
syhfr2	head	sell a yearling heifer from ration 2
syhfr3	head	sell a yearling heifer from ration 3
syhfr4	head	sell a yearling heifer from ration 4
systr1	head	sell a yearling steer from ration 1
systr2	head	sell a yearling steer from ration 2
systr3	head	sell a yearling steer from ration 3
systr4	head	sell a yearling steer from ration 4
rep1	head	replacement heifer from ration 1
rep2	head	replacement heifer from ration 2
rep3	head	replacement heifer from ration 3
rep4	head	replacement heifer from ration 4
sprlabo	hour	spring hired labor
sumlabo	hour	summer hired labor
fwlabor	hour	fall and winter hired labor
spolabo	hour	spring owner labor
suolabo	hour	summer owner labor
fwolabo	hour	fall and winter owner labor
intpaid	dollar	operating interest expense
intinc	dollar	operating interest income

The following pages contain the complete LP tableau for the basic model ranch.

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