



The economic consequences of varying the rate of grazing on eastern Montana rangeland
by Harold H Ramsbacher

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree
of Master of Science in Agricultural Economics
Montana State University
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Abstract:

The scope of the study is limited to the economic implications of varying the rate of grazing on given areas of range in Eastern Montana. The optimum grazing rate was estimated between three relative intensities of range resource use ((1) heavy, (2) moderate, and, (3) light) by different combinations of cow numbers and surface acres.

The general methodological procedure of the study is to: (1) formulate a ranch budget describing a cattle ranch typical to Eastern Montana; and (2) substitute experimental production data from the United States Range Livestock Experiment Station, Miles City, Montana, grazing trials into the ranch budget in order to estimate the average net returns accruing to each of the three levels of grazing use.

The conclusions of the study indicate that grazing at a moderate level of range resource use is the more profitable alternative, but this conclusion must be qualified because of the lack of market grade data previous to 1955. Budgets using market grade data for 1955 indicate that the light rate of grazing would rank in a more favorable position if grade data had been available for the entire study period. .

The last chapter¹ points out the experimental models necessary to produce range resource combination data that will be applicable to proper economic analysis.

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20

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ABSTRACT

The scope of the study is limited to the economic implications of varying the rate of grazing on given areas of range in Eastern Montana. The optimum grazing rate was estimated between three relative intensities of range resource use ((1) heavy, (2) moderate, and (3) light) by different combinations of cow numbers and surface acres.

The general methodological procedure of the study is to: (1) formulate a ranch budget describing a cattle ranch typical to Eastern Montana; and (2) substitute experimental production data from the United States Range Livestock Experiment Station, Miles City, Montana, grazing trials into the ranch budget in order to estimate the average net returns accruing to each of the three levels of grazing use.

The conclusions of the study indicate that grazing at a moderate level of range resource use is the more profitable alternative, but this conclusion must be qualified because of the lack of market grade data previous to 1955. Budgets using market grade data for 1955 indicate that the light rate of grazing would rank in a more favorable position if grade data had been available for the entire study period.

The last chapter points out the experimental models necessary to produce range resource combination data that will be applicable to proper economic analysis.

PART I

STATEMENT OF THE PROBLEM

Introduction

Livestock ranching is one of the major types of agricultural production in Eastern Montana. The 1950 Census of Agriculture reports: 65 percent of the total number of classified farms or ranches in 1949 were livestock farms other than dairy and poultry, 86 percent of all operators interviewed reported having breeding beef cows.^{1/}

Much of Eastern Montana is best suited for livestock production, because the semiarid climate, soil, and topography impose a delicate balance between favorable and unfavorable growing conditions for tilled crops and in some cases range vegetation. Holscher^{2/} reports that in the Northern Great Plains:

"The total vegetation . . . in the spring of 1937, was only 10% of what it had been in 1933, before the drouth years. . . . By 1943 the vegetation on the experimental range had recovered 92% of the area it had lost as a result of the drouth, and cactus, while present was no longer conspicuous on the range."

Drought has occurred on the average of once every five years at Miles City, Montana, during the period 1878 to 1939, but the drought periods did not occur regularly as five-year cycles.

^{1/} James R. Gray and Chester B. Baker, Organization, Costs and Returns on Cattle Ranches in the Northern Great Plains, 1930-1952, Montana Agricultural Experiment Station Bulletin 495, Bozeman, Montana, December 1953, p. 6.

^{2/} Clark E. Holscher, "Controlling of Prickly Pear," Western Livestock Journal, Nelson R. Crow Publications, Volume 22, Number 42, 1944, p. 7.

Beef cattle have formed one of the most favorable enterprises to the plains rancher because of the vast acres that must remain in grazing forage. It has been estimated that approximately 75 percent of the land in the Northern Great Plains is utilized as grazing land.^{1/} Crop agriculture (mainly spring wheat) now occupies considerable areas of the rolling glacial plains north of the Missouri River, but it accounts for only a small part of the northern plains roughlands that lie south of the Yellowstone River. Probably less than 10 percent of this land was ever plowed.^{2/}

Generally, the ranchers of the northern plains have evolved their type of ranch operation to take advantage of the production opportunities best afforded by the natural resources and markets. They have had to do this or "go broke." Eastern Montana ranches have a natural feed balance through the grazing season, because the natural vegetative composition is comprised of midgrasses and shortgrasses. Shortgrasses provide late summer and early fall range requirements, and the midgrasses provide the spring, early summer, and late fall grazing. Usually, sufficient winter feed can be produced to balance the rangeland grazing capacity. The feeds commonly grown are: alfalfa, small-grain hay and straw, corn, sweet clover, and native hay.

^{1/} Bradford Knapp, Jr. and A. L. Baker, Crossbred Beef Cattle for the Northern Great Plains, United States Department of Agriculture Circular 810, U. S. Government Printing Office, Washington, D. C., 1949, p.2.

^{2/} Mont H. Saunderson, Western Livestock Ranching, Minneapolis, Minnesota, The University of Minnesota Press, 1950, p. 26.

To maintain this balance of natural resources and livestock numbers now and in the future is the big job of the plains rancher. Overgrazing discriminates against the midgrasses in favor of the shortgrasses, thus causing a shortage in early spring and late fall grazing (unless the supplemental feeding periods are extended). Hay is usually a very expensive substitute for grass, though, and better range management and development would probably be a more effective and cheaper means of attaining the forage-animal balance.

During periods of high precipitation and abundant range forage many ranchers have increased the number of cattle on the ranges. But the weather invariably will change, and the operator who has increased his operation is unwilling to sell on a declining market unless absolutely forced to. Hurtt reports that:

⁰⁰Worse than a single drought or dry year is a succession of such years. In such a period the operator who has made a practice of grazing his range to the limit of usable forage finds to his dismay that the interval between such droughts is insufficient for the forage to regain its vigor. As a result, the second year of drought hits harder than the first, and for the operator it may well mean ruin.^{001/}

It now seems doubtful that numerical increases of livestock resulted in any material increase in meat after the maintenance requirements of the breeding herds were met.^{2/}

^{1/} Leon C. Hurtt, Managing Northern Great Plains Cattle Ranges to Minimize Effects of Drought, United States Department of Agriculture Circular 865, U. S. Government Printing Office, Washington, 1951, p.2.

^{2/} Leon C. Hurtt, Cattle Production Increased on Northern Great Plains Under Conservative Stocking, Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana, Research Note 22, May 1942.

Steers are sometimes included in the herd, because they can usually be disposed of earlier in the season and have a more available market than "wet" cows. The use of steers to insure greater flexibility in the rate of stocking in times of extreme drought may prove beneficial in conserving needed range forage for the foundation herd.

Research Problem

There have been wide differences of opinion among ranchers concerning the methods of achieving the proper balance between livestock numbers and range forage, but essentially the producer must be concerned with the yearly costs and returns from the breeding herd as well as the permanent condition of his range forage. The balance of range forage and supplemental feed requirements must give the greatest net returns from livestock production in the long run.

The scope of this study shall be limited to the economic implications of varying the rate of grazing on given areas of range. The combination of resources (cows and forage acres) which will give the maximum net returns currently and in the long run will be estimated.

The optimum economic rate of combining land and cows will be approximated by the use of budgets. The general methodological procedure of this study is to: (1) formulate a ranch budget describing a ranch typical to the area; and (2) substitute experimental production data from the United States Range Livestock Experiment Station, Miles City, Montana, grazing trials into the ranch budget in order to estimate the net returns accruing to each of the three grazing intensity levels.

The Hypothesis

The hypothesis of the study is: either excessive or very light use of the range resources of Eastern Montana will increase yearly costs per animal unit and/or reduce the current and long-run net returns to the livestock rancher.

The Sources of Data

The main source of secondary data for the formulation of a budget for the organization of the typical family-operated cattle ranch of Eastern Montana (taken as the averages of the years 1932 through 1955) was the recent study by Gray and Baker.^{1/} The data from this publication were brought up to date through 1955 by Mr. James R. Gray.^{2/}

The empirical data substituted into the "typical" ranch organization were obtained from the manuscript, Vegetation, Soil, and Cattle Responses to Grazing on the Northern Great Plains Range, by M. J. Reed and R. A. Peterson. This study, an analysis of the Miles City grazing trials, will be published in the near future. The above mentioned manuscript was supplemented and brought up to date (1946-1955) with livestock and plant production data from the files of the Forage and Range Branch, Agricultural Research Service, United States Range Livestock Experiment Station, Miles City, Montana.

^{1/} James R. Gray and Chester B. Baker, op. cit., pp. 1-107.

^{2/} James R. Gray, Agricultural Economist, Farm Economics Research Division, ARS, USDA, Agr. Econ., New Mexico State College, Las Cruces, New Mexico.

PART II

DEVELOPMENT OF THE MODEL (BUDGET)

Ranch Organization

The ranch organization of the "typical" family-operated cattle ranch^{1/} in this study is based on the average organization of the family-operated cattle ranch in the Gray and Baker cattle ranch study for the period 1932-55.

The land tenure status of the typical family-operated cattle ranch is given in Table I. An additional 108 animal unit months (AUM's) of grazing are furnished by a public range permit.

TABLE I. LAND TENURE - TYPICAL FAMILY-OPERATED CATTLE RANCH ON THE NORTHERN GREAT PLAINS, 1932-55.

Acres	Owned	Leased	Total
Range and Pasture	1,577	1,621	3,198
Crop Lands Harvested	199	---	199
Idle and Waste Lands	75	---	75
Total	1,851	1,621	3,472

The Livestock Plan -- The average number of animals for each class of livestock on the Northern Great Plains family-operated cattle ranches during the period 1932-55 was used in compiling Table II. Livestock

^{1/} A family-operated cattle ranch is defined as a range livestock organization which produces at least 50 percent of its gross income from beef cattle, and the labor and management is supplied primarily by the operator and his family.

numbers are converted to animal units (AU's) on the basis of the relationship between different livestock classes with respect to their need for food.

TABLE II. CONVERSION OF LIVESTOCK CLASSES TO ANIMAL UNITS IN THE TYPICAL FAMILY-OPERATED CATTLE RANCH.

Class of Stock	No. Head	AU Equivalent	Animal Units
Mature Horses	11.8	1.0	11.80
Dairy Cow	2.7	1.2	3.24
Dairy Heifer	0.5	0.7	0.35
Sub Total	---	---	15.39 AU's
Beef Cow	67.7	1.0	67.70
Beef Heifer	14.7	0.7	10.29
Beef Steer	8.6	0.7	6.02
Beef Bull	2.3	1.2	2.76
Calves	40.4	0.4	16.16
Sub Total	---	---	102.93 AU's
Grand Total	---	---	118.32 AU's

The ranch study's beef herd was comprised of mixed classes including steers. To make the average "typical" livestock budget comparable to the experimental data available, it was desirable to exclude the steer class and keep only enough calves to use as stock cow replacements. At the same time, it was essential to keep the total animal units of beef cattle in the "adjusted" budget equivalent to the total number of animal units (102.93) of beef cattle in the livestock organization of the typical cattle ranch in the Gray and Baker study. Also, it was desirable to keep the remaining animal age and sex classes in the same proportion respective

to each other as was experienced in the original study. The following is an account of the procedure used to change the mixed beef herd into a cow-calf operation. The formula below was constructed from Table II to meet the criteria mentioned above.

(1) X equals the number of "cow equivalents" in the "adjusted" livestock organization.

$$(2) \frac{(67.7 \text{ cows})(1.0X \text{ AU's})}{67.7 \text{ cow units}} + \frac{(14.7 \text{ heifers})(0.7X \text{ AU's})}{67.7 \text{ cow units}} + \frac{(2.3 \text{ bulls})(1.2X \text{ AU's})}{67.7 \text{ cow units}} + \left(\frac{14.7 \text{ calves}}{67.7 \text{ cow units}} + .04 \right)^{1/}$$

(0.4X AU's) = 102.93 AU's.

(3) 1.0X AU's of cows + .1519X AU's of heifers + .0408X AU's of bulls + .1028X AU's of calves = 102.93 AU's.

(4) 1.296X = 102.93 AU's
X = 79.4 AU's of cows
.1519X = 12.06 AU's of heifers
.0408X = 3.24 AU's of bulls
.1028X = 8.16 AU's of calves

(5) $\frac{79.4 \text{ AU's}}{1 \text{ AU equivalent}} = 79.4 \text{ cows}$
 $\frac{12.06 \text{ AU's}}{0.7 \text{ AU equivalent}} = 17.2 \text{ heifers}$
 $\frac{3.24 \text{ AU's}}{1.2 \text{ AU equivalent}} = 2.7 \text{ bulls}$
 $\frac{8.16 \text{ AU's}}{0.4 \text{ AU equivalent}} = 20.4 \text{ calves}$

^{1/} Percentages of calves in cow herd is obtained by adding .04 to the percentage of the heifers. This procedure maintains a sufficient number of calves for replacement purposes.

With the above data, Table III was compiled. Livestock prices^{1/} and production data are averages taken from the cattle ranch study. The livestock inventories and purchases were calculated on the basis of average prices paid by farmers for the period 1932-55, while average prices received by farmers for the same period were used to determine the livestock sales values.

Death losses are averages of the years 1932-55. Death losses are not given explicitly for the seasonal calves but they are shown indirectly because the calving percentage employed in the study is actually based on the number of calves raised to weaning age.

The average number of beef cows sold each year is approximately 14 percent of the cow herd. The number of animals from the other beef classes that were sold each year are the animals not needed for the replacement of animals sold, died, or consumed at home.

The ending inventory (December 31) is the same as the beginning inventory (January 1) because each inventory reflects the average number of animals for the years 1932-55. The ranch livestock organization (other than the beef herd) will be identical to Table III in all subsequent livestock budgets, as it is the net returns due to changes in beef animal units for a given area of land that is to be evaluated.

Now, with the typical beef herd organization set up in Table III, the calving percentage and animal weights of the beef herd will be

^{1/} Prices received for beef animals were taken from Agricultural Statistics, United States Department of Agriculture, United States Government Printing Office, Washington, D. C., 1952 and 1955.

TABLE III. ADJUSTED LIVESTOCK BUDGET -- TYPICAL FAMILY-OPERATED CATTLE RANCH, 1932-55.

Class	Inventory Jan. 1		To Raise		To Buy		Home Use Unit	No. Died Head	Sales		Inventory Dec. 31		Cash Sales ± Inv., minus Purchases \$
	Unit	Value \$	Born	Need Repl.	Unit	Value \$			Unit Head	Value \$	Head	Value \$	
<u>Variable Organization</u>													
Beef Cows	79.4	7,225	---	14.5	---	---	1.0	2.4	11.1	1,522	79.4	7,225	1,522
Beef Heifers	17.2	1,187	---	20.4	---	---	---	0.9	5.0	697	17.2	1,187	697
Beef Weaned Calf	20.4	898	---	20.8	---	---	0.4	---	---	---	20.4	898	---
Beef Seasonal Calf	---	---	60	---	---	---	---	---	39.2	2,075	---	---	2,075
Bulls	2.7	435	---	---	0.9	145	---	0.1	0.8	156	2.7	435	11
Sub Total	---	9,745	---	---	---	145	---	---	---	4,450	---	9,745	4,305
<u>Constant Organization</u>													
Milk Cows	2.7	333	---	---	0.2	18	---	---	0.7	96	2.7	333	78
Dairy Heifers	0.5	22	1.3	---	---	---	---	---	0.8	40	0.5	22	40
Swine: Hogs	5.3	148	---	---	---	---	2.0	---	3.3	107	5.3	148	107
Pigs	---	---	7.0	---	---	---	---	1.0	0.7	20	---	---	20
Poultry: Hens	44.0	44	---	---	---	---	---	---	44.0	44	44.0	44	44
Chicks	---	---	---	---	100	14	46.0	10.0	---	---	---	---	14
Doz. Eggs	---	---	---	---	---	---	300.0	---	433.0	134	---	---	134
Horses	11.8	543	---	3.0	---	---	---	---	3.0	135	11.8	543	135
Colts	---	---	3.0	---	---	---	---	---	---	---	---	---	---
Sub Total	---	1,090	---	---	---	32	---	---	---	576	---	1,090	544
Total	---	10,835	---	---	---	177	---	---	---	5,026	---	10,835	4,849

allowed to vary (shown in Appendix A₁ and E₁) according to, the production yields actually experienced on the Northern Great Plains during the period 1932-55. Price of beef will be held constant (in Appendix A₁) in order that the values reflected will be due to production changes -- not to price fluctuations. The total average value of beef sold was \$4,500, a return of \$56.67 per beef-cow of the age of two years and over in the typical herd.

Hay and Crop Plan -- The typical budget for hay and crop production is compiled in Table IV. The inventories are set up so that the totals approximate the average investment in feed and seed for the typical (average) Northern Great Plains cattle ranch during the period 1932 through 1955. Price averages for the period 1932-55 are held constant for beginning and ending inventories. Feed stocks are kept constant for beginning and ending inventories because the feed that is sold and/or fed is assumed to be replaced by the intervening harvest period.

The hay and crop yields are averages for 1932-55 taken from the cattle ranch study, and the AUM's of grazing allotted to the rangeland is the average rate for the Northern Great Plains family-operated cattle ranches.^{1/}

Feed Requirements -- Table V gives the feed requirements for the livestock listed in Table III. The requirements are based on the average feeding standards for the Northern Great Plains cattle ranches for the years 1932-55.^{2/}

^{1/} James R. Gray and Chester B. Baker, op. cit., p. 41.

^{2/} Ibid., pp. 52, 53.

TABLE IV. BUDGET FOR HAY AND CROP PRODUCTION -- TYPICAL FAMILY-OPERATED CATTLE RANCH, 1932-55.

Crops	Yield		Total Units	Inventory Jan. 1		Disposal			Inventory Dec. 31		Gross Receipts Cash Sales + Inv. Change	
	Unit	Per Acre		Unit	Value	Feed Seed	Unit	Gross Sales	Unit	Value		
	Acres	Bu.		Bu.	\$	Lbs.	Unit	\$	Bu.	\$		
Corn	12.6	12.8	161	161	156	9,660	---	---	---	161	156	---
Wheat	26.0	11.9	309	309	399	26bu.	283bu.	1.29	365.00	309	300	365.00
Oats	13.6	22.5	306	306	148	9,120	---	---	---	306	148	---
Barley	8.4	18.5	155	155	112	6,936	---	---	---	155	112	---
Alfalfa seed	5.0	0.87	4.4	4.4	113	27.6	3.9bu.	25.61	90.34	4.4	113	90.34
	Acres	Ton	Ton	Ton	\$	Ton				Ton	\$	\$
Alfalfa hay	29.5	1.08	31.9	31.9	427	31.9	---	---	---	33.0	441	14.00
Other tame hay	21.6	0.94	20.3	20.3	272	20.3	---	---	---	20.3	272	---
Wild hay	81.9	0.64	52.4	52.4	702	52.4	---	---	---	52.4	702	---
Alfalfa hay	2.9	1.08	3.1	3.1	42	3.1	---	---	---	3.1	42	---
	Acres		AUM	AUM		AUM						
Range AUM's	3,198.0	---	940	940	---	940.0	---	---	---	---	---	---
Grazing Permit	---	---	108	108	---	108.0	---	---	---	---	---	---
Idle and Waste	75.0	---	---	---	---	---	---	---	---	---	---	---
Total	3,472.0	---	---	---	2,371	---	---	---	455.34	2,385	---	469.34

TABLE V. NORMAL FEED REQUIREMENTS -- TYPICAL FAMILY-OPERATED CATTLE RANCH, 1932-55.

Kind	No.	Hay Tons	Grain (lbs.)	Protein Conc. (lbs.)
<u>Variable Organization</u>				
Beef Cows	79.4	52.8	5,161	937
Beef Heifers	17.2	9.2	1,118 ^{a/}	---
Calves	20.4	9.0	2,346	---
Bulls	2.7	5.0	929	140
Sub Total	---	76.0	9,554	1,077
<u>Constant Organization</u>				
Milk Cows	2.7	8.10	11,340	378
Dairy Heifers	0.5	0.22	20	---
Swine: Hogs	5.3	---	5,130	---
Pigs	---	---	7,088	---
Poultry: Hens	44	---	3,740	---
Chicks	90	---	2,250	---
Horses: Mature	11.8	22.30	5,322	---
Colts	---	---	---	---
Sub Total	---	30.62	34,890	378
Grand Total	---	106.62	44,444	1,455

^{a/} Two-year olds were fed the same rate of grain as aged cows.

The feed requirements for the "constant portion" of the livestock feed budget, Table V, will also be used in the constant parts of subsequent grazing intensity budgets.

Feed and Seed Costs -- The difference between the animal requirements in Table V and the feed raised in the crop plan in Table IV indicates the feed purchases needed each year, or on the other hand, the feed surpluses that may be carried over to the next year as changes in the

feed inventory. Hay, grain, and protein supplements were fed to the typical beef herd each year, and the costs for these items varied each year according to the amount fed due to range and weather conditions. Mineral, seed, leasing, and grazing costs are itemized in Table VI as averages for the study period, and this latter group of costs was held constant for each year of the study. Feed prices are averages from the cattle ranch study for the years 1932 through 1955.^{1/} Public grazing fees are based on the Bureau of Land Management grazing fees for the period 1936-55. The average value of the privately leased grazing land was \$9,288, and the cost of leasing this land was estimated at a 5 percent capital charge.

TABLE VI. MINERAL, SEED, AND LEASING COSTS -- TYPICAL FAMILY-OPERATED CATTLE RANCH, 1932-55.

Item	Unit	Price	Cost
Salt	2,395 lbs.	\$1.41/cwt.	\$33.80
Corn seed	1.7 bu.	5.57/bu.	9.50
Grazing fees	106 AUM	0.07/AUM	8.00
Sub Total	---	---	51.30
Lease fees	1,621 acres	5.73/acre at 5%	464.41
Total	---	---	515.71

The variable costs of hay, grain, and protein concentrates were totaled with the constant costs of minerals, seed, etc. each year to estimate the feed costs in Table IX for the typical cattle ranch.

^{1/} James R. Gray and Chester B. Baker, op. cit., p. 43.

Labor Costs and Requirements -- Yearly labor requirements for the family-operated cattle ranch are based on data for the years 1945-52. The years previous to this period reflect the transition from animal power to mechanized farm equipment and are not especially meaningful in this study.

TABLE VII. YEARLY LABOR REQUIREMENTS -- TYPICAL FAMILY-OPERATED CATTLE RANCH.

Item	Unit	Hours Total	Pre-harvest Hours	Harvest Hours	Man-days (10 hr. days)
<u>Constant Ranch Organization</u>					
<u>Crops</u>	<u>Acres</u>				
Corn	12.6	50.4	50.4	---	5.0
Wheat	26.0	130.0	62.4	67.6	13.0
Oats	13.6	68.0	28.6	39.4	6.8
Barley	8.4	54.6	25.2	29.4	5.5
Alfalfa seed	5.0	36.0	---	36.0	3.6
Alfalfa hay	29.5	265.5	53.1	212.4	26.6
Other tame hay	21.6	129.6	43.2	86.4	13.0
Wild hay	81.9	388.6	---	368.6	36.9
Alfalfa straw	2.9	---	---	---	---
Garden	0.5	100.0	---	---	10.0
<u>Livestock</u>	<u>Head</u>				
Cows milked	2.7	378.0	---	---	37.8
Horses	11.8	483.0	---	---	48.3
Sows and gilts	12.3	442.8	---	---	44.3
Hens and pullets	44.0	74.8	---	---	7.5
Chicks raised	90.0	27.0	---	---	2.7
Sub Total	---	2,608.3	262.9	839.8	261.0
<u>Variable Ranch Organization</u>					
Beef cows	79.4	1,191.0	---	---	119.1
Other beef cattle	40.3	443.0	---	---	44.3
Sub Total	---	1,634.0	---	---	163.4
Grand Total	---	4,242.3	262.9	839.8	424.4

Labor requirement data for the period 1953-55 are not available at this time, but it is assumed that they will not differ greatly from the averages (1945-52) used in Table VII.

The hired labor cost in Table VIII will depend on the amount of family labor available. The labor cost is based on an average rate of \$4.15 per day.^{1/}

TABLE VIII. LABOR COSTS -- TYPICAL FAMILY-OPERATED CATTLE RANCH, 1932-55.

Item	Days	Wage/Day	Cost
Family labor	356.5	---	---
Hired labor	67.5	\$4.15	\$280
Total	424.0	---	\$280

Budget Summary

The budget summary is shown below in Table IX for the typical ranch organization. Power and machinery, building repair and depreciation, perquisites, and government payments are taken as averages of the period 1932-55 from the range cattle study. Taxes, miscellaneous, and livestock costs are adjusted to the change in animal classes from a mixed steer-cow-calf herd to an exclusive cow-calf operation. Other items listed in the summaries were developed in previous discussion.

All items not pertaining explicitly to the beef organization were held constant for the period 1932-55. Feed expenses reflect the following

^{1/} Ibid., pp. 59-63.

TABLE IX. 1932-55, AVERAGE COSTS AND RETURNS FOR A TYPICAL NORTHERN GREAT PLAINS CATTLE RANCH -- HISTORICAL AND CONSTANT PRICES.

	Unit	Prices	
		Historical ^{a/}	Constant
Beef prices received	Dollars		
Calves (cwt.)	"	---	13.86
Cows and bulls (cwt.)	"	---	13.33
Total cash receipts	Dollars	5,702	5,644
Grain	"	389	455
Beef sales	"	4,658	4,500
Calves	"	2,230	2,098
Cows	"	2,268	2,245
Bulls	"	160	156
Other livestock and livestock products	"	510	544
Government payment	"	145	145
Ranch perquisites	Dollars	605	632
Hay inventory change	Dollars	12	21
Gross ranch income	"	6,319	6,297
Total expenses	Dollars	3,859	3,884
Livestock	"	184	195
Power and machinery	"	1,436	1,346
Building and repair	"	244	226
Miscellaneous	"	491	514
Taxes	"	541	454
Wages	"	214	280
Feed (excludes hay)	"	749	869
Net ranch income	Dollars	3,859	2,413

^{a/} See the Appendices.

costs: the difference between grain fed and grain raised, purchases of protein concentrates, minerals, and leasing and grazing fees. The costs for the amount of hay fed in excess of the 107.7 tons raised on the ranch are recorded as negative changes in the hay inventory in Table IX.

Net ranch income (NRI) is calculated by subtracting total ranch expenses from the gross ranch income. The NRI (\$2,413) represents the return to the rancher for his labor, management, risk-bearing, interest on his investment, and the labor contributed by his family. The average annual net returns per cow over the age of two years in the beef herd was \$30.40 for the period.

A more detailed tabulation of the typical ranch's beef production, summaries of ranch expenses, and ranch income is available in Appendices A, B, C, D, E, F, G, and H.

The typical ranch organization developed above will be used as the framework within which the experimental data from the grazing trials at the United States Range Livestock Experiment Station, Miles City, Montana will be substituted in place of the typical livestock production and grazing data from the range cattle study. The subsequent "grazing trial" budgets will estimate net ranch incomes accruing to each of the three respective grazing intensities: (1) heavy, (2) moderate, and (3) light.

PART III

APPLICATION OF EMPIRICAL DATA TO THE MODEL (BUDGET)

The Source of Empirical Data

The problem of proper stocking has been studied at the United States Range Livestock Experiment Station, Miles City, Montana, since 1932. A representative area of the Northern Great Plains rangeland was selected as the site of the grazing trials. Two sets of experimental range pastures were established; one set on rather gently rolling land was used as summer range, and the other set was located in rougher country for winter grazing. The summer grazing season ordinarily extended from May 15 until November 15 each year and the winter season included the remaining six months. Two pastures of each set were lightly stocked at 38.8 acres per cow-year; two were moderately stocked at 30.5 acres per cow-year; and two were heavily stocked at 23.1 acres per cow-year.

All the range pastures were somewhat similar. The pastures were wedge-shaped, and each set radiated from a central well from which stock water was equally accessible. Salt was placed in each range pasture as an aid in obtaining uniform distribution of grazing. Topography was not a factor in distribution of grazing on either the summer or the winter range pastures.^{1/}

Three groups of high quality Hereford breeding cows were stocked on the range pastures during 1932-55. The first group was carried through

^{1/} Clark E. Holscher and E. J. Woolfolk, Forage Utilization by Cattle on the Northern Great Plains Ranges, United States Department of Agriculture Circular 918, U. S. Government Printing Office, Washington, D. C., June 1953, p. 2.

early August, 1936, when they were sold because of uncertainties of feed resulting from the drought. The second group was started in 1937 and continued through November, 1945 when they were sold for salvage as open ten-year olds. The third group was started in the spring of 1948 as yearling heifers. This group dropped their first calves in the spring of 1950.

Cows were bred to registered Hereford bulls during a six-week period in June and July. In 1935 and the period 1939 through 1955 bulls were shifted between pastures periodically to equalize the possible effects of individual bulls. In the other years, one bull was furnished per pasture except in two years when a single bull was moved through a circuit of all pastures twice each day.

Detailed records were kept of how the range and cattle were affected by the weather and the three rates of stocking. The records contained vegetation data, supplemental feed required for each group of cows, and individual cow and calf weights recorded at 28 day intervals.^{1/}

To estimate the probable effects of grazing at different levels of use on the typical family-operated cattle ranch empirical data from the Miles City grazing experiment will be substituted into the typical ranch organization.

The land tenure organization of the typical cattle ranch (Table I), will remain the same for the subsequent grazing intensity budgets. Hay,

^{1/} M. J. Reed and R. A. Peterson, Vegetation, Soil, and Cattle Responses to Grazing on the Northern Great Plains Range, Unpublished manuscript, pp. 18-20.

grain, and ranch enterprises other than beef will have the same acreages, animal numbers, and yields as the typical ranch. Prices received and paid by the rancher will remain constant through the years, 1932-55, and between the different grazing level budgets. The desired end is to reflect the results of varying the rates of grazing, and this is accomplished by varying the number of beef animal units on a given area of range (3,558 acres).^{1/}

The Ranch With a Heavy Rate of Grazing --
Prices Held Constant

Using the same general ranch organization that was developed previously for the typical cattle ranch, all the ranch enterprises and management practices are carried over into the heavily grazed cattle ranch except for those practices employed in the beef cattle enterprises.

The number of beef animals for the heavy grazing rate are calculated by dividing the acres per cow-year (23.1 acres) into the surface acres grazed (3,558 acres). The constant ranch livestock organization (15.39 AU's) was subtracted from the quotient (154 AU's) to give 138.61 AU's in the beef herd. The animal units in the beef herd were then substituted into the general formula developed on page 8.

(1) $X =$ the animal units of cows in the herd.

(2) 154 AU's minus 15.39 AU's (horses and dairy) = 138.61 AU's (beef animals).

(3) $\frac{2}{X}$ cows + .1519X heifers + .0408X bulls + .1028X calves = 138.61 AU's.

^{1/} Three hundred and sixty acres are allowed for the 108 AUM's of public grazing permit for the typical cattle ranch. This method will subject the public range to a similar degree of use as the private land.

^{2/} See page 8 for the derivation of the formula.

(4) $1.29X = 138.61 \text{ AU's}$

$X = 106.95 \text{ AU's} = 106.95 \text{ cows}$

$.1519X = 16.24 \text{ AU's} = 23.2 \text{ heifers}$

$.0408X = 4.36 \text{ AU's} = 3.6 \text{ bulls}$

$.1028X = 10.99 \text{ AU's} = 27.5 \text{ calves}$

In Appendix B₁ the livestock inventory except for the calf crop is held constant for each year of the study. Replacements are withheld from the calf crop each year in order to replace the animals in the herd that are culled, slaughtered and lost due to death each year. The number of animals slaughtered and culled are based on the cattle ranch study while death losses are based on empirical data from the Miles City grazing experiments.

The beef herd for the heavily grazed ranch is applied in Appendix B₁ to the marketing procedure experienced in the typical ranch budgets. The total value of beef sold each year is then shown in Appendix B₁ as a component of the total cash receipts. The yearly sales of beef from the heavily grazed range averaged \$5,736 for the study period. Average organization, production, and costs and returns for the period, 1932-55, are given in Tables X and XI.

The heavily grazed ranch budgets increase in livestock, tax, and wage costs (relative to the typical ranch budgets) reflect the larger herd size of the heavily grazed ranch, while the rise in miscellaneous costs reflect the increase in board for hired labor. Feed costs (exclusive of hay bought) are the same for each year except 1938 and 1944 when protein

TABLE X. 1933-55, AVERAGE ORGANIZATION, AND PRODUCTION FOR A TYPICAL NORTHERN GREAT PLAINS CATTLE RANCH WITH THREE INTENSITIES OF GRAZING USE.

	Unit	Rate of Grazing		
		Heavy	Moderate	Light
Land in ranch	Acre	3,472	3,472	3,472
Cropland	"	199	199	199
Rangeland	"	3,198	3,198	3,198
Miscellaneous	"	75	75	75
Crops harvested	Acre			
Grain	"	60.6	60.6	60.6
Hay	"	133.0	133.0	133.0
Other crops	"	5.0	5.0	5.0
Livestock on ranch	Number			
Beef cows	"	107.0	78.1	58.9
heifers	"	23.2	16.9	12.8
calves	"	27.5	20.1	15.1
bulls	"	3.6	2.7	2.0
Dairy cows	"	2.7	2.7	2.7
heifers	"	0.5	0.5	0.5
Chickens	"	44.0	44.0	44.0
Hogs	"	5.3	5.3	5.3
Horses	"	11.8	11.8	11.8
Beef animals sold	Number			
Calves	"	53.8	45.9	35.7
Cows	"	27.0	15.8	11.9
Bulls	"	1.25	0.9	0.7
Weight per animal	Pounds			
Calf	"	359	396	396
Cow	"	1,005	1,080	1,076
Bull	"	1,315	1,461	1,461
Beef sold	Pounds			
Calves	"	19,501	18,209	14,354
Cows	"	21,111	17,059	12,797
Bulls	"	1,644	1,315	1,023

TABLE XI. 1933-55, AVERAGE COSTS AND RETURNS FOR A TYPICAL NORTHERN GREAT PLAINS CATTLE RANCH WITH THREE INTENSITIES OF GRAZING -- CONSTANT PRICES.

	Unit	Rate of Grazing		
		Heavy	Moderate	Light
Beef prices received (cwt)	Dollars			
Calves	"	13.86	13.86	13.86
Cows and bulls	"	13.33	13.33	13.33
Total cash receipts	Dollars	6,880	6,117	4,977
Grain	"	455	455	455
Beef sales	"	5,736	4,973	3,833
Calves	"	2,703	2,524	1,990
Cows	"	2,814	2,274	1,707
Bulls	"	219	175	136
Other livestock and livestock products	"	544	544	544
Government payments	"	145	145	145
Ranch perquisites	"	632	632	632
Hay inventory change	"	-652	271	436
Gross ranch income	"	6,859	7,020	6,044
Total cash expenditures	Dollars	4,193	3,716	3,401
Livestock	"	281	211	175
Power and machinery	"	1,346	1,346	1,346
Miscellaneous	"	590	512	458
Taxes	"	497	452	420
Wages	"	518	272	107
Feed	"	735	697	685
Building and repair	"	226	226	226
Net ranch income	Dollars	2,666	3,304	2,627

supplements were fed to the heavily grazed beef herd. In Appendix B₂ the constancy in the feed costs over the period of the study reflects the fact that no grain or protein concentrates were fed to the experimental animals at Miles City, Montana, except for the years stated above. The purchases of hay (when hay fed exceeded hay raised) are denoted as negative changes in the hay inventory in Table XI.

During the years 1938, 1950, 1951, 1952, and 1954 it was necessary to remove the experimental animals from the summer grazing trial pastures before the predetermined date of November 1.^{1/} Range management personnel have indicated that the moderately and lightly grazed pastures would probably have carried their animals through these periods without supplemental feeding. Therefore, extra feed costs have been charged against the heavily grazed ranch budgets for these years to account for the length of time that the summer grazing period was short of meeting the end of the normal grazing season.

The total expenses for the heavily grazed ranch averaged \$4,193 which when subtracted from the gross ranch income of \$6,859 leaves a net ranch income of \$2,666 or a net return of \$24.90 per cow over the age of two years in the beef herd.

The gaps in the Appendices for the years 1937, 1946, 1947, 1948, and 1949 reflect the lack of production data from the Miles City experiments.

^{1/} November 1st is the end of the grazing period for the later experiments, but the earlier experiments used November 15th. However, the author has arbitrarily chosen the former date for the purpose of the study.

The Ranch With a Moderate Rate of Grazing --
Prices Held Constant

The production responses from a moderate intensity of grazing were "plugged" into the budgets of the typical ranch organization to estimate the effects of this type of range and livestock management upon the net income of the plains rancher.

The total animal units of beef animals for the moderate intensity of grazing were calculated by dividing the acres per cow-year (30.5) into the surface acres grazed (3,558 acres). The constant ranch livestock organization (15.39 AU's) was subtracted from the quotient (116.6 AU's) to give 101.21 AU's in the beef herd.

The animal units of beef animals were then substituted into the same general formula as on page 8. The resulting number for each class of beef animals is as follows:

78.1 cows
16.9 heifers
2.7 bulls
20.1 calves

The beef herd for the moderately grazed ranch was then used to construct Column 4 in Tables X and XI. The total value from the sale of beef animals averaged \$4,973 yearly for the moderately grazed ranch.

The 1938 feed costs in Appendix C₂ show the one year of the study that protein concentrates were fed to the moderately grazed beef animals. Hay purchases and surpluses are given in Table XI in change of hay inventories.

Total ranch expenses for the moderately grazed ranch averaged \$3,716 -- a decrease of \$477 from the average total expense of \$4,193 for the heavily grazed ranch. The gross ranch income (GRI) for the moderately grazed ranch was \$7,020 which gave an average net ranch income (NRI) of \$3,304. The net returns for the moderately grazed ranch averaged \$42.30 per cow over the age of two years in the beef herd.

The Ranch With a Light Rate of Grazing --
Prices Held Constant

The same general procedure employed in the construction of the heavily and moderately grazed ranch organization budgets was utilized in compiling the budgets for the cattle ranch with a light rate of grazing (38.8 acres per cow-year). Tables X, and XI and Appendices D₁, D₂, and D₃ give the results for the study period.

Feed costs for the year 1938 reflect the purchases of protein concentrates. Hay purchases and surpluses are itemized in Appendix D₃ under hay inventory changes.

The GRI for the lightly grazed cattle ranch averaged \$6,044 while the total ranch expenses averaged \$3,417. The difference of the above figures gives a NRI of \$2,627 for the lightly grazed ranch for an average net return per cow two years old and over of \$44.60 for the study period.

Budgets Using Historical Prices

Estimation of net ranch income computed with prices actually experienced is interesting with respect to how price fluctuations interacted

with the physical production responses to comprise the yearly uncertainties experienced by the plains rancher during the study period. The summaries for the budgets using historical prices are given in Appendices E, F, G, and H.

The yearly prices of cattle sold were taken from Agricultural Statistics 1952 and 1955. Prices received and paid for other commodities during this period were based on the 1910-14 indices.

The average costs and returns for the period, 1933-55, are given in Table XII for the three intensities of grazing. The average net ranch incomes for the heavily, moderately, and lightly grazed ranches are \$2,514; \$3,075; and \$2,332 respectively. As in the case of the budgets with constant prices, the sequence of largest to least net returns according to grazing use is the same, but there are slight changes in the magnitude of the returns.

The results for the budgets with historical prices are probably not too meaningful in terms of grazing use implications because the fluctuations in price may entirely or in large part shroud the reactions of grazing responses if the two factors act in opposite directions. Or on the other hand, price fluctuations may actually give false impetus to grazing results if the two factors change in the same direction.

Therefore, the ranch returns that were developed in the previous budgets with the assumption of constant prices will be analyzed in the next section of the thesis in terms of beef production as affected by range condition and weather fluctuations.

TABLE XII. 1933-55, AVERAGE COSTS AND RETURNS FOR A TYPICAL NORTHERN GREAT PLAINS CATTLE RANCH WITH THREE INTENSITIES OF GRAZING USE -- HISTORICAL PRICES.

	Unit	Rate of Grazing		
		Heavy	Moderate	Light
Beef prices received	Dollars			
Calves	"	-----Historical prices-----		
Cows and bulls	"	-----Historical prices-----		
Total cash receipts	Dollars	6,539	5,897	4,826
Grain	"	367	367	367
Beef sales	"	5,515	4,878	3,802
calves	"	2,604	2,507	2,018
cows	"	2,697	2,200	1,651
bulls	"	214	171	133
Other livestock and livestock products	"	488	488	488
Government payments	"	169	169	169
Ranch perquisites	Dollars	581	581	581
Hay inventory change	Dollars	-545	247	331
Gross ranch income	Dollars	6,575	6,731	5,738
Total expenses	Dollars	4,061	3,656	3,406
Livestock	"	256	192	160
Power and machinery	"	1,436	1,436	1,436
Building and repair	"	241	241	241
Miscellaneous	"	561	487	436
Taxes	"	595	541	503
Wages	"	383	201	79
Feed (excludes hay)	"	589	558	551
Net ranch income	Dollars	2,514	3,075	2,332

PART IV

INFERENCES TO BE DRAWN FROM THE STUDY

Limitations of Comparing the Grazing Intensity Budgets With the Typical Cattle Ranch Study Budgets

While the data from the cattle ranch study are averages of the family-operated cattle ranches on the Northern Great Plains, the beef production data used to construct the grazing intensity budgets are the results of an experiment conducted in a specific area of the Northern Great Plains. Management and physical production responses respective to the two different sources of data cannot be assumed to be comparable in all cases. Therefore, the main inferences to be drawn from the study are restricted to the results from the heavily, moderately, and lightly grazed ranch budgets.

Range Condition, as it Affects Net Ranch Income

Major trends in range vegetation are usually set by weather conditions, and these trends are modified by the intensities of grazing use. This is especially true as shown in Figure 1, where the changes in forage production due to fluctuations in weather are greater than the differences due to grazing and stocking treatments.

Vegetation data obtained from the Miles City grazing experiments indicate that the moderate rate of stocking approximated an optimum in maintaining range forage productivity. The relative condition of the lightest and the moderately stocked ranges was apparently about equal. In Figure 1, forage yields indicate that the light and moderately grazed

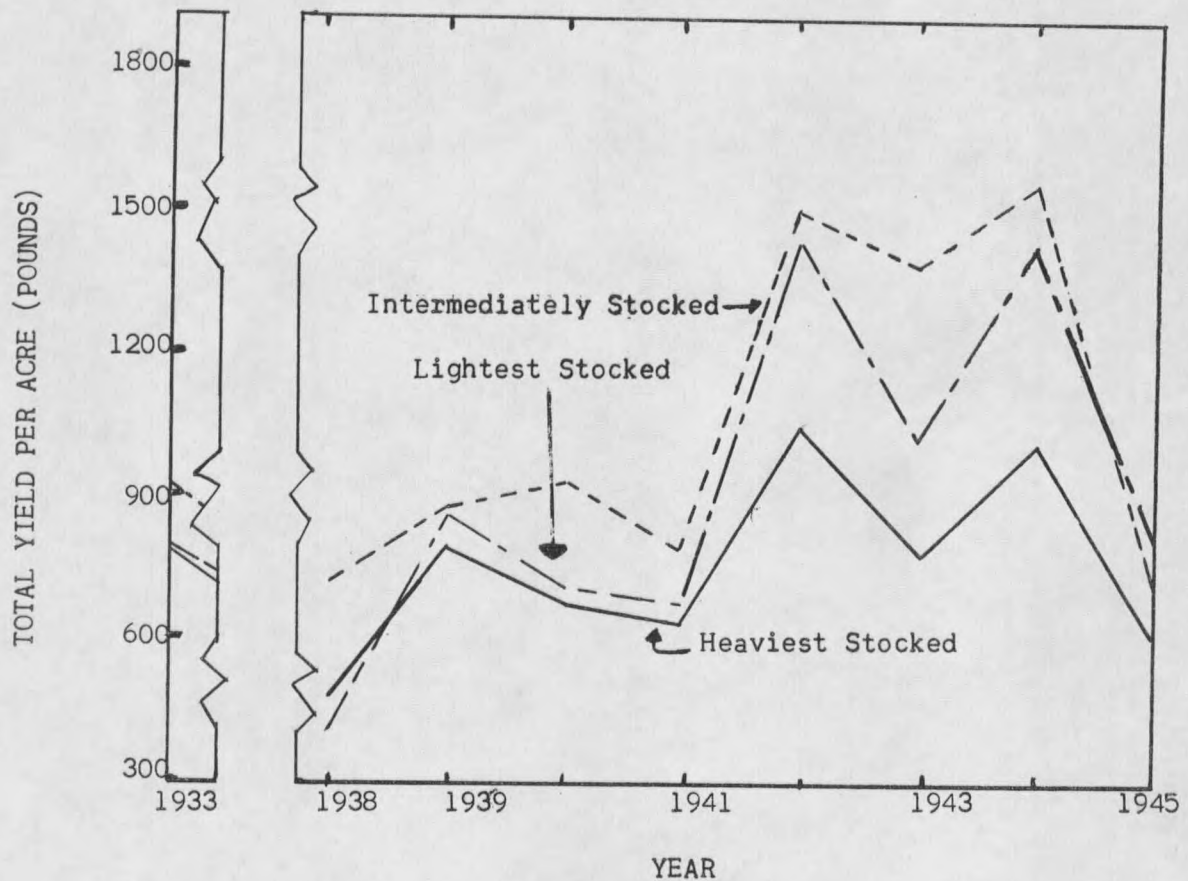


Figure 1. Forage Production on the Summer Cattle Ranges Was Reduced During the Later Years of the Study by the Heaviest Level of Stocking, Miles City, Montana Experimental Range. (Based on yields calculated from cattle weights, days of stocking, and herbage utilization).^{1/}

^{1/} M. J. Reed and R. A. Peterson, Vegetation, Soil, and Cattle Responses to Grazing on the Northern Great Plains Range, Unpublished manuscript, p. 31a.

pastures consistently produced more forage than the heavier grazed pastures in the later years of the experiment.^{1/}

The data in Figures 1 and 2 would tend to support the commonly held belief of many range management workers that extended overgrazing becomes more critical as the period of overgrazing is prolonged.

In Figure 2 the yearly forage production is transformed into pounds of marketable beef through the use of relative numbers of grazing animals. The heavy rate of grazing on the average produces considerably more beef for each acre of range than the other grazing intensities, but its beef turnoff per cow is considerably lower than the lighter rates of grazing use. In other words, the heavily grazed herd's larger number of animals (producing a relatively lower beef turnoff per animal than the other intensities) will produce more beef on a given area of land than the relatively smaller sized moderately and lightly grazed herds (with a relatively larger yield of beef per animal than the heavily grazed herd) can produce on the given area of land.

On the other hand, it should be remembered that the output of beef turnoff for each grazing intensity is not the result of certain constant inputs plus the one variable input, forage acres. In reality, the beef turnoff for each grazing intensity is a function of the variables: forage acres, hay fed, protein supplements (in some years), supplemental pasture in other years, labor, etc. When the cost of all the factors of production are allocated to their respective grazing intensities, the

^{1/} Ibid., p. 33.

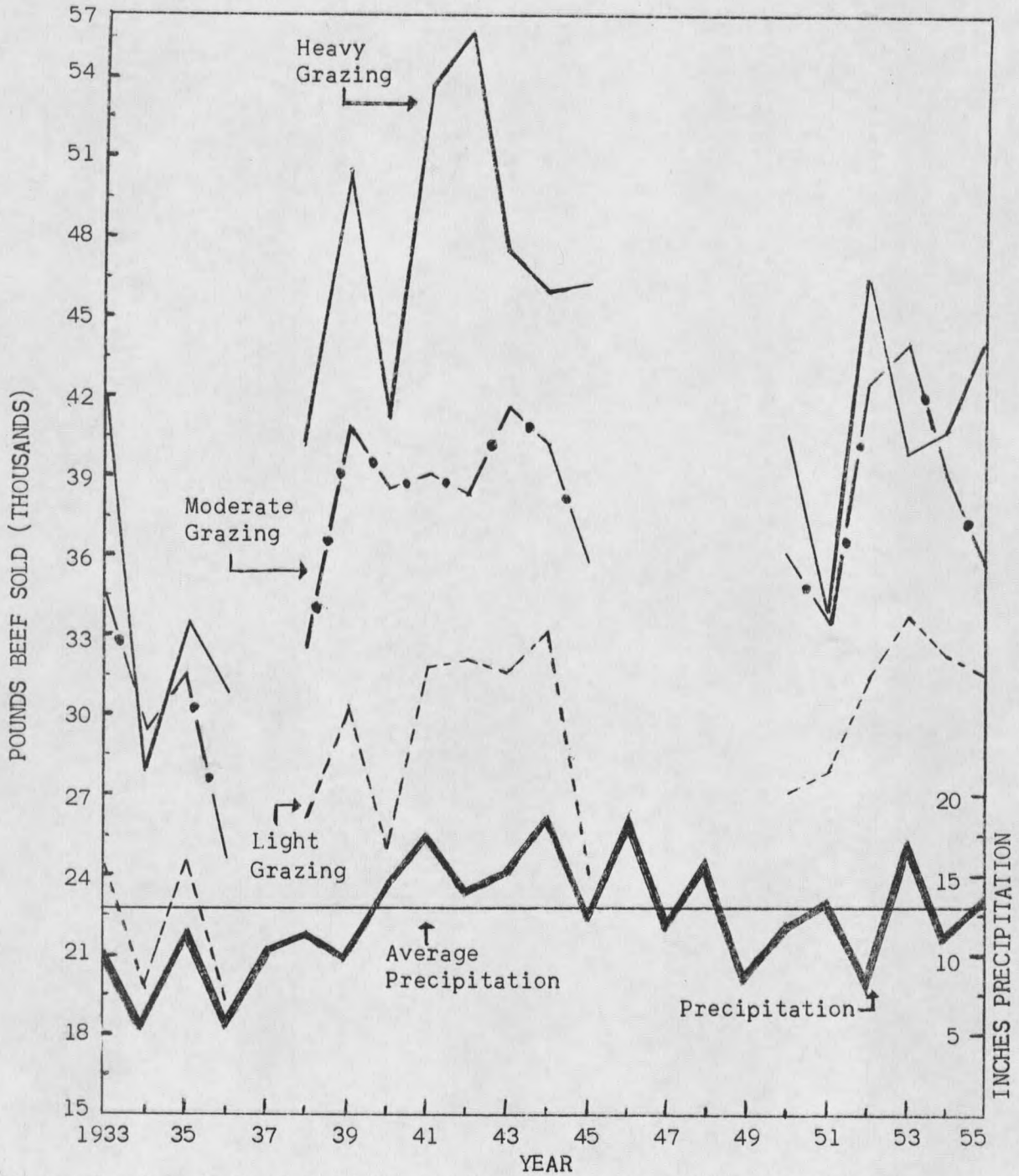


Figure 2. Pounds Beef Sold From a Family-operated Cattle Ranch with Three Intensities of Grazing.

residual in terms of dollars (net ranch income) is illustrated in Figure 3. A detailed tabulation of costs and returns for each grazing intensity is given in the Appendices.

Figure 1 denotes a general decrease in the amount of forage produced by the heavily grazed range in relation to the other two grazing intensities. From this might be construed that forage production on the heavily grazed range becomes even more critical during the period 1950-55 when the pounds of beef produced in Figure 2 for this period is compared to the period 1938-45.

The gradual diminution of range forage produced on the heavily grazed pastures is also characterized by a deterioration in range condition. As a range deteriorates in condition, its carrying capacity of animal units is also adversely affected. It seems as if the value of such a range might vary directly in proportion to its potential to produce a turnoff. Therefore, ^{the} a type of management that is so intensive as to be operating under diminishing marginal productivity (beef) and a deteriorating physical plant (range), will face the prospect of declining land values relative to properly managed ranges. It is beyond the scope of this paper to analyze land values, but the relative value of rangeland under different forms of management should be kept in mind when evaluating the consequences of different grazing practices.

It might seem from a comparison of beef production in Figure 2 and forage production in Figure 1 that the lightly grazed range is utilized too lightly, but this aspect will be discussed later.

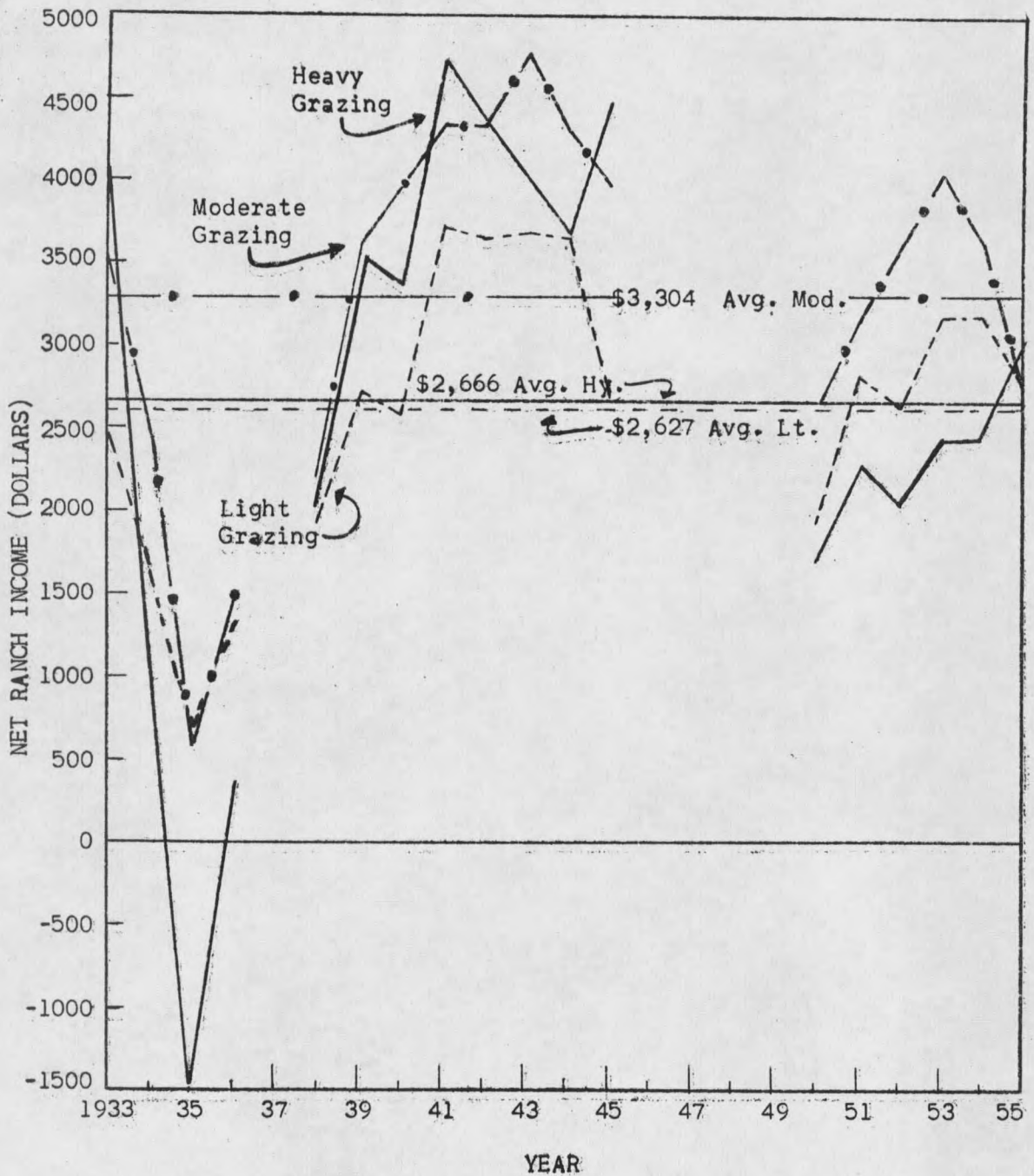


Figure 3. Net Ranch Income for a Typical Family-operated Cattle Ranch with Three Rates of Grazing -- Prices Constant.

Net Ranch Income Each Year for Three Intensities
of Grazing in Relation to Weather

The total pounds of beef that would go to market each year from each of the three levels of grazing is illustrated in Figure 2. Generally the changes in beef production parallel the fluctuations in weather rather closely. However, the relative production of beef is greatly modified by each grazing intensity.

The early and later stages of the grazing experiments show that the heavily grazed herd's production fluctuates more sharply during periods of unfavorable precipitation than does the production from the other intensities. This is due mainly to the amount of forage produced on the range each year. The amount of range forage produced each year reflects directly on the quantity of feed that must be fed during the winter months. Therefore, the respective feed costs for the three alternatives of grazing use must be considered in order to obtain a picture of the net returns that would accrue to each type of management. The relative effect of each type of grazing use on yearly net returns is illustrated in Figure 3 as the average net ranch incomes which for the respective alternatives of heavy, moderate, and light grazing are \$2,666, \$3,304, and \$2,627.

For the purpose of comparing the relative effects of different levels of grazing use over time, the histogram in Figure 4 is given. The first period, 1933-36, illustrates the very severe effects of the drought of the 30's when the moderately grazed alternative gave an average net return of \$1,038 in excess of the alternative of heavy grazing.

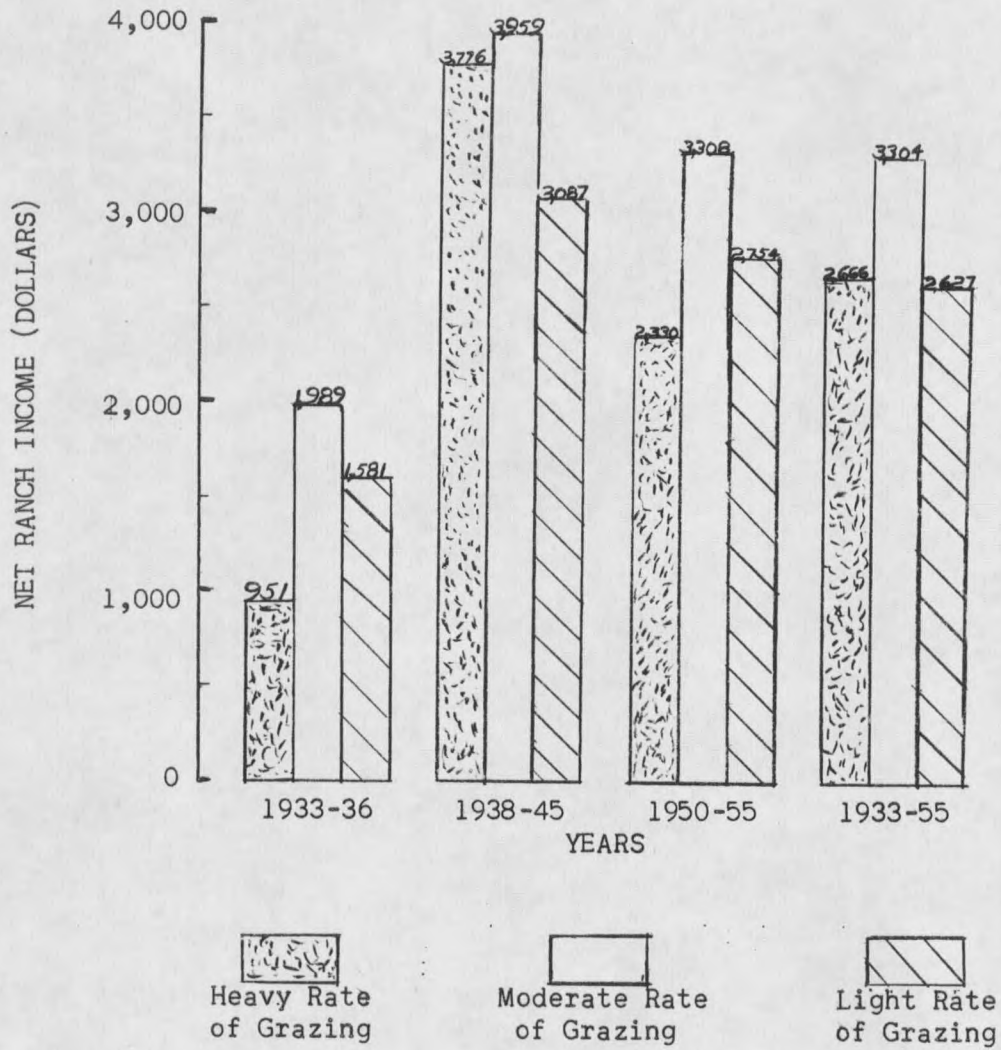


Figure 4. Average NRI -- Four Periods with Three Grazing Intensities on Typical Northern Great Plains Cattle Ranch.

The second period, 1938-45, reflects the breaking of the drought; and the years, 1940-44, reflect a period of above normal rainfall. The moderately grazed range would give an average net return of \$183 in excess of the same range with a heavy rate of grazing use. The difference of \$183 in net return between the moderately and the heavily grazed range is probably not significant, but it does indicate the weather conditions that probably must exist in order for the average net returns from a heavily grazed range to approximate the average net returns from a moderately grazed range.

The third period reflects sharp fluctuations in yearly precipitation but with an average that closely approximates the long time normal. The average net returns from the moderately grazed range during this period exceeds the average net returns from the heavily grazed range by \$978.

When the net returns of each respective level of grazing use are averaged for the whole study period, the average net returns are as previously mentioned: \$2,666; \$3,304; and \$2,627 for the heavy, moderate, and light rates of grazing use. The relative differences in the net returns for the above grazing levels are: moderate over heavy, \$638; moderate over light, \$677; heavy over light, \$39.

The average net returns from the lightly grazed range were always below those from the moderately grazed range, but the average net returns from the lightly grazed range were exceeded only during the period 1938-45 by the net returns of the heavily grazed range, and as mentioned previously, this is a period of exceptionally favorable rainfall in respect to the normal precipitation expectations.

The Probable Effect on Net Ranch Income by Livestock
Market Grades for Animals Sold

The practice of grading into market classes the cows and calves that were sold from the Miles City grazing experiments was started in 1955. The market grades and prices received respectively for the calves from the heavily, moderately and lightly grazed pastures averaged low good, \$17.00/cwt.; top good, \$18.50/cwt.; and low choice to, top good, \$18.50/cwt. The cows sold from the above pastures averaged high cutter, \$8.00/cwt.; medium to low utility, \$8.25/cwt.; and low utility to high cutter, \$8.00/cwt. respectively.

The prices received for beef from the heavily grazed range will now be arbitrarily employed as the constant price received for beef sold from each grazing intensity budget for the year 1955. This procedure will give the same common denominator to each grazing intensity budget for 1955 and the subsequent budgets with the introduced market grades and market grade prices.

Using the "common" price of \$17.00/cwt. for calves and \$8.00/cwt. for cows and bulls, the NRI's are as follows: heavily grazed range, \$2,360; moderately grazed range, \$2,264; and the lightly grazed range, \$2,574.

The NRI's established above are not the same as those given in Appendices B₃, C₃, and D₃ because the Appendices reflect Chicago prices while this analysis utilizes Billings, Montana market prices.

With the introduction of market grade data (1955) and the corresponding prices for the market grades, a set of budgets is constructed

(Table XIII) which give a NRI of \$2,360 for the heavily grazed ranch; \$2,700 for the moderately grazed ranch; and \$2,832 for the lightly grazed ranch.

The use of actual market grade data and the corresponding prices in 1955 give the lightly grazed ranch a NRI of \$132 (5 percent) in excess of the moderately grazed ranch and \$472 (20 percent) in excess of the heavily grazed ranch; and the moderately grazed ranch exceeds the heavily grazed rate in net returns by \$310 (14 percent).

In contrast, if the "common" price is used in making a comparison between the grazing intensities, the light rate of grazing will exceed the moderate rate in net returns by \$310 (14 percent) and the heavy rate by \$214 (9 percent); and the heavy rate will exceed the moderate rate in net returns by \$94 (4 percent).

An intra-grazing intensity analysis for the year 1955 shows the relative directional changes in net returns by the introduction of grade data. If it is assumed that the net returns from the heavily grazed ranch remain constant, the moderately grazed ranch's net returns will increase by \$346 (16 percent), and the lightly grazed ranch's net returns will increase by \$258 (10 percent).

Previous to 1955, budgets using actual market grades for beef animals sold were not constructed because of the lack of grade data. However, the reader may make a rough calculation of the importance of market grades and prices by comparing the actual cow and calf weights for the respective grazing intensities in Appendices B₁, C₁, and D₁.

TABLE XIII. SUMMARY OF INCOME FOR A TYPICAL FAMILY-OPERATED CATTLE RANCH WITH THREE INTENSITIES OF GRAZING -- BEEF PRICES CORRESPONDING TO MARKET GRADES OF BEEF SOLD IN 1955.

	Unit	Rate of Grazing		
		Heavy	Moderate	Light
Grain sales	Dollars	455	455	455
Other ranch products	"	544	544	544
Beef sales	Dollars	5,310	4,737	4,333
Calves	"	3,385	2,981	3,184
Cows	"	1,789	1,634	1,064
Bulls	"	136	122	85
Government payments	"	145	145	145
Total cash income	"	6,454	5,881	5,477
Ranch perquisites	"	632	632	632
Hay inventory change	"	-581	-119	124
Gross ranch income	"	6,505	6,394	6,233
Total expenses	"	4,145	3,694	3,401
Net ranch income	Dollars	2,360	2,700	2,832

In view of the above discussion, the light rate of grazing may not be far from the optimum rate, when all the variable factors are considered. When sufficient marketing and grading data are available from the Miles City grazing trials to make an exhaustive appraisal of the total effects of varying the rates of grazing, this aspect of the study might provide opportunities for further research in this field.

Until more comprehensive empirical data can be obtained, the previously constructed budgets indicate that the moderate rate of grazing approaches an optimum rate of grazing use.

The Optimum Rate of Grazing in the Northern Great Plains

Many of the range management practices advocated today to improve the range and thereby increase carrying capacity involve large outlays of cash and time to the rancher. However, if the plains rancher is to counteract the wide fluctuations in range forage production as affected by uncontrollable weather conditions, he must implement range management practices that will put the range in such a condition that it is able to take advantage of favorable weather conditions and to withstand adverse weather conditions. To a large extent the above mentioned ends may be accomplished on the plains ranches by the proper stocking of the ranges to maintain or in some cases to restore their ability to produce optimum quantities of forage now and in the future.

It is conceivable that the operator of a deteriorated plains range may increase his income in the long run by cutting the size of his herd to conform to the use that would rebuild the range to its optimum carrying capacity. The short-run returns in this situation would depend largely on the degree of range depletion and the market prices for beef. But this point should be verified by further research.

In order to give the plains rancher a starting point or a comparison as to relative stocking rates for different sections of the Northern Great Plains, Table XIV is presented.

TABLE XIV. BEEF CATTLE STOCKING CAPACITIES FOR RANGE IN GOOD CONDITION AT SEVERAL LOCATIONS IN THE NORTHERN GREAT PLAINS.^{a/}

Location and Reference	Approximate long-time average precipitation, April-September, incl. ^{b/}	Season of Stocking
	<u>Inches</u>	<u>Months</u>
Miles City, Montana	9.5	Jan.-Dec.
Manyberries, Alberta (Clarke, et al, 1943)	7.8	Apr.-Oct.
Southwestern Saskatchewan and Southeastern Alberta (Clarke, et al, 1942):		
---drier phase, "short grass prairie"	8-9	Apr.-Oct.
---more moist phase, "mixed prairie"	10-11	Apr.-Oct.
Mandan, North Dakota (Sarvis, 1941)	12.3	Mid-May to Mid-Oct.
		Jan.-Dec.
Western South Dakota, exclusive of Black Hills (Albee, et al, 1943)	10-14	May-Nov., Dec.
Cottonwood, South Dakota (Johnson, et al, 1951)	11.8	May-Nov.
Ardmore, South Dakota (Black, et al, 1937)	12.5	Mid-May Sept., Oct.

^{a/} M. J. Reed and R. A. Peterson, Vegetation, Soil, and Cattle Responses to Grazing on the Northern Great Plains Range, Unpublished manuscript, p. 166.

^{b/} For United States locations, from U. S. Weather Bureau records; for Canadian locations, from Dominion experiment station progress reports and Canada Department Transport climatic summaries.

TABLE XIV. (Continued). BEEF CATTLE STOCKING CAPACITIES FOR RANGE IN GOOD CONDITION AT SEVERAL LOCATIONS IN THE NORTHERN GREAT PLAINS.

Location and Reference	Class of Stock	Approximate rate recommended on the average for satisfactory cattle performance and range productivity <u>acres/month</u>
Miles City, Montana	Cows with spring calves	Minimum of 2.6
Manyberries, Alberta (Clarke, et al, 1943)	Cows with spring calves	Slightly over 4.3
Southwestern Saskatchewan and Southeastern Alberta (Clarke, et al, 1942):		
---drier phase, "short grass prairie"	1000 lb. cow	Average 4.7
---more moist phase, "mixed prairie"	1000 lb. cow	Average 2.8
Mandan, North Dakota (Sarvis, 1941)	2 year old steers	1.4
	2 year old steers	Over 2.1 (estimated)
Western South Dakota, exclusive of Black Hills (Albee, et al, 1943)	1000 lb. animal unit	Mostly 2.3-2.6
Cottonwood, South Dakota (Johnson, et al, 1951)	Cows with spring calves	2.3
Ardmore, South Dakota (Black, et al, 1937)	2 year old steers	Over 1.5 ^{a/}

^{a/} 1.5 acres was apparently satisfactory for range maintenance but inadequate for satisfactory animal gains.

As to the use of the above table, Reed and Peterson say:^{1/}

"Because productivity of ranges may vary considerably within the same locality due to natural factors and past grazing, estimates of proper stocking from experimental ranges or other areas are primarily useful as a starting point or check on stocking. More critical evaluation of range management is provided by estimates of forage utilization and, especially, range condition and trend on the particular ranges as compared to acceptable standards, if they are available."

In view of the above statement, estimates of proper grazing probably should be treated as being tentative until they prove adequate for the particular ranges to which they are applied.

^{1/} Ibid., p. 165.

PART V

TECHNICAL AND ECONOMIC EFFICIENCY IN THE USE OF RANGE RESOURCES

Stock-grazing trials are conducted in order to find the optimum stocking rate of the land under investigation. This optimum stocking rate is known as the carrying capacity (grazing capacity) of the land.

Any quantitative statement of carrying capacity involves three variables: animals, area, and time. Therefore grazing capacity may be expressed in three ways: (1) the number of animals which a unit area of land will support for a given length of time; (2) the area which is required to support one animal for a unit period of time; (3) the number of time-units of grazing provided by a unit area of land for one animal.

The grazing trial experiments at the United States Range Livestock Experiment Station at Miles City, Montana used an experimental design incorporating the one variable, area, and the constants: animals and time, for each production period. However, for intertemporal periods, time (length of grazing season) also becomes a variable factor due to various climatic influences on animals and range vegetation.

A hypothetical model of the Miles City grazing trials is presented in Figure 5 as one variable analysis.

The points a, b, and c on the total physical product curve (TPP) represent the turnoff per breeding cow on experiment in pounds of calves at weaning time for the heavily, moderately and lightly grazed ranches, respectively. The letters represent 276, 337, and 351 pounds in ascending

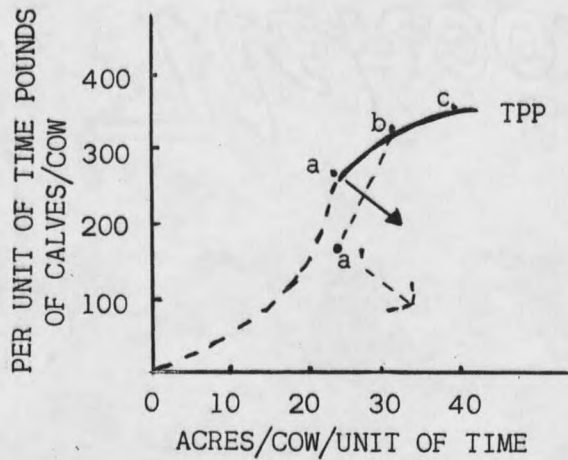


Figure 5. Pounds of Calves Produced Per Cow Under Three Intensities of Use.

order or rank. The position of the letter, "a" does not represent a true average calf weight for the heavy rate of grazing, because the amount of hay fed to the heavy intensity was common only to that alternative. Therefore, any time the amount of hay fed to the heavily grazed herd was in excess of the amount of hay fed the other two herds, the letter "a" in Figure 5 would tend to shift down and to the right as indicated by the solid arrow. The dotted portion of the TPP curve indicates that experimental data are not available for that area of the diagram.

The calf weights per cow might be "weighted" according to the market grade values received for each level of grazing for the year 1955. The corrected weights of points a, b, and c would then be 254, 337, and 351 pounds respectively. Point "a" now becomes a' in Figure 5.

Five of the 18 years of the study period had instances in which the stock were fed supplemental hay or put on supplemental pastures in order

to complete the summer grazing period. These instances introduce a resource that is "common" to the alternatives for those said years, but it is not "common" to the "normal" years. Therefore, caution must be exercised in comparing "extra-feed" years with "normal" years, because the production function will have an extra factor (resource).

If the assumption that constant returns to scale (for the fixed ratios of cattle numbers to land area) holds true for reasonable ranges of resource inputs, the fixed proportion lines: 38.3 acres per cow, 30.5 acres per cow, and 23.5 acres per cow may be drawn as in Figure 6. In other words, if 23.5 acres will support one cow for a year, then 47 acres will support two cows for a year. The same logic is used to construct the other two fixed proportion lines.

Assume that a cow will produce a calf weighing 254 pounds if grazed at the rate of 23.5 acres per year, 337 pounds if grazed at the rate of 30.5 acres per year, and 351 pounds if grazed at the rate of 38.8 acres per year. Then to produce 10,000 pounds of calves at weaning age the following combinations of resources are needed: 28.5 cows and 1,105 acres grazed at the ratio of 1:38.8; 29.7 cows and 905 acres grazed at the rate of 1:30.5; and 36.2 cows and 851 acres grazed at the rate of 1:23.5. The same method may be used in determining any desired iso-product curve in Figure 6.

Now that the various levels of products are charted for different combinations of inputs, a choice indicator must be selected to determine the optimum point at which to produce on any given iso-product curve. The choice indicator must define some condition of a maximum (such as

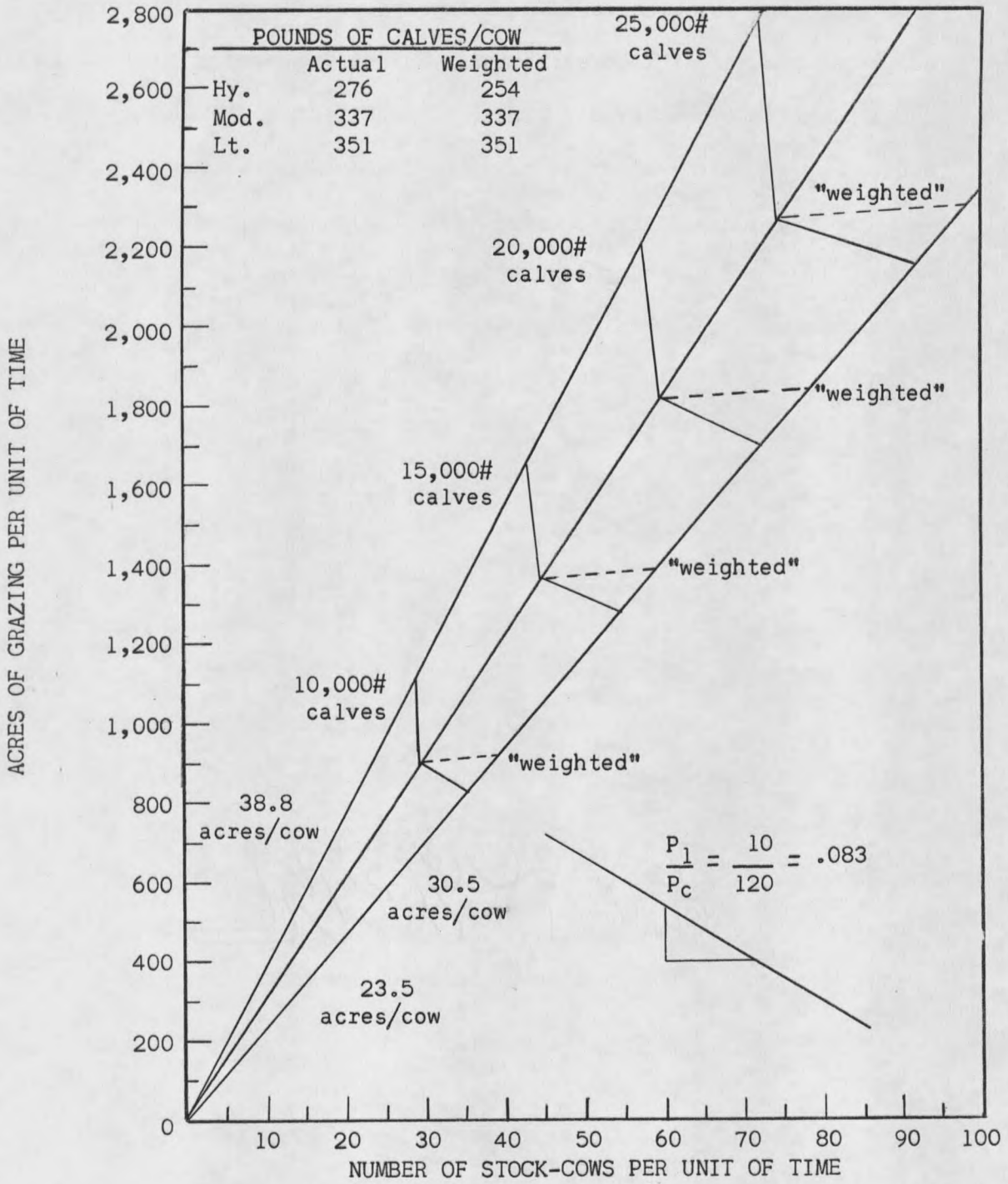


Figure 6. Pounds of Calves Produced at Various Combinations of Stock-cows and Range Acres (Iso-product Curves) Equated With the Price Line of Cattle and Land.

maximum ranch profits). In this paper the choice indicator used will be the price ratio of cattle and land. The optimum point of production will be where the marginal rate of substitution of cattle for land ($MRS_{c,1}$) will equal the inverse price ratio $\frac{P_c}{P_l}$ of the two resources.

$$MRS_{c,1} = \frac{P_c}{P_l}$$

The price ratio line in Figure 6 shows a geometric solution when cattle are valued at \$120 per head, land is worth \$10 per acre, and other costs are assumed to be equal between grazing intensities. According to the data in Figure 6 land would have to be almost free and cows relatively expensive before a rancher should produce calves on the fixed proportion line of 38.8 acres/cow-year. On the other hand, before a rancher could afford to graze cattle at the rate of one cow:23.5 acres (using weighted data) cattle would have to have a value less than the cost of a (cow-carrying) unit of range land.

For the solution presented above to be equivalent to the results presented in the budgets (the maximizing of net returns) the marginal cost of beef produced from using resources specific to the grazing alternatives must be zero or essentially the same for each alternative.

The data from the Miles City grazing trials lends itself fairly well to the analysis presented above (except for certain discrepancies concerning marginal cost of resources specific to different alternatives). On the other hand if the argument is presented that constant returns to scale do not exist for the ratios of cattle numbers to land area, then a new experimental design must be constructed.

If decreasing returns to scale (with cattle and land inputs increased in constant proportions) is hypothesized, the experimental design must include treatments which have (1) different ratios of cattle to land, and (2) different levels of the given ratios. The points on the fixed proportion lines in Figure 7 might depict the relevant ratios.

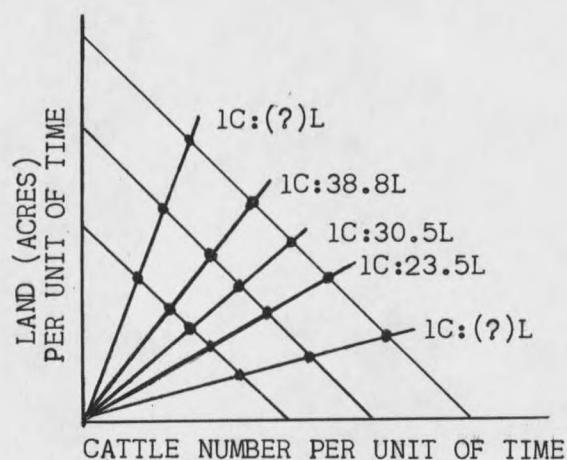


Figure 7. Cattle to Land Ratios -- Pattern of Treatments.

The possible points in this case are determined by drawing a series of parallel 45 degree lines from the land axis downward and to the right to the cattle number axis. The points where these 45 degree lines intersect the fixed proportion lines might then serve to denote treatments.^{1/} The marginal rate of substitution of cattle numbers to land area may then be equated to the inverse price ratios of cattle and land to determine an optimum rate of stocking.

^{1/} Earl O. Heady, "Economics of Range Resources," Journal of Farm Economics, Vol. XXXVIII, No. 5, December 1956, p. 1615.

The experimental models described above should contribute to the optimum use of the range resources: animal numbers and area, but the third variable, time, remains ever present in intertemporal resource use relationships. Time (length of grazing season) is a function of the interactions of many variables, such as: specific vegetative species, soil types, topography, season of use, plant vigor, weather, insects, etc. In order to measure the effect of different levels of grazing use over time these inputs should be common to all treatments in the experiment. The production function may be expressed conceptually in the algebraic form:

t = time (length of grazing season)

k = an arbitrary constant

X_n = the n^{th} common factor

$t_1 = f(23.5 \text{ acres/1 cow, } k\% \text{ forage utilization, } \dots X_n)$

$t_2 = f(30.5 \text{ acres/1 cow, } k\% \text{ forage utilization, } \dots X_n)$

$t_3 = f(38.8 \text{ acres/1 cow, } k\% \text{ forage utilization, } \dots X_n)$

Different levels for each treatment may be attained by changing the percentage of forage utilization for each group of treatments. The marginal rates of substitution (MRS) for the resource combination, length of growing season relative to number of surface acres, may then be determined. The $MRS_{t,A}$ can be used to estimate the two-variable production function for beef which is given below.

Beef = $f(\text{time, acres})$

From here, transformation curves for the beef product of two time periods may be drawn as in Figure 8.

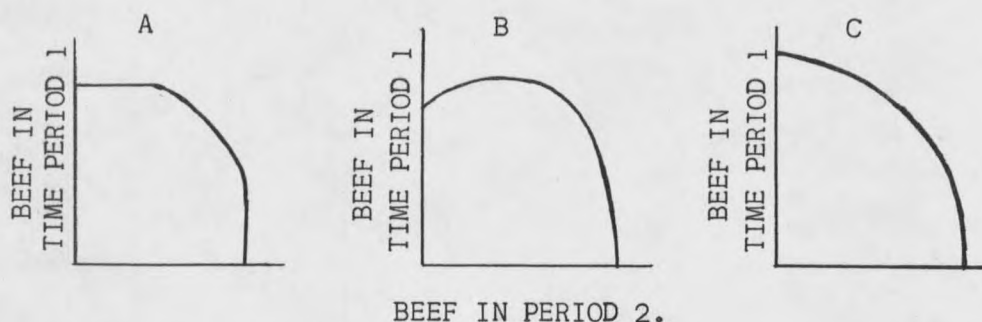


Figure 8. Alternative Production Possibilities.^{a/}

^{a/}Source: Earl O. Heady, *ibid.*, p. 1610.

The hypothetical product transformation curves of Figure 8 illustrate three relationships over time: supplementary, complementary, and competitive. Supplementary relationships are evidenced in Figure 8-A by the horizontal and vertical portions of the opportunity curve. Here, beef can be produced in one time period without diminishing or enhancing the amount produced in another period. In C, the two alternatives are competitive for every point on the opportunity curve, therefore the production of beef of one time causes a sacrifice in the amount of beef in another time period.

Figure 8-B's positive sloping (complementary) portion of the opportunity (transformation) curve indicates that beef produced in that period increases beef produced in another period. In C, the two alternatives are competitive for every point on the opportunity curve, therefore the production of beef of one time causes a sacrifice in the amount of beef in another time period.

The points on opportunity curves which delineate product relationships should be sought for in setting up physical experiments. The areas set by these points denote certain ranges of technological efficiency. The irrational area of resource use under the complementary range of the opportunity curve is the portion with the positive slope. Within the supplementary range, optimum resource combination cannot be attained, because larger output may be obtained by moving off the supplementary range of the opportunity curve. Economic criteria must be used to determine the optimum point at which to produce within the competitive range of the opportunity curve. In other words, maximum profits are attained (with resources fixed in quantity) when the marginal rate of product substitution is inversely equal to the product price ratio.

$$\frac{B_1}{B_2} = \frac{P_{B2}}{P_{B1}}$$

Range experiments should be designed to determine the rate at which ranges can be stocked for in any one given time period without diminishing the amount produced in any given future time period. Then product substitution effects may be evaluated and weather fluctuations averaged out if the experiment is of sufficient duration.

This paper is not written to press the use of economic criteria into physical and biological research, especially where that research may be fundamental or basic; but where the research is directed towards a practical or applied end, use of economic criteria is essential because decisions concerning resource use are determined by equating the physical

relationships with economic choice indicators. A reasonable marriage of the physical relationships and economic choice indicators can (usually) only be made if there has been close cooperation between the range technician and the economist in the formulative stages of the proposed research project. It is hoped that this section of the thesis will serve to point up the need for technical efficiency in range research and the usefulness of economic criteria for decision-making in resource combination.

APPENDIX

APPENDIX A₁. PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE TYPICAL BEEF HERD WITH ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES CONSTANT

Year	Typical Beef Herd								No. Calves Sold	Weight Per Calf	Total Weight Pounds Calves Sold	Price (cwt.) Calves Constant
	Areas Grazed	Beef Cow	No. 2 yr.		No. Yrlg. Heif.	% Calf Crop	No. Calves	No. Calves				
			Old Heif.	No. Steer								
1932	3,558	79.4	17.2	---	2.7	20.4	72.0	57.2	36.4	383	13,941	\$13.86
33	00	00	00	---	00	00	72.0	57.2	36.4	380	13,832	00
34	00	00	00	---	00	00	69.3	55.0	34.2	338	11,560	00
35	00	00	00	---	00	00	61.7	49.0	28.2	364	10,265	00
36	00	00	00	---	00	00	68.0	54.0	33.2	318	10,558	00
37	00	00	00	---	00	00	63.3	50.3	29.5	359	10,591	00
38	00	00	00	---	00	00	76.1	60.4	39.6	371	14,692	00
39	00	00	00	---	00	00	77.1	61.2	40.4	381	15,392	00
40	00	00	00	---	00	00	76.4	60.7	39.9	387	15,441	00
41	00	00	00	---	00	00	78.9	62.6	41.8	388	16,218	00
42	00	00	00	---	00	00	80.9	64.2	43.4	386	16,752	00
43	00	00	00	---	00	00	80.3	63.8	43.9	385	16,555	00
44	00	00	00	---	00	00	78.1	62.0	41.2	388	15,986	00
45	00	00	00	---	00	00	79.6	63.2	42.4	378	16,027	00
46	00	00	00	---	00	00	73.8	58.6	37.8	395	14,931	00
47	00	00	00	---	00	00	78.9	62.6	41.8	400	16,720	00
48	00	00	00	---	00	00	78.9	62.6	41.8	403	16,845	00
49	00	00	00	---	00	00	76.9	61.0	40.2	394	15,839	00
50	00	00	00	---	00	00	79.6	63.2	42.4	390	16,536	00
51	00	00	00	---	00	00	82.0	65.1	44.3	412	18,252	00
52	00	00	00	---	00	00	80.9	64.2	43.4	380	16,492	00
53	00	00	00	---	00	00	78.3	62.2	41.4	410	16,974	00
54	00	00	00	---	00	00	79.0	62.7	41.9	390	16,341	00
55	00	00	00	---	00	00	81.0	64.3	43.5	380	16,530	00
Total	---	---	---	---	---	---	1,823.0	1,447.3	949.0	9,160	363,270	13.86
Avg.	3,558	79.4	17.2	---	2.7	20.4	75.9	60.3	39.5	381.7	15,136	---

APPENDIX A₁ (Continued). PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE TYPICAL BEEF HERD
ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES
CONSTANT

Year	Value of Calves	Weight Per Cow (lbs.)	No. ^{a/} Cows Sold	Pounds Cows Sold	Price of Cows Constant	Value of Cows	Weight Per Bull	No. Bulls Sold	Pound Bull Sold	Price Bulls Constant	Value Bulls Sold	Total Value Beef Sold
1932	\$1,932	1,059	16.1	17,018	\$13.33	\$2,268	1,460	0.8	1,168	\$13.33	\$156	\$4,356
33	1,917	1,051	"	16,921	"	2,256	1,451	"	1,161	"	155	4,328
34	1,602	933	"	15,021	"	2,002	1,337	"	1,070	"	143	3,747
35	1,423	1,006	"	16,197	"	2,159	1,389	"	1,111	"	148	3,030
36	1,463	924	"	14,876	"	1,983	1,273	"	1,018	"	136	3,582
37	1,468	991	"	15,955	"	2,127	1,367	"	1,094	"	146	3,741
38	2,036	1,026	"	16,519	"	2,202	1,417	"	1,134	"	151	4,889
39	2,133	1,053	"	16,953	"	2,260	1,454	"	1,163	"	155	4,548
40	2,140	1,070	"	17,227	"	2,296	1,478	"	1,182	"	158	4,594
41	2,249	1,073	"	17,275	"	2,303	1,482	"	1,185	"	158	4,710
42	2,322	1,073	"	17,275	"	2,303	1,472	"	1,178	"	157	4,782
43	2,295	1,065	"	16,147	"	2,286	1,470	"	1,176	"	157	4,738
44	2,216	1,073	"	17,275	"	2,303	1,482	"	1,186	"	158	4,677
45	2,221	1,055	"	16,986	"	2,264	1,449	"	1,159	"	154	4,639
46	2,069	1,093	"	16,597	"	2,346	1,509	"	1,207	"	161	4,576
47	2,317	1,106	"	17,807	"	2,374	1,527	"	1,222	"	163	4,854
48	2,335	1,114	"	17,935	"	2,391	1,538	"	1,230	"	164	4,890
49	2,195	1,046	"	16,841	"	2,245	1,500	"	1,200	"	160	4,600
50	2,291	1,086	"	17,485	"	2,331	1,530	"	1,224	"	163	4,785
51	2,530	1,053	"	16,953	"	2,260	1,530	"	1,224	"	163	4,963
52	2,286	1,050	"	16,905	"	2,253	1,520	"	1,216	"	162	4,701
53	2,353	1,050	"	16,905	"	2,253	1,530	"	1,224	"	163	4,769
54	2,265	1,040	"	16,744	"	2,232	1,530	"	1,225	"	163	4,660
55	2,291	1,020	"	16,422	"	2,189	1,510	"	1,208	"	161	4,641
Total	50,349	25,110	---	402,239	---	53,886	35,205	---	28,165	---	3,755	107,990
Avg.	2,098	1,046	16.1	16,759	13.33	2,245	1,467	0.8	1,174	13.33	156	4,500

^{a/} Includes age classes two years old and over.

APPENDIX A₂. SUMMARY RANCH EXPENSES FOR TYPICAL RANCH--PRICES CONSTANT--FEED (QUANTITY)
VARIABLE

Year	Livestock Expense Dollars	Power & Mach. Expense Dollars	Misc. Expense Dollars	Bldg.&Repair Expense Dollars	Taxes Dollars	Wages Expense Dollars	Feeda/ Expense Dollars	Total Expense Dollars
1932	\$195 ^{b/}	\$1,346	\$514	\$226	\$454	\$280	\$805	\$3,820
33	00	00	00	00	00	00	826	3,841
34	00	00	00	00	00	00	809	3,824
35	00	00	00	00	00	00	820	3,835
36	00	00	00	00	00	00	852	3,867
37	00	00	00	00	00	00	819	3,834
38	00	00	00	00	00	00	844	3,859
39	00	00	00	00	00	00	820	3,835
40	00	00	00	00	00	00	844	3,859
41	00	00	00	00	00	00	850	3,865
42	00	00	00	00	00	00	844	3,859
43	00	00	00	00	00	00	839	3,854
44	00	00	00	00	00	00	839	3,854
45	00	00	00	00	00	00	866	3,881
46	00	00	00	00	00	00	866	3,881
47	00	00	00	00	00	00	866	3,881
48	00	00	00	00	00	00	866	3,881
49	00	00	00	00	00	00	915	3,930
50	00	00	00	00	00	00	951	3,966
51	00	00	00	00	00	00	939	3,954
52	00	00	00	00	00	00	934	3,949
53	00	00	00	00	00	00	941	3,956
54	00	00	00	00	00	00	920	3,935
55	00	00	00	00	00	00	990	4,005
Total	---	---	---	---	---	---	20,865	93,225
Avg.	195	1,346	514	226	454	280	869	3,884

a/ Feed varied by yearly requirements.

b/ Includes animal purchases.

APPENDIX A₃. INCOME BY YEARS (1932-55) FOR TYPICAL RANCH--PRICES CONSTANT

Year	Other Ranch		Beef Sale Dollars	Govt. Payt. Dollars	Total ^{a/}		Hay Inv. Change Dollars	Gross ^{b/}		N. R. I. Dollars
	Grain Sales Dollars	Prod. Sales Dollars			Cash Inc. Dollars	Ranch Perq. Dollars		Ranch Income Dollars	Total Expenses Dollars	
1932	\$455	\$544	\$4,356	\$145	\$5,500	\$632	\$ -13	\$6,119	\$3,820	\$2,299
33	"	"	4,328	"	5,472	"	245	6,349	3,841	2,508
34	"	"	3,747	"	4,891	"	189	5,712	3,824	1,888
35	"	"	3,730	"	4,874	"	-244	5,262	3,835	1,427
36	"	"	3,582	"	4,726	"	74	5,432	3,867	1,565
37	"	"	3,741	"	4,885	"	-367	5,150	3,834	1,316
38	"	"	4,389	"	5,533	"	-10	6,155	3,859	2,296
39	"	"	4,548	"	5,692	"	123	6,447	3,835	2,612
40	"	"	4,594	"	5,738	"	3	6,373	3,859	2,514
41	"	"	4,710	"	5,854	"	87	6,573	3,865	2,708
42	"	"	4,782	"	5,926	"	149	6,707	3,859	2,848
43	"	"	4,738	"	5,882	"	175	6,689	3,854	2,835
44	"	"	4,677	"	5,821	"	116	6,569	3,854	2,715
45	"	"	4,639	"	5,783	"	71	6,486	3,881	2,605
46	"	"	4,576	"	5,720	"	71	6,423	3,881	2,542
47	"	"	4,854	"	5,998	"	66	6,696	3,881	2,815
48	"	"	4,890	"	6,034	"	63	6,729	3,881	2,848
49	"	"	4,600	"	5,744	"	24	6,400	3,930	2,470
50	"	"	4,785	"	5,929	"	-27	6,534	3,966	2,568
51	"	"	4,953	"	6,097	"	23	6,752	3,954	2,798
52	"	"	4,701	"	5,845	"	35	6,512	3,949	2,563
53	"	"	4,769	"	5,913	"	-39	6,506	3,956	2,550
54	"	"	4,660	"	5,804	"	3	6,439	3,935	2,504
55	"	"	4,641	"	5,785	"	-319	6,098	4,005	2,093
Total	---	---	107,800	---	135,446	---	498	151,112	93,225	57,886
Avg.	455	544	4,500	145	5,644	632	21	6,297	3,884	2,413

a/ Sum of columns 2, 3, 4, and 5.
b/ Sum of columns 6, 7, and 8.
c/ Difference of columns 9 and 10.

APPENDIX B₁. PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE HEAVILY GRAZED BEEF HERD
ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES CONSTANT

Heavily Grazed Beef Herd												
Year	Acres Grazed	No. Beef Cow	No. 2 yr. Old Heif.	No. Steer	No. Bull	No. Yrlg. Heif.	% Calf Crop	No. Calves	No. Calves Sold	Weight Per Calf	Pounds Calves	Price (cwt.) Calves Constant
1932												
33	3,558	107	23.2	---	3.6	27.5	90	96.3	68.4	293	20,041	\$13.86
34	"	"	"	---	"	"	60	64.2	36.3	219	7,950	"
35	"	"	"	---	"	"	60	64.2	36.3	314	11,398	"
36	"	"	"	---	"	"	80	85.6	57.7	173	9,982	"
37	---	---	---	---	---	---	---	---	---	---	---	---
38	3,558	107	23.2	---	3.6	27.5	75	80.3	52.4	354	18,550	13.86
39	"	"	"	---	"	"	90	96.3	68.4	404	27,634	"
40	"	"	"	---	"	"	70	74.9	47.0	365	17,155	"
41	"	"	"	---	"	"	95	101.7	73.8	407	30,037	"
42	"	"	"	---	"	"	95	101.7	73.8	423	31,217	"
43	"	"	"	---	"	"	75	80.3	52.4	425	22,270	"
44	"	"	"	---	"	"	70	74.9	47.0	452	21,244	"
45	"	"	"	---	"	"	85	90.9	63.0	374	23,562	"
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	3,558	107	23.2	---	3.6	27.5	80	85.6	57.7	339	19,560	13.86
51	"	"	"	---	"	"	60	64.2	36.3	361	13,104	"
52	"	"	"	---	"	"	80	85.6	57.7	392	22,618	"
53	"	"	"	---	"	"	60	64.2	36.3	401	14,556	"
54	"	"	"	---	"	"	75	80.3	52.4	386	20,226	"
55	"	"	"	---	"	"	75	80.3	52.4	380	19,912	"
Total	---	---	---	---	---	---	---	1,471.5	969.3	6,462	351,016	---
Avg.	3,558	107	23.2	---	3.6	27.5	76.3	81.7	53.8	359	19,501	13.86

APPENDIX B₁ (Continued). PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE HEAVILY GRAZED BEEF HERD WITH ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES CONSTANT

Year	Value of Calves	Weight Per Cow (lbs.)	No. ^{a/} Cows Sold	Pounds Cows Sold	Price of Cows Constant	Value of Cows	Weight Per Bull	No. Bulls Sold	Pound Bull Sold	Price Bulls Constant	Value Bulls Sold	Total Value Beef Sold
1932												
33	\$2,778	970	21.0	20,370	\$13.33	\$2,715	1,309	1.25	1,636	\$13.33	\$218	\$5,711
34	1,102	884	"	18,564	"	2,474	1,203	"	1,504	"	200	3,776
35	1,580	972	"	20,412	"	2,721	1,250	"	1,563	"	208	4,509
36	1,384	923	"	19,383	"	2,584	1,146	"	1,433	"	191	4,159
37	---	---	---	---	---	---	---	---	---	---	---	---
38	2,571	947	21.0	19,887	13.33	2,651	1,275	1.25	1,594	13.33	212	5,434
39	3,830	1,013	"	21,273	"	2,836	1,309	"	1,636	"	218	6,884
40	2,378	1,062	"	22,302	"	2,973	1,330	"	1,663	"	222	5,573
41	4,163	1,041	"	21,861	"	2,914	1,334	"	1,668	"	222	7,299
42	4,327	1,086	"	22,806	"	3,040	1,325	"	1,656	"	221	7,588
43	3,087	1,116	"	23,436	"	3,124	1,323	"	1,654	"	220	6,431
44	2,944	1,103	"	23,163	"	3,088	1,334	"	1,668	"	222	6,254
45	3,266	1,012	"	21,252	"	2,833	1,304	"	1,630	"	217	6,316
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	2,711	920	21.0	19,320	13.33	2,575	1,377	1.25	1,721	13.33	229	5,515
51	1,816	908	"	19,068	"	2,542	1,377	"	1,721	"	229	4,587
52	3,135	1,054	"	22,134	"	2,950	1,368	"	1,710	"	228	6,313
53	2,017	1,122	"	23,562	"	3,141	1,377	"	1,721	"	229	5,387
54	2,803	897	"	18,837	"	2,511	1,377	"	1,721	"	229	5,543
55	2,760	1,065	"	22,365	"	2,981	1,359	"	1,699	"	226	5,967
Total	48,652	18,095	---	379,995	---	50,653	23,677	---	29,598	---	3,941	103,246
Avg.	2,703	1,005	21.0	21,111	13.33	2,814	1,315	1.25	1,644	13.33	219	5,736

a/ Includes age classes two years old and over.

APPENDIX B₂. SUMMARY OF EXPENSES FOR A HEAVILY GRAZED CATTLE RANCH--CONSTANT PRICES

Year	Livestock Expense Dollars	Power & Mach. Expense Dollars	Misc. Expense Dollars	Bldg. & Repair Expense Dollars	Taxes Dollars	Wage Expense Dollars	Feeda/ Expense Dollars	Total Expense Dollars
1932								
33	\$281	\$1,346	\$590	\$226	\$497	\$518	\$687	\$4,145
34	"	"	"	"	"	"	"	4,145
35	"	"	"	"	"	"	"	4,145
36	"	"	"	"	"	"	"	4,145
37	---	---	---	---	---	---	---	---
38	281	1,346	590	226	497	518	1,222	4,680
39	"	"	"	"	"	"	687	4,145
40	"	"	"	"	"	"	"	4,145
41	"	"	"	"	"	"	"	4,145
42	"	"	"	"	"	"	"	4,145
43	"	"	"	"	"	"	"	4,145
44	"	"	"	"	"	"	1,024	4,482
45	"	"	"	"	"	"	687	4,145
46	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---
50	281	1,346	590	226	497	518	687	4,145
51	"	"	"	"	"	"	"	4,145
52	"	"	"	"	"	"	"	4,145
53	"	"	"	"	"	"	"	4,145
54	"	"	"	"	"	"	"	4,145
55	"	"	"	"	"	"	"	4,145
Total	---	---	---	---	---	---	13,238	75,482
Avg.	281	1,346	590	226	497	518	735	4,193

a/ Exclusive of hay bought.

APPENDIX B₃. SUMMARY OF INCOME FOR A HEAVILY GRAZED CATTLE RANCH--CONSTANT PRICES

Year	Other Ranch		Beef Sale	Govt. Payt.	Total ^{a/}		Hay Inv. Change	Gross ^{b/}		N. R. I. ^{c/}
	Grain Sales Dollars	Prod. Sales Dollars			Cash Inc. Dollars	Ranch Perq. Dollars		Ranch Income Dollars	Total Expenses Dollars	
1932										
33	\$455	\$544	\$5,711	\$145	\$6,855	\$632	\$597	\$8,084	\$4,145	\$3,939
34	"	"	3,776	"	4,920	"	-427	5,125	4,145	980
35	"	"	4,509	"	5,653	"	-3,611	2,674	4,145	-1,471
36	"	"	4,159	"	5,303	"	-1,434	4,501	4,145	356
37	---	---	---	---	---	---	---	---	---	---
38	455	544	5,434	145	6,578	632	-549	6,661	4,680	1,981
39	"	"	6,884	"	8,028	"	-961	7,699	4,145	3,554
40	"	"	5,573	"	6,717	"	161	7,510	4,145	3,365
41	"	"	7,299	"	8,443	"	-197	8,878	4,145	4,733
42	"	"	7,588	"	8,732	"	-870	8,494	4,145	4,349
43	"	"	6,431	"	7,575	"	-13	8,194	4,145	4,049
44	"	"	6,254	"	7,398	"	147	8,177	4,482	3,695
45	"	"	6,316	"	7,460	"	532	8,624	4,145	4,479
46	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---
50	455	544	5,515	145	6,659	632	-1,395	5,894	4,145	1,749
51	"	"	4,587	"	5,731	"	62	6,425	4,145	2,280
52	"	"	6,313	"	7,457	"	-1,904	6,185	4,145	2,040
53	"	"	5,387	"	6,531	"	-581	6,582	4,145	2,437
54	"	"	5,543	"	6,687	"	-715	6,604	4,145	2,459
55	"	"	5,967	"	7,111	"	-581	7,162	4,145	3,017
Total	---	---	103,246	---	123,838	---	-11,731	123,473	75,482	47,991
Avg.	455	544	5,736	145	6,880	632	-652	6,859	4,193	2,666

^{a/} Sum of columns 2, 3, 4, and 5.

^{b/} Sum of columns 6, 7, and 8.

^{c/} Difference of columns 9 and 10.

APPENDIX C₁. PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM A MODERATELY GRAZED BEEF HERD
ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES CONSTANT

Moderately Grazed Beef Herd													
Year	Acres Grazed	No.		No. Steer	No. Bull	No. Yrlg. Heif.	% Calf Crop	No. Calves	No. Calves Sold	Weight Per Calf	Pounds Calves	Price	
		No. Beef Cow	2 yr. Old Heif.									(cwt.) Calves Constant	
1932													
33	3,558	78.1	16.9	---	2.7	20.1	95.0	74.2	53.7	319	17,130	\$13.86	
34	"	"	"	---	"	"	90.0	70.3	49.8	281	13,994	"	
35	"	"	"	---	"	"	75.0	58.6	38.1	372	14,173	"	
36	"	"	"	---	"	"	80.0	62.5	42.0	204	8,568	"	
37	---	---	---	---	---	---	---	---	---	---	---	---	
38	3,558	78.1	16.9	---	2.7	20.1	80.0	62.5	42.0	359	15,078	13.86	
39	"	"	"	---	"	"	90.0	70.3	49.8	449	22,360	"	
40	"	"	"	---	"	"	85.0	66.4	45.9	428	19,645	"	
41	"	"	"	---	"	"	80.0	62.5	42.0	454	19,068	"	
42	"	"	"	---	"	"	85.0	66.4	45.9	414	19,003	"	
43	"	"	"	---	"	"	90.0	70.3	49.8	433	21,563	"	
44	"	"	"	---	"	"	85.0	66.4	45.9	449	20,609	"	
45	"	"	"	---	"	"	80.0	62.5	42.0	400	16,800	"	
46	---	---	---	---	---	---	---	---	---	---	---	---	
47	---	---	---	---	---	---	---	---	---	---	---	---	
48	---	---	---	---	---	---	---	---	---	---	---	---	
49	---	---	---	---	---	---	---	---	---	---	---	---	
50	3,558	78.1	16.9	---	2.7	20.1	90.0	70.3	49.8	376	18,725	13.86	
51	"	"	"	---	"	"	75.0	58.6	38.1	417	15,888	"	
52	"	"	"	---	"	"	95.0	74.2	53.7	437	23,467	"	
53	"	"	"	---	"	"	95.0	74.2	53.7	458	24,595	"	
54	"	"	"	---	"	"	85.0	66.4	45.9	457	20,976	"	
55	"	"	"	---	"	"	75.0	58.6	38.1	423	16,116	"	
Total	---	---	---	---	---	---	---	1,165.2	826.2	7,130	327,758	---	
Avg.	3,558	78.1	16.9	---	2.7	20.1	85.0	64.7	45.9	396	18,209	13.86	

APPENDIX C₁ (Continued). PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM A MODERATELY GRAZED BEEF HERD ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--CONSTANT PRICES

Year	Value of Calves	Weight Per Cow (lbs.)	No. ^{a/} Cows Sold	Pounds Cows Sold	Price of Cows Constant	Value of Cows	Weight Per Bull	No. Bulls Sold	Pound Bull Sold	Price Bulls Constant	Value Bulls Sold	Total Value Beef Sold
1932												
33	\$2,374	1,012	15.8	15,990	\$13.33	\$2,131	1,451	0.9	1,306	\$13.33	\$174	\$4,679
34	1,940	900	"	14,220	"	1,896	1,337	"	1,203	"	160	3,996
35	1,964	1,022	"	16,148	"	2,153	1,389	"	1,250	"	167	4,284
36	1,188	946	"	14,947	"	1,992	1,273	"	1,146	"	153	3,333
37	---	---	---	---	---	---	---	---	---	---	---	---
38	2,090	1,019	15.8	16,100	13.33	2,146	1,417	0.9	1,275	13.33	170	4,406
39	3,099	1,088	"	17,190	"	2,291	1,454	"	1,309	"	174	5,564
40	2,723	1,116	"	17,633	"	2,350	1,478	"	1,330	"	177	5,250
41	2,643	1,178	"	18,612	"	2,481	1,482	"	1,334	"	178	5,302
42	2,634	1,140	"	18,012	"	2,401	1,472	"	1,325	"	177	5,212
43	2,989	1,195	"	18,881	"	2,517	1,470	"	1,323	"	176	5,682
44	2,856	1,164	"	18,391	"	2,452	1,482	"	1,334	"	178	5,486
45	2,328	1,129	"	17,838	"	2,378	1,449	"	1,340	"	174	4,880
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	2,595	1,022	15.8	16,148	13.33	2,153	1,530	0.9	1,377	13.33	184	4,932
51	2,202	1,031	"	16,290	"	2,171	1,530	"	1,377	"	184	4,557
52	3,253	1,117	"	17,649	"	2,353	1,520	"	1,368	"	182	5,788
53	3,409	1,139	"	17,996	"	2,399	1,530	"	1,377	"	184	5,992
54	2,907	1,067	"	16,859	"	2,247	1,530	"	1,377	"	184	5,338
55	2,234	1,148	"	18,154	"	2,420	1,510	"	1,359	"	181	4,835
Total	45,428	19,433	---	307,058	---	40,931	26,304	---	23,674	---	3,157	89,516
Avg.	2,524	1,080	15.8	17,059	13.33	2,274	1,461	0.9	1,315	13.33	175	4,973

^{a/} Includes age classes two years old and over.

APPENDIX C₂. SUMMARY RANCH EXPENSES FOR A MODERATELY GRAZED CATTLE RANCH--CONSTANT PRICES

Year	Livestock Expense Dollars	Power & Mach. Expense Dollars	Misc. Expense Dollars	Bldg. \$ Repair Expense Dollars	Taxes Dollars	Wage Expense Dollars	Feeda/ Expense Dollars	Total Expense Dollars
1932								
33	\$211	\$1,346	\$512	\$226	\$452	\$272	\$675	\$3,694
34	00	00	00	00	00	00	00	00
35	00	00	00	00	00	00	00	00
36	00	00	00	00	00	00	00	00
37	---	---	---	---	---	---	---	---
38	211	1,346	512	226	452	272	1,066	4,085
39	00	00	00	00	00	00	675	3,694
40	00	00	00	00	00	00	00	00
41	00	00	00	00	00	00	00	00
42	00	00	00	00	00	00	00	00
43	00	00	00	00	00	00	00	00
44	00	00	00	00	00	00	00	00
45	00	00	00	00	00	00	00	00
46	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---
50	211	1,346	512	226	452	272	675	3,694
51	00	00	00	00	00	00	00	00
52	00	00	00	00	00	00	00	00
53	00	00	00	00	00	00	00	00
54	00	00	00	00	00	00	00	00
55	00	00	00	00	00	00	00	00
Total	---	---	---	---	---	---	12,541	66,883
Avg.	211	1,346	512	226	452	272	697	3,716

a/ Exclusive of hay bought.

APPENDIX C₃. SUMMARY OF INCOME FOR A MODERATELY GRAZED RANCH--CONSTANT PRICES

Year	Other Ranch		Beef Sale	Govt. Payt.	Total ^{a/}		Hay Inv. Change	Gross ^{b/}		N. R. I. c/
	Grain Sales Dollars	Prod. Sales Dollars			Cash Inc. Dollars	Ranch Perq. Dollars		Ranch Income Dollars	Total Expenses Dollars	
1932										
33	\$455	\$544	\$4,479	\$145	\$5,323	\$632	\$720	\$7,175	\$3,694	\$3,481
34	"	"	3,996	"	5,140	"	308	6,080	3,694	2,386
35	"	"	4,284	"	5,428	"	-1,783	4,278	3,694	584
36	"	"	3,333	"	4,477	"	90	5,199	3,694	1,505
37	---	---	---	---	---	---	---	---	---	---
38	455	544	4,406	145	5,550	632	104	6,286	4,085	2,201
39	"	"	5,564	"	6,708	"	-25	7,315	3,694	3,621
40	"	"	5,250	"	6,394	"	799	7,825	3,694	4,131
41	"	"	5,302	"	6,446	"	956	8,034	3,694	4,340
42	"	"	5,212	"	6,356	"	1,023	8,011	3,694	4,317
43	"	"	5,682	"	6,826	"	1,012	8,470	3,694	4,776
44	"	"	5,486	"	6,630	"	735	7,997	3,694	4,303
45	"	"	4,880	"	6,024	"	1,022	7,678	3,694	3,984
46	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---
50	455	544	4,932	145	6,076	632	-412	6,296	3,694	2,602
51	"	"	4,557	"	5,701	"	528	6,861	3,694	3,167
52	"	"	5,788	"	6,932	"	-276	7,288	3,694	3,594
53	"	"	5,992	"	7,136	"	-17	7,751	3,694	4,057
54	"	"	5,338	"	6,482	"	212	7,326	3,694	3,632
55	"	"	4,835	"	5,979	"	-119	6,492	3,694	2,798
Total	---	---	29,516	---	110,108	---	4,877	126,362	66,883	59,479
Avg.	455	544	4,973	145	6,117	632	271	7,020	3,716	3,304

- ^{a/} Sum of columns 2, 3, 4, and 5.
^{b/} Sum of columns 6, 7, and 8.
^{c/} Difference of columns 9 and 10.

APPENDIX D₁. PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE LIGHTLY GRAZED BEEF HERD
ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES CONSTANT

Lightly Grazed Beef Herd												
Year	Acres Grazed	No.		No. Steer	No. Bull	No. Yrlg. Heif.	% Calf Crop	No. Calves	No. Calves Sold	Weight Per Calf	Pounds Calves	Price (cwt.) Calves Constant
		No. Beef Cow	2 yr. Old Heif.									
1932												
33	3,558	58.9	12.8	---	2.0	15.1	85.0	50.1	34.6	324	11,210	\$13.86
34	"	"	"	---	"	"	70.0	41.2	25.7	291	7,479	"
35	"	"	"	---	"	"	75.0	44.2	28.7	362	10,389	"
36	"	"	"	---	"	"	80.0	47.1	31.6	213	66,731	"
37	---	---	---	---	---	---	---	---	---	---	---	---
38	3,558	58.9	12.8	---	2.0	15.1	90.0	53.0	37.5	356	13,350	13.86
39	"	"	"	---	"	"	95.0	56.0	40.5	422	17,091	"
40	"	"	"	---	"	"	70.0	41.2	25.7	421	10,820	"
41	"	"	"	---	"	"	90.0	53.0	37.5	462	17,325	"
42	"	"	"	---	"	"	95.0	56.0	40.5	427	17,294	"
43	"	"	"	---	"	"	90.0	53.0	37.5	456	17,100	"
44	"	"	"	---	"	"	100.0	58.9	43.4	431	18,705	"
45	"	"	"	---	"	"	80.0	47.1	31.6	340	10,744	"
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	3,558	58.9	12.8	---	2.0	15.1	85.0	50.1	34.6	391	13,529	13.86
51	"	"	"	---	"	"	80.0	47.1	31.6	449	14,188	"
52	"	"	"	---	"	"	90.0	53.0	37.5	454	17,025	"
53	"	"	"	---	"	"	100.0	58.9	43.4	444	19,270	"
54	"	"	"	---	"	"	95.0	56.0	40.5	467	18,914	"
55	"	"	"	---	"	"	95.0	56.0	40.5	425	17,213	"
Total	---	---	---	---	---	---	---	921.9	642.9	7,133	258,377	---
Avg.	3,558	58.9	12.8	---	2.0	15.1	86.9	51.2	35.7	396.3	14,354	13.86

APPENDIX D₁ (Continued). PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM A LIGHTLY GRAZED BEEF HERD ANIMAL WEIGHT, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES CONSTANT

Year	Value of Calves	Weight Per Cow (lbs.)	No. ^a / Cows Sold	Pounds Cows Sold	Price of Cows Constant	Value of Cows	Weight Per Bull	No. Bulls Sold	Pound Bull Sold	Price Bulls Constant	Value Bulls Sold	Total Value Beef Sales
1932												
33	\$1,554	1,029	11.9	12,245	\$13.33	\$1,632	1,451	0.7	1,016	\$13.33	\$135	\$3,321
34	1,037	946	"	11,257	"	1,501	1,337	"	936	"	125	2,662
35	1,440	1,111	"	13,221	"	1,762	1,389	"	972	"	130	3,332
36	933	977	"	11,626	"	1,550	1,273	"	891	"	119	2,601
37	---	---	---	---	---	---	---	---	---	---	---	---
38	1,850	983	11.9	11,698	13.33	1,559	1,417	0.7	992	13.33	132	3,542
39	2,369	1,041	"	12,388	"	1,651	1,454	"	1,018	"	136	4,156
40	1,500	1,110	"	13,209	"	1,761	1,478	"	1,035	"	138	3,398
41	2,401	1,133	"	13,483	"	1,797	1,482	"	1,037	"	138	4,337
42	2,397	1,152	"	13,709	"	1,827	1,472	"	1,030	"	137	4,362
43	2,370	1,135	"	13,507	"	1,800	1,470	"	1,029	"	137	4,308
44	2,593	1,132	"	13,471	"	1,796	1,482	"	1,037	"	138	4,526
45	1,489	1,084	"	12,900	"	1,720	1,449	"	1,014	"	135	3,344
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	1,875	1,048	11.9	12,471	13.33	1,662	1,530	0.7	1,071	13.33	143	3,680
51	1,966	1,066	"	12,685	"	1,715	1,530	"	1,071	"	143	3,824
52	2,360	1,112	"	13,233	"	1,764	1,520	"	1,064	"	142	4,265
53	2,671	1,134	"	13,495	"	1,799	1,530	"	1,071	"	143	4,612
54	2,621	1,045	"	12,436	"	1,658	1,530	"	1,071	"	143	4,422
55	2,386	1,118	"	13,304	"	1,774	1,510	"	1,057	"	141	4,300
Total	35,811	19,356	---	230,338	---	30,728	26,304	---	18,412	---	2,454	68,992
Avg.	1,990	1,076	11.9	12,797	13.33	1,707	1,461	0.7	1,023	13.33	136	3,833

^a/ Includes age classes two years old and over.

APPENDIX D₂. SUMMARY OF EXPENSES FOR A LIGHTLY GRAZED CATTLE RANCH--CONSTANT PRICES

Year	Livestock Expense Dollars	Power & Mach. Expense Dollars	Misc. Expense Dollars	Bldg. & Repair Expense Dollars	Taxes Dollars	Wage Expense Dollars	Feeda/ Expense Dollars	Total Expense Dollars
1932								
33	\$175	\$1,346	\$458	\$226	\$420	\$107	\$669	\$3,401
34	00	00	00	00	00	00	00	00
35	00	00	00	00	00	00	00	00
36	00	00	00	00	00	00	00	00
37	---	---	---	---	---	---	---	---
38	175	1,346	458	226	420	107	963	3,695
39	00	00	00	00	00	00	669	3,401
40	00	00	00	00	00	00	00	00
41	00	00	00	00	00	00	00	00
42	00	00	00	00	00	00	00	00
43	00	00	00	00	00	00	00	00
44	00	00	00	00	00	00	00	00
45	00	00	00	00	00	00	00	00
46	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---
50	175	1,346	458	226	420	107	669	3,401
51	00	00	00	00	00	00	00	00
52	00	00	00	00	00	00	00	00
53	00	00	00	00	00	00	00	00
54	00	00	00	00	00	00	00	00
55	00	00	00	00	00	00	00	00
Total	---	---	---	---	---	---	12,336	61,512
Avg.	175	1,346	458	226	420	107	685	3,417

a/ Exclusive of hay bought.

APPENDIX D₃. SUMMARY OF INCOME FOR A LIGHTLY GRAZED CATTLE RANCH--CONSTANT PRICES

Year	Other Ranch		Total ^{a/}			Hay	Gross ^{b/}		Total Expense	c/ N. R. I. Dollars
	Grain Sales Dollars	Prod. Sales Dollars	Beef Sale Dollars	Govt. Payt. Dollars	Cash Inc. Dollars	Ranch Perq. Dollars	Inv. Change Dollars	Ranch Income Dollars		
1932										
33	\$455	\$544	\$3,321	\$145	\$4,465	\$632	\$783	\$5,880	\$3,401	\$2,479
34	"	"	2,662	"	3,806	"	537	4,975	3,401	1,574
35	"	"	3,332	"	4,476	"	-1,036	4,072	3,401	671
36	"	"	2,601	"	3,745	"	372	4,749	3,401	1,348
37	---	---	---	---	---	---	---	---	---	---
38	455	544	3,542	145	4,686	632	301	5,619	3,695	1,924
39	"	"	4,156	"	5,300	"	200	6,132	3,401	2,731
40	"	"	3,398	"	4,542	"	813	5,987	3,401	2,586
41	"	"	4,337	"	5,481	"	1,032	7,145	3,401	3,744
42	"	"	4,362	"	5,506	"	931	7,069	3,401	3,668
43	"	"	4,308	"	5,452	"	996	7,080	3,401	3,679
44	"	"	4,526	"	5,670	"	757	7,059	3,401	3,658
45	"	"	3,344	"	4,488	"	986	6,106	3,401	2,705
46	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---
50	455	544	3,680	145	4,824	632	-157	5,299	3,401	1,898
51	"	"	3,824	"	4,968	"	632	6,232	3,401	2,831
52	"	"	4,265	"	5,409	"	-3	6,038	3,401	2,637
53	"	"	4,612	"	5,756	"	193	6,581	3,401	3,180
54	"	"	4,422	"	5,566	"	384	6,582	3,401	3,181
55	"	"	4,300	"	5,444	"	124	6,200	3,401	2,799
Total	---	---	68,992	---	89,584	---	7,845	108,804	61,512	47,292
Avg.	455	544	3,833	145	4,977	632	436	6,044	3,417	2,627

- a/ Sum of columns 2, 3, 4, and 5.
- b/ Sum of columns 6, 7 and 8.
- c/ Difference of columns 9 and 10.

APPENDIX E₁. PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE TYPICALLY GRAZED BEEF HERD
ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--HISTORICAL PRICES

Typical Beef Herd												
Year	Acres Grazed	No. Beef Cow	No.		No. Yrlg. Heif.	% Calf Crop	No. Calves Sold	No. Calves Sold	Weight Per Calf	Pounds Calves	Price (cwt.) Calves Constant	
			No. 2 yr. Old Heif.	No. Steer								
1932	3,558	79.4	17.2	---	2.7	20.4	72.0	57.2	36.4	383	13,941	\$ 5.05
33	00	00	00	---	00	00	72.0	57.2	36.4	380	13,832	4.63
34	00	00	00	---	00	00	69.3	44.0	34.2	338	11,560	4.66
35	00	00	00	---	00	00	61.7	49.0	28.2	364	10,265	6.95
36	00	00	00	---	00	00	68.0	54.0	33.2	318	10,558	6.90
37	00	00	00	---	00	00	63.3	50.3	29.5	359	10,591	7.78
38	00	00	00	---	00	00	76.1	60.4	39.6	371	14,692	7.83
39	00	00	00	---	00	00	77.1	61.2	40.4	381	15,392	8.34
40	00	00	00	---	00	00	76.4	60.7	39.9	387	15,441	8.50
41	00	00	00	---	00	00	78.9	62.6	41.8	388	16,218	10.11
42	00	00	00	---	00	00	80.9	64.2	43.4	386	16,742	12.07
43	00	00	00	---	00	00	80.3	63.8	43.0	385	16,444	12.28
44	00	00	00	---	00	00	78.1	62.0	41.2	388	15,986	11.59
45	00	00	00	---	00	00	79.6	63.2	42.4	378	16,027	12.40
46	00	00	00	---	00	00	73.8	58.6	37.8	395	14,931	14.39
47	00	00	00	---	00	00	78.9	62.6	41.8	400	16,720	19.59
48	00	00	00	---	00	00	78.9	62.6	41.8	403	16,845	24.32
49	00	00	00	---	00	00	76.9	61.0	40.2	394	15,839	22.71
50	00	00	00	---	00	00	79.6	63.2	42.4	390	16,536	26.15
51	00	00	00	---	00	00	82.0	65.1	44.3	412	18,252	31.88
52	00	00	00	---	00	00	80.9	64.2	43.4	380	16,492	25.61
53	00	00	00	---	00	00	78.3	62.2	41.4	410	16,974	16.89
54	00	00	00	---	00	00	79.0	62.7	41.9	390	16,341	15.95
55	00	00	00	---	00	00	81.0	64.3	43.5	380	16,530	16.00
Total	---	---	---	---	---	---	1,823.0	1,447.3	949.0	9,160	363,270	---
Avg.	3,558	79.4	17.2	---	2.7	20.4	75.9	60.3	39.5	381.7	15,136	13.86

APPENDIX E₁ (Continued). PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE TYPICALLY GRAZED BEEF HERD ANIMAL WEIGHT, CALVING PERCENTAGE, FEEDING RATES VARIABLE-- HISTORICAL PRICES

Year	Value of Calves	Weight Per Cow (lbs.)	No. ^a / _{Cows Sold}	Pounds Cows Sold	Price of Cows Constant	Value of Cows	Weight Per Bull	No. Bulls Sold	Pound Bull Sold	Price Bulls Constant	Value Bulls Sold	Total Value Beef Sales
1932	\$ 704	1,057	16.1	17,018	\$ 4.94	841	1,460	0.8	1,168	\$ 4.94	\$ 58	\$1,603
33	640	1,051	"	16,921	4.14	701	1,451	"	1,161	4.14	48	1,389
34	539	933	"	15,021	4.55	683	1,337	"	1,070	4.55	49	1,271
35	713	1,006	"	16,197	6.54	1,059	1,389	"	1,111	6.54	73	1,845
36	729	924	"	14,876	6.26	931	1,273	"	1,018	6.26	64	1,724
37	824	991	"	15,955	7.42	1,184	1,367	"	1,094	7.42	81	2,089
38	1,150	1,026	"	16,519	7.05	1,165	1,417	"	1,134	7.05	80	2,395
39	1,284	1,053	"	16,953	7.67	1,300	1,454	"	1,163	7.67	89	2,673
40	1,312	1,070	"	17,227	7.95	1,370	1,478	"	1,182	7.95	94	2,776
41	1,640	1,073	"	17,275	9.14	1,579	1,482	"	1,186	9.14	108	3,327
42	2,022	1,073	"	17,275	10.98	1,897	1,472	"	1,178	10.98	129	4,048
43	2,033	1,065	"	17,147	12.22	2,095	1,470	"	1,176	12.22	144	4,272
44	1,853	1,073	"	17,275	11.08	1,914	1,482	"	1,186	11.08	131	3,898
45	1,987	1,055	"	16,986	12.41	2,108	1,449	"	1,159	12.41	144	4,239
46	2,149	1,093	"	17,597	14.66	2,580	1,509	"	1,207	14.66	177	4,906
47	3,275	1,106	"	17,807	18.88	3,362	1,527	"	1,222	18.88	231	6,868
48	4,097	1,114	"	17,935	23.29	4,117	1,538	"	1,230	23.29	286	8,500
49	3,597	1,046	"	16,841	20.74	3,493	1,500	"	1,200	20.74	249	7,339
50	4,324	1,086	"	17,485	24.06	4,207	1,530	"	1,224	24.06	294	8,825
51	5,819	1,053	"	16,953	29.69	5,033	1,530	"	1,224	29.69	363	11,215
52	4,224	1,050	"	16,905	25.71	4,346	1,520	"	1,216	25.71	313	8,883
53	2,867	1,050	"	16,905	17.66	2,985	1,530	"	1,224	17.66	216	6,068
54	2,606	1,040	"	16,744	17.44	2,920	1,530	"	1,224	17.44	213	5,739
55	3,141	1,020	"	16,422	15.60	2,562	1,510	"	1,208	15.60	188	5,891
Total	53,529	25,110	---	402,239	---	54,432	35,205	---	28,165	---	3,822	111,783
Avg.	2,230	1,046	16.1	16,760	13.33	2,268	1,467	0.8	1,174	13.33	159	4,658

^a/ Includes age classes two years old and over.

APPENDIX E₂. SUMMARY OF RANCH EXPENSES FOR A TYPICALLY GRAZED CATTLE RANCH--HISTORICAL PRICES

Year	Livestock Expense Dollars	Power & Mach. Expense Dollars	Misc. Expense Dollars	Bldg. & Repair Expense Dollars	Taxes Dollars	Wage Expense Dollars	Feeda/ Expense Dollars	Total Expense Dollars
1932	\$ 62	\$ 988	\$343	\$138	\$558	\$ 77	\$271	\$2,439
33	56	973	319	143	486	65	317	2,359
34	57	1,027	336	160	414	74	438	2,506
35	95	1,035	336	157	392	80	458	2,553
36	91	1,065	341	156	396	85	489	2,622
37	103	1,089	359	162	399	96	535	2,742
38	102	1,128	366	160	410	97	413	2,674
39	113	1,097	356	158	403	94	401	2,623
40	116	1,081	366	160	410	96	444	2,672
41	131	1,113	391	171	412	112	483	2,813
42	153	1,190	431	188	416	146	587	3,111
43	174	1,237	482	196	408	195	690	3,381
44	164	1,299	504	208	408	236	765	3,584
45	180	1,323	511	214	423	267	784	3,702
46	203	1,359	514	233	468	288	909	3,975
47	254	1,534	555	303	522	311	1,074	4,553
48	314	1,750	591	339	608	328	1,144	5,073
49	279	1,911	617	334	658	319	989	5,108
50	328	1,857	617	341	704	316	1,055	5,218
51	398	2,059	663	380	740	350	1,164	5,754
52	333	2,127	704	382	776	372	1,232	5,927
53	236	1,884	714	384	817	381	1,120	5,537
54	240	2,154	689	384	863	378	1,094	5,801
55	236	2,194	673	396	903	384	1,109	5,895
Total	4,418	34,474	11,778	5,847	12,944	5,147	17,965	92,592
Avg.	184	1,436	491	244	541	214	749	3,859

â/ Exclusive of hay bought.

APPENDIX E₃. SUMMARY OF INCOME FOR TYPICAL GRAZED CATTLE RANCH--HISTORICAL PRICES

Year	Other Ranch				Total ^{a/}	Ranch Perq. Dollars	Hay	Gross ^{b/}	Total Expenses Dollars	c/ N. R. I. Dollars
	Grain Sales Dollars	Prod. Sales Dollars	Beef Sale Dollars	Govt. Payt. Dollars	Cash Inc. Dollars		Inv. Change Dollars	Ranch Income Dollars		
1932	\$109.	\$190	\$1,603	\$---	\$1,902	\$243	\$ -5	\$2,140	\$2,439	\$ -299
33	164	185	1,389	16	1,754	236	94	2,084	2,359	-275
34	223	212	1,271	82	1,788	254	102	2,144	2,506	-362
35	241	299	1,845	79	2,464	321	-136	2,649	2,553	96
36	268	310	1,724	103	2,405	327	42	2,774	2,622	152
37	296	332	2,089	61	2,778	362	-240	2,900	2,742	158
38	187	294	2,395	180	3,056	354	-5	3,405	2,674	731
39	117	277	2,673	229	3,296	300	60	3,656	2,623	1,033
40	209	283	2,776	315	3,583	323	1	3,907	2,672	1,235
41	241	364	3,327	246	4,178	351	49	4,578	2,813	1,765
42	296	452	4,048	361	5,517	402	104	5,663	3,111	2,552
43	364	522	4,272	236	5,394	523	144	6,061	3,381	2,680
44	410	517	3,898	165	4,990	458	106	5,554	3,584	1,970
45	423	555	4,239	134	5,351	520	64	5,935	3,702	2,233
46	496	636	4,906	65	6,103	597	75	6,775	3,975	2,800
47	669	756	6,868	136	8,429	909	82	9,420	4,553	4,867
48	619	827	8,500	100	10,046	1,035	83	11,164	5,073	6,091
49	541	718	7,339	90	8,688	924	26	9,638	5,108	4,530
50	555	734	8,825	92	10,206	929	-30	11,105	5,218	5,887
51	601	887	11,215	139	12,842	1,113	29	13,984	5,754	8,230
52	605	865	8,883	175	10,528	1,093	46	11,667	5,927	5,740
53	573	718	6,068	186	7,545	1,013	-46	8,512	5,537	2,975
54	573	718	5,739	186	7,123	981	4	8,108	5,802	2,306
55	564	626	5,891	165	7,246	854	-357	7,843	5,895	1,948
Total	9,334	12,234	111,783	3,491	136,852	14,522	292	151,666	92,592	59,043
Avg.	389	510	4,658	145	5,702	605	12	6,319	3,859	2,460

a/ Sum of columns 2, 3, 4, and 5.

b/ Sum of columns 6, 7, and 8.

c/ Difference of columns 9 and 10.

APPENDIX F₁. PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE HEAVILY GRAZED BEEF HERD
ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES HORIZONTAL

Heavily Grazed Beef Herd												
Year	Acres Grazed	No. Beef Cow	No.		No. Yrlg. Heif.	%	%	No. Calves	No. Calves Sold	Weight Per Calf	Pounds Calves	Price (cwt.) Calves Constant
			2 yr. Old Heif.	No. Steer								
1932												
33	3,558	107	23.2	---	3.6	27.5	90	96.3	68.4	293	20,041	\$ 4.63
34	"	"	"	---	"	"	60	64.2	36.3	219	7,950	4.66
35	"	"	"	---	"	"	60	64.2	36.3	314	11,398	6.95
36	"	"	"	---	"	"	80	85.6	57.7	173	9,982	6.90
37	---	---	---	---	---	---	---	---	---	---	---	---
38	3,558	107	23.2	---	3.6	27.5	75	80.3	52.4	354	18,550	7.83
39	"	"	"	---	"	"	90	96.3	68.4	404	27,634	8.34
40	"	"	"	---	"	"	70	74.9	47.0	365	17,155	8.50
41	"	"	"	---	"	"	95	101.7	73.8	407	30,037	10.11
42	"	"	"	---	"	"	95	101.7	73.8	423	31,217	12.07
43	"	"	"	---	"	"	75	80.3	52.4	425	22,270	12.28
44	"	"	"	---	"	"	70	74.9	47.0	452	21,244	11.59
45	"	"	"	---	"	"	85	90.9	63.0	374	23,562	12.40
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	3,558	107	23.2	---	3.6	27.5	80	85.6	57.7	339	19,560	26.15
51	"	"	"	---	"	"	60	64.2	36.3	361	13,104	31.88
52	"	"	"	---	"	"	80	85.6	57.7	392	22,618	25.61
53	"	"	"	---	"	"	60	64.2	36.3	401	14,556	16.89
54	"	"	"	---	"	"	75	80.3	52.4	386	20,226	15.95
55	"	"	"	---	"	"	75	80.3	52.4	380	19,912	16.00
Total	---	---	---	---	---	---	1,375	1,471.5	969.3	6,462	351,016	238.74
Avg.	3,558	107	23.2	---	3.6	27.5	76.3	81.7	53.8	359	19,501	13.26

APPENDIX F₁ (Continued). PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE HEAVILY GRAZED BEEF HERD ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--PRICES HISTORICAL

Year	Value of Calves	Weight Per Cow (lbs.)	No. ^{a/} Cows Sold	Pounds Cows Sold	Price of Cows Constant	Value of Cows	Weight Per Bull	No. Bulls Sold	Pound Bull Sold	Price of Bulls Constant	Value of Bulls Sold	Total Value of Beef Sold
1932												
33	\$ 928	970	21.0	20,370	\$4.14	843	1,309	1.25	1,636	\$4.14	\$ 68	\$1,839
34	370	884	"	18,564	4.55	844	1,203	"	1,504	4.55	68	1,282
35	792	972	"	20,412	6.54	1,335	1,205	"	1,563	6.54	102	2,229
36	689	923	"	19,383	6.26	1,213	1,146	"	1,433	6.26	90	1,992
37	---	---	---	---	---	---	---	---	---	---	---	---
38	1,452	947	21.0	19,887	7.05	1,402	1,275	1.25	1,594	7.05	112	2,966
39	2,305	1,013	"	21,273	7.67	1,632	1,309	"	1,636	7.67	125	4,062
40	1,458	1,062	"	22,302	7.95	1,773	1,330	"	1,663	7.95	132	3,363
41	3,037	1,041	"	21,861	9.14	1,998	1,334	"	1,668	9.14	152	5,187
42	3,768	1,086	"	22,806	10.98	2,504	1,325	"	1,656	10.98	182	6,454
43	2,735	1,116	"	23,436	12.22	2,864	1,323	"	1,654	12.22	202	5,801
44	2,462	1,103	"	23,163	11.08	2,566	1,334	"	1,668	11.08	185	5,213
45	2,922	1,012	"	21,252	12.41	2,637	1,304	"	1,630	12.41	202	5,761
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	5,115	920	21.0	19,320	24.06	4,648	1,377	1.25	1,721	24.06	414	10,177
51	4,178	908	"	19,068	29.69	5,661	1,377	"	1,721	29.69	511	10,350
52	5,792	1,054	"	22,134	25.71	5,691	1,368	"	1,710	25.71	440	11,923
53	2,459	1,122	"	23,562	17.66	4,161	1,377	"	1,721	17.66	304	6,924
54	3,226	897	"	18,837	17.44	3,285	1,377	"	1,721	17.44	300	6,811
55	3,186	1,065	"	22,365	15.60	3,489	1,359	"	1,699	15.60	265	6,940
Total	46,874	18,095	---	379,995	230.15	48,546	23,677	---	29,598	230.15	3,854	99,274
Avg.	2,604	1,005	21.0	21,111	12.79	2,697	1,315	1.25	1,644	12.79	214	5,515

^{a/} Includes age classes two years old and over.

APPENDIX F₃. SUMMARY OF INCOME FOR A HEAVILY GRAZED CATTLE RANCH--HISTORICAL PRICES

Year	Other Ranch		Beef Sale	Govt. Payt.	Total ^{a/}		Hay Inv. Change	Gross ^{b/}		N. R. I. c/ Dollars
	Grain Sales Dollars	Prod. Sales Dollars			Cash Inc. Dollars	Ranch Perq. Dollars		Ranch Income Dollars	Total Expenses Dollars	
1932										
33	\$164	\$185	\$1,839	\$ 16	\$2,204	\$236	\$208	\$2,648	\$2,455	\$ 193
34	223	212	1,282	82	1,799	254	-231	1,822	2,616	-794
35	241	299	2,229	79	2,848	321	-2,015	1,154	2,674	-1,520
36	268	310	1,992	103	2,673	327	-823	2,177	2,727	-550
37	---	---	---	---	---	---	---	---	---	---
38	187	294	2,966	180	3,627	354	-268	3,713	3,079	634
39	117	277	4,062	229	4,685	300	-470	4,515	2,779	1,736
40	209	283	3,363	315	4,170	323	85	4,578	2,814	1,764
41	241	364	5,187	246	6,038	351	-112	6,277	2,971	3,306
42	296	452	6,454	361	7,563	402	-605	7,360	3,297	4,063
43	364	522	5,801	236	6,923	523	-11	7,435	3,600	3,835
44	410	517	5,213	165	6,305	458	135	6,898	4,143	2,755
45	423	555	5,761	134	6,873	520	481	7,874	3,961	3,913
46	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---
50	555	734	10,177	92	11,558	929	-1,551	10,936	5,496	5,440
51	601	887	10,350	139	11,977	1,113	77	13,167	6,083	7,084
52	605	865	11,923	175	13,568	1,093	-2,513	12,148	6,244	5,904
53	573	718	6,924	186	8,401	1,013	-691	8,723	5,845	2,878
54	573	675	6,811	136	8,195	981	-851	8,325	6,136	2,189
55	564	626	6,940	165	8,295	954	-651	8,598	6,171	2,427
Total	6,614	8,775	99,274	3,039	117,702	10,452	-9,806	118,348	73,091	45,237
Avg.	367	488	5,515	169	6,539	581	-545	6,575	4,061	2,514

a/ Sum of columns 2, 3, 4, and 5.

b/ Sum of columns 6, 7, and 8.

c/ Difference of columns 9 and 10.

APPENDIX G₁. PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM A MODERATELY GRAZED BEEF HERD
ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--HISTORICAL PRICES

Moderately Grazed Beef Herd												
Year	Acres Grazed	No. Beef Cow	No. 2 yr. Old Heif.	No. Steer	No. Bull	No. Yrlg. Heif.	% Calf Crop	No. Calves	No. Calves Sold	Weight		Price (cwt.) Calves Constant
										Per Calf	Pounds Calves	
1932												
33	3,558	78.1	16.9	---	2.7	20.1	95.0	74.2	53.7	319	17,130	\$ 4.63
34	00	00	00	---	00	00	90.0	70.3	49.8	281	13,994	4.66
35	00	00	00	---	00	00	75.0	58.6	38.1	372	14,173	6.95
36	00	00	00	---	00	00	80.0	62.5	42.0	204	8,568	6.90
37	---	---	---	---	---	---	80.0	62.5	42.0	359	15,078	7.83
38	3,558	78.1	16.9	---	2.7	20.1	80.0	62.5	42.0	359	15,078	7.83
39	00	00	00	---	00	00	90.0	70.3	49.8	449	22,360	8.34
40	00	00	00	---	00	00	85.0	66.4	45.9	428	19,645	8.50
41	00	00	00	---	00	00	80.0	62.5	42.0	454	19,068	10.11
42	00	00	00	---	00	00	85.0	66.4	45.9	414	19,003	12.07
43	00	00	00	---	00	00	90.0	70.3	49.8	433	21,563	12.28
44	00	00	00	---	00	00	85.0	66.4	45.9	449	20,609	11.59
45	00	00	00	---	00	00	80.0	62.5	42.0	400	16,800	12.40
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	3,558	78.1	16.9	---	2.7	20.1	90.0	70.3	49.8	376	18,725	26.15
51	00	00	00	---	00	00	75.0	58.6	38.1	417	15,888	31.88
52	00	00	00	---	00	00	95.0	74.2	53.7	437	23,467	25.61
53	00	00	00	---	00	00	95.0	74.2	53.7	458	24,595	16.89
54	00	00	00	---	00	00	85.0	66.4	45.9	457	20,976	15.95
55	00	00	00	---	00	00	75.0	58.6	38.1	423	16,116	16.00
Total	---	---	---	---	---	---	---	1,165.2	862.2	7,130	327,758	238.74
Avg.	3,558	78.1	16.9	---	2.7	20.1	85.0	64.7	45.9	396	18,209	13.26

APPENDIX G₁ (Continued). PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM A MODERATELY GRAZED BEEF HERD ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE-- HISTORICAL PRICES

Year	Value of Calves	Weight Per Cow (lbs.)	No. a/ Cows Sold	Pounds Cows Sold	Price of Cows Constant	Value of Cows	Weight Per Bull	No. Bulls Sold	Pound Bull Sold	Price of Bulls Constant	Value of Bulls Sold	Total Value Beef Sold
1932												
33	\$ 793	1,012	15.8	15,990	\$ 4.14	662	1,451	0.9	1,306	\$ 4.14	\$ 54	\$1,509
34	652	900	"	14,220	4.55	647	1,337	"	1,203	4.55	55	1,354
35	985	1,022	"	16,148	6.54	1,056	1,389	"	1,250	6.54	82	2,123
36	591	946	"	14,947	6.26	936	1,273	"	1,146	6.26	72	1,599
37	---	---	---	---	---	---	---	---	---	---	---	---
38	1,181	1,019	15.8	16,100	7.05	1,135	1,417	0.9	1,275	7.05	90	2,406
39	1,865	1,088	"	17,190	7.67	1,318	1,454	"	1,309	7.67	100	3,283
40	1,670	1,116	"	17,633	7.95	1,402	1,478	"	1,330	7.95	106	3,178
41	1,928	1,178	"	18,612	9.14	1,701	1,482	"	1,334	9.14	122	3,751
42	2,294	1,140	"	18,012	10.98	1,978	1,472	"	1,325	10.98	145	4,417
43	2,648	1,195	"	18,881	12.22	2,307	1,470	"	1,323	12.22	162	5,117
44	2,389	1,164	"	18,391	11.08	2,038	1,482	"	1,334	11.08	148	4,575
45	2,083	1,129	"	17,838	12.41	2,214	1,449	"	1,304	12.41	162	4,459
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	4,897	1,022	15.8	16,148	24.06	3,885	1,530	0.9	1,377	24.06	331	9,113
51	5,065	1,031	"	16,290	29.69	4,837	1,530	"	1,377	29.69	409	10,311
52	6,010	1,117	"	17,649	25.71	4,538	1,520	"	1,368	25.71	352	10,900
53	4,154	1,139	"	17,996	17.66	3,178	1,530	"	1,377	17.66	243	7,575
54	3,346	1,067	"	16,859	17.44	2,940	1,530	"	1,377	17.44	240	6,526
55	2,579	1,148	"	18,154	15.60	2,832	1,510	"	1,359	15.60	212	5,623
Total	45,130	19,433	---	307,058	230.15	39,604	26,304	---	23,674	230.15	3,085	87,819
Avg.	2,507	1,080	15.8	17,059	12.79	2,200	1,461	0.9	1,315	12.79	171	4,878

a/ Includes age classes two years old and over.

APPENDIX G₂. SUMMARY RANCH EXPENSES FOR A MODERATELY GRAZED CATTLE RANCH--HISTORICAL PRICES

Year	Livestock Expense Dollars	Power & Mach. Expense Dollars	Misc. Expense Dollars	Bldg. & Repair Expense Dollars	Taxes Expenses	Wage Expense Dollars	Feeda/ Expense Dollars	Total Expense Dollars
1932								
33	\$ 61	\$ 973	\$317	\$143	\$484	\$ 63	\$235	\$2,276
34	62	1,027	335	160	412	72	366	2,434
35	103	1,035	335	157	391	77	378	2,476
36	99	1,065	339	156	395	82	387	2,523
37	---	---	---	---	---	---	---	---
38	110	1,128	365	160	408	94	521	2,786
39	122	1,097	355	158	401	92	330	2,555
40	126	1,081	365	160	408	93	355	2,588
41	142	1,113	390	171	410	109	383	2,718
42	165	1,190	430	188	414	142	469	2,998
43	188	1,237	480	196	406	189	548	3,244
44	177	1,299	502	208	406	230	615	3,437
45	194	1,323	509	214	421	259	611	3,531
46	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---
50	354	1,857	614	341	701	307	749	4,923
51	430	2,059	660	380	737	340	837	5,443
52	361	2,127	701	382	773	362	891	5,597
53	255	1,884	712	384	814	370	803	5,222
54	260	2,154	686	384	859	367	803	5,513
55	255	2,194	671	396	899	373	756	5,544
Total	3,464	25,843	8,766	4,338	9,739	3,621	10,037	65,808
Avg.	192	1,436	487	241	541	201	558	3,656

a/ Exclusive of hay bought.

APPENDIX G₃. SUMMARY OF INCOME FOR A MODERATELY GRAZED RANCH--HISTORICAL PRICES

Year	Grain Sales Dollars	Other Ranch Prod. Sales Dollars	Beef Sale Dollars	Govt. Payt. Dollars	Total ^{a/} Cash Inc. Dollars	Ranch Perq. Dollars	Hay Inv. Change Dollars	Gross ^{b/} Ranch Income Dollars	Total Expenses Dollars	c/ N. R. I. Dollars
1932										
33	\$164	\$185	\$1,509	\$ 16	\$1,874	\$236	\$251	\$2,361	\$2,276	\$ 85
34	223	212	1,354	82	1,871	254	167	2,292	2,434	-142
35	241	299	2,123	79	2,742	321	-994	2,069	2,476	-407
36	268	310	1,599	103	2,280	327	52	2,659	2,523	136
37	---	---	---	---	---	---	---	---	---	---
38	187	294	2,406	180	3,067	354	51	3,472	2,786	686
39	117	277	3,282	229	3,906	300	-12	4,194	2,555	1,639
40	209	283	3,178	315	3,985	323	420	4,728	2,588	2,140
41	241	364	3,751	246	4,602	351	543	5,496	2,718	2,778
42	296	452	4,417	361	5,526	402	711	6,639	2,998	3,641
43	364	522	5,117	236	5,239	523	822	7,584	3,244	4,340
44	410	517	4,575	165	5,667	458	670	6,795	3,437	3,358
45	423	555	4,459	134	5,571	520	925	7,016	3,531	3,485
46	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---
50	555	734	9,113	92	10,494	929	457	11,880	4,923	6,957
51	601	887	10,311	139	11,938	1,113	655	13,706	5,443	8,263
52	605	865	10,900	175	12,545	1,093	-364	13,274	5,597	7,677
53	573	718	7,575	186	9,052	1,013	-20	10,045	5,222	4,823
54	573	675	6,526	136	7,910	981	252	9,143	5,513	3,630
55	564	626	5,623	165	6,978	954	-133	7,799	5,544	2,255
Total	6,614	8,775	87,819	3,039	106,247	10,452	4,453	121,152	65,808	55,344
Avg.	367	488	4,878	169	5,902	581	247	6,731	3,656	3,075

- ^{a/} Sum of columns 2, 3, 4, and 5.
^{b/} Sum of columns 6, 7, and 8.
^{c/} Difference of columns 9 and 10.

APPENDIX H₁. PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM THE LIGHTLY GRAZED BEEF HERD
ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES VARIABLE--HISTORICAL PRICES

Lightly Grazed Beef Herd												
Year	Acres Grazed	No. Beef Cow	No. 2 yr. Old Heif.	No. Steer	No. Bull	No. Yrlg. Heif.	% Calf Crop	No. Calves	No. Calves Sold	Weight Per Calf	Pounds Calves	Price (cwt.) Calves Constant
1932												
33	3,558	58.9	12.8	---	2.0	15.1	85.0	50.1	34.6	324	11,210	4.63
34	"	"	"	---	"	"	70.0	41.2	25.7	291	7,479	4.66
35	"	"	"	---	"	"	75.0	44.2	28.7	362	10,389	6.95
36	"	"	"	---	"	"	80.0	47.1	31.6	213	66,731	6.90
37	---	---	---	---	---	---	---	---	---	---	---	---
38	3,558	58.9	12.8	---	2.0	15.1	90.0	53.0	37.5	356	13,350	7.83
39	"	"	"	---	"	"	95.0	56.0	40.5	422	17,091	8.34
40	"	"	"	---	"	"	70.0	41.2	25.7	421	10,820	8.50
41	"	"	"	---	"	"	90.0	53.0	37.5	462	17,325	10.11
42	"	"	"	---	"	"	95.0	56.0	40.5	427	17,294	12.07
43	"	"	"	---	"	"	90.0	53.0	37.5	456	17,100	12.28
44	"	"	"	---	"	"	100.0	58.9	43.4	431	18,705	11.59
45	"	"	"	---	"	"	80.0	47.1	31.6	340	10,744	12.40
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	3,558	58.9	12.8	---	2.0	15.1	85.0	50.1	34.6	391	13,529	26.15
51	"	"	"	---	"	"	80.0	47.1	31.6	449	14,188	31.88
52	"	"	"	---	"	"	90.0	53.0	37.5	454	17,025	25.61
53	"	"	"	---	"	"	100.0	58.9	43.4	444	19,270	16.89
54	"	"	"	---	"	"	95.0	56.0	40.5	467	18,914	15.95
55	"	"	"	---	"	"	95.0	56.0	40.5	425	17,213	16.00
Total	---	---	---	---	---	---	---	921.9	642.9	7,133	258,377	238.74
Avg.	3,558	58.9	12.8	---	2.0	15.1	86.9	51.2	35.7	396.3	14,354	13.26

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APPENDIX H₁ (Continued). PHYSICAL PRODUCTION AND VALUE OF PRODUCTION FROM A LIGHTLY GRAZED BEEF HERD ANIMAL WEIGHTS, CALVING PERCENTAGE, FEEDING RATES, AND PRICES VARIABLE

Year	Value of Calves	Weight Per Cow (lbs.)	No. ^{a/} Cows Sold	Pounds Cows Sold	Price of Cows Constant	Value of Cows	Weight Per Bull	No. Bulls Sold	Pound Bull Sold	Price of Bulls Constant	Value of Bulls Sold	Total Value Beef Sold
1932												
33	\$ 519	1,029	11.9	12,245	\$ 4.14	\$ 507	1,451	0.7	1,016	\$ 4.14	\$ 42	\$1,068
34	349	946	"	11,257	4.55	512	1,337	"	936	4.55	43	903
35	722	1,111	"	13,221	6.54	865	1,389	"	972	6.54	64	1,650
36	464	977	"	11,626	6.26	728	1,273	"	891	6.26	56	1,248
37	---	---	---	---	---	---	---	---	---	---	---	---
38	1,045	983	11.9	11,698	7.05	825	1,417	0.7	992	7.05	70	1,940
39	1,425	1,041	"	12,388	7.67	950	1,454	"	1,018	7.67	78	2,454
40	920	1,110	"	13,209	7.95	1,050	1,478	"	1,035	7.95	82	2,052
41	1,752	1,133	"	13,483	9.14	1,232	1,482	"	1,037	9.14	95	3,079
42	2,087	1,152	"	13,709	10.98	1,505	1,472	"	1,030	10.98	113	3,706
43	2,100	1,135	"	13,507	12.22	1,651	1,470	"	1,039	12.22	126	3,876
44	2,168	1,132	"	13,471	11.08	1,493	1,482	"	1,037	11.08	115	3,775
45	1,332	1,084	"	12,900	12.41	1,601	1,449	"	1,014	12.41	126	3,059
46	---	---	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---	---	---
50	3,538	1,048	11.9	12,471	24.06	3,001	1,530	0.7	1,071	24.06	258	6,796
51	4,523	1,066	"	12,685	29.69	3,766	1,530	"	1,071	29.69	318	8,607
52	4,360	1,112	"	13,233	25.71	3,402	1,520	"	1,064	25.71	274	8,036
53	3,255	1,134	"	13,495	17.66	2,383	1,530	"	1,071	17.66	189	5,827
54	3,017	1,045	"	12,436	17.44	2,169	1,530	"	1,071	17.44	187	5,372
55	2,754	1,118	"	13,304	15.60	2,075	1,510	"	1,057	15.60	165	4,994
Total	36,330	19,356	---	230,338	230.15	29,715	26,304	---	18,412	230.15	2,399	68,443
Avg.	2,018	1,076	11.9	12,797	12.79	1,651	1,461	0.7	1,023	12.79	133	8,802

^{a/} Includes age classes two years old and over.

APPENDIX H₂. SUMMARY OF EXPENSES FOR A LIGHTLY GRAZED CATTLE RANCH--HISTORICAL PRICES

Year	Livestock Expense Dollars	Power & Mach. Expense Dollars	Misc. Expense Dollars	Bldg. & Repair Expense Dollars	Taxes Dollars	Wages Expense Dollars	Feeda/ Expense Dollars	Total Expense Dollars
1932								
33	\$ 50	\$ 973	\$284	\$143	\$449	\$ 25	\$257	\$2,181
34	51	1,027	300	160	383	28	363	2,312
35	85	1,035	300	157	363	30	373	2,343
36	82	1,065	304	156	367	32	384	2,390
37	---	---	---	---	---	---	---	---
38	91	1,128	326	160	379	37	471	2,592
39	105	1,097	317	158	373	36	327	2,413
40	104	1,081	326	160	379	37	352	2,439
41	117	1,113	349	171	381	43	380	2,554
42	137	1,190	384	188	385	56	465	2,805
43	156	1,237	429	196	377	74	543	3,013
44	147	1,299	449	208	377	90	610	3,180
45	161	1,323	456	214	391	102	606	3,253
46	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---
50	294	1,857	550	341	651	121	743	4,557
51	357	2,059	591	380	685	134	830	5,036
52	299	2,127	627	382	718	142	883	5,178
53	212	1,884	637	384	756	146	796	4,815
54	215	2,154	614	384	798	144	796	5,105
55	212	2,194	600	396	836	147	750	5,135
Total	2,875	25,843	7,843	4,338	9,048	1,424	9,929	61,301
Avg.	160	1,436	436	241	503	79	551	3,406

a/ Exclusive of hay bought.

APPENDIX H₃. SUMMARY OF INCOME FOR A LIGHTLY GRAZED CATTLE RANCH--HISTORICAL PRICES

Year	Other Ranch		Beef Sales Dollars	Govt. Payt. Dollars	Total ^{a/}		Hay Inv. Change Dollars	Gross ^{b/}		N. R. I. Dollars
	Grain Sales Dollars	Prod. Sales Dollars			Cash Inc. Dollars	Ranch Perq. Dollars		Ranch Income Dollars	Total Expenses Dollars	
1932										
33	\$164	\$185	\$1,068	\$ 16	\$1,433	\$236	\$301	\$1,970	\$2,181	\$ -211
34	223	212	903	82	1,420	254	291	1,965	2,312	-347
35	241	299	1,650	79	2,269	321	-578	2,012	2,343	-332
36	268	310	1,248	103	1,929	327	214	2,470	2,390	81
37	---	---	---	---	---	---	---	---	---	---
38	187	294	1,940	180	2,601	354	147	3,102	2,592	509
39	117	277	2,454	229	3,077	300	98	3,475	2,413	1,062
40	209	283	2,052	315	2,859	323	428	3,610	2,439	1,171
41	241	364	3,079	246	3,930	351	586	4,867	2,554	2,312
42	296	452	3,706	361	4,815	402	647	5,864	2,805	3,060
43	364	522	3,876	236	4,998	523	809	6,330	3,013	3,317
44	410	517	3,775	165	4,867	458	690	6,015	3,180	2,835
45	423	555	3,059	134	4,171	520	892	5,583	3,253	2,330
46	---	---	---	---	---	---	---	---	---	---
47	---	---	---	---	---	---	---	---	---	---
48	---	---	---	---	---	---	---	---	---	---
49	---	---	---	---	---	---	---	---	---	---
50	555	734	6,796	92	8,177	929	-174	8,932	4,557	4,375
51	601	887	8,607	139	10,234	1,113	784	12,131	5,036	7,096
52	605	865	8,036	175	9,681	1,093	-4	10,770	5,178	5,591
53	573	718	5,827	186	7,304	1,013	230	8,547	4,815	3,732
54	573	675	5,372	136	6,756	981	457	8,194	5,106	3,088
55	564	626	4,994	165	6,349	954	139	7,442	5,135	2,309
Total	6,614	8,775	68,442	3,039	86,870	10,452	5,957	103,279	61,301	41,978
Avg.	367	488	3,802	169	4,826	581	331	5,738	3,406	2,332

a/ Sum of columns 2,3,4, and 5.

b/ Sum of columns 6, 7, and 8.

c/ Difference of columns 9 and 10.

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