

# Returns to Rangelands

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**Highlight:** *Gross value of production from western rangelands average \$7.46 per AUM based upon aggregate data from Wyoming, Utah, Nevada, and Oregon for 1966-70 and reached about \$10 per AUM in 1972. Privately owned lands leased on an acreage basis but with the lease expressed on an AUM basis generally leased at \$1.50 to \$2 per AUM during 1966-70 and a little over \$2 per AUM in 1972. Returns to rangeland estimated from published research by a real estate appraisal approach in which returns are imputed from an income statement were comparable to the lease rates. The imputational procedures in arriving at returns to land and the definition of an AUM should both be standardized for better comparisons among diverse areas or ranching types where animal-size and herd composition vary.*

Gross value of production of rangelands and other associated types of land is significant from the standpoint of society or the economy of an area. It can best be measured by gross receipts adjusted for changes in inventory. It is basic income brought into the local economy as a result of ranching. It is spent and respent within the economy, producing activity which as been estimated conservatively at 2.25 to 3.0 times the actual cash received (Clark, et al., 1972; Osborn and McCray, 1972). It must be carefully distinguished from returns to land, which represents a fair lease from the standpoint of landlord or tenant and is relevant from the standpoint of individual land users and managers.

A third measure, net ranch income is the return to a ranch operator for his labor, management, and use of his capital. It is determined by deducting production expenses, including depreciation from gross value of production. This measure is relevant to individual ranch operators but must be carefully distinguished from either value of production or return to land.

Net ranch incomes and return to capital published in eleven different studies dated from 1926 through 1968 giving the results for 27 different particular situations have been summarized (Agee, 1972). A number of other studies since 1968 showing net returns may also be of interest (Goodsell, 1971, 1972; Goodsell and Belfield, 1972, 1973a, 1973b; Gray et al., 1969, 1970, 1971; Kearl, 1972; Stevens, 1971).

Some of these studies will be used in an elaboration of gross value of production and returns to land, which is the major purpose of this paper.

## Gross Value of Production

Determination of gross value of production attributable to range or ranchlands, or returns to those factors, is complicated because the yearly production cycle often uses public and

private rangelands of differing qualities and also uses croplands and harvested feeds. Published statistics combine value of beef produced from both dairy and beef animals and from rangelands and feedlots or farm lands. Wyoming, Utah, Nevada, and Oregon, are lowest in production from feedlots and the value of beef production from the dairy herds of the public land states in the West.

For purposes of further comparisons, an animal-month (A.M.) will be defined as the monthly forage requirement for five sheep or for cattle over six months of age, without regard to size. Gross value of production per A.M. was \$6.31 for the 1966-70 price levels and \$9.77 at 1972 price levels, which may represent a reasonable outlook for the longer-term future (Table 1). Variations among the four states are within the range of approximately plus or minus 10% of the four-state average.

Value of production and A.M.'s for cattle on feed or dairy breeds being grown out for beef have been included. Value of production is exaggerated slightly in relation to A.M.'s due to sale of cull dairy stock without corresponding allowance for animal months.

**Table 1. Gross value of production from cattle and calves 1966-70 averages, and 1972.**

Item	Gross value of production		
	Total	Per A.M.	Per AUM
1966-70 averages			
State aggregate data <sup>1</sup>			
Wyoming	\$119,184,000	\$ 6.83	\$ 7.68
Utah	59,407,000	5.89	7.52
Nevada	43,692,000	5.85	6.43
Oregon	126,564,000	6.24	7.64
4-States	348,847,000	6.31	7.46
Costs and returns <sup>2</sup>			
Northern Plains	\$ 41,763	\$ 7.48	\$ 8.24
Northwest mountains	42,941	8.71	9.05
Southwest <sup>3</sup>	34,913	7.42	7.58
University of Wyoming <sup>4</sup>	45,739	6.86	7.61
1972			
State aggregate data <sup>1</sup>			
Wyoming	\$206,240,000	\$10.98	\$12.02
Utah	84,302,000	9.03	9.84
Nevada	73,556,000	9.15	9.55
Oregon	163,585,000	9.18	10.07
4-States	527,683,000	9.77	10.62
Costs and returns <sup>2</sup>			
Northern plains	\$ 69,460	\$11.76	\$13.10
Northern Rockies	71,105	13.62	14.35
University of Wyoming <sup>4</sup>	67,936	10.19	11.30

Derived from the following sources:

<sup>1</sup> Annual Supplements to "Livestock and Meat Statistics, 1962." Stat. Bull. No. 333, A.M.S., S.R.S., and E.R.S., U.S. Dep. Agr.

<sup>2</sup> (Goodsell, 1971, 1972) (Goodsell and Belfield, 1973b) (Gray, Goodsell, and Belfield, 1969, 1970, 1971).

<sup>3</sup> 1965-70 averages.

<sup>4</sup> (Kearl, 1972).

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Costs and returns studies of the U.S. Department of Agriculture can also give some useful indications of gross value of production from ranch and rangelands. Those studies indicate values ranging from \$7.42 to \$8.71 per A.M. at 1966-70 average prices, and considerably higher at 1972 prices, depending upon the area. It should be noted that these studies represent typical commercial ranch operations, rather than averages.

A study from the University of Wyoming indicates a gross value of production of \$6.86 for the 1966-70 averages and \$10.19 per A.M. at 1972 prices. These returns are reasonably consistent with state aggregate data but do not correspond closely with the costs and returns studies of the U.S. Department of Agriculture.

Coefficients for an animal-unit-month (AUM) related to basal metabolic requirements can be derived from the formula  $AU = \frac{W^{.75}}{1,000^{.75}}$  W is the average monthly weights of the animal in question; the denominator represents the weight of a mature cow in pounds and puts the AUM coefficients in relation to the maintenance requirements of a 1,000-lb cow. Average weight, AUM coefficients, months in inventory, and AUM's for annual use for various classes and weights of livestock are shown in Table 2. These coefficients were used to estimate AUM's more accurately than perhaps was done with the administrative basis for calculating A.M.'s used previously. AUM coefficients derived by this method have been found to be proportional to requirements for both maintenance and gain derived using net energy methods (Kearl, 1970). Calculated AUM's are slightly less than A.M.'s, and consequently returns per AUM are slightly higher.

### Returns to Range and Ranchlands

Returns to rangeland may be indicated by lease rates on rented lands or returns imputed from an income statement or appraisal approach. These two methods are easily and universally applied to the type of data commonly available and are recommended on that basis. The imputation procedure has been subject to criticism by economists on theoretical and other bases. Shadow prices from mathematical programming or marginal value productivities from a production function approach are more acceptable from a theoretical point of view. However, there are other drawbacks to these approaches, primarily related to data requirements and costs.

Based on the imputation process, return to rangeland would be determined by deducting from net ranch income allowances for the non-land inputs including operators' labor, manage-

ment, and capital invested in livestock and machinery. Obviously, return to rangeland would be much lower than net ranch income, which in turn must be much lower than gross value of production.

Frequently mentioned lease rates of \$3.50 to \$5.00 or more per animal month, per AUM, or per cow-calf pair for a month probably cannot be justified for the entire livestock complement on a year-long basis on typical ranches under price and cost conditions prevailing in the past few years. Pasture costs at those levels may be found: (1) under drought conditions; (2) where a ranch operator has a few more cattle than he can carry due to slight drought or over-large inventory and leases pasture for part of his cattle; or, (3) for yearling steers, but even then such lease rates are questionable from the standpoint of economics and from the leasee's point of view.

It should be noted that under pasture leases on head-month basis, the leasor usually takes care of all maintenance of improvements, does herding and moving, and looks after water and salting. Thus, considerably more than just the products of the land (forage) are provided by the leasor.

### Public Land Studies

A study of effects of changes in fee levels or permitted use of National Forest or BLM lands was made in 1961-62. At that time, based upon data from about 100 ranch schedules, 90 to 95% of all privately owned grazing leased in Wyoming was leased on a per-acre basis. Rentals on a per-acre basis converted to costs per AUM were far below the commonly quoted head-month rentals. In fact, many of those leases were in the range of \$1.25 to \$1.75 per AUM (Kearl, 1962).

The U.S. Forest Service and Bureau of Land Management sponsored a second study of costs of using privately owned and public lands in 1966. About 14,000 personal interviews were made throughout the western states and information was obtained on 4,271 private leases. The average cost of private leases to Forest Service permittees throughout the study at that time was estimated at \$1.86 per A.M. for cattle permittees and \$1.64 for sheep permittees (Table 3). Private lease rates paid by BLM permittees in several states are summarized in Table 3. The relatively low lease rates for sheep permittees in Wyoming probably includes much "checker-board" land of the Union Pacific Railroad in southern Wyoming sheep winter range area. Other analyses to be developed later indicate lower returns on winter than on other seasonal ranges (Table 4). It is likely that lack of alternatives to sheep use also depresses the rentals.

Although this study is two years earlier than the mid-point of 1966-70 average gross value of production data presented previously, comparisons are interesting.

Table 2. Animal-unit-month coefficients and annual requirements per head for various average weights of livestock.

Class of stock <sup>1</sup>	Average weight <sup>2</sup> (lb)	AUM coeff.	Months required	AUM's required
Cows 2+	1,000	1.00	12	12
Heifers 1-2	780	.83	12	10
Weaned calves	505	.60	10	6
Calves-birth to weaning	230	.33	6	2
Steers 1-2	780	.83	12	10
Bulls	1,345	1.25	12	15
Cattle on feed		1.50	6	9

<sup>1</sup> Numbers indicate age attained January 1.

<sup>2</sup> Beginning and ending weights which could produce these average weights include: nursing calves, 75-385 lb; weaned calves, 385-625 lb.

### AUM Rental Rates Derived from Published Research

Studies reflecting 1966-70 cost and price levels also have been used to gain some insight into earning capacity per AUM for range and ranchlands (Table 3). Weighted average returns per AUM for 5,800 AUM's of carrying capacity on the Northern Plains cattle ranch amount to \$1.60. This is consistent with those indicated previously from the 1961-62 and the 1966 U.S. Forest Service-BLM fee studies.

Studies on sheep ranching in Wyoming, based on the 1968 year and representing the 1966-70 cost and price averages also show returns to land consistent with other determinations indicated previously (Stevens, 1971).

**Table 3. Summary of returns per animal-month (A.M.) or animal-unit-month (AUM) to rangelands and ranchlands.**

Study	Returns per	
	A.M. <sup>1</sup>	AUM
<b>Public land studies (1966)<sup>2</sup></b>		
U.S. Forest Service		
All states, cattle, and sheep	\$1.82	
Cattle	1.86	
Sheep	1.64	
Bureau of Land Management		
Montana, cattle and sheep	\$1.89	
Colorado, cattle and sheep	1.77	
Idaho, cattle and sheep	1.76	
Utah, cattle and sheep	1.40	
Wyoming, sheep only	1.18	
<b>Published research</b>		
Northeast Wyoming cattle ranches (1966-70) <sup>3</sup>	\$1.44	\$1.60
Wyoming sheep ranches (1968) <sup>4</sup>		
North-central	\$1.95	\$1.67
Northeast	2.04	1.79
Southwest	1.76	1.56
State	1.88	1.64
<b>Costs and returns studies (1966-70)<sup>5</sup></b>		
Northern plains cattle	\$1.36	\$1.50
Northern Rocky Mountain cattle	2.01	2.10
Intermountain sheep	1.52	

<sup>1</sup> Per animal-month for cattle over 6 months of age or per five sheep months.

Derived from the following sources:

<sup>2</sup> Lester Hoffman, Unpublished data, U.S. Dept. of Agriculture, Cheyenne, Wyoming.

<sup>3</sup> (Kearl, 1972).

<sup>4</sup> (Stevens, 1971).

<sup>5</sup> (Goodsell, 1971, 1972) (Goodsell and Belfield, 1972).

Returns to land based on cost and returns studies and summarized in Table 3 are also consistent with other information.

The ranches reported in these studies, whether U.S. Department of Agriculture or University of Wyoming cattle or sheep ranches, are all large enough to take advantage of most economies of size.

A study was initiated in 1972 to determine net rental returns on privately owned land in Wyoming (Table 4). A mail survey was used to collect basic data. There were 135 usable responses from ranch operations which made use of a considerable amount of leased rangeland, and 12 responses from complete leased ranch operations. AUM's were calculated using coefficients based on estimated weights of animals for various seasons of use.

Gross rent is the average of total cash rent reported paid by respondents. Landlord's cash expenses, except property taxes, and an allowance of 10% of current value of buildings to account for depreciation, repairs, and insurance were entered as costs to the landlord and deducted from gross rent to determine return to taxes and land, including buildings. A percentage of return on current value of buildings equal to percentage return on land was determined and deducted to arrive at return to land and taxes only. The return to land and taxes in this case differs from returns to land derived from the published research, but is probably comparable to the rental costs obtained from the 1966 public land study.

Return to land and taxes for all seasons of use was \$2.28 and \$2.38 per AUM for cattle ranges in western and eastern Wyoming, and \$1.71 for the reasonably well-balanced year-long uses on the complete leased ranch operations.

A regression analysis was used to estimate the net rental return to the landlord as a function of season of use of rented lands. The function was  $NR = b_1 SS + b_2 F + b_3 W + b_4 H$ . The variables were: NR, total net returns to land and taxes, as defined above; SS, total AUM's of spring and summer use; F, total AUM's of fall use; W, total AUM's of winter use; H, AUM equivalents produced by hay. Each separate lease constituted one observation for this analysis. The  $b_i$  coefficients represent the return to land and taxes for each AUM of a particular seasonal use and are also summarized in Table 4.

The number of observations and acreages involved are sufficient to represent a good sample for western or eastern Wyoming. Most land was leased as marginal additions to an operating ranch unit. The returns are generally lower for fall and winter range than for spring-summer range. The returns are higher but still consistent with those shown previously. Since prices were higher in 1971 and 1972 than for 1966 or the 1966-70 averages, higher leases would be expected.

**Table 4. Summary of returns to land and taxes for Wyoming cattle range and ranchlands.**

Item	Cattle ranches		Range and hayland
	Western	Eastern	
Number of observations	46	89	12
Average acres leased			
Rangeland	1,951	3,203	4,263
Hayland	—	17	202
Average production			
AUM's	863	1,264	1,182
Hay (tons)	—	11	181
Returns per AUM			
Weighted average	\$2.28	\$2.38	\$1.71
Seasonal coefficient <sup>1</sup>			
Spring-summer	2.26**	2.99**	2.01*
Fall	2.56**	1.58**	—
Winter	1.71**	1.53**	—
Fall and winter	—	—	1.35*
Hayland	—	.45	1.74*

\* Statistically significant,  $P < .05$ .

\*\* Statistically significant,  $P < .005$ .

<sup>1</sup> Return to land and taxes derived from regression analysis.

Variations in returns to rangeland based upon costs and returns studies from 1960 through 1972 are summarized in Table 5. Returns were low in 1960, 1961, 1964 and 1965 due to low prices and drouth problems in some areas. The up-trend in prices for cattle for 1965 through 1972 is reflected in the rather strong increases in returns to land through those years. Prices for sheep and lambs and returns to range and ranchlands for the Intermountain Sheep Area kept pace with those for the cattle ranches up to about 1970. Prices for wool and lambs and sheep failed to keep pace in 1970 and 1971 with the advancing prices for cattle.

Returns to rangelands reached extremely high levels for the cattle ranches in 1972 as prices achieved high levels and costs were still lagging and increasing only gradually.

### Summary and Conslusions

Gross value of production from rangelands and ranchlands is of particular concern to individual ranch operators, communities, and society, particularly in areas highly dependent on agriculture and upon the use of range and ranchlands. Gross value of production has been less than generally believed through the time periods prior to 1971, averaging \$7.46 per

**Table 5. Variations in returns (\$/AUM) to rangelands and ranchlands based on costs and returns studies.**

Year	Cattle ranches		
	Northern Plains	Northern Rocky Mountains	Intermountain sheep
1960	.34	.23	-.12
1961	.05	.75	-.28
1962	1.24	1.61	.84
1963	.84	1.33	.35
1964	-.01	.10	.57
1965	.19	.73	1.01
1966	.83	1.44	.93
1967	.95	1.43	1.57
1968	1.18	1.85	1.64
1969	1.72	2.81	2.09
1970	2.11	2.51	1.49
1971	2.61	3.08	1.19
1972	4.52	5.47	.89

Derived from the following sources:

(Goodsell, 1971, 1972) Goodsell and Belfield, 1972, 1973a, 1973b).

AUM based upon aggregate data from Wyoming, Utah, Nevada, and Oregon for 1966-70. Gross value of production reached \$10 per AUM levels in 1972 when prices were higher.

Lease rates of \$3.50 to \$5.00 per AUM or more are commonly quoted as prevailing returns to rangelands. However, privately owned lands leased on an acreage basis but with the lease converted and expressed on an AUM basis generally leased at \$1.50 to \$2.00 per AUM during 1966-70, and a little over \$2.00 per AUM in 1972.

Most of the actual production of value occurs in the spring-summer-fall period when green forage is available. Nevertheless, animals must be maintained through the winter time period, using hay or winter range in some fixed proportion to the summer use. The animal unit must generate enough production and value during the period of a year when both forage and animals make most of their growth and operating costs are lowest, and then part of that value must sustain the animals when forages are in their dormancy, supplemental feeding may be required, and operating costs are high.

Return to land may be determined by marginal value productivities from mathematical programming or production

function techniques. Those approaches would be preferred for accurately determining returns to specific types of ranching or range types. Land rental rates (a market approach) or imputation procedures similar to those used by an appraiser using an income approach could also be used. These approaches, particularly the appraisal imputation procedures, can be used to give "ball-park" estimates of aggregate or average values for larger areas or more generalized types of ranching and range conditions. Although the data sources used in this paper have some limitations, they are thought adequate to provide such "ball-park" estimates to indicate levels and trends in returns to rangelands.

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