Evaluation of Federal grazing permits on Montana cattle ranches
by Arne Degn

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of DOCTOR OF PHILOSOPHY in AGRICULTURAL ECONOMICS
Montana State University

Abstract:
Montana cattle ranchers use large quantities of federal grazing land in the production of livestock. As the other citizens of our nation increase their demand for federal land for uses other than grazing, there becomes increased pressure for determination of the true value received by the rancher for this input factor.

This study included a survey of ranchers who used virtually no federal grazing land. The organization of the segment of Montana's cattle industry that runs only on deeded land was thereby defined. The results of this survey revealed significant economies due to increasing ranch size only after the inclusion of the unpaid ranch labor contributed by the rancher and his family as a cost item. Ranch size categories of less than 150 animal units showed negative returns to investment, while all larger sizes showed positive returns.

To determine a monetary value for federal grazing permits to the Montana cattle ranchers, the costs and returns data from the present study were compared to data from a previous study of ranchers who utilized federal grazing land. It. was found that these permits do indeed have a monetary value to the Montana cattleman. The returns attributable to the possession and use of one animal-unit-month of federal grazing ranged from $1.81 to $24.15. Capitalized animal-unit-month permit values ranged from $36.00 to $483.00. The range was due to various size and area comparisons.

Before raising grazing fees to a level high enough to remove all permit value, policy makers should be cognizant of several components of permit value such as: the portion needed for risk of tenure in federal land use, the portion that has already been capitalized into the value of the rancher's base property, and the portion that is brought about by a nearer to optimum input balance due to the use of the federal land.

EVALUATION OF FEDERAL GRAZING PERMITS ON MONTANA CATTLE RANCHES

by

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A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree

of

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The author accepts full responsibility for any omissions or errors in this paper.

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ABSTRACT

Montana cattle ranchers use large quantities of federal grazing land in the production of livestock. As the other citizens of our nation increase their demand for federal land for uses other than grazing, there becomes increased pressure for determination of the true value received by the rancher for this input factor.

This study included a survey of ranchers who used virtually no federal grazing land. The organization of the segment of Montana's cattle industry that runs only on deeded land was thereby defined. The results of this survey revealed significant economies due to increasing ranch size only after the inclusion of the unpaid ranch labor contributed by the rancher and his family as a cost item. Ranch size categories of less than 150 animal units showed negative returns to investment, while all larger sizes showed positive returns.

To determine a monetary value for federal grazing permits to the Montana cattle ranchers, the costs and returns data from the present study were compared to data from a previous study of ranchers who utilized federal grazing land. It was found that these permits do indeed have a monetary value to the Montana cattleman. The returns attributable to the possession and use of one animal-unit-month of federal grazing ranged from $1.81 to $24.15. Capitalized animal-unit-month permit values ranged from $36.00 to $483.00. The range was due to various size and area comparisons.

Before raising grazing fees to a level high enough to remove all permit value, policy makers should be cognizant of several components of permit value such as: the portion needed for risk of tenure in federal land use, the portion that has already been capitalized into the value of the rancher's base property, and the portion that is brought about by a nearer to optimum input balance due to the use of the federal land.

GLOSSARY OF TERMS

To establish a common frame of reference for the study, the following terms are defined:

1. A privileged ranch is defined as one which has federal grazing amounting to more than 7 percent of its annual grazing requirements.

2. A non-privileged ranch is one which has less than 7 percent of its annual grazing on federal land.

3. The abbreviation AU means animal units or animal unit equivalents. It is based on one mature cow; other classes of livestock are commonly converted to AU's for comparative purposes.

4. The abbreviation AUM means one animal unit month and has reference to the grazing requirements of one animal unit (as described above) for one month.

5. BLM is an abbreviation for Bureau of Land Management, a branch of the United States Department of the Interior.

6. FS designates the United States Forest Service, a branch of the United States Department of Agriculture.

7. Permits, federal permits or federal grazing permits have reference to grazing privileges granted to ranchers for grazing on BLM and FS administered land.

8. BLM land refers to public rangeland owned by the federal government and administered by the Bureau of Land Management.

9. FS land refers to public forest land owned by the federal government and administered by the Forest Service.

10. Base property has reference to the commensurate property requirement for ranches with federal grazing permits.

11. Area "W" designates the southwestern Montana study area.

12. Area "E" designates the southeastern Montana study area.

CHAPTER I

INTRODUCTION

Cattle ranchers in Montana use vast acreages of federal grazing land as a factor of production. As the public increases its demand for this federal land for other uses, there is increased pressure for determining the true value received by the rancher for this input factor. This thesis attempts to determine the value of federal grazing permits to the cattle ranchers of Montana.

The Problem Situation

This research project is designed to solve a specific research problem. Therefore only a very brief historical account of the development of western range policy leading up to the existence of permit value will be included in this section to acquaint the reader with the general problem and to define the following terms: (1) federal grazing land, (2) grazing permits, (3) permit fees, and (4) permit values.

Federal Grazing Lands

During the initial settlement of the public domain in the western states, the homesteaders and other settlers acquired the best land, leaving the remainder in government ownership. These unpatented lands were, in general, the most undesirable for settlement; they were extremely arid, had rough terrain or were heavily forested. As the early settlers took up the choice land, the remaining parcels were frequently left in isolated tracts, often only a section of less per tract. Even the relatively solid blocks of federal land had islands of deeded land within

their boundaries. 1/ It is these lands that now remain in federal ownership and are administered by the United States Forest Service and the Bureau of Land Management.

Prior to settlement by homesteaders, the livestock producers had free use of virtually all western land. As the settlers crowded the stockmen, and as demand for beef increased, the stockmen tried to maintain herd size on the ever shrinking quantity of free grazing land. 2/ Competition for grass use became more and more keen. The result was extreme overgrazing of much federally owned land which led to serious damage through erosion.

To overcome this "first-come-first-served" use and abuse pattern of federal land, the government began reserving land and imposing controls. By 1934, with the passage of the Taylor Grazing Act, all federal land had come under some degree of grazing control. As Peffer points out in the main theme of her book, the Taylor Grazing Act removed the last of the public domain from entry until it was classified. 3/

1/ Marion Clawson and Burnell Held, The Federal Lands: Their Use and Management, Baltimore: The John Hopkins Press, 1957, p. 49.

2/ Warren R. Bailey, "Historical Antecedants of the Range Livestock Industry of the Great Plains", Economic Problems in Great Plains Ranching, Great Plains Council, Bozeman, Montana, Pub. 22, Montana Agricultural Experiment Station, MP-6, Bozeman, Montana, October, 1964, p. 18.

3/ E. Louise Peffer, The Closing of the Public Domain, Stanford, Calif., Stanford University Press, 1951.

Grazing Permits

Prior to the time of the closing of the public domain, "occupancy was based on the custom of priority, 'squatters sovereignty as old as the frontier'". 4/ To implement the controls of the new Act, the administrators issued grazing permits to ranchers who could prove prior use of the federal range and who also had sufficient base property to maintain their herds on private land for the seasons that federal grazing was prohibited. This commensurate property requirement assures stability of the cattle industry as pointed out by Kelso:

> "Stability of operation, desirable to individual and society alike, can only be insured if the federal grazing privilege is tied to the privately-owned ranch lands with some degree of permanence." 5/

The commensurability requirement also removed the threat of the nomadic sheepmen and cattlemen that had long plagued the permanent livestock growers. 6/

These grazing permits gave the rancher the privilege (not the right) to run a specified number of livestock on the federal range for a predetermined number of months per year. The permits were given on an animal unit month basis (AUM), with an animal unit being a mature cow or its approximate equivalent in grazing requirements for other livestock classes.

4/ Bailey, op. cit., p. 16.

5/ M. M. Kelso, "Current Issues in Federal Land Management in the Western United States", Journal of Farm Economics, Vol. XXIX, Nov. 1947, p. 1304.

6/ Clawson and Held, op. cit., p. 85.

Grazing Fees

Nominal grazing fees were charged the ranchers soon after grazing controls were begun. These fees were low and were primarily for the purpose of meeting the costs of administering the grazing controls. "The concept of grazing fees based on the costs of administration was in effect for more than 20 years." 7/ The stockmen opposed fee increases but finally (in 1957) the policy of the "Cost of Administration Concept" was abandoned by the Bureau of Land Management, and a new system based on cattle and sheep prices was adopted. 8/ The new fee has no direct relationship to forage value, but it does have some economic justification in that the fees do vary according to average livestock market prices. 9/ The two major public land administering agencies now have similar fee basing policies. Calef summarized the Forest Service system as follows:

> "The two variables that are taken into consideration in setting fees are the market price of cattle and the ranchers operating cost on a particular forest. As market prices of cattle and sheep rise, grazing fees rise; a drop in livestock prices brings a reduction in grazing fees". 10/

7/ Roy E. Huffman, "Public Land Policy Related to Ranching", Economic Problems in Great Plains Ranching, Great Plains Pub. 22, Mont. Ag Expt. Station, MP-6, Bozeman, Montana, October, 1964, p. 99.

8/ Phillip O. Foss, "Grazing Fees on Federally Owned Lands", Journal of Farm Economics, Vol. XLI, August, 1959, p. 546.

9/ Ibid, p. 547.

10/ Wesley Calef, Private Grazing and Public Lands, Chicago: The University of Chicago Press, 1960, p. 42.

Permit Value

Many people consider grazing permits to have a value above and beyond the fee that is actually paid by the rancher for use of public rangeland. That is, they feel that ranchers are not paying fees that are adequate to cover the full value of forage obtained from federal grazing permits. Any net returns to the rancher attributable to his grazing privileges, and not paid for through grazing fees, can be capitalized and termed permit value.

Some examples of opinions of noted economists concerning permit values are as follows:

> Roberts at Utah stated, "Fees for public ranges were placed so low in relation to the value of the forage that a sales value for the forage resulted." 11/

> Calef wrote, "No one seriously argued at this time that the grazing district license holders were paying for the forage what it was worth. On the contrary, it was well known that permittees were paying only a fraction of what it was worth."12/

> He wrote in a later section of his book, "Under the current fee scale, public domain forage is such a bargain that pressure is strong to acquire and retain the right to harvest it. However, almost no permits are available except by purchase; all the forage on the public domain has already been leased. In preceding sections it was shown that the difference between the grazing fees and the full value of the forage has been capitalized into the value of the permits. That these values are real and substantial is shown clearly by the fact that Taylor permits are accepted at a bank as security for loans. 13/

11/ N. K. Roberts, "Economic Foundations for Grazing Use Fees on Public Lands", Journal of Farm Economics, Vol. XLV, Nov., 1963, p. 726.

12/ Calef, op. cit., p. 74.

13/ Ibid., p. 272.

Clawson wrote, "The amount collected for grazing fees on federal land does not at all measure the value of these lands in the national economy." 14/

The Research Problem

The specific problem of this research project is to determine values of federal permits in excess of that portion paid by ranchers as grazing fees for use of federal grazing lands. The study is confined to cattle ranches in two study areas of southern Montana.

Objectives of the Study

The objectives of the study are:

1. To define the organization of Montana cattle ranches that are not dependent upon federal grazing permits for forage.

2. To determine the costs and returns, and the rates of return to investment, labor and management of Montana cattle ranches using deeded land.

3. To determine grazing permit values to Montana cattle ranchers having federal grazing permits.

General Procedure

It is hypothesized that federal grazing permits have a monetary value to their Montana cattle ranch users beyond that paid as grazing fees.

14/ Marion Clawson, Uncle Sam's Acres, Dodd, Mead and Co., New York, 1951, p. 171.

A comparison of the current non-privileged ranch survey is made with a previous study of privileged ranches. 15/ Net-return differences between these two studies in capitalized to derive permit values for ranches in different size categories and in different areas of Montana.

This method of procedure introduces not only the effect of differences between federal and private grazing fees into the study but also introduces the effect of organizational differences as well. The resulting derivation is therefore a total value of permits beyond that which the ranchers pay as grazing fees.

Previous Research

Segments of Total Permit Value

Several segments of total permit value to the ranchers became apparent upon review of previous research done on permit value determination.

1. The most readily discernible is the part of the permit value actually paid by the rancher to the federal government in the form of grazing fees. This becomes part of the rancher's cash operating cost and is not a part of the capitalized permit value.

2. A segment of the permit value is capitalized into values of base properties of ranches. This segment of permit value is included in the total ranch investment and reflects upon costs of production only if opportunity costs to investment are considered in ranch operating cost analysis. This item has resulted in windfall profits to the original permittees, but it is a very real cost to ranchers who have purchased ranches more recently.

3. Permits have direct sales values in some areas. As reported by Dr. N. K. Roberts, "In Utah, BLM permits sell for around

15/ D. D. Caton, et. al., Economic Relationships of Grazing Fees and Permitted Use of Public Rangelands to Net Income on Western Livestock Ranches: A Regional Analysis, ERS, USDA, Administrative Report, 1962.

3. $10 and Forest Service permits for about $20 per AUM. In some parts of the West, permits sell for much more per AUM. Furthermore, part of the difference between fees charged and the value of the forage at the allowable limit was capitalized into the value of the base property." 16/

4. A portion of the total permit value is retained by the permittees to compensate for risk of tenure. It must be remembered that grazing permits on federal land are a privilege and not a right. Therefore, a rancher is faced with the possibility of losing his grazing privileges or having the number of animals permitted on the public range reduced and he must consider this risk factor when evaluating permits.

5. Another part of permit value can be found in organizational differences between ranches having federal grazing privileges and those not having such privileges. This portion can be either positive or negative depending on whether ranch organization is benefited more from having federal grazing privileges than it is harmed. Such positive factors as being nearer to the optimum balance of input factors obtained through combining federal grazing privileges with deeded land must be considered, as well as negative factors such as costs of transporting cattle to federal lands for the grazing season and lower calving percentages due to poor bull dispersion during the breeding season on federal land. These factors are by themselves difficult to quantify but will enter into the determination of the value of a grazing permit in this study.

Alternative Methods of Permit Value Determination

Gardner derived values for federal grazing permits by comparing fees on federal lands with rents on private grazing lands. 17/ He did this by capitalizing the difference between the costs of the two sources of range forage. Before capitalizing, he subtracted an extra cost of running on federal range. The extra cost included such items as transportation costs to the public grazing land, extra costs of watching or herding the livestock, additional stray or death loss, and lower calf crops due to poor bull dispersion at breeding time. Values per AU derived by Gardner were

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16/ Roberts, op. cit., p. 726

17/ B. Delworth Gardner, "Transfer Restrictions and Misallocations in Grazing Public Range", Journal of Farm Economics, Vol. XLIV, Feb. 1962, pp. 50-63.

$23 to $28.33 for Forest Service permits and $44.33 for Bureau of Land Management permits. 18/

Roberts proposed a method that would involve multiplying the marginal product of the forage obtained from federal permits by livestock prices to derive a marginal value product of the forage. This value could then be used together with a marginal factor cost associated with livestock production on federal range to determine a net value productivity of the forage. The difference between this value and the fee that is presently being paid for the grazing privilege could then be capitalized to determine permit value. 19/

Another possible method of deriving permit value would be to compile lists of ranch sales prices for ranches with and for those without federal permits and then compare the sales prices against the grazing capacity of the deeded land in each ranch classification.

Another possible method would be to collect direct sales values of the permits themselves where available.

Each of these alternative methods arrive at part of the total permit value but ignore organizational differences between privileged and non-privileged ranches.

18/ Ibid., p. 60.

19/ Roberts, op. cit., pp. 722-723.

CHAPTER II

PROCEDURE

Sampling Areas

Ranches in two areas of Montana were studied to determine the cost and returns as well as the general organization of non-privileged cattle ranches. To facilitate comparisons with the previous study of privileged cattle ranches, the areas were chosen to approximate the boundaries of the privileged study areas. Area "W" is composed of Beaverhead and Madison counties in the western Montana mountain region while Area "E" is made up of the following southeastern Montana plains counties: Carter, Custer, Garfield, Petroleum, Powder River, Prairie and Rosebud (Figure 1).

Livestock ranching predominates as the major economic activity of both of the study areas, with relatively small amounts of cash cropping existing in conjunction with ranching. The importance of livestock relative to other income sources for the two areas is depicted by the map in Figure 2.

Both of the study areas have high proportions of federal lands. Virtually all of the federal land in these particular counties is used by ranchers for livestock grazing, hence the importance of federal grazing lands to cattle ranchers in the two-study areas becomes apparent.

Area "W"

The physical features of Area "W" are dominated by five north-south mountain chains interspered with valleys or basins. It is within these

mountain valleys that the ranching economy is centered. The mountain chains are often rugged and forested and offer some seasonal grazing but the wintering operation of the ranches is carried on in the valley areas. Area "W" is one of extreme variation from one valley to the next; it is diverse in topography, soil type, and climatic conditions.

The geological formation of the mountains is crystaline while the valleys are floored with sedimentary deposits of various types and depths.

On the western extremity of Area "W", the Continental Divide forms the boundary between Montana and Idaho. The Big Hole basin, which is the valley of the Big Hole river, lies between the Idaho border and the Pioneer Mountains. Virtually the whole basin is flood irrigated during the May-June run-off by a system of control gates. The result is a relatively high yield of nutritious native grasses which are harvested for hay and are grazed for several months of the year after hay harvest. Many of the ranchers have Forest Service permits which allow from two to three months of summer grazing, thereby lightening the grazing load on the meadows. The ranchers interviewed for this phase of the study, however, ran exclusively on deeded meadow land or on privately owned foothill land lying adjacent to the basin itself.

The soil in the basin at the time of settlement was very fertile and deep. The original climax vegetation was meadow or wet-land grasses with some grasses being especially nutritious. During the ensuing years, the long period of spring flood irrigation and the heavy production of grass has reduced both the hay yield and the hay quality of the meadows. Some

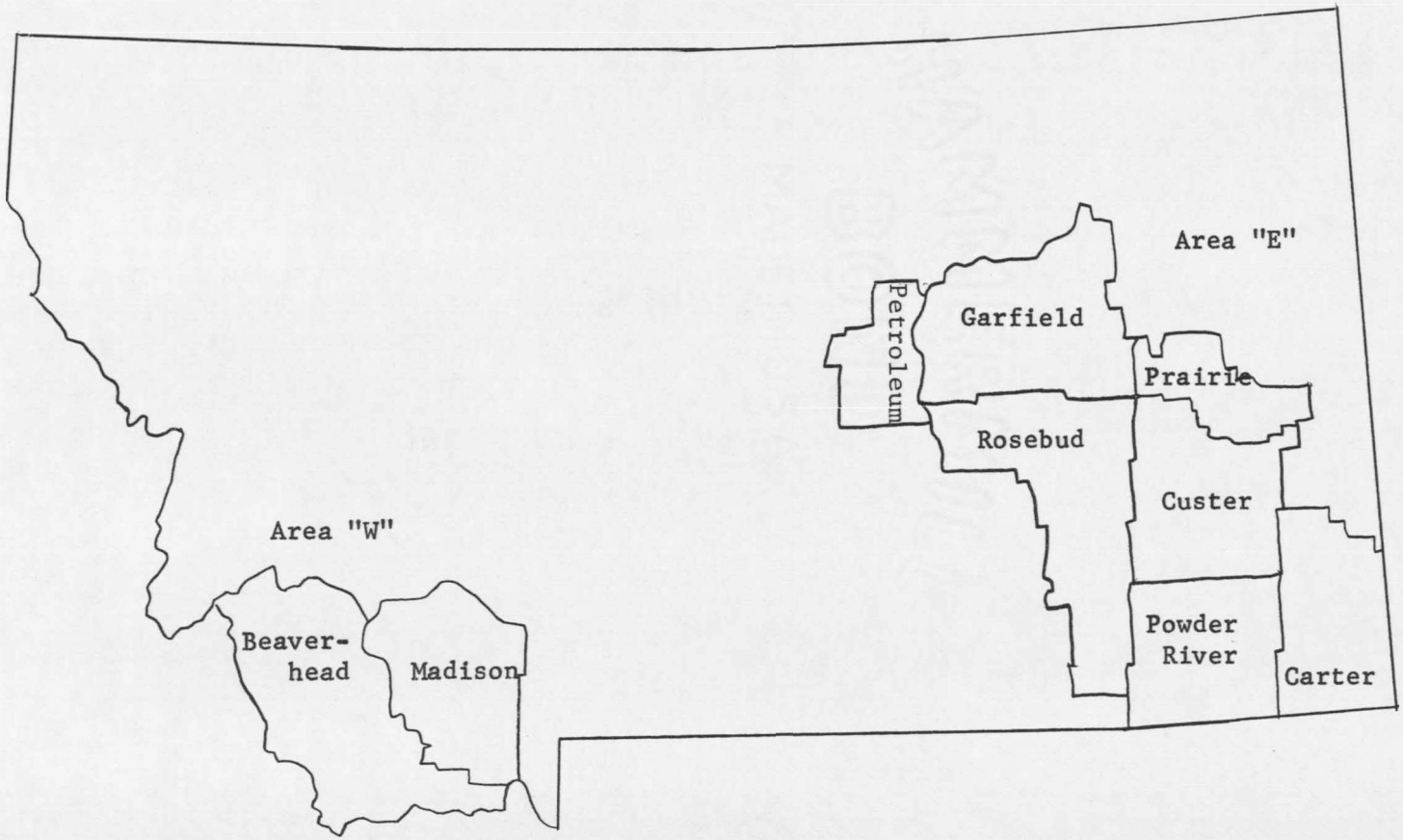

Figure 1. State of Montana, showing study areas.

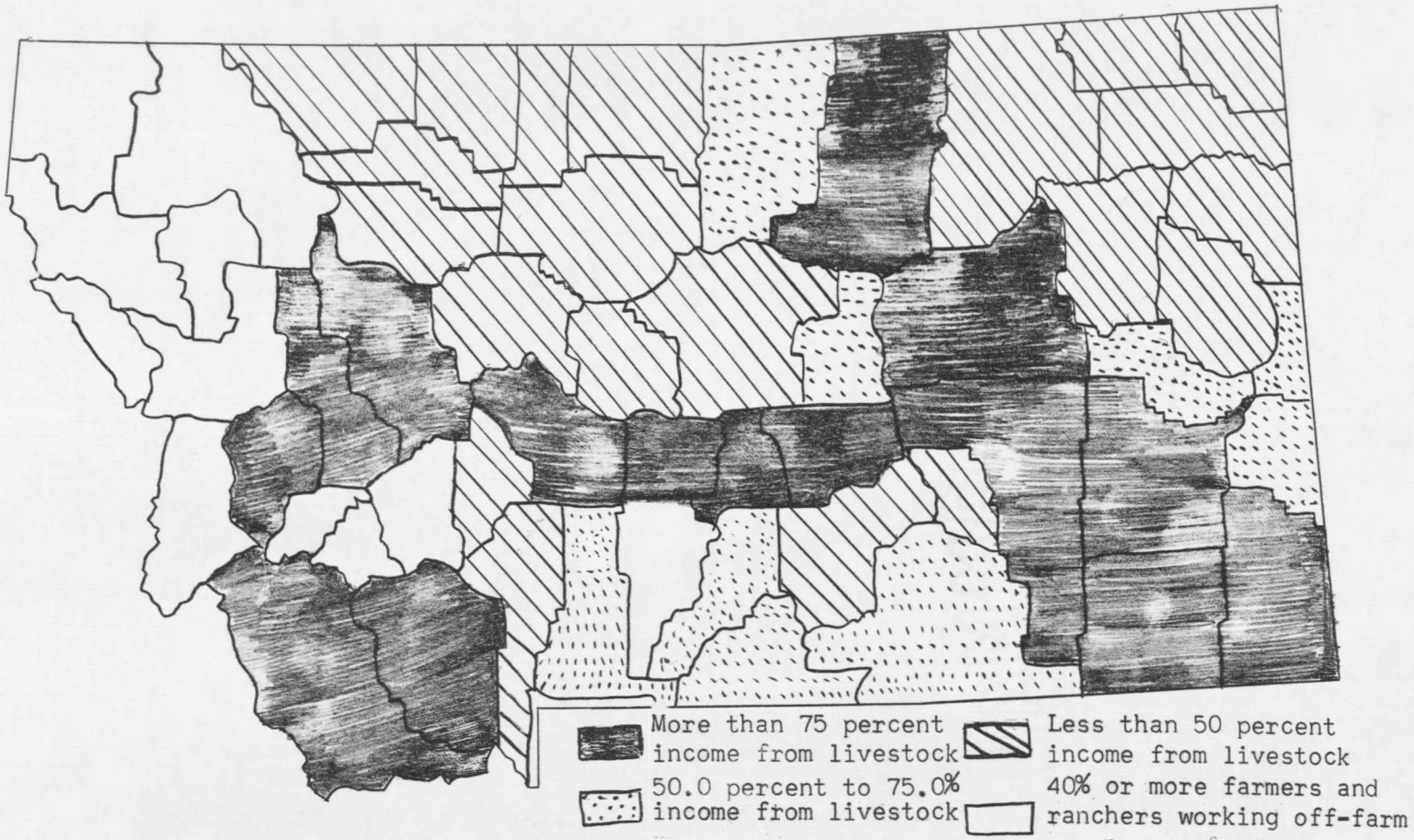

Figure 2. Classification of Montana Counties Showing Percent of Farmers Income from Livestock. *

* Source: Carl F. Kraenzel, "The Rural Community and the Agricultural Program", Montana Agricultural Experiment Station, Montana State College, Bozeman, Montana, Bulletin 552, 1960, p. 35.

ranchers reported fertilizer applications on a trial basis, and others indicated that improved irrigation methods had increased yields again.

The growing season in the Big Hole basin is relatively short due to the high elevation. Heavy winter precipitation in the form of snow limits the grazing season, consequently hay requirements per AU for winter feeding are high. Winter temperatures are relatively mild and the livestock are usually wintered on the protected meadows near the location of hay production.

Lying within the general region of the Pioneer mountains and the Tendoy mountains are numerous small valleys similar to the Big Hole basin but not as extensive nor homogeneous in type of operation.

East of the Pioneer and Tendoy mountains lies the Beaverhead valley. The natural vegetation is short bunch grass and sage brush, typical of the arid portions of the states south of Montana. Irrigation is prevalent in the valley bottom with the major agricultural production being hay. Wheat, feed grains and some seed potatoes are also grown under irrigation.

Dillon, the county seat of Beaverhead County and the largest town in the two-county study area, is located in this central valley. The longer growing season and comparatively open winters result in a longer grazing season with less winter feeding than is typical in most Mountain valleys. Surrounding the valley bottoms are large, arid bench areas which generally have remained in state and federal ownership. These lands are typically in grazing districts and those ranchers having such permits were excluded from this study of non-privileged ranches.

The Ruby range lying along the western edge of Madison County separates the Ruby valley from the larger Beaverhead valley. The Ruby mountains themselves are a relatively narrow range with few transverse valleys. Therefore this mountain area offers only limited grazing opportunity.

The Ruby valley is more typical of other mountain valleys in the West. The precipitation is slightly higher than in the Beaverhead valley and the elevation is considerably lower than the Big Hole. The winters are mild, due to the protection of the surrounding mountain ranges, and cattle ranching is carried on in a manner similar to that of other mountain valleys.

The Tobacco Root range and the Gravelly mountains lying to the east of the Ruby valley are wider and more complex than the Ruby mountain range. Grazing is extensive in these mountains.

The Madison valley is similar to the Beaverhead valley and is highly dependent on irrigation for feed reserve and winter feed production. The area is unique in that several large ranches are held by eastern firms as summer guest ranches.

The eastern edge of this study area is bounded by the Madison mountain range. Summer grazing on Forest Service lands is of importance to the valley ranchers, but because of the ruggedness of the terrain the total grazing is limited.

Area "E"

This study area is made up of seven Plains counties in southeastern

Montana. The land itself is far from flat although the word "plain" might imply otherwise. In reality, the land surface is cut by numerous water courses, many of which are dry during most of the year. Over much of the area infrequent but torrential rains and frequent strong winds have eroded deeply into the soft sedimentary geological formations to create badlands, or breaks as they are commonly termed in the area. These badland areas are suited to little other than livestock ranching.

The soils are sedimentary in origin and are quite similar throughout the region. The natural grasses are short prairie grasses and forbs with the stream valleys being lightly wooded with deciduous trees. The only regions in the eastern study area that can be considered forested are found in the extreme southern part of Rosebud and Powder River counties and in the eastern part of Carter County. These forested areas are lightly wooded with pine trees. Forest Service grazing permits allow summer grazing in these areas but most of the federal land in this study area is open prairie and is administered by the Bureau of Land Management.

As a result of low annual precipitation and poor water holding capacity of the soil, natural water supplies are scarce and the provision of livestock water by wells or storage reservoirs throughout most of the area is necessary.

Interspersed among the rough grazing areas are occasional benches or plateaus that have soil and topography suited to the dry farming of small grains. In the Yellowstone river valley, which bisects the study area, there is a considerable acreage of diversified irrigated agriculture, sugar beets, feed grains and hay predominate as crops.

Irrigation along streams and rivers, other than the Yellowstone, is used primarily for the production of wintering roughage for the ranch livestock. Numerous flood irrigation systems were observed along the intermittent streams. These are designed to utilize the water from the spring run-off and occasional flash floods that occur. Many ranchers are able to produce adequate supplies of winter forage from these small, recently developed irrigation systems.

Though the region is much more homogeneous in land type, topography and grass type than Area "W", extreme climatic fluctuations occur from season to season and from year to year. Consequently, the natural vegetation that has evolved is of a type that is able to withstand these fluctuations by extreme growth restrictions during dry years. Therefore forage production is very susceptible to drought and overgrazing. Careful management to establish and maintain a stable ranch organization becomes extremely important in this region.

It can be seen from the preceding discussion (and Figure 3 and 4) that the western area is much more diverse in physical structure and climate than is the southeastern study area. However, annual climatic fluctuations are less severe in the western area, resulting in a more stable forage supply.

Sampling Procedure

To insure representative sampling of ranch size during the survey, the ranches in each area were stratified according to cow numbers from The Bureau of the Census data. 20/ Each size stratum (cell) was than

20/ Bureau of Census Agricultural Census of 1959, unpublished material.

assigned a number of ranches to be sampled by the stratified proportional allocation technique. 21/ Since proportional allocation resulted in large-size category cells that were too small to permit valid size comparisons, it was necessary to modify the proportional sampling technique slightly by taking larger than proportional samples in the large size categories. The result was a sample that gave a composite description of the ranching population and also gave enough large-size ranch interviews to make size comparisons possible. The goal was then to fill these predetermined cells by ranch interviews.

To make the ranch composition of the current study more homogeneous, the following limitations were imposed upon each ranch in the sample:

1. The ranch had to have at least 20 head of range cows in 1962 to be termed a cattle ranch.

2. The ranch could have no more than 7 percent of its grazing on Bureau of Land Management and Forest Service lands.

3. The ranch did not have over 30 percent of its animal unit equivalents in the form of sheep.

4. At least 50 percent of the gross ranch income had to be from livestock

5. The ranches were all located within two predetermined ranching areas.

21/ William G. Cochran, Sampling Techniques, N.Y.: John Wiley and Sons, Inc., 1962, pp.88-89. In the stratified proportional technique, equal percentages of each predetermined stratum are interviewed to give a self-weighting sample that insures sampling throughout the population range.

Upon entering the field for schedule taking it was soon verified that ranches in the large size category were not numerous, especially after the imposition of the limitations on sheep percentages and federal grazing permits. The smaller size categories had a tendency to show a larger percentage of income from sources other than cattle. Therefore even though the cells in these categories contained higher initial numbers, the final number of usable schedules was reduced considerably in these small size categories after schedule analysis excluded those with over 50 percent of their income from other sources than livestock.

In date analysis, animal units per ranch were used as criteria for stratifying the completed ranch schedules by size, rather than carrying through with the cow-number stratification that was used in the initial cell formation. This was done to permit the grouping of ranches by total feed requirements. By using this method, all classes of livestock were considered, rather than considering only cow numbers per ranch. Conversion standards for changing the various species and classes of livestock to animal unit equivalents approximated those used in the privileged ranch study, and are shown in Table I.

After conversion to animal units and after applying the limitations to get a more uniform sample, the final result was a fairly well dispersed relatively homogeneous sample of ranches. Tables II and III show the original cells, the conversion to animal units and the final usable number of schedules per cell. The tables point out the formation of the strata, with animal units as criteria, from the original cells based on cow numbers. The limitations also had their affect on the final number of

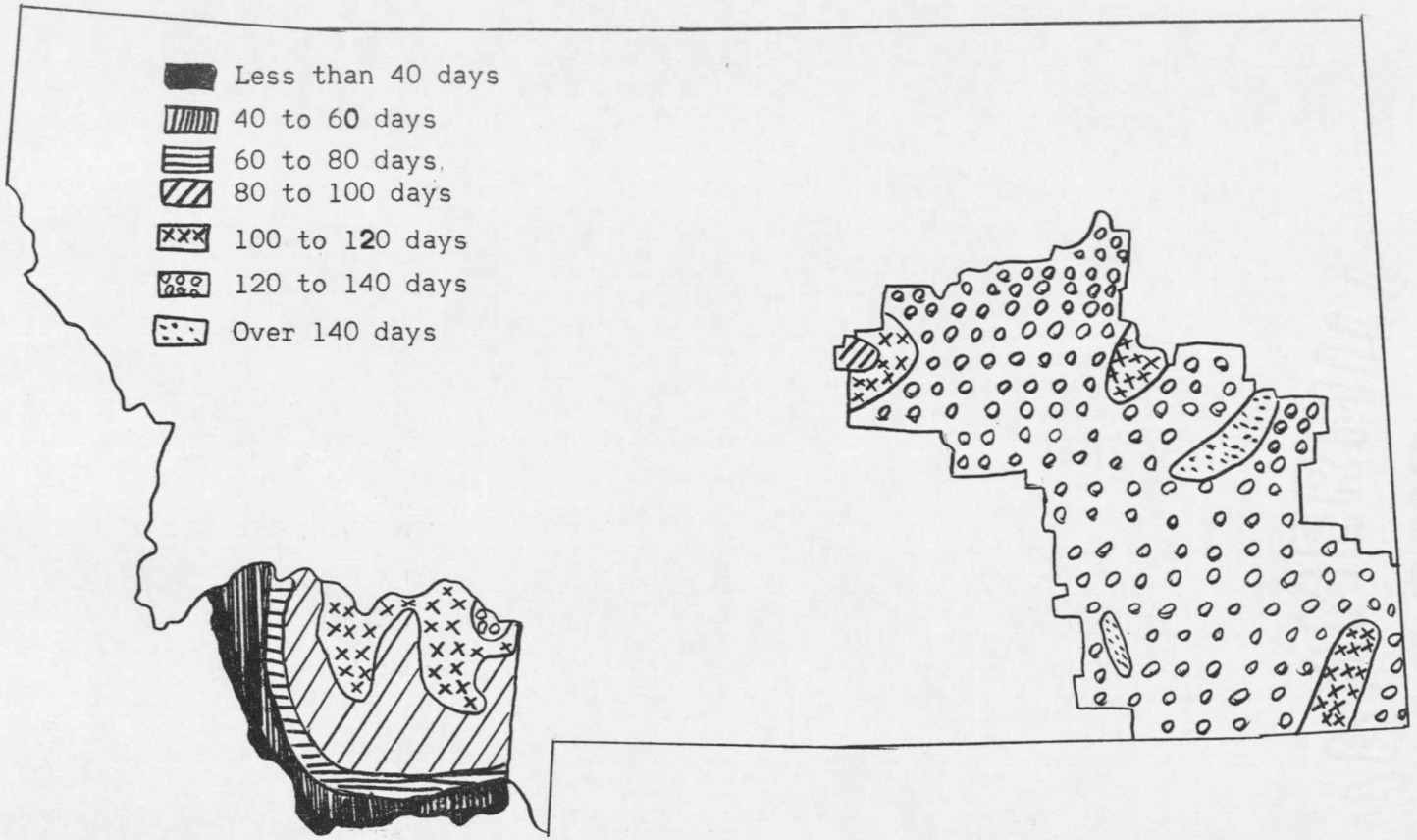

Figure 3. Study areas showing average number of days without killing frost. *

* Source: Climate and Man, 1941 Yearbook of Agriculture, U.S. Department of Agriculture, Washington, D. C., 1941, p. 964.

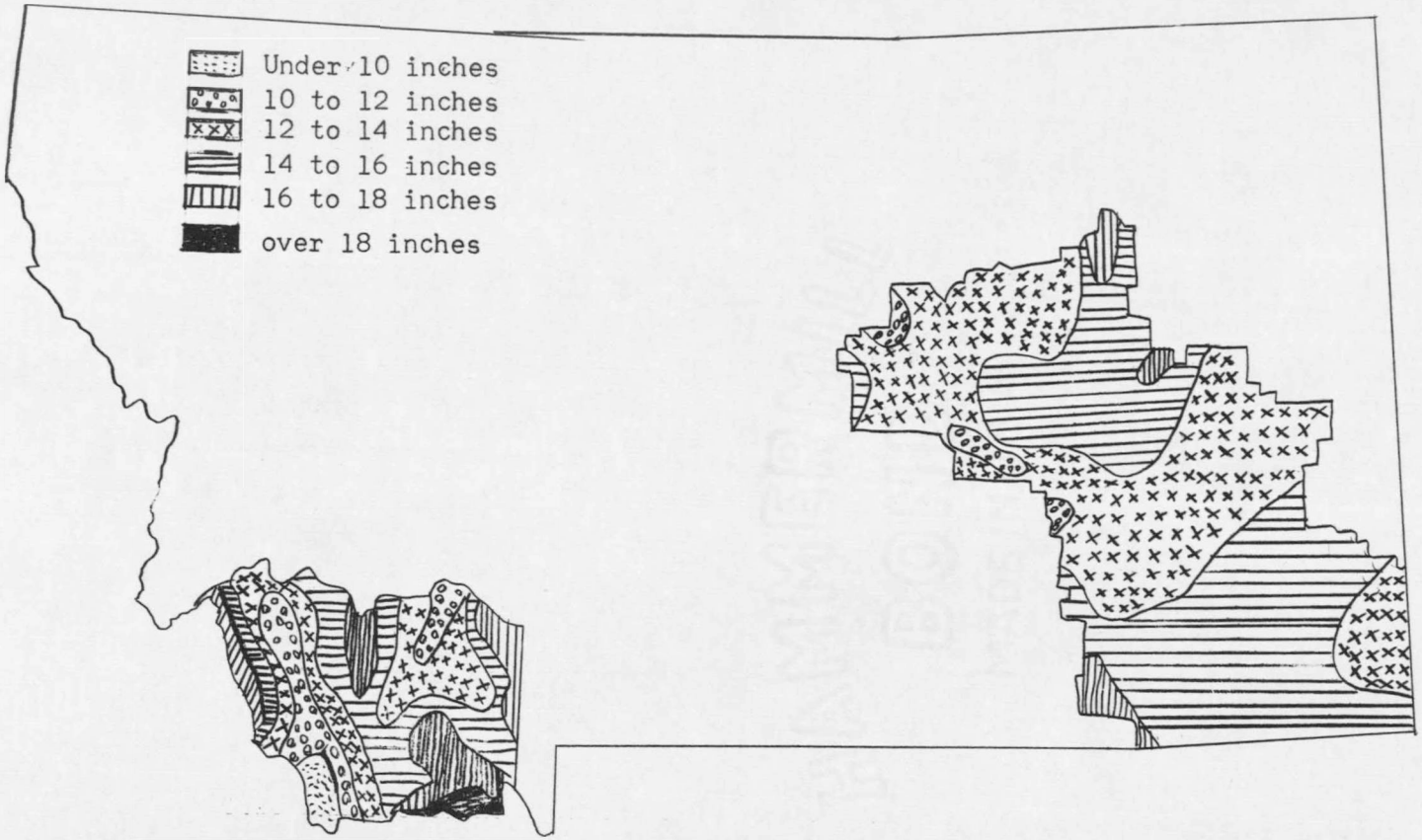

Figure 4. Study areas showing average annual precipitation. *

* Source: Climate and Man, 1941 Yearbook of Agriculture, U. S. Department of Agriculture, Washington, D. C., 1941, p. 965.

TABLE I. ANIMAL UNIT EQUIVALENTS FOR VARIOUS LIVESTOCK CLASSES. *

Livestock Class	Animal Unit Equivalents
Mature Cow	1.0
Long Yearling	0.8
Weaned Calf	0.6
Unweaned Calf	0.4
Pregnant Heifer	1.0
Bull	1.2
Ewe	0.2
Lamb	0.08
Milk Cow	1.2
Horse	1.5

* Source: D. D. Caton, et. al., Economic Relationships of Grazing Fees and Permitted Use of Public Rangelands to Net Income on Western Livestock Ranches: A Regional Analysis, ERS, USDA, Administrative Report, 1962, p. 16.

TABLE II. STRATIFICATION OF THE SAMPLE BY COW NUMBERS AND BY ANIMAL UNITS, NON-PRIVILEGED RANCH STUDY--AREA "W".

Criteria	Stratified by Cow Numbers Initial Stratification	Stratified by Cow Numbers Actual Sample	Stratified by AU's Per Ranch Actual Sample a/	Stratified by AU's Per Ranch Usable Schedules b/
Cows Per Ranch	Cell Size	Cell Size	Cell Size	Cell Size
20-49	15	6		
50-74	10	9	18 c/	15
75-99	7	7		
100-124	6	8	17 d/	13
125-149	6	5		
150-199	6	13	17 e/	14
200-299	6	7		
over 300	8	7	10 f/	10
Total	64	62	62	52

a/ This column represents the stratification by AU criteria from the original "cows per ranch" criteria. The brackets show the division of the sample from one classification criteria to the other.

b/ This column represents the usable schedules after applying the limitations of the study. The numbers are the (Ns) or the category sample sizes used in following statistical analyses.

c/ 150 and under AUs per ranch.

d/ 151 to 250 AUs per ranch.

e/ 251 to 400 AUs per ranch.

f/ Over 400 AUs per ranch

TABLE III. STRATIFICATION OF THE SAMPLE BY COW NUMBERS AND BY ANIMAL UNITS, NON-PRIVILEGED RANCH STUDY--AREA "E".

Criteria	Stratified by Cow Numbers Initial Stratification	Stratified by Cow Numbers Actual Sample	Stratified by AU's Per Ranch Actual Sample a/	Stratified by AU's Per Ranch Usable Schedules b/
Cows per Ranch				
20-49	9	9		
50-74	9	7	23 c/	10
75-99	11	12		
100-124	10	11	22 d/	13
125-149	7	6		
150-199	7	9	14 e/	11
200-299	7	9		
over 300	10	14	18 f/	15
Total	70	77	77	49

a/ This column represents the stratification by AU criteria from the original "cows per ranch" criteria. The brackets show the division of the sample from one classification criteria to the other.

b/ This column represents the usable schedules after applying the limitations of the study. The numbers are the (N's) or the category sample sizes used in following statistical analyses.

c/ 150 and under AU's per ranch.

d/ 151 to 250 AU's per ranch.

e/ 251 to 400 AU's per ranch.

f/ Over 400 AU's per ranch.

usable schedules, especially in the small size categories.

The resulting number of schedules per stratum that were finally used in the cost and return analyses for Area "W" were 15, 13, 14 and 10 for the small to large categories respectively. The corresponding schedule numbers for Area "E" were 10, 13, 11 and 15.

Questionnaire Design

The questionnaires were completed in the field by personal interviews during October, November and December of 1963. Since the calendar year 1963 was not yet completed, data were obtained for 1962. Questions were asked regarding all resources used in the ranch business including also rates of resource use, unpaid family labor, perquisite values and inventory changes. The questionnaire was designed to provide cross checks on livestock sales and feed and crop inventory changes.

The ranchers were very cooperative in answering the questions and produced ranch record books or completed income tax forms at the majority of the interviews.

Data Organization

Depreciation Determination.

Individual ranch depreciation was determined by using a standard depreciation and average investment schedule. This schedule was compiled for machinery and equipment of the type and quality that was found on the Montana ranches. Similar schedules of machinery and equipment inventories compiled for other areas of the nation are not applicable to Montana

ranches. Montana's severe winter conditions and great distances from ranch to market necessitate heavy duty equipment. Similarly, buildings must be constructed to withstand strong winds and to give good service during prolonged periods of cold.

Machinery depreciation for the standard schedule was calculated by using the straight-line method and a 10 percent salvage value. Machinery investment was obtained by subtracting a 10 percent salvage value and then taking one-half of the remainder as the average life of machinery.

Buildings and improvements were figured on a similar basis but with no salvage value considered. The removal cost was assumed to cancel any salvage value that remains at the end of the useful life period.

Livestock investment was also determined by the average investment method. The initial January 1, 1962 value and the salvage value were obtained from the Billings, Montana market report for the month of January, 1962. (See Appendix A for a complete schedule of initial cost, average investment and annual depreciation for machinery, improvements and livestock as used in this study.)

In applying the depreciation schedule to the individual ranch questionnaires, machinery and improvement depreciation was taken directly from the standard schedule for the items reported by the respondent. Only one half of the automobile depreciation was included as ranch expense. Bull and milk cow depreciation was included in livestock depreciation since the majority of the ranches reported purchases of these livestock classes. Cow depreciation or appreciation was included if the cow inventory change

was greater or smaller than normal replacement rates as determined by expected useful cow life and thereby, in essence, placed a value on the age change of the cow herd. Horse depreciation was not included as a cost because the ranchers generally raised all replacement horses and the cost of raising them was included as a cash operating cost.

Operating Costs

Costs which are associated with the land were recorded separately as fixed costs. These costs include taxes, rent and ranch insurance and generally remain constant regardless of quantity of livestock production per year on the ranch.

Hired labor, including social security tax paid for hired labor was included in operating costs. Small size ranches generally used only small amounts of hired labor on a seasonal basis while the larger ranches often had one or more full time employees. Salary paid to the operator's family was included as hired labor cost as was the operator's salary if the ranch was operated as a corporation and the salary was actually paid.

Unpaid family labor was recorded as hours worked per year for each ranch. These hours were then given a dollar value by the following procedure. A per month salary of $250 for hired men who board themselves was reported by the majority of the respondents. An average rate of $1 per hour for operator labor was thereby derived. Family members, other than the operator, were given an allowance of 60 cents per hour derived in the same manner from a monthly salary of $150. The hourly rates of $1 and 60 cents were then combined in the proportions reported to arrive

at an overall hourly rate of all unpaid family labor of 90 cents per hour.

Average hours of unpaid family labor between different ranch size groups within each area were not significantly different, consequently averages for each area were determined. Annual unpaid labor allowances for Area "E" of $3,500 and for Area "W" of $3,250 were derived. These allowances were then used for each size group in the respective areas. It might well be argued that the ranches in the smaller size categories are in reality underemployed at the reported annual hours worked but this was the labor use pattern found to exist on Montana ranches at the time of the study. If the ranch families were to seek employment off their individual ranches, the allowances derived by the above method would almost exactly coincide with the wage rates for unskilled workers in their respective areas.

Other costs such as supplies, ranch utilities, repairs, fuel, seed, feed and veterinarian expense, office and accounting costs and board for hired labor were included in cash costs. Not included were expenses for personal dwelling, family share of utilities, one half of automobile expenses, actual interest payments 22/ and family living costs.

22/ Two methods of determining total interest costs are usable with the latter being equally accurate and much less complicated: (1) Add interest payments made on the total ranch debt to an interest charge for the owners equity; or (2) Assume full ownership and compute an interest return on the total ranch investment.

An interest cost on operating expenditures was computed by the following formula:

$$\frac{\text{Annual cash operating costs x 6\%}}{2}$$

Six percent interest was an approximate average of reported interest rates paid by ranchers as reported on schedules at the interviews. The result in the numerator of the formula was divided by two, since the rancher's expenditures are assumed to be spread throughout the year. This method resulted in an average annual cash operating cost of one half of the total cash operating cost. This interest cost was then entered as an item of total cost.

No effort was made to isolate receipts from other ranch enterprises nor to separately identify costs associated with these enterprises. The limitations previously outlined resulted in a relatively homogeneous sample in this respect for the current study when compared to the budgets o of the previous study (Table IV). The fact that the ranches in the small size categories of both areas have comparatively high percentages of their receipts from sources other than livestock can be explained by the relatively high degree of enterprise diversification found on these ranches. Area "E" ranches in all size categories had higher percentages of non-livestock receipts than those in the corresponding categories of Area "W". The prevalence of small grain enterprises, which are more common on plains ranches than on intermountain ranches, was usually accountable for the non-livestock receipts.

Receipts

Cattle receipts were used in analysis as reported by ranchers. The respondents gave total cattle receipts by class, approximate weight and number of each class sold and price per unit received. Other livestock sales were reported in a similar manner with the inclusion of lamb and wool incentive payments. An average livestock price of each size and area category was obtained by dividing total livestock receipts for the category by the total pounds of livestock sold.

Livestock inventory increases or decreases were included as receipts or expenditures respectively. Livestock values applied to the closing inventory were the same as those applied to the January 1, 1962 beginning inventory, and are shown in Appendix A.

The only adjustment needed on reported crop sales was the addition or subtraction of the inventory change of this class of ranch receipts.

Government payments including gasoline refunds, ASC payments for crop diversion, soil bank and soil conservation projects were included as gross income.

Estimates of "on the ranch" values were made for ranch products such as livestock, milk, eggs and garden products consumed by the operator's family. The total value of these was included in the gross receipts of the individual ranch schedules.

Ranch Investment

Total real estate investment estimates were obtained directly from the ranchers at the interviews. The price per acre of grazing and farm

TABLE IV. DOLLAR RECEIPTS FROM SOURCES OTHER THAN LIVESTOCK SALES EXPRESSED PER ANIMAL UNIT BY RANCH TYPE, SIZE GROUPS AND BY AREA.

Area and Type of Ranch	RANCH SIZE (AU's) 150 and under	151 to 250	251 to 400	401 and over
	Dol.	Dol.	Dol.	Dol.
Area "W"				
Non-privileged	19.70	21.91	21.28	8.76
Privileged b/				
(FS only)	66.68	.82	a/	7.67
(BLM only)	17.58	1.75	a/	1.48
(BLM + FS)	44.90	11.48	a/	1.07
Area "E"				
Non-privileged	41.05	27.29	32.80	17.57
Privileged b/	52.98	11.93	a/	3.53

a/ The privileged-ranch study did not have this size category.

b/ D. D. Caton, et. al., Economic Relationships of Grazing Fees and Permitted Use of Public Rangelands to Net Income on Western Livestock Ranches: A Regional Analysis, ERS, USDA, Administrative Report, 1962, pp. 30-31.

land was also obtained from the ranchers in most cases. This served as a double check on all ranch values in the respective area. The average investment value of the operator's dwelling was deducted from the reported ranch value to arrive at a real estate investment associated with production. 23/ To this land and improvement investment was added the average livestock investment and the average machinery investment to obtain a total investment per ranch. 24/

Indexing Privileged Ranch Study to 1962 Levels

Since the privileged ranch study used data from 1960 it was necessary to adjust the privileged ranch study prices and values to 1962 levels before comparing data from the two studies. Indexes of Montana prices paid and prices received were used to make these adjustments. Table V lists the index numbers and the adjustment factors used.

The index for receipts of all farm products was used to adjust receipts other than cattle receipts. Cattle receipts from the privileged ranch study were indexed to the average price received as reported in the schedules of the current study. The adjustment factors for cattle derived

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23/ An alternative method would have been to include the value of ranch dwelling as well as cash costs connected with the personal dwelling and then include a perquisite value for the dwelling as a receipt.

24/ An average, or half-life, investment was used. This method assumes that the investment item is depreciated to one-half of its initial value.

TABLE V. MONTANA PRICE INDEXES USED FOR ADJUSTING 1960 DATA TO 1962 LEVELS.

Item	Index for 1960	Index for 1962	Adjustment Factor
	Pct.	Pct.	
Receipts & Expenditures a/ (1947 - 49 = 100)			
Receipts of all Farm Products	87	95	1.092
Motor Vehicles	150	154	1.027
Farm Machinery	164	175	1.067
All Commodities Purchased	131	134	1.023
Wages	130	135	1.038
Real Estate Investment b/ (1957 - 59 = 100)			
Montana Grazing Land	121	131	1.083
Montana Farm Land	112	123	1.098

a/ Maurice C. Taylor, et. al., Prices Received and Prices Paid by Montana Farmers and Ranches 1960-62, Montana Agricultural Experiment Station, Bozeman, Montana in cooperation with United States Department of Agriculture Statistical Reporting Service, Helena, Montana, Bulletin 587, June, 1964.

b/ Farm Real Estate Market Developments, Economic Research Service, USDA, Washington, D. C., August, 1963, p. 42.

by this method were 1.329 for Area "W" and 1,308 for Area "E" from respective 1962 average per pound prices of 22.35 and 23.02 cents for all beef sold by respondents.

Farm machinery depreciation and average investment were adjusted by a 2:1 ratio of farm machinery to motor vehicles respectively. 25/ The resulting adjustment factor was 1.053.

Cash operating expenses were adjusted by using the adjustment factor from the index for commodities, taxes and wages.

An opportunity cost approach was used in adjusting the unpaid family labor of the privileged study, consequently the unpaid family labor allowances of the non-privileged study were applied to the privileged study. These annual allowances were $3,250 per ranch for Area "W" and $3,500 per ranch for Area "E".

Total ranch investment was indexed proportionately by indexes of the components of total ranch investment. Weighted averages of the various components of total ranch investment were derived from the non-privileged study. Non-privileged investment data will give a better approximation of the total investment index than will the privileged study, because the privileged ranches have some of the permit value capitalized into the base property value and would therefore show a higher value than would be indicated by the real estate index shown in Table V. This does not imply that the non-privileged and the privileged groups have the same percentage of investment in the various investment components, but only that the change in investment from 1960 to 1962 is better represented

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25/ A 2:1 ratio is an approximation of the ratio of farm machinery value to the value of motor vehicles as reported by the respondents.

by the adjustment factor derived from the non-privileged study. 26/ For the current study, the results of this method indicated that 15 percent of the total investment of ranches in Area "W" was for livestock, 13 percent was for machinery and equipment and 72 percent was for real estate. For Area "E" the corresponding percentages were 14, 12 and 74. These percentages were then multiplied by the respective adjustment factor for the various classes of investment as shown in Table V, to obtain an overall investment adjustment factor to be applied to the privileged study data. Area "W" total investment was adjusted upward by 1.117 and Area "E" was increased by 1.112.

Figure 5 shows graphically the increase in grazing land values (the major component of total ranch investment) for Montana and the 11 western states.

Area "E" Drought Adjustment

Area "E", which is always at the mercy of the erratic climate of the Great Plains, suffered a severe drought between 1959 and 1962. As a consequence cattle numbers dropped 20.68 percent between the January 1, 1960 inventory date of the privileged study and the January 1, 1962 inventory date of the non-privileged study.

26/ For instance, ranchers in Area "W" of privileged study who had both BLM and FS permits had 26 percent of their investment in livestock, 11 percent in machinery and 63 percent in real estate compared to 15 percent, 13 percent and 72 percent respectively for the non-privileged study in the same study area.

Precipitation records for the two-study areas are presented in Table VI(a). While some reduction in precipitation was indicated between the two time periods for the western area, cattle numbers were not appreciably affected as is shown in Table VII(a). Deviations from the six-year average cattle numbers are shown in Table VII(b) as percentages. The six-year average might be considered "normal" in that the ranchers tend to stock at this rate, but this need not imply a "correct" stocking rate.

As a result of partial liquidation of cow herds in the eastern study area at the time of the non-privileged study, actual cash receipts were reduced, while many of the costs remained unchanged. An adjustment in the data of the non-privileged study was therefore made to permit a more valid comparison between the two studies. In the adjustment, Area "E" cattle numbers and gross income were both increased by the full 20.68 percent. Feed and veterinary costs were increased by 20.68 percent; hired labor, unpaid family labor and depreciation were held constant; other cash costs including machinery repair, utilities and supplies were increased by 6 percent; fixed costs were increased by 1 percent to allow for taxes on the adjusted increase in cattle inventory; and the interest on operating capital was recalculated. Total ranch investment was increased only by the amount of the adjusted increase in cattle inventory.

These adjustments resulted in an increase of net returns per ranch for the non-privileged study as indicated by Table VIII.

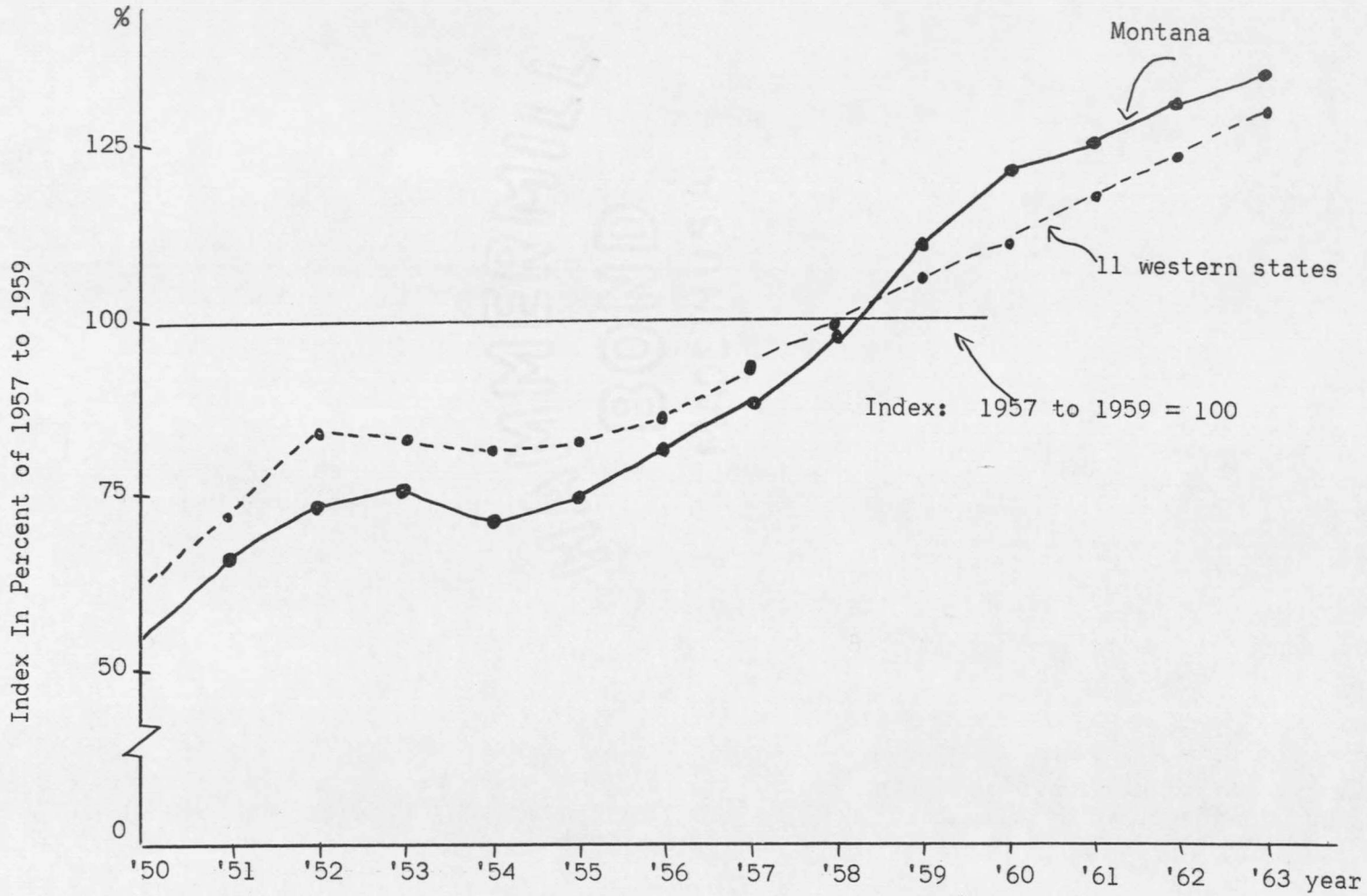

Figure 5. Grazing land indexes for Montana and the 11 western states. *

* Source: Farm Real Estate Market Development, Economic Research Service, USDA, Washington, D. C., August, 1963, p. 42.

TABLE VI(a). ANNUAL PRECIPITATION RECORDS FOR STUDY AREAS, 1957-61. *

County	1957	1958	1959	1960	1961	Normal a/
	in.	in.	in.	in.	in.	in.
Beaverhead	11.77	11.54	11.79	7.59	9.72	11.34
Madison	15.87	15.56	18.38	12.24	16.55	13.95
Ave. Area "W"	13.82	13.55	15.08	9.92	13.14	12.64
Garfield	8.89	11.65	9.51	6.16	9.32	10.31
Petroleum	17.53	13.30	13.17	8.37	9.91	12.57
Carter	14.80	14.42	11.88	12.14	11.86	13.22
Custer	12.62	13.22	9.48	7.34	9.97	12.17
Powder River	17.29	13.90	13.73	9.17	12.98	13.85
Prairie	14.42	13.20	9.65	7.29	8.07	12.36
Rosebud	14.10	10.76	7.66	6.09	10.16	11.73
Ave. Area "E"	14.24	12.92	10.73	8.08	10.32	12.32

TABLE VI(b). PRECIPITATION AVERAGES FOR THREE YEARS PRECEDING STUDY INVENTORY DATES. EXPRESSED AS PERCENTAGES OF NORMAL AND PERCENTAGE DECREASE. *

	Unit	1957-59	1959-61
Area "W"			
Three Year Total	inches	42.45	38.14
Three Year Average	inches	14.15	12.71
Percent of Normal a/	percent	111.95	100.55
Percent Decrease	percent	- - -	10.18
Area "E"			
Three Year Total	inches	37.89	29.13
Three Year Average	inches	12.63	9.71
Percent of Normal a/	percent	102.52	78.81
Percent Decrease	percent	- - -	23.13

a/ Normal is an average of the years 1931 through 1960.

* Source: Montana Agricultural Statistics, Montana Department of Agriculture in cooperation with USDA Statistical Reporting Service, Helena, Montana, Vol. VII, VIII and IX, 1958, 1960 and 1962.

TABLE VII(a). TOTAL CATTLE ON FARMS AND RANCHES ON JANUARY 1. *

County	Number of Cattle on Ranches Jan. 1 1957	1958	1959	1960	1961	1962	Total of Yrs
	Thousands of Head						
Beaverhead	199.8	123.6	127.7	116.6	106.3	113.7	
Madison	63.7	64.2	64.7	69.2	67.8	69.2	
Area "W" Total	183.5	187.8	192.4	185.8	174.1	182.9	1,106.5
Six Yr. Ave.							184.4
Garfield	49.9	45.9	44.6	44.4	43.1	36.6	
Petroleum	25.3	26.2	25.4	27.1	27.1	22.8	
Carter	43.4	42.5	39.4	40.0	38.0	28.9	
Custer	65.8	66.7	65.2	64.0	55.7	53.0	
Powder River	69.6	65.2	65.8	61.5	52.9	46.0	
Prairie	24.9	26.9	27.0	29.5	26.8	27.3	
Rosebud	79.2	72.6	75.9	71.5	60.8	53.5	
Area "E" Total	358.1	346.0	343.3	338.0	304.4	268.1	1,957.9
Six Yr. Ave.							326.3

TABLE VII(b). LIVESTOCK INVENTORIES OF JANUARY 1, 1960 AND JANUARY 1, 1962 EXPRESSED AS PERCENTAGE CHANGE FROM SIX-YEAR AVERAGE AND AS PERCENTAGE DECREASE. *

	Unit	1960	1962	Decrease
Area "W"				
Cattle Inventory	head	185,800	182,900	2,900
Percent of 6 Year Average	percent	100.75	99.18	
Percent Change	percent	- - -	- - -	1.56
Area "E"				
Cattle Inventory	head	338,000	268,100	69,900
Percent of 6 Year Average	percent	103.58	82.15	
Percent Change	percent	- - -	- - -	20.68

* Source: Montana Agricultural Statistics, Montana Department of Agriculture in cooperation with USDA Statistical Reporting Service Helena, Montana, Vol. VII, VIII and IX, 1958, 1960 and 1962.

TABLE VIII. NET RETURN TO INVESTMENT BEFORE AND AFTER ADJUSTING FOR DROUGHT, AREA "E", 1962, NON-PRIVILEGED RANCH STUDY.

Item	Ranch Size (AU's) 150 and under	151 to 250	251 to 400	401 and over
	Pct.	Pct.	Pct.	Pct.
Net Return to Investment as Calculated from Questionnaires a/	-2.80	1.59	1.27	3.85
Net Return to Investment After Adjusting for Drought	-1.70	3.24	3.29	6.07
Effect of Drought on Return to Investment	1.10	1.65	2.02	2.22

a/ Derived from simple averages of ranches in a size category rather than by weighted means as in Chapter IV.

Method of Comparison Between The Two Studies

Comparison between the privileged study using indexed 1960 data and the current study using 1962 data was made by comparing trend lines based on the size category averages of residuals to land, unpaid labor, capital and management derived from the two studies. Given the equation for a straight line as $Y = a + bx$, where the slope $(b) = \frac{N(\Sigma xy) - (\Sigma x)(\Sigma y)}{N(\Sigma x^2) - (\Sigma x)^2}$ 27/ and the y axis intercept $(a) = \bar{y} - b\bar{x}$, trend lines can be drawn by using the straight line estimation formula $\hat{Y} = a + bx$.

Trend lines were used to facilitate comparisons between the two studies at equivalent ranch sizes as expressed by AU's without converting all of the data to an animal unit basis. Trend lines also aid in presenting the effects of size in the comparisons.

Precise differences between the trend lines of the two studies were calculated by using the above formula. The above differences were originally hypothesized to be entirely attributable to the federal grazing permits that the privileged group had in excess of the federal grazing permits of the non-privileged group (also determined by differences between trend lines as shown in Chapter V, Figures 7-10). After indexing for the price level change, and adjusting for drought, the remaining net return

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27/ John E. Freund, Modern Elementary Statistics, Englewood Cliffs, N.J., Prentice Hall, Inc., 3rd Ed., 1960, p. 317.

differences between the two studies can then be attributed to the possession of federal grazing permits. The number of permits, expressed as animal unit months (AUM's), was then divided into the net return differences to determine an annual value per AUM of each permit in addition to the amount paid. The procedure is expressed in the following formula:

$$AV = \frac{(NR_1 - NR_2)}{(P_1 - P_2)}$$

Where: AV = Annual per AUM permit value.
NR_1 = Net return for privileged ranch study.
NR_2 = Net return for non-privileged ranch study.
P_1 = Number of AUM permits for privileged ranch study.
P_2 = Number of AUM permits for non-privileged ranch study.

Annual per AUM permit values were determined by applying the above formula to the difference between net returns to the management factor alone, and also by applying the formula to the difference between net returns to land, unpaid labor, capital and management. 28/ The results were also expressed as capitalized per AUM permit values by applying the following simple capitalization formula: $V = \frac{AV}{r}$

Where: V = Capitalized value of AUM permit
AV = Annual AUM permit value.
r = Capitalization rate.

Comparisons of the following budgets were made between the two studies in permit value determination: The Area "E" non-privileged study budgets were compared with the privileged study budgets of ranches using BLM permits year-long. The Area "W" non-privileged study budgets were compared with three sets of budgets: Those of ranches having FS permits for

28/ Grazing fees paid by permittees were included as cash costs, therefore the resulting permit values do not include this segment of permit value.

summer use only, those ranches having BLM permits for spring and fall use, and those ranches having BLM permits for spring and fall use plus FS permits for summer grazing.

The results of comparisons between study budgets is reported in Chapter V, but first the non-privileged ranch organization and cost and returns are shown in Chapters III and IV as outlined in objectives one and two that were presented in Chapter I.

CHAPTER III

MONTANA CATTLE RANCH ORGANIZATION
NON-PRIVILEGED RANCH CLASSIFICATION

As a method of determining Montana cattle ranch organization, data from the current non-privileged study were used. It should be recalled that these data were from the calendar year 1962, so the resulting description is for that year. In the analysis of this chapter, no adjustment was made for drought in Area "E"; the assumption was made that the 1962 stocking rate was more in line with a rate necessary to give a margin of safety for recurring climatic hazards.

The quantity used of each of the four general factors of beef cattle production, land, labor, capital and management are presented as a method of defining cattle ranch organization.

Land

Land as a factor of production becomes difficult to isolate from other production factors in practical application. Recognizing the complexity of the land factor, all real estate was considered as land in this analysis. This approach has validity since improvements, once placed on the land, become a part of the land in legal, practical and economic applications of the term.

Total acres of all classes of land per ranch in Area "W" ranged from an average of 503 acres per ranch in the small size category (150 AU's and under to an average of 6,770 acres in the large size category (401 AU's and over, Table IX). Per ranch land investment averages,

exclusive of all improvements, ranged from $41,256 for the small size to $323,055 for the large size. 29/

Total acres per ranch for the size groups in Area "E" were approximately three times greater than for the respective size categories in Area "W" and ranged from 3,676 acres to 19,981 acres (Table X). The land investment for corresponding size categories, however, were almost identical in the two study areas (Table XI). Greater production, and consequently higher per acre price for land in Area "W", accounts for these acreage relationships. A higher percentage of irrigated land in Area "W" is a prime factor of higher production.

Real estate items found to be typical on cattle ranches of different size categories in the two study areas are listed in Table IX and X. The building and improvement items became progressively greater in number and/or size as the ranch size increased. The increase was not, however in proportion to the size increase. Improvement differences between the two study areas were most noticeable in the lack of man-made watering improvements in Area "W". The western area also had grainaries of smaller capacity and fewer miles of fence per ranch than did the eastern study area.

Statistical significance levels were obtained for the acres per AU means among the four size groups of each area and between the weighted

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29/ The average number of AU's in the small to large size categories respectively in Area "W" were 104, 197, 314 and 656; for Area "E" the averages were 100, 204, 305 and 776.

means of the two study areas (Table XII). 30/

The comparison between means of various size groups within an area were found to be significant in some acreage comparisons. However, no valid conclusions can be drawn from these acreage comparisons since little consistency can be observed in comparing results of the two areas. For instance, the small size category of Area "W" had the lowest acreage per AU of any category in the area while the same size category in Area "E" revealed the highest acreage per AU of any size category in that area. Explanation through speculation might possibly justify the results of the comparison for one area but the same arguments would invalidate the justifications in the other area since the relationship between size and acreage per AU is reversed in the two areas.

The area mean differences, however, were significant at the 1 percent level as was previously discussed in the acres per ranch comparison at the beginning of this chapter.

30/ For statistical analysis in this chapter and Chapter IV, the data were converted to an AU basis. This facilities comparisons between size groups and between areas since the corresponding AU size category means of the two areas were not identical.

The level of significance is the average proportion of times that the investigator will be wrong in his assertion of mean differences. Consequently, the lower the significance percent of the statistical test, the more significant or valid are the results of the comparisons that are made. For example, if a comparison were to be found significant at the 1 percent significance level, there is a 1 percent probability that the correlation found was due to chance while at the 30 percent significance level the probability that the correlation found was due to chance is 30 percent.

For those readers not familiar with the statistical test used in these chapters, reference to Appendices B, C, D, and E will be helpful.

TABLE IX. AN ORGANIZATIONAL COMPARISON OF REAL ESTATE AND IMPROVEMENT COMPONENTS ON AREA "W" CATTLE RANCHES BY SIZE CATEGORY MEANS, 1962.

Item	Unit	Ranch Size (AU's) 150 and under	151 to 250	251 to 400	401 and over
Total Ranch Land	Acres	503	1,587	3,624	6,770
Irrigated Land	Acres	218	422	762	1,473
Rangeland	Acres	285	1,155	2,857	5,297
Dry Cropland	Acres	0	10	5	0
Operators Dwelling	Sq. Ft.	1,093	1,228	1,321	1,800
Other Dwellings & Bunk Houses	Sq. Ft.	170	382	389	908
Barns & Livestock Sheds	Sq. Ft.	2,673	3,469	3,107	6,934
Garages, Shops & Machine Sheds	Sq. Ft.	514	1,253	1,239	2,178
Grainary	Bu. Cap.	1,857	2,400	1,128	1,320
Fence	Miles	6	9	17	36
Corrals	Head Cap.	164	192	486	660
Wells	No.	---	1	---	1
Developed Springs	No.	---	---	1	1
Reservoirs	No.	---	---	1	---
Irrigation Dikes	1000 Cu Yds.	---	---	---	---
Reseeding	Acres	---	---	---	---
Stock Chutes	No.	1	1	2	2

TABLE X. AN ORGANIZATIONAL COMPARISON OF REAL ESTATE AND IMPROVEMENT COMPONENTS ON AREA "E" CATTLE RANCHES BY SIZE CATEGORY MEANS, 1962.

Item	Unit	Ranch Size (AU's) 150 and under	151 to 250	251 to 400	401 and over
Total Ranch Land	Acres	3,676	4,716	8,785	19,981
Irrigated Land	Acres	0	71	110	221
Rangeland	Acres	3,333	4,142	8,174	19,219
Dry Cropland	Acres	343	503	501	541
Operators Dwelling	Sq. Ft.	1,060	1,000	1,025	1,273
Other Dwellings & Bunk Houses	Sq. Ft.	84	134	328	708
Barns & Livestock Sheds	Sq. Ft.	1,670	1,769	2,791	3,365
Garage, Shops & Machine Sheds	Sq. Ft.	600	626	1,200	2,044
Grainary	Bu. Cap.	3,180	3,681	2,154	4,257
Fence	Miles	17	21	36	63
Corrals	Head Cap.	140	203	391	737
Wells	No.	3	4	6	12
Developed Springs	No.	2	1	4	3
Reservoirs	No.	4	5	11	19
Irrigation Dikes	1000 Cu. Yds.	1	6	20	15
Reseeding	Acres	114	89	357	306
Stock Chutes	No.	---	1	1	1

TABLE XI. AN ORGANIZATIONAL COMPARISON OF TYPICAL CATTLE RANCH INVESTMENT COMPONENTS BY SIZE CATEGORY MEANS AND BY AREAS, 1962.

Item	Average Investment by AU Size Categories							
	150 & Under		151 to 250		251 to 400		401 & over	
	Dol.	Pct.	Dol.	Pct.	Dol.	Pct.	Dol.	Pct.
Area "W"								
Land	41,256	57.33	76,295	60.26	142,968	66.74	323,055	71.70
Buildings and a/ Improvements	6,444	8.96	10,552	8.33	14,139	6.60	27,775	6.17
Machinery and Equipment	14,311	19.89	18,844	14.88	24,346	11.37	34,386	7.63
Livestock	9,947	13.82	20,923	16.53	32,758	15.29	65,341	14.50
Total Investment	71,958	100.00	126,614	100.00	214,211	100.00	450,557	100.00
Area "E"								
Land	60,412	61.01	71,062	56.02	124,961	60.37	321,679	65.89
Buildings and a/ Improvements	13,678	13.81	18,250	14.39	29,039	14.03	57,216	11.72
Machinery and Equipment	14,830	14.98	17,565	13.85	23,028	11.12	32,721	6.70
Livestock	10,096	10.20	19,974	15.74	29,973	14.48	76,603	15.69
Total Investment	99,016	100.00	126,851	100.00	207,001	100.00	488,219	100.00

a/ Excluding value of personal dwelling.

TABLE XII(a). ACRES REQUIRED PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Acres	Pct.	Acres	Pct.
150 and under	4.7	52.77	40.5	64.59
151 to 250	8.0	86.12	23.2	29.14
251 to 400	11.7	48.38	29.0	34.28
401 and over	8.9	66.97	27.8	39.93
Significance Level Among Size means a/	*		*	
Area Mean	8.2		29.4	
Significance Level Between Area Means a/	**		**	

TABLE XII(b). ACRES REQUIRED PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WB (11.7) - WD (4.7)	**
WB (11.7) - WC (8.0)	NS
WB (11.7) - WA (8.9)	NS
WA (8.9) - WD (4.7)	NS
WA (8.9) - WC (8.0)	NS
WC (8.0) - WD (4.7)	NS
ED (40.5) - EC (23.2)	*
ED (40.5) - EA (27.8)	*
ED (40.5) - EB (29.0)	NS
EB (29.0) - EC (23.2)	NS
EB (29.0) - EA (27.8)	NS
EA (27.8) - EC (23.2)	NS

a/* Significant at the 5 percent significance level.

** Significant at the 1 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D, and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

Capital

Machinery and equipment items most frequently found on cattle ranches are shown by area and size category in Tables XIII and XIV. Area "W" had more tractors, more haying equipment and more equipment for irrigated agriculture than Area "E". Irrigated hay production, to provide forage for the long mountain-valley feeding season, was responsible for this organizational difference. Area "E" had more trucks, more grain machinery and more fencing equipment. A greater proportion of grain grown on the ranches and the greater acreage per animal unit are factors responsible for these machinery differences.

Age of machinery differed only slightly between study areas with the exception that small haying tractors tended to be older in Area "E". Age differences did occur among size categories, with the smaller ranches generally having older machines.

Machinery investment per ranch, as derived from the standard average investment schedule of Appendix A, differed only slightly between comparable size categories of the two study areas (Table XI). When the data where converted to AU machinery requirements and statistical test applied, machinery investment per AU was found to be significantly different at the 1 percent level among size group means within areas, but the difference between area means did not show significance (Table XV). The highly significant differences among the size category means points out one of the major contributing factors in economies of size on cattle ranches.

TABLE XIII. COMPARISON OF CATEGORY AVERAGES OF MACHINERY INVENTORY AND AGE ON AREA "W" CATTLE RANCHES BY SIZE CATEGORIES, 1962.

Item	Ranch Size (AU's) 150 and Under		151 to 250		251 to 400		401 and over	
	No.	Age	No.	Age	No.	Age	No.	Age
20 hp. Tractor	2	14	2	13	2	12	3	7
30 hp. Tractor	1	14	1	8	1	10	2	6
40 hp. Tractor	1	8	1	6	1	8	1	2
50 hp. Tractor	-	-	-	-	-	-	1	6
Crawler tractor 50 hp.	-	-	-	-	-	-	1	7
1½ to 2 ton truck	1	12	1	9	1	11	1	7
4 WD pickup	-	-	-	-	1	5	-	-
½ ton pickup	1	6	1	6	1	5	2	4
Automobile	1	4	1	3	1	3	2	2
Mower	1	10	1	5	2	7	1	3
Side rake	1	8	1	9	1	4	1	4
Dump rake 21'	-	-	1	6	1	6	1	6
Hay baler	1	6	1	4	1	4	1	4
Hydraulic stacker	1	5	1	5	1	6	1	8
Beaverslide stacker	-	-	1	7	1	6	1	6
Truck buck rake	-	-	-	-	1	10	1	7
Saddles	2	-	3	-	5	-	5	-
Plow (2 or 3 bottom)	1	7	1	8	1	8	1	5
Disk harrow	1	8	-	-	1	7	1	6
Spike harrow	1	11	1	10	1	9	-	-
Grain drill	1	14	1	10	1	8	1	6
Leveler	-	-	1	6	1	8	1	6
Ditcher	1	8	1	6	1	5	1	5
Grain Auger	1	6	-	-	-	-	-	-
Wagons	1	7	2	7	2	7	3	7
Sprayer	-	-	-	-	-	-	1	4
Fuel Tanks	1	5	1	5	1	5	1	5
Welder	1	10	1	10	1	10	1	10
Manure Spreader	1	7	1	5	1	8	1	6

TABLE XIV. COMPARISON OF CATEGORY AVERAGES OF MACHINERY INVENTORY AND AGE ON AREA "E" CATTLE RANCHES BY SIZE CATEGORIES, 1962.

Item	Ranch Size (AU's) 150 and under		151 to 250		251 to 400		401 and over	
	No.	Age	No.	Age	No.	Age	No.	Age
20 hp. Tractor	1	13	1	15	1	17	1	17
30 hp. Tractor	1	12	1	9	1	11	1	11
40 hp. Tractor	1	12	1	13	-	-	1	9
50 hp. Tractor	-	-	-	-	1	6	1	5
Crawler Tractor 50 hp.	-	-	-	-	-	-	1	10
1½ to 2 ton truck	-	-	1	10	1	10	2	8
½ ton pickup	1	6	1	6	1	5	2	6
Automobile	1	2	1	4	1	3	1	3
Mower	1	10	1	10	1	8	2	5
Side rake	-	-	1	7	1	7	1	5
Dump rake 12'	1	5	1	8	1	8	-	-
Hay baler	-	-	-	-	1	5	1	4
Hydraulic stacker	1	7	1	9	1	7	1	4
Saddles	2	-	2	-	3	-	4	-
Plow (2 or 3 bottom)	1	9	1	10	-	-	-	-
Plow (4 or 5 bottom)	-	-	-	-	1	9	1	7
Disk harrow	1	11	1	8	1	7	1	7
Tool bar	1	6	1	9	1	6	-	-
Spike harrow	1	8	1	10	1	10	1	9
Grain drill	1	13	1	10	1	13	1	9
SP combine	-	-	-	-	-	-	1	8
Grain Auger	-	-	-	-	1	6	1	7
Wagons	1	8	1	7	2	7	2	8
Sprayer	1	8	1	5	1	5	1	5
Post hole auger	-	-	-	-	1	6	1	5
Fuel tanks	2	5	2	5	2	5	2	6
Welder	1	8	1	10	1	10	1	10
Manure Spreader	-	-	-	-	-	-	1	8

Indivisibility of some machinery items prevent optimum input factor balance at these low levels of production. 31/

Livestock investment is another important component of the total capital requirement. Livestock investment made up an almost equal proportion of the total investment of the different size categories in the two study areas (Table XI). This is indicative of the constant need for this investment as a tool of production on Montana cattle ranches.

A look at the composition of the AU classification of the different size categories in the two areas will give some insight into the proportion of cows to the total AU equivalents in each size category (Table XVI). It should be pointed out that in this analysis producing ewes were converted to cow equivalents by a 5:1 ratio.

Note the similarity of livestock organization between size categories and areas. The major exception was in the large size category of each area where the percentage of cows to the total AU's is low. Accountable, in part, for this difference was the larger percentage of calves that were held beyond the January 1 inventory date and sold as yearlings the following year.

31/ Edward H. Chamberlin, "Proportionality, Divisibility and Economies of Scale", Quarterly Journal of Economics, Vol. LXII, Feb., 1948 pp. 229-262.

TABLE XV (a). MACHINERY INVESTMENT PER ANIMAL UNIT. COMPARISON OF MEANS COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	144.07	44.51	165.95	63.46
151 to 250	96.71	36.67	86.20	33.04
251 to 400	76.30	30.67	76.08	42.93
401 and over	54.35	46.70	49.72	60.76
Significance Levels Among Size Means a/	**		**	
Area Means	96.73		89.04	
Significance Levels Between Area Means a/	NS		NS	

TABLE XV(b). MACHINERY INVESTMENT PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (144.07) - WA (54.35)	**
WD (144.07) - WB (76.30)	**
WD (144.07) - WC (96.71)	*
WC (96.71) - WA (54.35)	*
WC (96.71) - WB (76.30)	NS
WB (76.30) - WA (54.35)	NS
ED (165.95) - EA (49.72)	**
ED (165.95) - EB (76.08)	**
ED (165.95) - EC (86.20)	**
EC (86.20) - EA (49.72)	NS
EC (86.20) - EB (76.08)	NS
EB (76.08) - EA (49.72)	NS

a/ *Significant at the 5 percent significance level.

**Significant at the 1 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D, and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

TABLE XVI. COMPOSITION OF AU STRATIFICATIONS, BY COW NUMBERS AND BY COWS AS PERCENTAGE OF TOTAL AU'S, 1962.

Area and Ranch Size (AU's)	AU Means for Size Category	Cow Means For Size Category	Cows As Percentage of Total AU's
	No.	No.	Pct.
Area "W"			
150 and under	104	61	58.65
151 to 250	197	113	57.36
251 to 400	314	182	57.96
401 and over	656	374	57.01
Weighted area mean			57.43
Area "E"			
150 and under	100	60	60.00
151 to 250	204	114	55.88
251 to 400	305	191	62.62
401 and over	776	383	49.36
Weighted area mean			53.25

Again for statistical testing, the investment per AU means were compared by sizes. The small size category in both areas had higher investment per AU than the larger sizes, but the statistical tests revealed only a low level of significance (5 percent level or lower), for the mean differences. (Table XVII).

The area mean differences tested significant at a low level (significance level of 30 percent).

Labor

Total labor use on ranches can be divided into two parts: hired labor and unpaid family labor. In an effort to gain accuracy in respondent answers, the hired labor was recorded as annual cost per year and the unpaid family labor was recorded as hours worked per year. The 90 cents per hour conversion rate, as derived in Chapter II, is applicable to both of the total labor components. Table XVIII shows the amount of total labor that was being used on cattle ranches of different size groups in the two study areas. It can be noted that the percentage of hired labor is higher for the large size categories while the small size categories revealed lower percentages of hired labor. Needless to say the converse was true for the unpaid family labor percentages.

Upon application of statistical tests of total labor use per AU, the means in the size categories were found to be significantly different (Table XIX). The small size groups in both areas had significantly higher labor requirements per AU than did the larger size categories.

TABLE XVII(a). TOTAL INVESTMENT PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE AND SIGNIFICANCE BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C. V.	Area "E" Means	Area "E" C. V.
Ranch Size(AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	695.43	45.09	1,015.53	52.14
151 to 250	640.62	30.77	623.59	24.72
251 to 400	679.95	27.37	687.06	46.24
401 and over	652.21	40.28	680.97	37.55
Significance Levels Among Size Means a/	NS		*	
Area Mean	669.25		735.39	
Significance Levels Between Area Means a/	NS		NS	

TABLE XVII(b). TOTAL INVESTMENT PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (695.43) - WC (640.62)	NS
WC (695.43) - WA (652.21)	NS
WD (695.43) - WB (679.95)	NS
WB (679.95) - WC (640.62)	NS
WB (679.95) - WA (652.21)	NS
WA (652.21) - WC (640.62)	NS
ED(1015.53) - EC (623.59)	*
ED(1015.53) - EA (680.97)	*
ED(1015.53) - EB (687.06)	*
EB (687.06) - EC (623.59)	NS
EB (687.06) - EA (680.97)	NS
EA (680.97) - EC (623.59)	NS

a/* Signficant at the 5 percent significance level.

** Significant at the 1 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

TABLE XVIII. TOTAL ANNUAL LABOR USE ON MONTANA CATTLE RANCHES BY SIZE AND AREA, 1962.

Area and Ranch Size (AU's)	Total Labor	Hired Labor		Unpaid Family Labor	
	Dol.	Dol.	Pct.	Dol.	Pct.
Area "W"					
150 and under	3,096	448	14	2,648	86
151 to 250	4,416	1,532	35	2,884	65
251 to 400	6,543	2,001	31	4,542	69
401 and over	12,315	9,385	76	2,930	24
Area "E"					
150 and under	4,052	302	7	3,750	93
151 to 250	3,510	207	6	3,303	94
251 to 400	6,284	2,392	38	3,892	62
401 and over	9,110	5,802	64	3,308	36

TABLE XIX(a). TOTAL LABOR COSTS PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE AND SIGNIFICANCE BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C. V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	32.54	50.06	44.74	57.29
151 to 250	22.66	36.50	17.24	22.68
251 to 400	20.92	36.62	20.94	53.10
401 and over	18.12	55.24	13.44	43.15
Significance Level Among Size Means a/	*		**	
Area Mean	24.17		22.52	
Significance Level Between Area Means a/	NS		NS	

TABLE XIX(b). TOTAL LABOR COSTS PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (32.54) - WA (18.12)	**
WD (32.54) - WB (20.92)	**
WD (32.54) - WC (22.66)	*
WC (22.66) - WA (18.12)	NS
WC (22.66) - WB (20.92)	NS
WB (20.92) - WA (18.12)	NS
ED (44.74) - EA (13.44)	**
ED (44.74) - EC (17.24)	**
ED (44.74) - EB (20.94)	**
EB (20.94) - EA (13.44)	NS
EB (20.94) - EC (17.24)	NS
EC (17.24) - EA (13.44)	NS

a/ * Significant at the 5 percent significance level.

** Significant at the 1 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices, B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

This indicates less efficient labor utilization, underemployment and immobility of labor for these size groups. Note that it is only in the small size category, of 150 AU's and under, that the extreme labor inefficiencies were apparent.

Differences in total labor costs between areas were not significant at any test level including the 40 percent level.

Management

The management factor of production is difficult to isolate or quantify. The economic payment to management is termed profit, and must be included in economic analysis to compensate the enterpreneur for his contribution to the firm as organizer, risk taker, innovator and manager. This factor must not be confused with operator's labor but should be considered above and beyond his labor contribution. The manager's profit (or loss) should not be confused with excess profits or monopoly profits but should be dealt with as a payment for a production factor.

Because of the difficulty in pricing the management factor, the method of deriving a net return to management is sometimes used. This is the net residual remaining after all of the other production factors have received their compensation.

After deducting all cash costs, allowing a 5 percent opportunity cost for investment and assigning a family living allowance, the net return to management per ranch derived from a simple average of ranches in each size category for Area "W" were -$4819, -$6206, and -$7275 for the smallest to largest size categories respectively. The corresponding net return figures for Area "E" were -$7721, -$4324, -$7727, and -$5594.

All residuals were negative with no appreciable differences among size categories or areas. This is to say that management on Montana ranches was receiving a net loss for its effort in 1962. Is this to imply that management was really worth less than nothing or were the other factors of production over-priced? In reality our accounting system ignores the capital gains or appreciation in ranch property values that have often resulted in incomes to the ranchers that have been adequate to compensate management effort.

The full derivation and the statistical tests for the per animal unit management residuals are shown in the following chapter.

CHAPTER IV

COSTS, RETURNS AND NET RESIDUALS--NON-PRIVILEGED RANCH CLASSIFICATION

This chapter is devoted to the derivation of net returns to selected factors of production. To permit a complete analysis of net returns, expenditures for goods or services provided by the operator himself were included together with all cash receipts and expenditures. 32/

Derivation of net returns, in this chapter, was made by the following formula:

$$\text{Gross Receipts} - \begin{pmatrix}\text{Cost of Specified} \\ \text{Factors of Production}\end{pmatrix} = \begin{pmatrix}\text{Net Returns to} \\ \text{Remaining Factors} \\ \text{of Production}\end{pmatrix}$$

The data used were from the ranch interview schedules completed in this study. All of the data used in this chapter were converted to an AU basis to facilitate comparisons and to give more meaningful statistical tests among size categories and between areas. The common classes of production factors were broken down into the subclasses that were readily discernible from the survey data. Each of the following sections of this chapter contains a discussion of the cost or return item and a table showing the statistical analysis of the item. Table XXXII, near the end of the chapter, summarizes the statistical tests of significance for the various cost or return items all the way to the low significance level of 40 percent.

32/ Kenneth E. Boulding, Economic Analysis, New York: Harper & Brothers, 3rd Edition, 1955, pp. 492-501.

TABLE XX. IMPORTANCE OF LIVESTOCK SALES AS SOURCE OF INCOME BY SIZE CATEGORY AND AREA, 1962.

Area and Ranch Size	Livestock Production Per AU	Livestock Price Per Pound	Livestock Receipts Per AU	Livestock Income as a Percent of Total Income
	Lbs.	Cents	Dols.	Pct.
Area "W"				
150 and under	334	25.10	83.83	81.0
151 to 250	301	23.63	71.13	76.5
251 to 400	264	22.16	58.50	73.3
401 and over	344	21.89	75.30	89.6
Area "E"				
150 and under	219	24.69	54.07	56.8
151 to 250	249	22.83	56.85	67.6
251 to 400	271	23.68	64.17	66.2
401 and over	339	22.71	76.99	81.4

Gross Receipts Per AU

All classes of receipts were included in the analysis of this chapter. Livestock receipts, receipts from various crops, government and miscellaneous income, inventory changes and perquisite values were all included. The importance of livestock sales to the ranchers interviewed for this study can be seen in Table XX. Income not credited to livestock includes income such as government payments to the rancher for range development, gasoline refunds and perquisite value of ranch products used by the ranch family. These income items are as closely related to livestock production as they are to cash crop production. Any conclusions about income sources must bear consideration of this fact.

Gross ranch receipts per AU were used in testing for significance. With reference to Table XXI it can be noted, after testing by size categories, that means were not significantly different (tests showed 20 percent for Area "W" and less than 40 percent for Area "E". This indicates that the small size category ranchers in the two study areas were able to derive receipts per animal unit that were nearly as high as those in the larger sizes.

The relatively low coefficient of variation (C.V.) and the low level of significance among size categories also indicates a sample with relatively homogeneous income sources as was shown in Table IV of Chapter II. The conclusion can therefore be made that the receipts from income sources other than livestock, though varying slightly in proportion from one size

TABLE XXI(a). GROSS RECEIPTS PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREA, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	104.63	32.44	99.63	37.82
151 to 250	91.31	44.23	84.46	26.96
251 to 400	80.42	22.23	97.90	37.37
401 and over	83.67	31.28	94.23	40.14
Significance Level Among Size Means a/	NS		NS	
Area Mean	90.75		93.56	
Significance Level Between Area Means a/	NS		NS	

TABLE XXI(b). GROSS RECEIPTS PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (104.63) - WB (80.42)	NS
WD (104.63) - WA (83.67)	NS
WD (104.63) - WC (91.31)	NS
WC (91.31) - WB (80.42)	NS
WC (91.31) - WA (83.67)	NS
WA (83.67) - WB (80.42)	NS
ED (99.63) - EC (84.46)	NS
ED (99.63) - EA (94.23)	NS
ED (99.63) - EB (97.90)	NS
EB (97.90) - EC (84.46)	NS
EB (97.90) - EA (94.23)	NS
EA (94.23) - EC (84.46)	NS

a/ NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

TABLE XXII(a). TOTAL COSTS PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	115.60	40.12	134.50	47.00
151 to 250	89.06	35.31	72.71	27.33
251 to 400	68.38	37.17	89.07	66.13
401 and over	60.61	42.83	70.48	63.69
Significance Level Among Size Means a/	**		*	
Area Mean	85.68		88.31	
Significance Levels Between Area Means a/	NS		NS	

TABLE XXII(b). TOTAL COSTS PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (115.60) - WA (60.61)	**
WD (115.60) - WB (68.38)	**
WD (115.60) - WC (89.06)	*
WC (89.06) - WA (60.61)	NS
WC (89.06) - WB (68.38)	NS
WB (68.38) - WA (60.61)	NS
ED (134.50) - EA (70.48)	**
ED (134.50) - EC (72.71)	**
ED (134.50) - EB (89.07)	*
EB (89.07) - EA (70.48)	NS
EB (89.07) - EC (72.71)	NS
EC (72.71) - EA (70.48)	NS

a/ * Significant at the 5 percent significance level.

** Significant at the 1 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

category to another, had little or no effect on variations in gross income per animal unit.

The difference between the weighted gross receipts means of $90.75 for Area "W" and $93.56 for Area "E" was not found to be significant at even the 40 percent significance level. This indicates that neither area has an advantage over the other in regards to receipts per animal unit.

Total Costs Per AU

For analysis, costs were broken down into several cost categories. But, first, to gain knowledge of the overall cost of producing beef, the total costs were examined. Much can be learned from a careful examination of the results of the various statistical tests presented in Table XXII.

First of all, the size of the C.V.'s is not great. This indicates relative homogeneity of total production costs among the individual observations in any one size category. That is, the total costs of raising beef did not vary a great deal from one ranch to another in a given size group. However by looking at the C.V. column for some of the cost items comprising total costs (discussed in following sections), larger C.V.'s can be observed. This indicates substitution of input factors. For example, some ranchers were substituting capital, in the form of equipment, for labor. This resulted in higher equipment costs and lower hired labor costs but in the final analysis the total cost of production would not be greatly different from a ranch with a different input balance.

In the tests for significance among and between size category means, the smallest size categories in both study areas displayed highly significant differences (at the 1 percent level) from the other size groups. However, differences between means of other size groups were not significant at the 5 percent level. This is important to note because it emphasizes the need for adequate ranch size to obtain a nearer to optimum resource balance, but it also points out that further advantages in production efficiency are not great with extremely large ranch sizes.

Area means of $85.68 for Area "W" and $88.31 for Area "E" were not found to be signficantly different at even the 40 percent level. This indicates the lack of comparative production advantages of one area over the other. A comparison of net returns to investment and management, as derived from the differences between the gross receipts and total costs, will be shown in a later section; but next a look at a comparison of some separate cost items.

Fixed Cash Costs Per AU

Separation of fixed from variable costs becomes extremely difficult. By definition, fixed costs are those costs which continue even if production falls to zero. 33/ Fixity of costs can also only be determined after definition of the time period involved. All costs, in a sense, are variable if given a long enough period of time to adjust. Conversely, all are

33/ Earl O. Heady, Economics of Agricultural Production and Resource Use, New York: Prentice-Hall, Inc., 1952, pp. 316-317, 680.

TABLE XXIII(a). FIXED CASH COSTS PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	13.92	94.11	10.54	40.32
151 to 250	11.04	56.61	8.30	90.96
251 to 400	8.68	54.38	9.89	70.88
401 and over	5.84	48.97	7.12	27.97
Significance Level Among Size Means a/	NS		NS	
Area Mean	10.24		8.76	
Significance Level Between Area Means a/	NS		NS	

TABLE XXIII(b). FIXED CASH COSTS PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (13.92) - WA (5.84)	*
WD (13.92) - WB (8.68)	NS
WD (13.92) - WC (11.04)	NS
WC (11.04) - WA (5.84)	NS
WC (11.04) - WB (8.68)	NS
WB (8.68) - WA (5.84)	NS
ED (10.54) - EA (7.12)	NS
ED (10.54) - EC (8.30)	NS
ED (10.54) - EB (9.89)	NS
EB (9.89) - EA (7.12)	NS
EB (9.89) - EC (8.30)	NS
EC (8.30) - EA (7.12)	NS

a/ * Significant at the 5 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

fixed after they have been incurred (that is, if the period of time is extremely short).

For the analysis of this study, such cash costs as taxes, rent, grazing fees and ranch insurance were considered fixed.

After statistical analysis of fixed cash costs per AU, few significant differences could be found among the size categories. Area "W" tested significant at the 20 percent level and Area "W" at the 40 percent level. (Tables XXIII and XXXII).

The difference between area means also displayed significance only at the low level of 30 percent, so firm conclusions would be difficult.

Annual Depreciation Per AU

Depreciation, in analysis, can be considered a fixed cost item. The annual depreciation allowance, is in effect, incurred at the time of purchase of the capital item. Depreciation is a very real cost and since it is a method of building a replacement fund, it should be considered a cost by every ranch manager. If ranchers fail to recognize depreciation as a cost item, they might consider their incomes adequate until the arrival of replacement date leaves them short of repurchase funds.

Tests of significance levels among and between size category means for depreciation per AU, emphasized the unfavorable economic position of the small size category in relation to the other categories. Both study areas tested significant at the 1 percent level. Furthermore, the small category mean, for Area "E", was significantly different from others in

TABLE XXIV(a). ANNUAL DEPRECIATION PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS, BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	29.39	51.92	35.06	56.19
151 to 250	23.00	26.30	19.77	49.01
251 to 400	13.50	64.96	17.40	70.92
401 and over	11.46	53.32	13.53	51.14
Significance Level Among Size Means a/	**		**	
Area Mean	20.07		20.45	
Significance Level Between Area Means a/	NS		NS	

TABLE XXIV(b). ANNUAL DEPRECIATION PER ANIMAL UNIT. SIGNFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (29.39) - WA (11.46)	**
WD (29.39) - WB (13.50)	**
WD (29.39) - WC (23.00)	NS
WC (23.00) - WA (11.46)	*
WC (23.00) - WB (13.50)	*
WB (13.50) - WA (11.46)	NS
ED (35.06) - EA (13.53)	**
ED (35.06) - EB (17.40)	**
ED (35.06) - EC (19.77)	**
EC (19.77) - EA (13.53)	NS
EC (19.77) - EB (17.40)	NS
EB (17.40) - EA (13.53)	NS

a/ * Significant at the 5 percent significance level.

** Significant at the 1 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices, B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

TABLE XXV(a). VARIABLE COSTS PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OR VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	44.21	51.87	47.50	58.88
151 to 250	39.99	68.84	28.35	34.92
251 to 400	31.63	64.15	48.98	82.73
401 and over	38.18	58.56	44.62	100.33
Significance Level Among Size Means a/	NS		NS	
Area Mean	38.61		41.87	
Significance Level Between Area Means a/	NS		NS	

TABLE XXV(b). VARIABLE COSTS PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (44.21) - WB (31.63)	NS
WD (44.21) - WA (38.18)	NS
WD (44.21) - WC (39.99)	NS
WC (39.99) - WB (31.63)	NS
WC (39.99) - WA (38.18)	NS
WA (38.18) - WB (31.63)	NS
EB (48.98) - EC (28.35)	NS
EB (48.98) - EA (44.62)	NS
EB (48.98) - ED (47.50)	NS
ED (47.50) - EC (28.35)	NS
ED (47.50) - EA (44.62)	NS
EA (44.62) - EC (28.35)	NS

a/ NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices, B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

TABLE XXVI(a). FEED AND VETERINARY COSTS PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	6.84	74.56	10.28	115.66
151 to 250	4.37	145.77	6.67	59.67
251 to 400	3.89	78.92	7.75	70.32
401 and over	3.34	67.66	6.80	85.74
Significance Level Among Size Means a/	NS		NS	
Area Mean	4.78		7.69	
Significance Level Between Area Means a/	*		*	

TABLE XXVI(b). FEED AND VETERINARY COSTS PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (6.84) - WA (3.34)	NS
WD (6.84) - WB (3.89)	NS
WD (6.84) - WC (4.37)	NS
WC (4.37) - WA (3.34)	NS
WC (4.37) - WB (3.89)	NS
WB (3.89) - WA (3.34)	NS
ED (10.28) - EC (6.67)	NS
ED (10.28) - EA (6.80)	NS
ED (10.28) - EB (7.75)	NS
EB (7.75) - EC (6.67)	NS
EB (7.75) - EA (6.80)	NS
EA (6.80) - EC (6.67)	NS

a/ * Significant at the 5 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

the area, while the means of the two smallest categories in Area "W" were found to be significantly different from the others in that area (Table XXIV).

Area means were almost identical with no significance being found between means.

Variable Costs Per AU

Costs which are directly related to production output are termed variable costs. The statistical tests of this cost classification gave support to the choice of items included. Significance at a higher level than 40 percent was not found between any of the size category means of either area. Furthermore, the difference between area means were not significant at any significance level. The conclusion must therefore be made that the cost items included in the variable costs do indeed vary in direct proportion with the output (Table XXV).

Some of the component items of variable costs do show a degree of significance as is shown by the following discussions of these components, but in summation, these differences cancel each other to make the total variable costs per AU almost the same for the different size categories.

Feed and Veterinary Costs Per AU.--These cost items are, as one would expect, directly related to livestock production. The small size categories did have larger expenditures than the other categories but the means were only significant at very low levels of significance (Table XXVI).

The per AU cost of $7.69 for Area "E" was significantly higher (at the 5 percent level) than the $4.78 for Area "W". This does not imply greater winter feed requirements for the plains area, but rather, greater

feed purchases. Area "W" ranchers produced more of their winter feed requirements, in the form of hay, as was pointed out in the discussion of machinery investment in Chapter III and therefore reported lower feed purchases.

Hired Labor Costs Per AU.--Statistical testing of this cost item revealed a direct relationship to ranch size. The larger ranches used a greater amount of hired labor per AU than the smaller size ranches. The difference was significant; at the 10 percent level in Area "W" and at the 1 percent level in Area "E". (Table XXVII).

The C.V.'s of size categories are relatively high. This is indicative of great variance in hired labor use among individual ranchers within a size category. In any discussion of ranch labor use, it must be remembered that part of the labor requirement on ranches is made up by unpaid family labor. The variance in hired labor use among ranches is thereby partly cancelled.

The difference between area means was not found to be significant at the 1 percent or 5 percent levels but was significant at the low level of 20 percent, with Area "W" using more hired labor per AU.

Miscellaneous Variable Costs Per AU.--This is a catch-all classification of costs not covered in the above classifications. Included, are all repair items, fuel and oil, seed and fertilizer, ranch share of utilities and numerous other minor cost items pertinent to the ranch operation (Table XXIII).

There was little significant difference indicated by statistical tests for this cost class, therefore it must be concluded that there was no appreciable difference in the use per AU of these cost items in the production of livestock among the difference size categories.

TABLE XXVII(a). HIRED LABOR COSTS PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OR VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	4.48	118.53	3.35	123.88
151 to 250	7.62	100.00	0.96	154.17
251 to 400	6.35	95.75	8.15	108.10
401 and over	13.00	97.69	8.24	87.14
Significance Level Among Size Mean a/	NS		**	
Area Mean	7.41		5.21	
Significance Level Between Area Means a/	NS		NS	

TABLE XXVII(b). HIRED LABOR COSTS PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WA (13.00) - WD (4.48)	*
WA (13.00) - WB (6.35)	NS
WA (13.00) - WC (7.62)	NS
WC (7.62) - WD (4.48)	NS
WC (7.62) - WB (6.35)	NS
WB (6.35) - WD (4.48)	NS
EA (8.24) - EC (0.96)	**
EA (8.24) - ED (3.35)	NS
EA (8.24) - EB (8.15)	NS
EB (8.15) - EC (0.96)	**
EB (8.15) - ED (3.35)	NS
ED (3.35) - EC (0.96)	NS

a/ * Significant at the 5 percent significance level.

** Significant at the 1 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

TABLE XXVIII(a). MISCELLANEOUS VARIABLE COSTS PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	32.90	63.16	33.88	51.48
151 to 250	28.00	61.39	20.71	33.56
251 to 400	21.39	66.85	33.08	112.06
401 and over	21.93	56.43	29.59	123.18
Significance Level Among Size Means a/	NS		NS	
Area Mean	26.43		28.89	
Significance Level Between Area Means a/	NS		NS	

TABLE XXVIII(b). MISCELLANEOUS VARIABLE COSTS PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (32.91) - WB (21.39)	NS
WD (32.91) - WA (21.93)	NS
WD (32.91) - WC (28.00)	NS
WC (28.00) - WB (21.39)	NS
WC (28.00) - WA (21.93)	NS
WA (21.93) - WB (21.39)	NS
ED (33.88) - EC (20.71)	NS
ED (33.88) - EA (29.59)	NS
ED (33.88) - EB (33.12)	NS
EB (33.12) - EC (20.71)	NS
EB (33.12) - EA (29.59)	NS
EA (29.59) - EC (20.71)	NS

a/ NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

Family Labor Allowance Per AU.

This cost item is difficult to evaluate, but is a definite factor of production and must be entered into the analysis. The unpaid family labor allowance might also be considered a family living allowance and is a necessary cost item to insure the survival of the family and the survival of the ranching enterprise.

Individual rancher estimates of hours worked per year were used for data. A value of 90 cents per hour, as derived in the procedure chapter, was used in evaluation of the ranch families' work efforts.

Significance tests among category means tested significant at the 1 percent level in both areas. There was an inverse relationship between ranch size and unpaid family labor use per AU (Table XXIX). This is understandable since, as discussed in Chapter III, unpaid family labor use per ranch was almost constant regardless of ranch size.

It can be noted on Table XXIX that the C.V. for the large size category in each area is large relative to the other categories. Family corporations, which paid salaries to family members and therefore had little or no unpaid family labor, were the primary reason for this great variation. Mean differences between areas again showed no significance even at the 40 percent level.

Net Returns

In this section the net return to land, unpaid labor, capital and management are presented and tested for statistical significance (Table XXX), as are the net return to land, capital and management (Table XXXI). The results of the statistical tests include one conspicuous point, namely, an extremely high C.V. for all size categories. This great variation resulted in a lowering of the significance levels for the means when tested statistically. By casual inspection, all mean differences would appear to be highly significant, but this was not the case. When unpaid

TABLE XXIX(a). FAMILY LABOR ALLOWANCE PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	28.06	51.18	41.39	55.13
151 to 250	15.03	34.20	16.28	23.46
251 to 400	14.57	49.21	12.79	39.25
401 and over	5.13	98.44	5.20	115.17
Significance Level Among Size Means a/	**		**	
Area Mean	16.76		17.23	
Significance Level Between Area Means a/	NS		NS	

TABLE XXIX(b). FAMILY LABOR ALLOWANCE PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WD (28.06) - WA (5.13)	**
WD (28.06) - WB (14.57)	**
WD (28.06) - WC (15.03)	**
WC (15.03) - WA (5.13)	*
WC (15.03) - WB (14.57)	NS
WB (14.57) - WA (5.13)	*
ED (41.39) - EA (5.20)	**
ED (41.39) - EB (12.79)	**
ED (41.39) - EC (16.28)	**
EC (16.28) - EA (5.20)	*
EC (16.28) - EB (12.79)	NS
EB (12.79) - EA (5.20)	NS

a/ * Significant at the 5 percent significance level.

** Significant at the 1 percent significance level. NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

TABLE XXX(a). NET RETURN TO LAND, UNPAID LABOR, CAPITAL AND MANAGEMENT PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE LEVELS BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	17.09	143.26	6.52	485.60
151 to 250	17.28	239.70	28.02	67.00
251 to 400	26.61	80.10	21.62	134.93
401 and over	28.19	62.30	28.95	82.13
Significance level Among Size Means a/	NS		NS	
Area Mean	21.84		22.48	
Significance Levels Between Area Means a/	NS		NS	

TABLE XXX(b). NET RETURN TO LAND, UNPAID LABOR, CAPITAL AND MANAGEMENT PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WA (28.19) - WD (17.09)	NS
WA (29.19) - WC (17.28)	NS
WA (28.19) - WB (26.61)	NS
WB (26.61) - WD (17.09)	NS
WB (26.61) - WC (17.28)	NS
WC (17.28) - WD (17.09)	NS
EA (28.95) - ED (6.52)	NS
EA (28.95) - EB (21.62)	NS
EA (28.95) - EC (28.02)	NS
EC (28.02) - ED (6.52)	NS
EC (28.02) - EB (21.62)	NS
EB (21.62) - ED (6.52)	NS

a/ NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

TABLE XXXI(a). NET RETURN TO CAPITAL AND MANAGEMENT PER ANIMAL UNIT. COMPARISON OF MEANS, COEFFICIENT OF VARIATION, SIGNIFICANCE LEVELS AMONG MEANS BY SIZE, AND SIGNIFICANCE BETWEEN AREAS, 1962.

Item	Area "W" Means	Area "W" C.V.	Area "E" Means	Area "E" C.V.
Ranch Size (AU's)	Dol.	Pct.	Dol.	Pct.
150 and under	-10.97	308.66	-34.87	131.46
151 to 250	2.25	1,929.77	11.74	162.10
251 to 400	12.04	175.58	8.83	367.84
401 and over	23.06	68.34	23.75	97.87
Significance Level Among Size Means a/	NS		**	
Area Mean	5.07		5.25	
Significance Level Between Area Means a/	NS		NS	

TABLE XXXI(b). NET RETURN TO CAPITAL AND MANAGEMENT PER ANIMAL UNIT. SIGNIFICANCE BETWEEN MEANS BY SIZE.

Means Compared b/	Significance Level a/
WA (23.06) - WD (-10.97)	*
WA (23.06) - WC (2.25)	NS
WA (23.06) - WB (12.04)	NS
WB (12.04) - WD (-10.97)	NS
WB (12.04) - WC (2.25)	NS
WC (2.25) - WD (-10.97)	NS
EA (23.75) - ED (-34.87)	**
EA (23.75) - EB (8.83)	NS
EA (23.75) - EC (11.74)	NS
EC (11.74) - ED (-34.87)	**
EC (11.74) - EB (8.83)	NS
EB (8.83) - ED (-34.87)	**

a/ * Significant at the 5 percent significance level.

** Significant at the 1 percent significance level.
NS not significant at the 5 percent level. For further explanation of the statistical tests used see Appendices B, C, D and E.

b/ WA and EA refer to the largest size categories in Area "W" and Area "E" respectively; other classifications refer to progressively smaller size categories.

family labor was not included as a cost, Area "W" tested significant at a level lower than 40 percent and Area "E" at the 30 percent level. (Table XXX). However, when unpaid family labor was included as a cost item, significance levels of 10 percent for Area "W" and 1 percent for Area "E" were found. The small size category means of both areas were found to be significantly different from the others in the respective areas (Table XXXI(b)). It therefore becomes apparent that income per unit of output is influenced by ranch size, especially on those ranches of extremely small size, when unpaid family labor is given a cost allowance.

In testing for significance between net return means of the two areas, no statistical difference was found for either method of net return derivation between areas.

The almost identical area means of net return per AU for the two study areas points out the tendency for the equation of input factors (notably land in this case) to their marginal value products (MVP) in ranch organization. In other words the ranchers in an area tend to bid up certain production factors to approximate the MVP of these factors which in the end, results in similar net returns between areas.

The various input factors have now been compared and tested. Some factors displayed significance when comparing size category means and some did not. However, it must be concluded that economies of size do exist despite the high variance displayed in this final comparison when family labor is included as a cost item. Table XXXII is included to further clarify the tests of significance among the four category means within

TABLE XXXII. SIGNIFICANCE LEVELS AMONG SIZE CATEGORIES AND BETWEEN AREAS. a/

Item Tested	Area "W"	Area "E"	Areas Compared
	Pct.	Pct.	Pct.
Acres Per AU	5	5	1
Machinery Investment Per AU	1	1	b/
Total Investment Per AU	30	5	30
Total Labor Costs Per AU	5	1	b/
Gross Receipts Per AU	20	b/	b/
Total Costs Per AU	1	5	b/
Fixed Cash Costs Per AU	20	40	30
Annual Depreciation Per AU	1	1	b/
Variable Costs Per AU	b/	40	b/
Feed and Veterinary Costs Per AU	30	b/	5
Hired Labor Costs Per AU	10	1	20
Miscellaneous Variable Costs Per AU	30	b/	b/
Family Labor Allowance Per AU	1	1	b/
Net Return to Land, Unpaid Labor, Capital and Management Per AU	b/	30	b/
Net Return to Capital and Management Per AU	10	1	b/

a/ All significance levels indicate significance between the level indicated and the next higher significance level test.

b/ Less than 40 percent.

TABLE XXXIII. RATE OF RETURN TO INVESTMENT AND MANAGEMENT PER AU, BY SIZE CATEGORIES AND BY AREA, 1962.

Item	Ranch Size (AU's) 150 & Under	151 to 250	251 to 400	401 & Over	Area Average
	Dol.	Dol.	Dol.	Dol.	Dol.
Area "W"					
Investment/AU	695.43	640.62	679.95	652.21	669.25
Net Return to Investment and Management/AU	-10.97	2.25	12.04	23.06	5.07
	Pct.	Pct.	Pct.	Pct.	Pct.
Rate of Return	-1.58	0.35	1.77	3.54	0.76
	Dol.	Dol.	Dol.	Dol.	Dol.
Area "E"					
Investment/AU	1,015.53	623.59	687.06	680.97	735.39
Net Return to Investment and Management/AU	-34.87	11.74	8.83	23.75	5.25
	Pct.	Pct.	Pct.	Pct.	Pct.
Rate of Return	-3.53	1.88	1.29	3.49	0.71

each study area and between the weighted means of the two study areas.

Rate of Return to Investment

The net return to capital and management of the preceding section can also be expressed as a percentage rate of return to investment. This is in reality a rate of interest that the rancher's investment is earning for him. The management share of return is also included but will be isolated in the next section.

The rate of return to capital and management for each size category was derived by the following formula:

$$\text{rate} = \frac{\text{average net return to capital and management per AU}}{\text{average investment per AU}} \times 100.$$

The results are exhibited in Table XXXIII.

Rates of return to investment, expressed as weighted area means of 0.76 and 0.71 percent for Areas "W" and "E" respectively, were low relative to alternative investment opportunities available to the general public. The rancher's returns were also low in comparison to the going rate of interest that many of the respondents reported paying on their borrowed capital. However, ranch investment can be advantageous to the investor for other reasons such as: The appreciation of land values and the resulting tax advantage through capital-gains tax rates, the tendency for increasing land values to give a hedge against inflation, and the pride of ownership resulting from owning ranch property.

Since the family labor allowance (or family living allowance) has been included as a cost in this analysis, the ranch family and the ranch

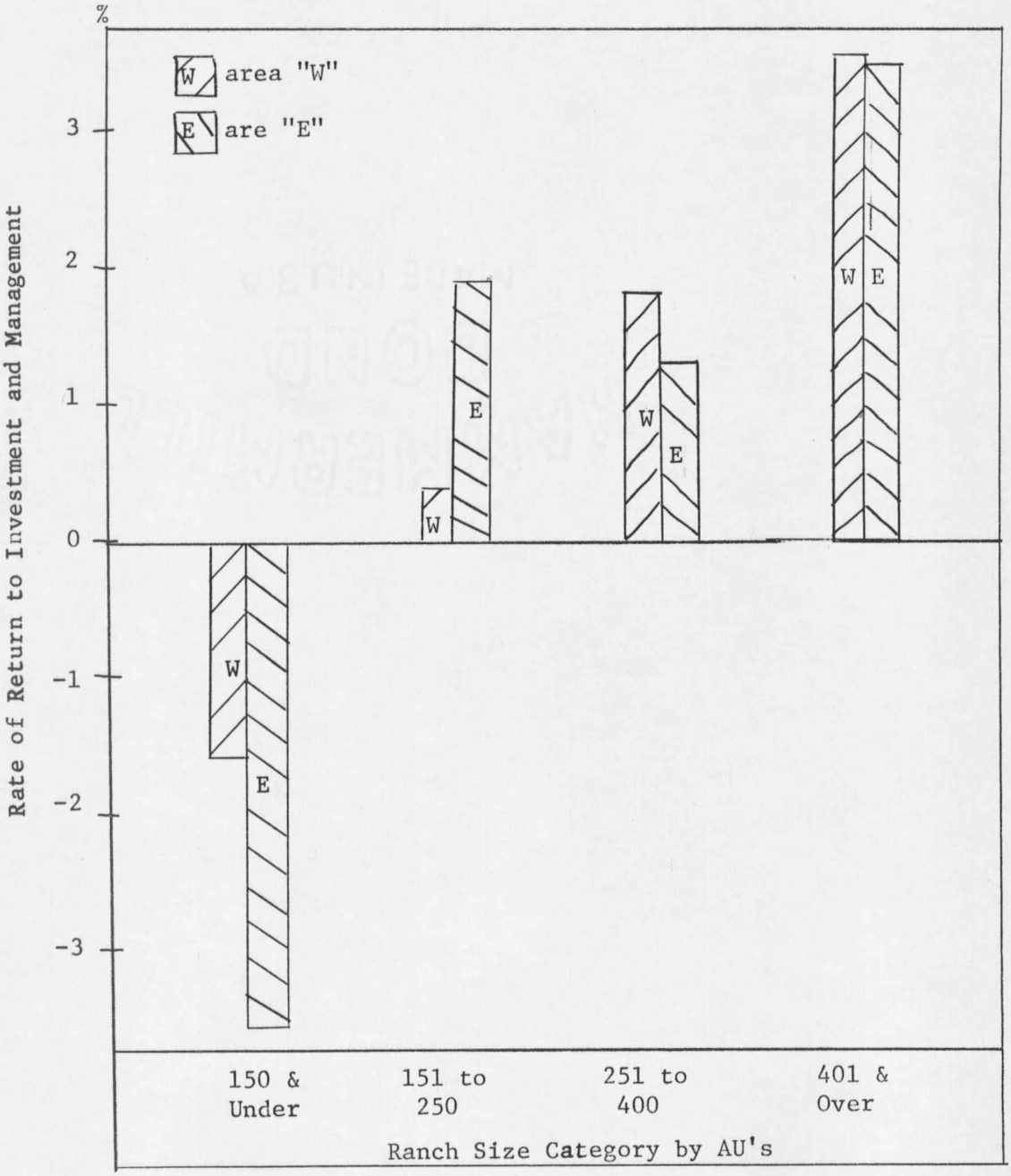

Figure 6. Net return to investment and management on Montana cattle ranches, 1962. Expressed as percentage rate of interest, by size category and by area.

TABLE XXXIV. NET RETURN TO LAND, UNPAID LABOR, CAPITAL AND MANAGEMENT PER AU ON AREA "W" CATTLE RANCHES BY SIZE CATEGORIES, 1962.

Entry Items	Ranch Size (AU's) 150 AUs & Under	151 to 250	251 to 400	401 & Over
	Dol.	Dol.	Dol.	Dol.
Gross Receipts	104.63	91.31	80.42	83.76
Less: Total Cash Costs and Depreciation	87.54	74.03	53.81	55.57
Fixed Cash Costs	13.92	11.04	8.68	5.84
Annual Depreciation	29.39	23.00	13.50	11.46
Total Variable Costs	44.23	39.99	31.63	38.27
Feed & Vet. Costs	6.84	4.37	3.89	3.34
Hired Labor Costs	4.48	7.62	6.35	13.00
Misc. Variable Costs	32.91	28.00	21.39	21.93
Net Return to Land, Unpaid Labor, Capital & Management	17.09	17.28	26.61	28.19
Less: Family Labor Allowance	28.06	15.03	14.57	5.13
Net Return to Land, Capital and Management	-10.97	2.25	12.04	23.06
Less: 5% Opportunity Cost on Investment	34.77	32.03	34.00	32.61
Net Return to Management	-45.74	-29.78	-21.96	-9.55

TABLE XXXV. NET RETURN TO LAND UNPAID LABOR, CAPITAL AND MANAGEMENT PER AU ON AREA "E" CATTLE RANCHES BY SIZE CATEGORIES, 1962.

Entry Item	Ranch Size (AU's) 150 & Under	151 to 250	251 to 400	401 & Over
	Dol.	Dol.	Dol.	Dol.
Gross Receipts	99.63	84.46	97.90	94.23
Less: Total Cash Costs and Depreciation	93.11	56.44	76.28	65.28
Fixed Cash Costs	10.54	8.30	9.89	7.12
Annual Depreciation	35.06	19.77	17.40	13.53
Total Variable Costs	47.51	28.37	48.99	44.63
Feed and Vet. Costs	10.28	6.69	7.72	6.80
Hired Labor Costs	3.35	0.96	8.15	8.24
Misc. Variable Costs	33.88	20.72	33.12	29.59
Net Return to Land, Unpaid Labor, Capital and Management	6.52	28.02	21.62	28.95
Less: Family Labor Allowance	41.39	16.28	12.79	5.20
Net Return to Land, Capital and Management	-34.87	11.74	8.83	23.75
Less: 5% Opportunity Cost on Investment	50.78	31.18	34.35	34.05
Net Return to Management	-85.65	-19.44	-25.52	-10.30

operation can survive with the indicated low returns to investment as long as the rancher is willing and able to forego alternative investment opportunities. However, many of the small size category ranches that were interviewed were not meeting cash costs and depreciation. In the short run they therefore must also use all or part of their depreciation allowance for family living allowance.

For a more concise display of rate of return to investment and management on Montana cattle ranches in 1962, see Figure 6.

Net Return to Management Per AU

Tables XXXIV and XXXV combine all of the preceding sections of this chapter into one concise analysis of net returns to factors of production. A further breakdown of total costs, separating the family labor allowance from the total costs, gave the net return to land, unpaid labor, capital and management. The result is a residual of gross receipts, minus cash costs and depreciation. This analysis resulted in a positive value for all size categories and is often the amount of living allowance that the small, self-financed rancher uses for survival. These are the same category means reported in Table XXX.

In the next step, unpaid labor was included as a cost. The results then were the same as in Table XXXI in a previous section of this chapter. The resulting negative returns to land, capital and management in the small size category in each study area reveals that the ranches in this size category failed to receive full value for their labor as well as not receiving a return to their investment.

In the third step, the land and capital factors of production were priced. After setting the opportunity cost on all investment at 5 percent and deriving a per AU interest charge for each size category, this cost item was also subtracted from the net returns to land, capital and management. When setting the rate of interest at 5 percent, it was assumed that the ranchers were borrowing a major portion of their capital requirements and that they are desirous of obtaining the going rate of interest for their equity in the ranch. The resulting returns to management were negative in all size categories of both study areas.

The negative net return to management tells us that the average ranch studied was not receiving the going rate of interest on reported investment plus an opportunity value for his own and his family's labor. If the ranch operator's family is willing and able to live on a smaller living allowance than the 90 cents per hour salary rate allows, or if the ranch operator is willing to forego alternative investment opportunities, then the management factor of production might, in some size categories, receive positive compensation for its effort.

CHAPTER V

DETERMINATION OF AUM PERMIT VALUE

In determination of federal grazing permit value, as outlined in Chapter II, differences between the non-privileged ranch study using 1962 data and the privileged ranch study using 1960 indexed data were compared. All differences were computed by using regression line equations, however the differences are also presented graphically to give visual comparisons.

Data from the 1960 privileged ranch study were adjusted to 1962 price levels and the data for Area "E" of the 1962 non-privileged ranch study were adjusted for drought as outlined in the procedure chapter (Chapter II). The data, as presented in this chapter, are simple averages of the interviewed ranches in a particular size and area category. This method was used in the current study to approximate, as nearly as possible, the procedure of the previous study. Slight differences in results from the previous chapters to this chapter might therefore appear, since the previous chapter's analyses were based on weighted means, i.e., a large ranch in a category had more affect on the category average than did a smaller ranch in the same category.

Two methods of derivation were used to bring out different segments of permit value as mentioned in the introductory chapter. In each method a net return difference, which was attributed to the possession and use of federal grazing permits, was divided by the respective number of AUM permits for various ranch sizes to derive an annual return per AUM permit.

In the first method, differences between the net return to land, unpaid

labor, capital and management of the two studies were compared, while the second method employed net return to management differences. 34/

Derivation of AUM Permit Number Differences

Before derivation of AUM permit values by the methods just outlined, permit number differences between the two studies had to be obtained. This was necessary because the non-privileged study data resulted in small numbers of AUM permits in each size category (Table XXXVI). Regression line formulae were used to facilitate getting an accurate difference at any desired ranch size comparison, since the ranch size category AU means were not identical in the two studies.

The differences between the trend lines for grazing permit numbers of the two studies (Figure 7-10) became the denominator for the following formula which was applied to three ranch sizes in each of the two methods.

$$AV = \frac{NR_1 - NR_2}{P_1 - P_2}$$

Where:

AV = Annual return per AUM permit.

NR_1= Net return for non-privileged study.

NR_2= Net return for privileged study.

P_1 = The number of AUM permits for the non-privileged study.

P_2 = The number of AUM permits for the privileged study.

34/ Net return to land, unpaid labor, capital and management is the residual after subtracting all cash costs and depreciation from the gross income. This amount is usually termed net ranch income.

Net return to management is the residual after subtracting all cash costs and depreciation as well as an opportunity cost for land, unpaid labor and capital from the gross income.

Derivation of AUM Permit Value from Study Differences of Net Returns to Land, Unpaid Labor, Capital and Management

This method of AUM permit valuation includes the part of permit value that is capitalized into the base property but does not include real estate organizational differences that might affect total AUM permit value. The part of AUM permit value needed for risk of tenure protection is included as well as the part for sales value of permit. Organizational differences other than that part contributed by real estate differences are also included. The organizational differences of machinery and equipment between studies also had their influence on total AUM permit values.

Differences between trend lines, as calculated by the regression formula, were again used as a basis for comparison. Ranch sizes of 100 AUs, 200 AUs and 500 AUs were used in derivation of representative AUM permit values. These were chosen for their obvious ease of handling and for their approximating of the size groupings studied.

Area "W"

Respective annual returns per AUM permit derived by this method for ranch sizes of 100, 200 and 500 AU's in the "FS privileges only" comparison resulted in AUM returns of $24.15, $15.85 and $10.65. For the "BLM privileges only" comparison the respective annual AUM permit returns were $11.58, $8.47 and $6.36. The comparison of privileged ranches having both BLM and FS privileges to the non-privileged study resulted in $11.36, $6.95 and $3.04 for the three ranch sizes. Figures 11-13 show the net

TABLE XXXVI. COMPARISON OF FEDERAL GRAZING PERMIT SIZE CATEGORY MEANS FOR PRIVILEGED AND NON-PRIVILEGED STUDIES. EXPRESSED BY AREAS AS AUM PERMITS AND AS PERCENTAGES OF 12-MONTH ANIMAL UNIT FEED REQUIREMENTS.

Study Classification	Ranch Size (AU) 150 and under		151 to 250		251 to 400		401 and over	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Area "W"								
Non-privileged	5	0.40	12	0.51	39	1.04	119	1.51
Privileged (FS) b/	120	15.38	404	18.71	a/	a/	980	18.11
Privileged (BLM) b/	140	19.13	292	13.44	a/	a/	1060	14.92
Privileged (FS&BLM) b/	331	37.79	738	33.24	a/	a/	1644	26.25
Area "E"								
Non-privileged	23	1.58	60	2.03	35	0.79	414	3.68
Privileged (BLM) b/	153	19.92	403	18.55	a/	a/	1216	17.97

a/ This size category was not included in the privileged ranch study.

b/ D. D. Caton, et. al., Economic Relationships of Grazing Fees and Permitted Use of Public Rangelands to Net Income On Western Livestock Ranches: A Regional Analysis, ERS, USDA, Administration Report, 1962, pp. 59-60.

return averages for the studied size categories and the derived trend lines. The AUM permit values determined by capitalizing at 5 percent were: For those with "FS privileges only" $483.00, $317.00 and $213.00; for those with "BLM privileges only" $232.00, $169.00 and $127.00; and for those with both BLM and FS privileges $227.00, $139.00 and $61.00 (Table XXXVII).

Area "E"

Annual returns for the eastern area were $17.32, $10.33 and $3.91, for small to large size categories respectively. Capitalized values were $346.00, $207.00 and $78.00. See Figure 14 for graphical comparisons of trend lines and study averages.

Derivation of AUM Permit Values From Study Differences of Net Return to Management

AUM permit values derived by this method reflect the net return to federal grazing permits after all of the factors of production have been deducted from gross receipts. This analysis removes the segment of AUM permit value that has already been included in price of base property from the derived permit value because of the inclusions of an opportunity cost to investment in the analysis, however real estate organizational differences

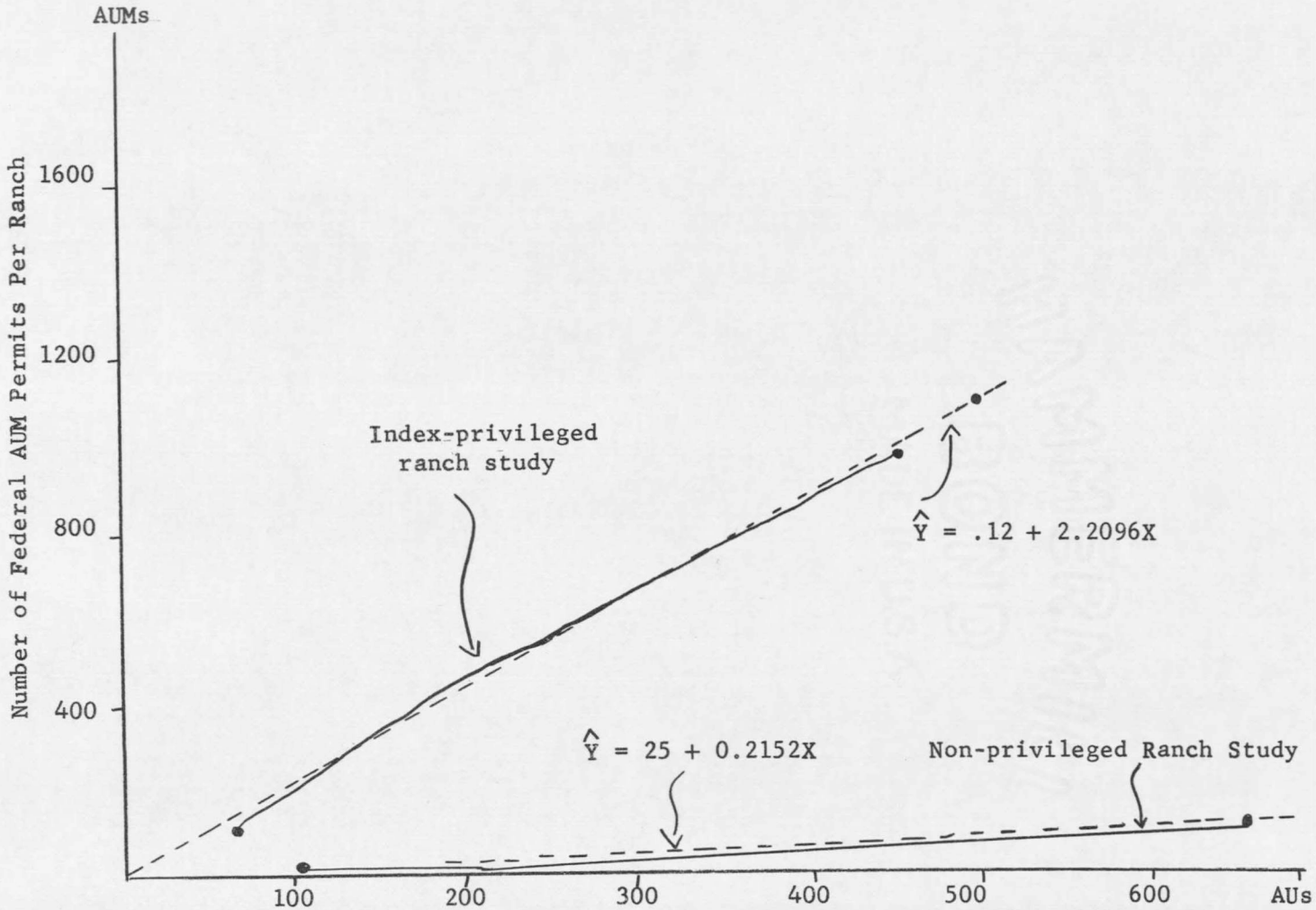

Figure 7. Grazing permit size category averages and trend lines for privileged and non-privileged ranch studies. Area "W", FS only.

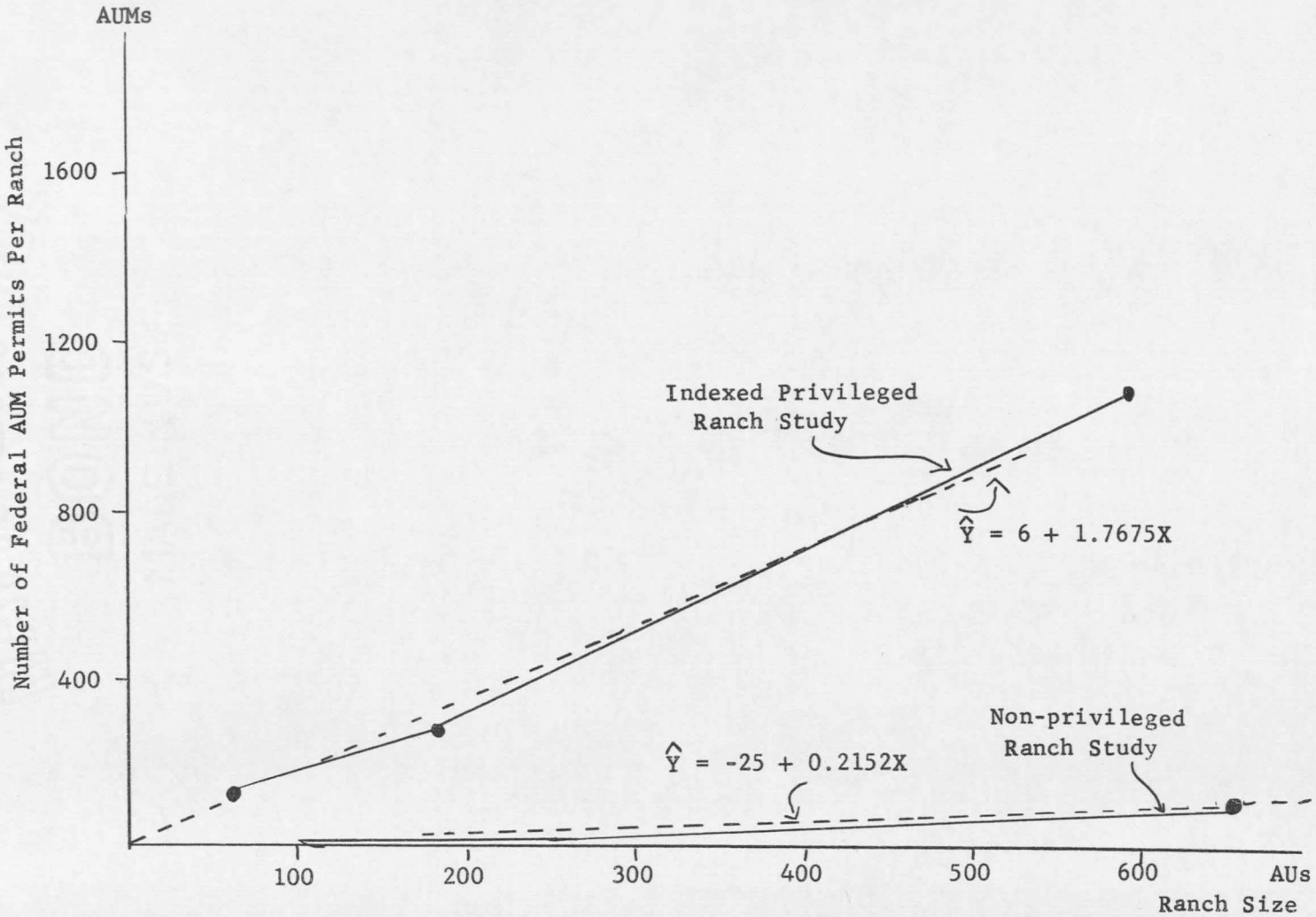

Figure 8. Grazing permit size category averages and trend lines for privileged and non-privileged ranch studies. Area "W", BLM privileges only.

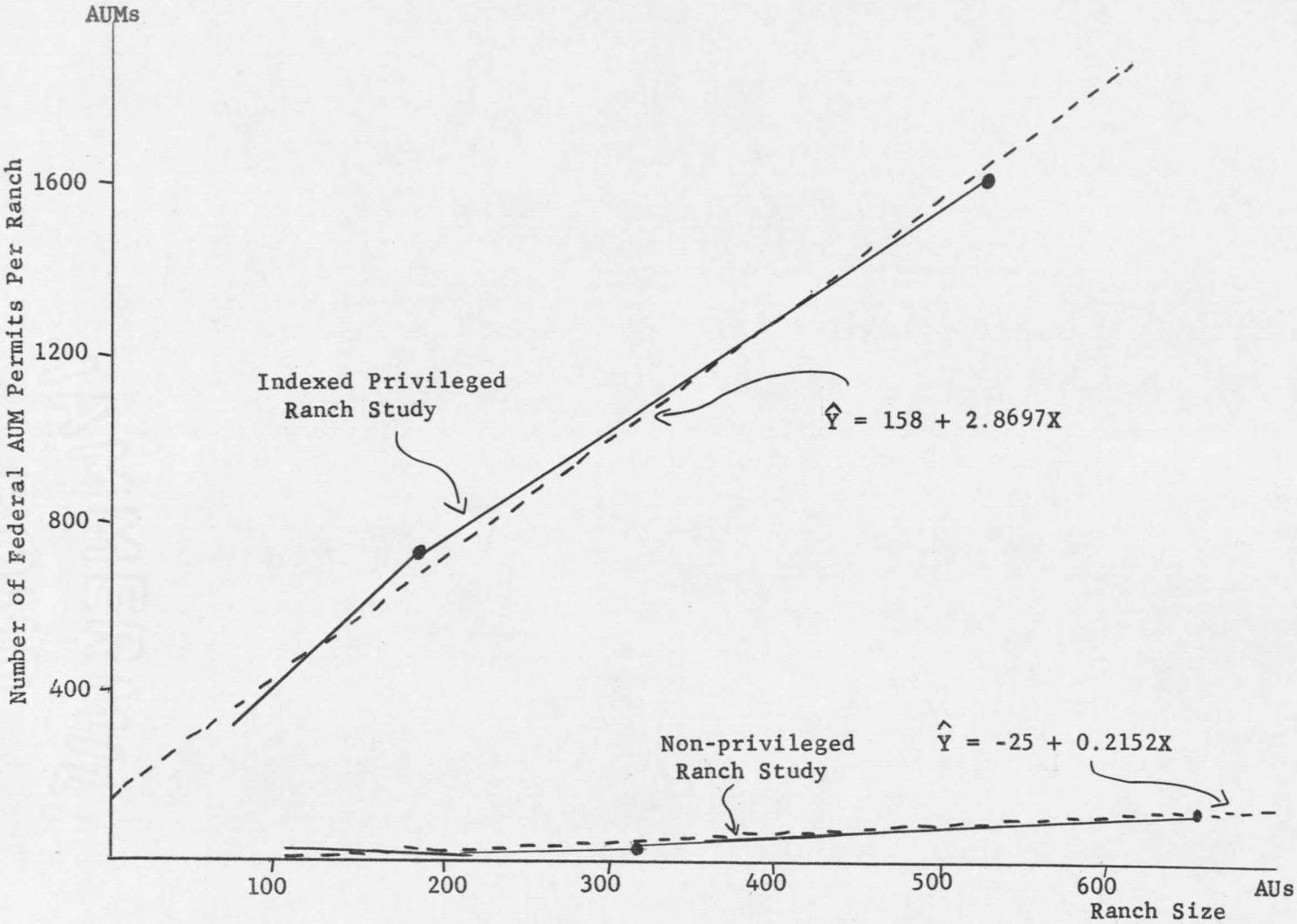

Figure 9. Grazing permit size category averages and trend lines for privileged and non-privileged ranch studies. Area "W", BLM and FS privileges.

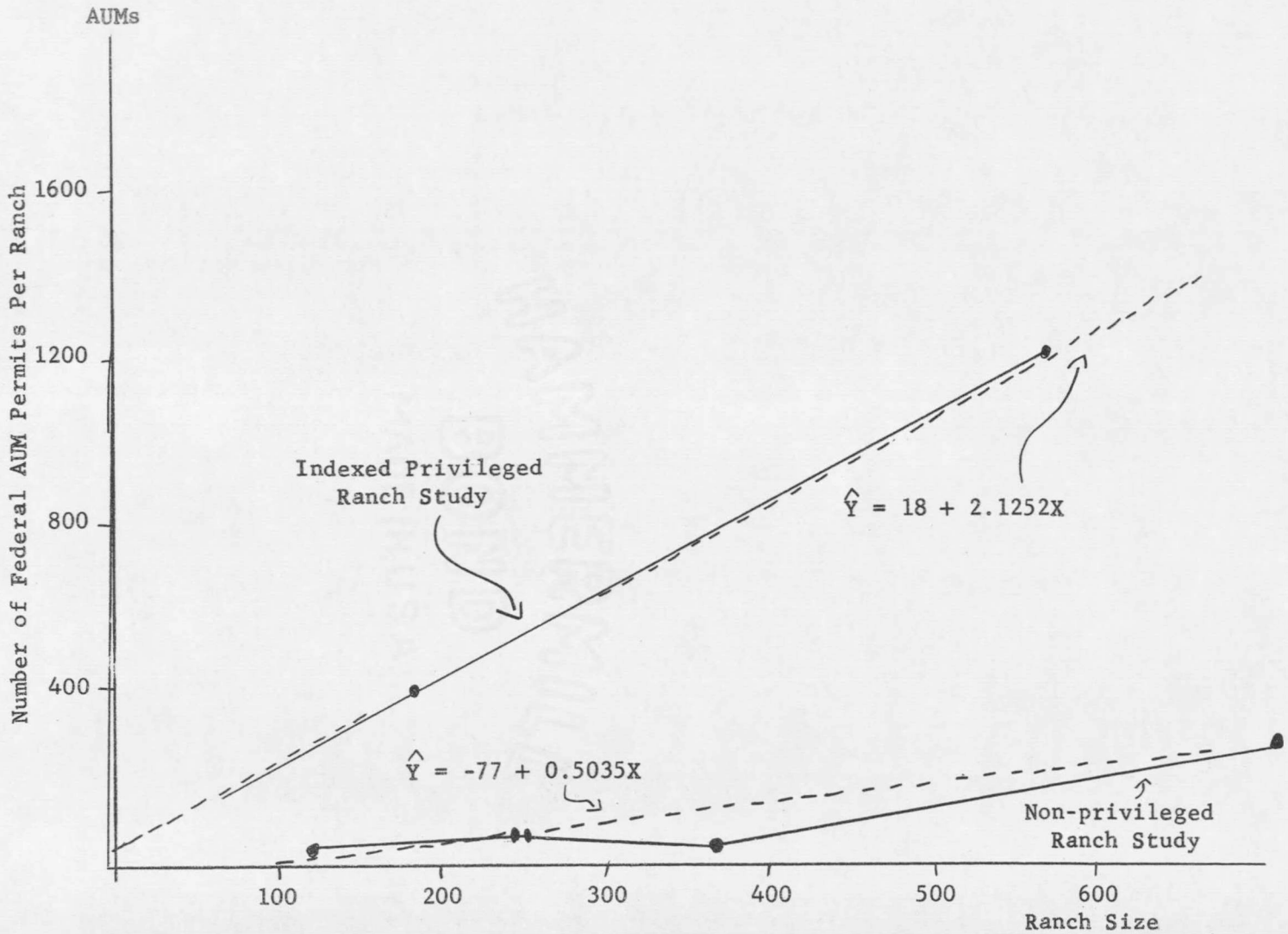

Figure 10. Grazing permit size category averages and trend lines for privileged and non-privileged ranch studies. Area "E".

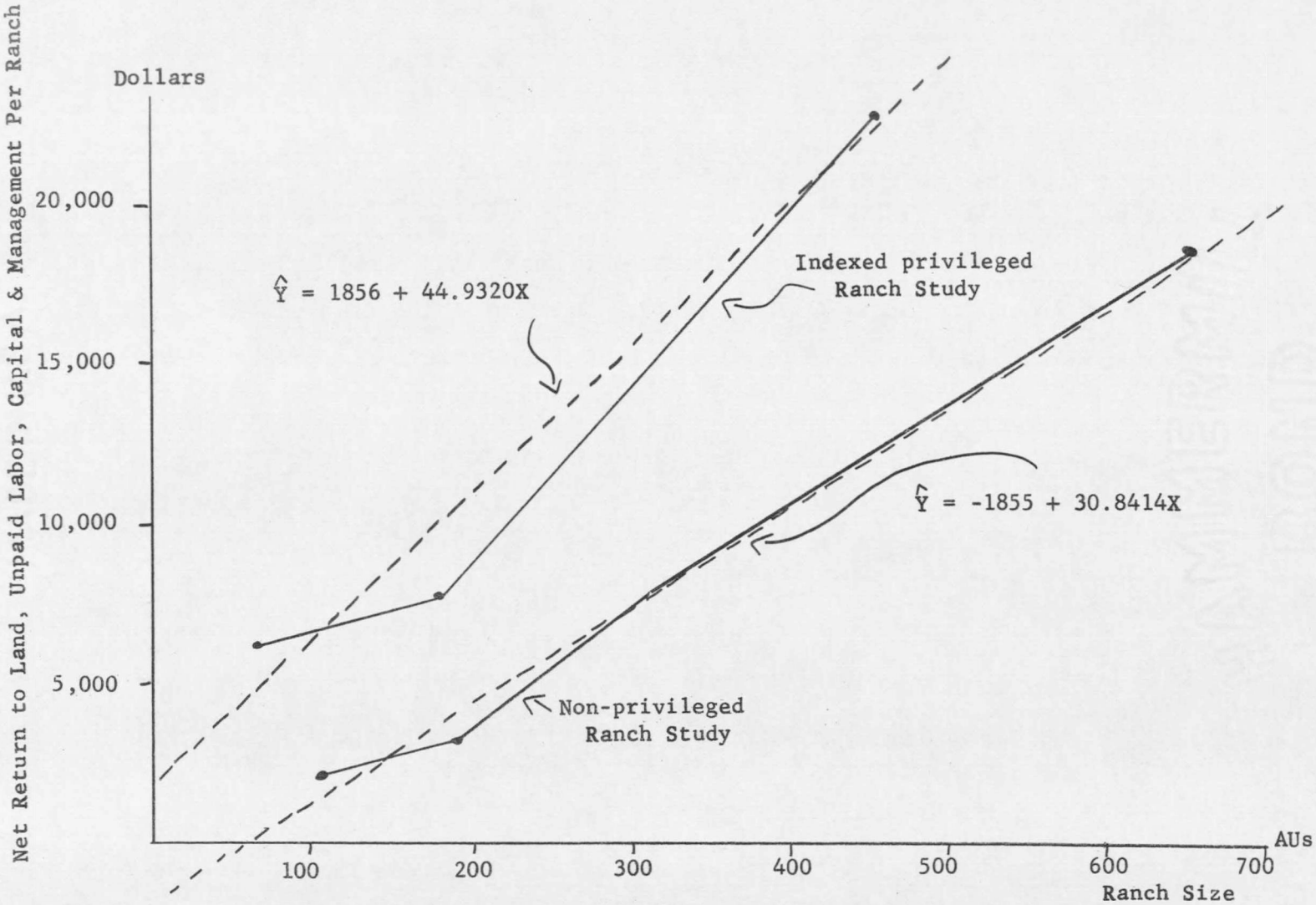

Figure 11. Net return to land, unpaid labor, capital and management size category averages and trend lines for privileged and non-privileged ranch studies. Area "W" FS privileges only.

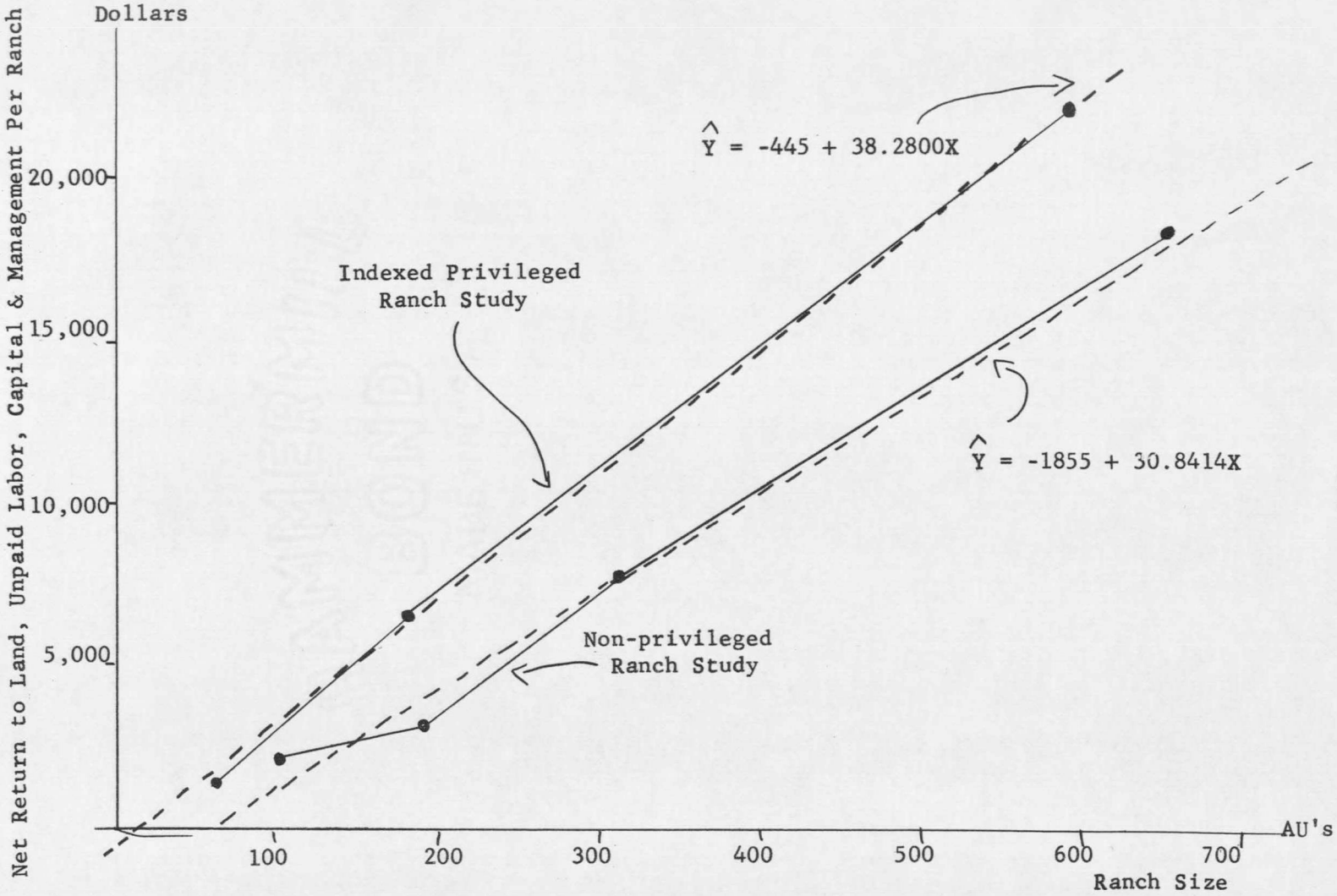

Figure 12. Net return to land, unpaid labor, capital and size management size category averages and trend lines for privileged and non-privileged ranch studies. Area "W", BLM privileges only.

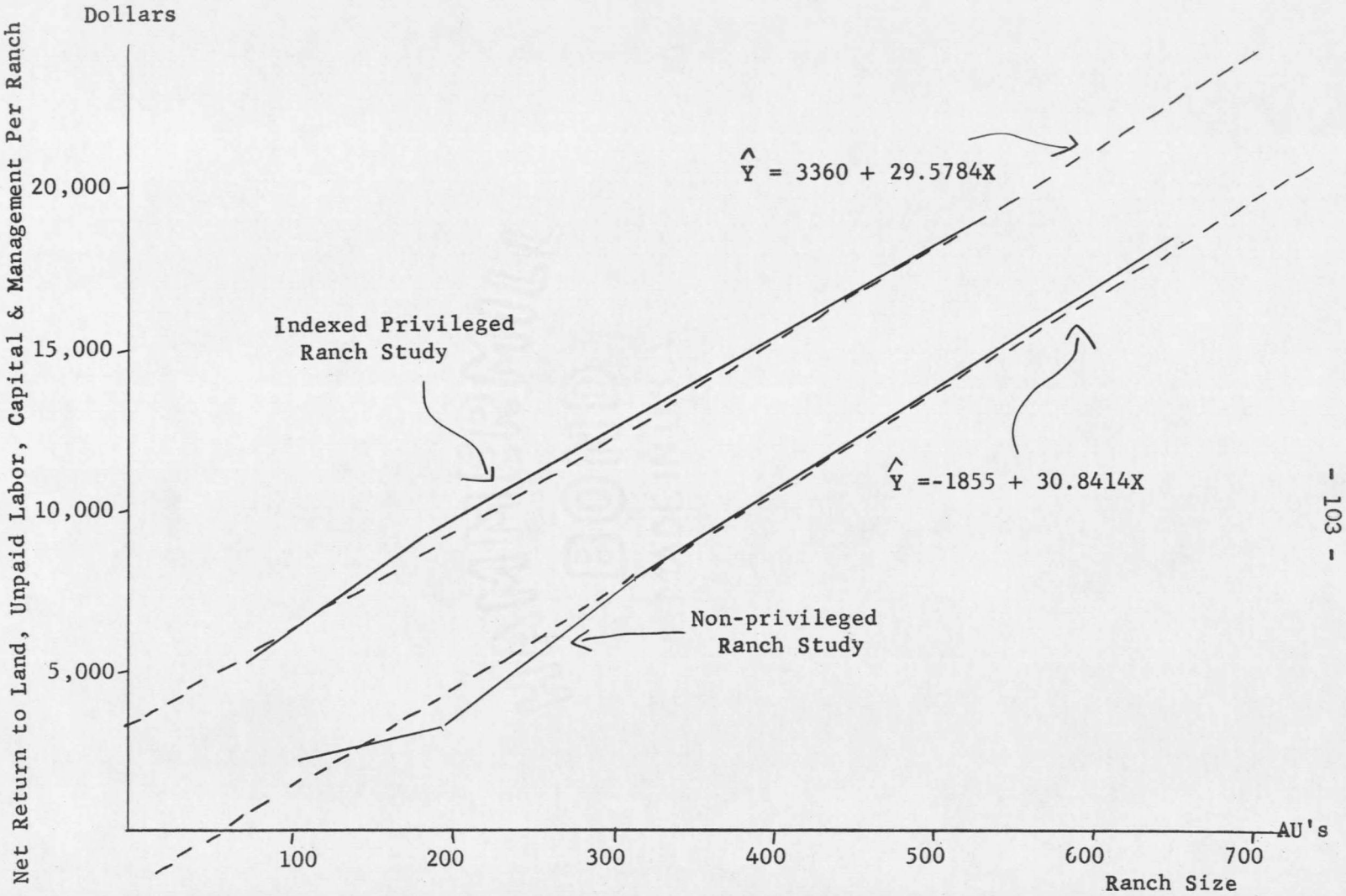

Figure 13. Net return to land, unpaid labor, capital and management size category averages and trend lines for privileged and non-privileged studies. Area "W", BLM and FS privileges.

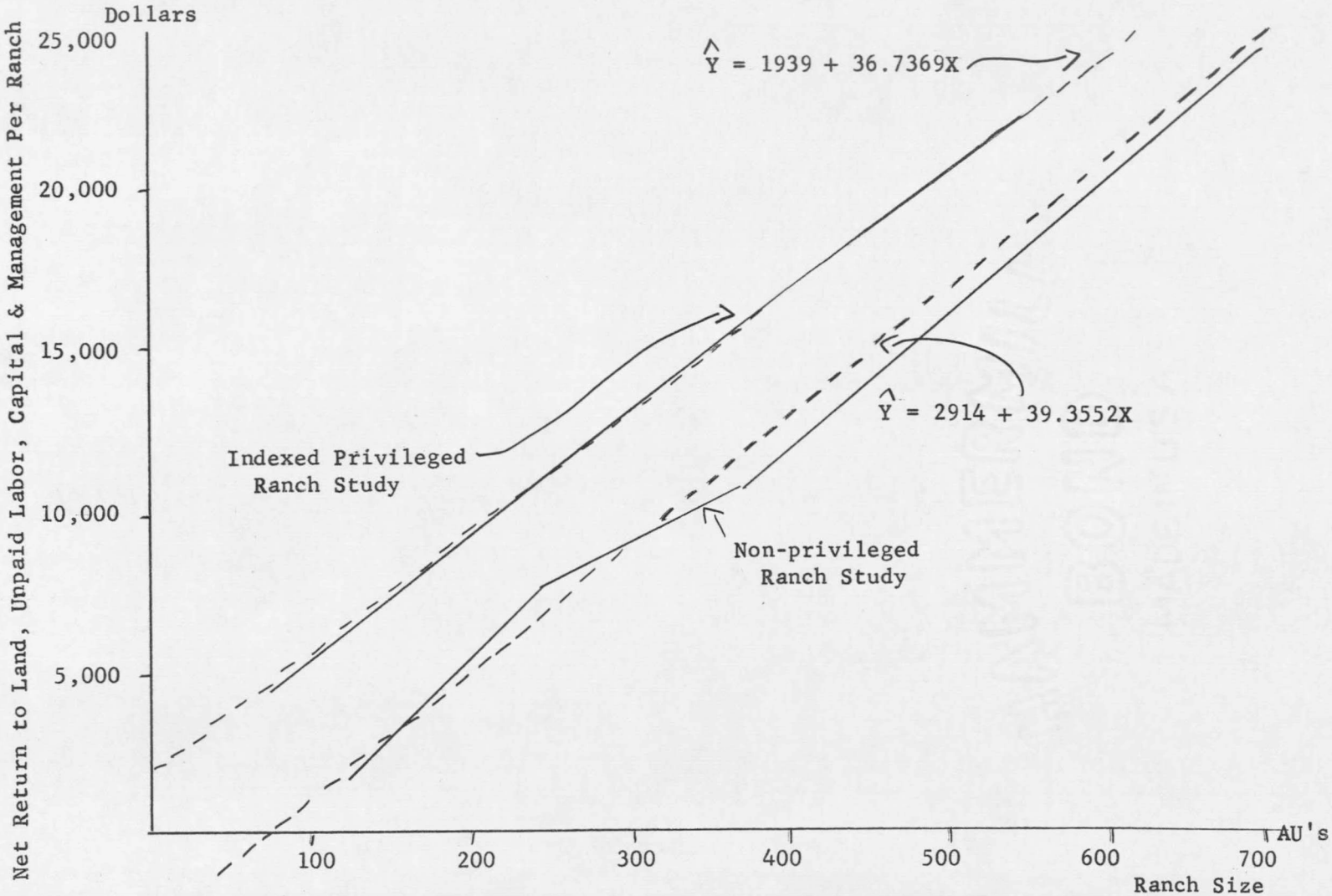

Figure 14. Net return to land, unpaid labor, capital and management size category averages and trend lines for privileged and non-privileged studies. Area "E".

are included in the analysis. 35/ This method then includes the effects of three parts of permit value--that part needed for risk of tenure, that part comprising sales value of permit and that part contributed by all organizational differences between the two studies.

Three typical ranches of 100, 200 and 500 AU's again were used.

35/ When deriving the net returns to management from the net returns to all factors of production of the previous section, the effect of the unpaid labor cost was to lower the curve, by a distance equal to the amount of the unpaid labor opportunity cost allowance for the area. The opportunity cost to investment had the effect of lowering the right hand side of the curve considerably more than the left hand side (or of flattening the curve). An opportunity allowance for management was assumed to be constant and in fact non-existant; this was a safe assumption since all of the residuals to management of Chapter IV were negative and nearly constant regardless of ranch size. Furthermore, since both studies were sampled out of the same areas, the management opportunity allowance can be assumed equal for both studies. Therefore a net return to management analysis will give the same permit evaluations as a net return to permit analysis.

This footnote can be summarized by the following schema:

$$GRR - (E + D) = NRI$$
$$NRI - (L + U + C) = NR_m$$
$$NR_m - M = NR_p$$

Where:

GRR = Gross ranch receipts.
E = Cash costs (expenditures)
D = Annual depreciation allowance
NRI = Net ranch income (net return to all factors)
L = Opportunity cost for land
U = Opportunity cost for unpaid labor
C = Opportunity cost for capital
NR_m = Net return to management
M = Opportunity cost for management ($0.00)
NR_p = Net return to federal permits of privileged study

Area "W"

The western or mountain study area resulted in annual returns per AUM permit for 100, 200 and 500 AU ranch sizes for those ranches having "FS privileges only" of $19.73, $14.75 and $11.63 respectively; for those ranches having "BLM privileges only" the respective annual returns were $9.25, $8.28 and $7.65; and for those having both BLM and FS privileges the annual returns were $10.53, $7.23 and $4.29. Values capitalized at 5 percent for the "FS only" comparison were $387, $295 and $232; for the "BLM only" comparison the values were $185, $166, and $153; and for the comparison of ranches having both BLM and FS privileges the capitalized values were $211, $145 and $86 respectively for the small to large size ranches. A graphical presentation of the net return averages for the studied size categories and the derived trend lines are shown in Figures 15-17.

Area "E"

The results derived from the data of the Plains area of southeastern Montana for three typical ranches of 100, 200 and 500 AU's indicated annual returns per AUM permit of $17.54, $9.30 and $1.81, and capitalized values of $351, $186 and $36 for the different size categories, respectively. Figure 18 depicts trend lines and study averages for this area graphically.

Recapitulation of AUM Permit Values Derived by Various Methods

Results from all of the methods are presented in Table XXXVII. Graphical comparison of all methods for each area are presented in Figures 19 and 20.

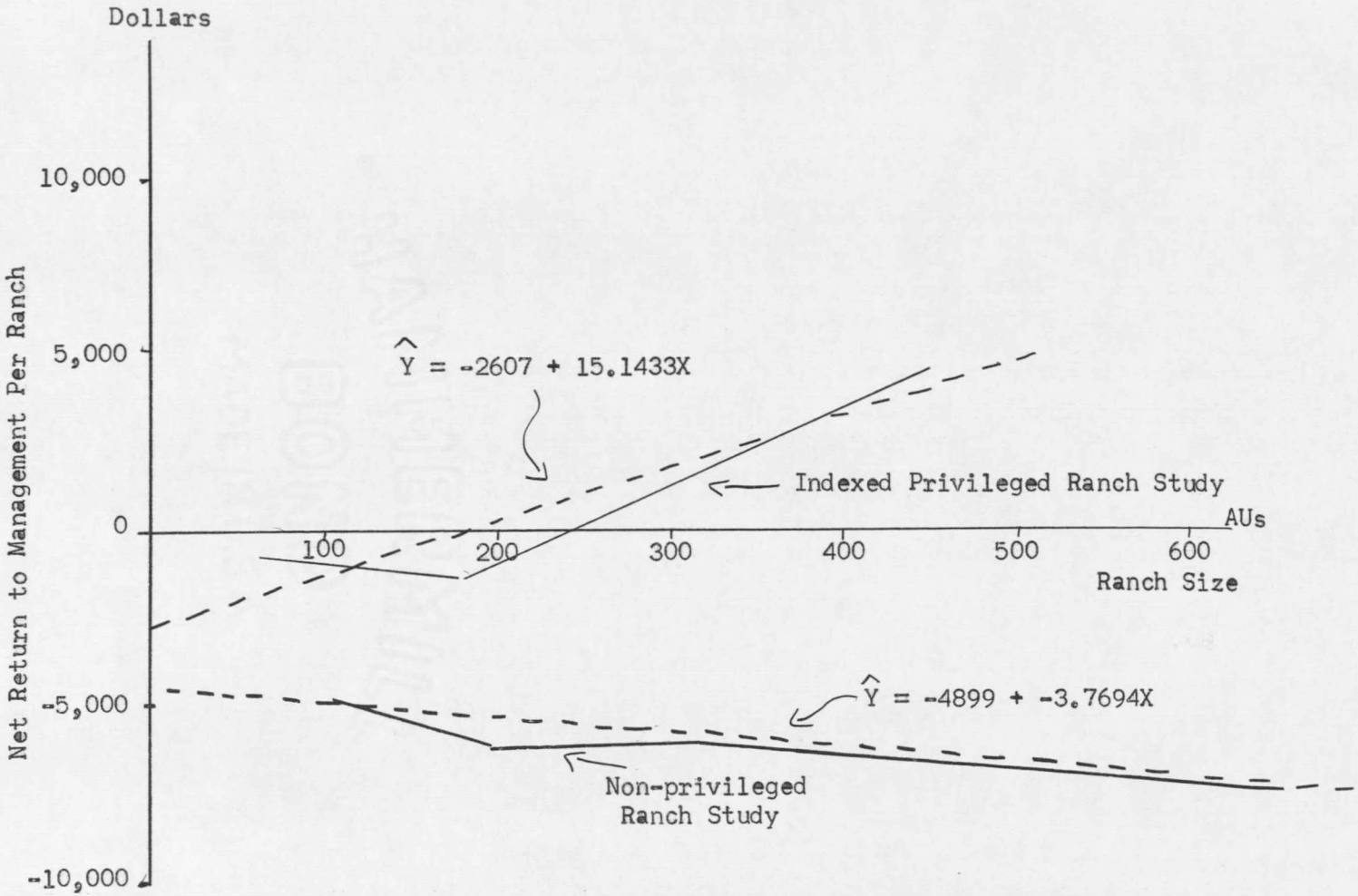

Figure 15. Net return to management, size category averages and trend lines for privileged and non-privileged ranch studies. Area "W", FS privileges only.

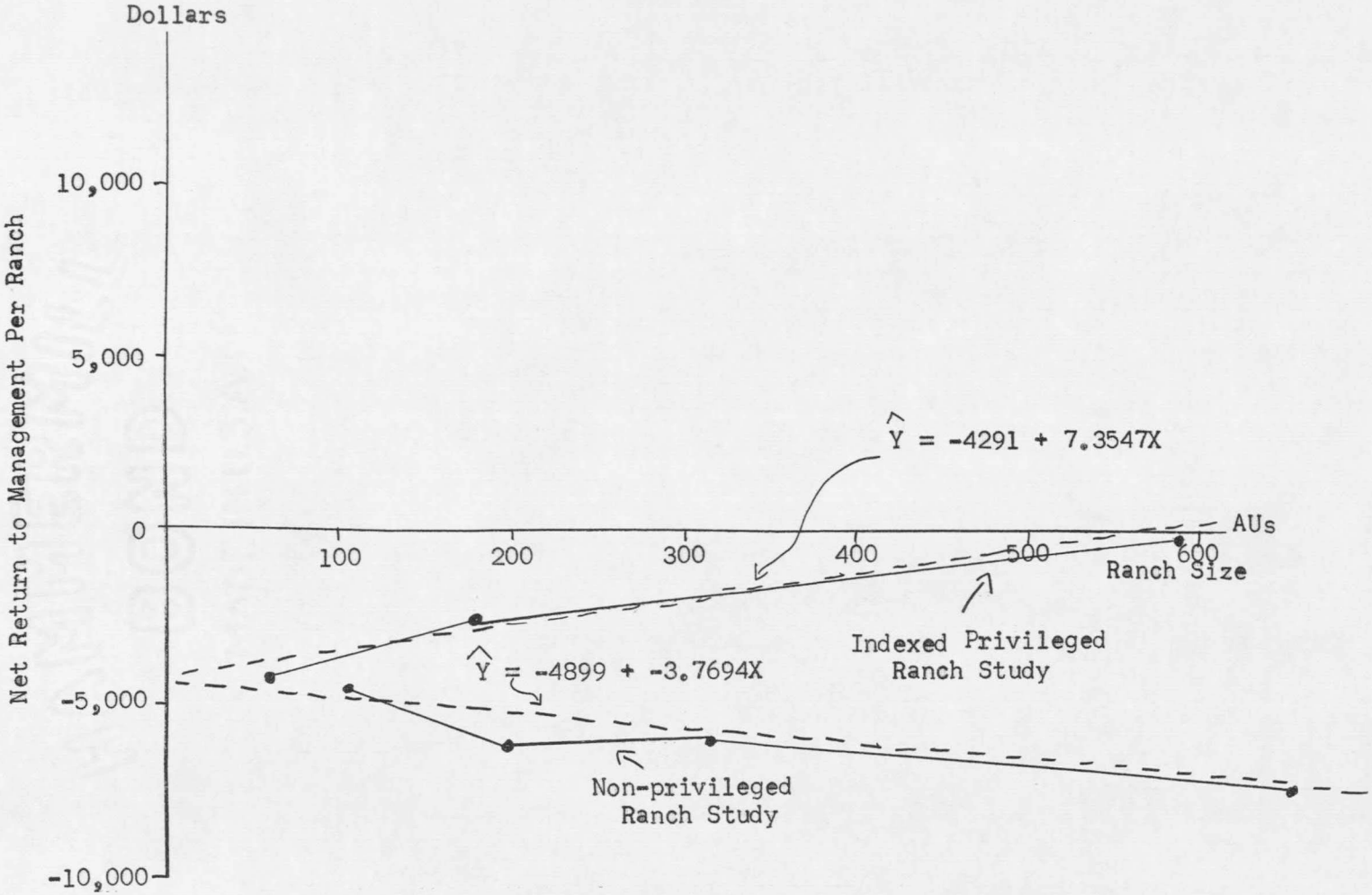

Figure 16. Net return to management, size category averages and trend lines for privileged and non-privileged ranch studies. Area "W", BLM privileges only.

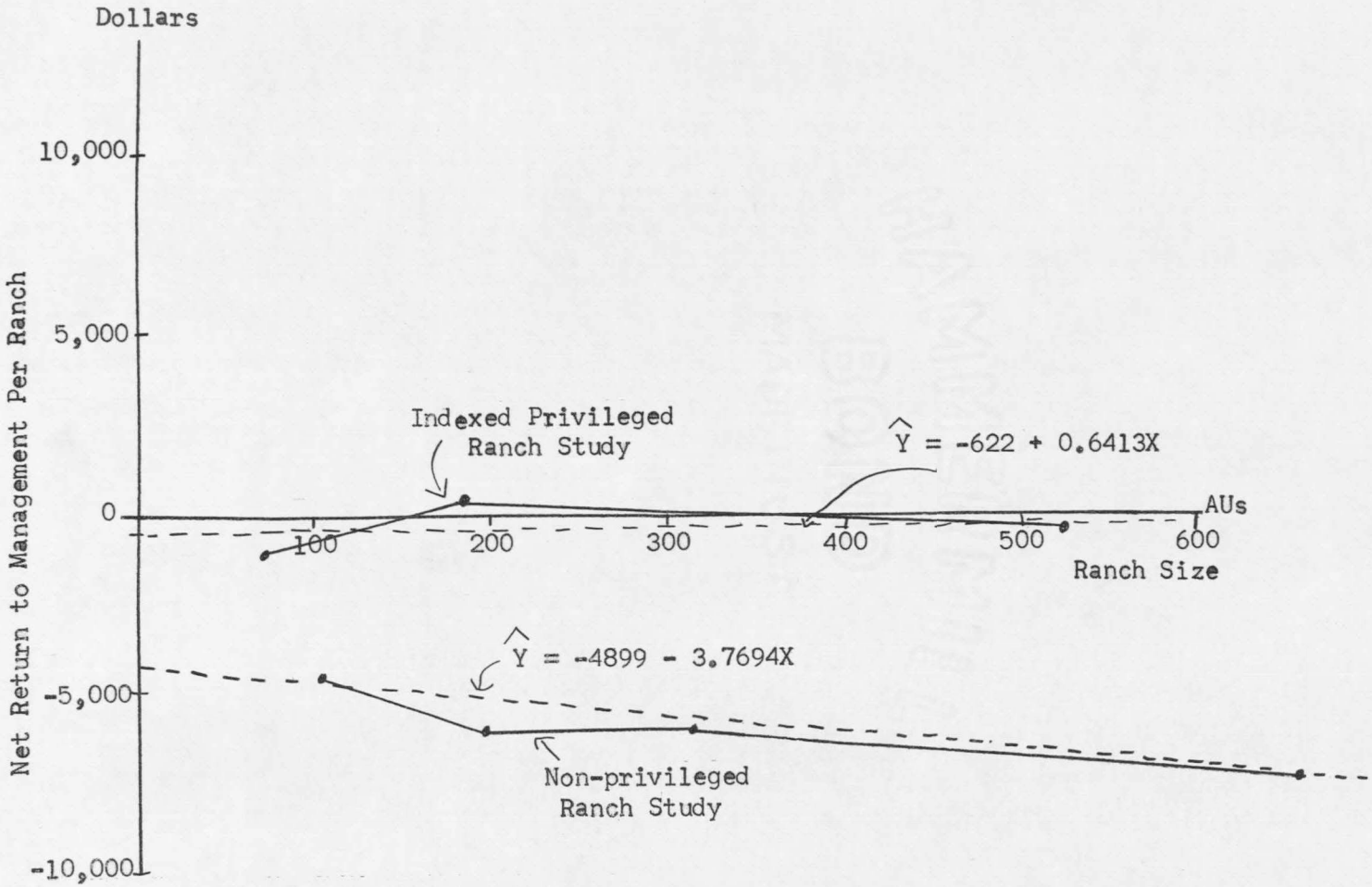

Figure 17. Net returns to management, size category averages and trend lines for privileged and non-privileged ranch studies. Area "W", FS and BLM.

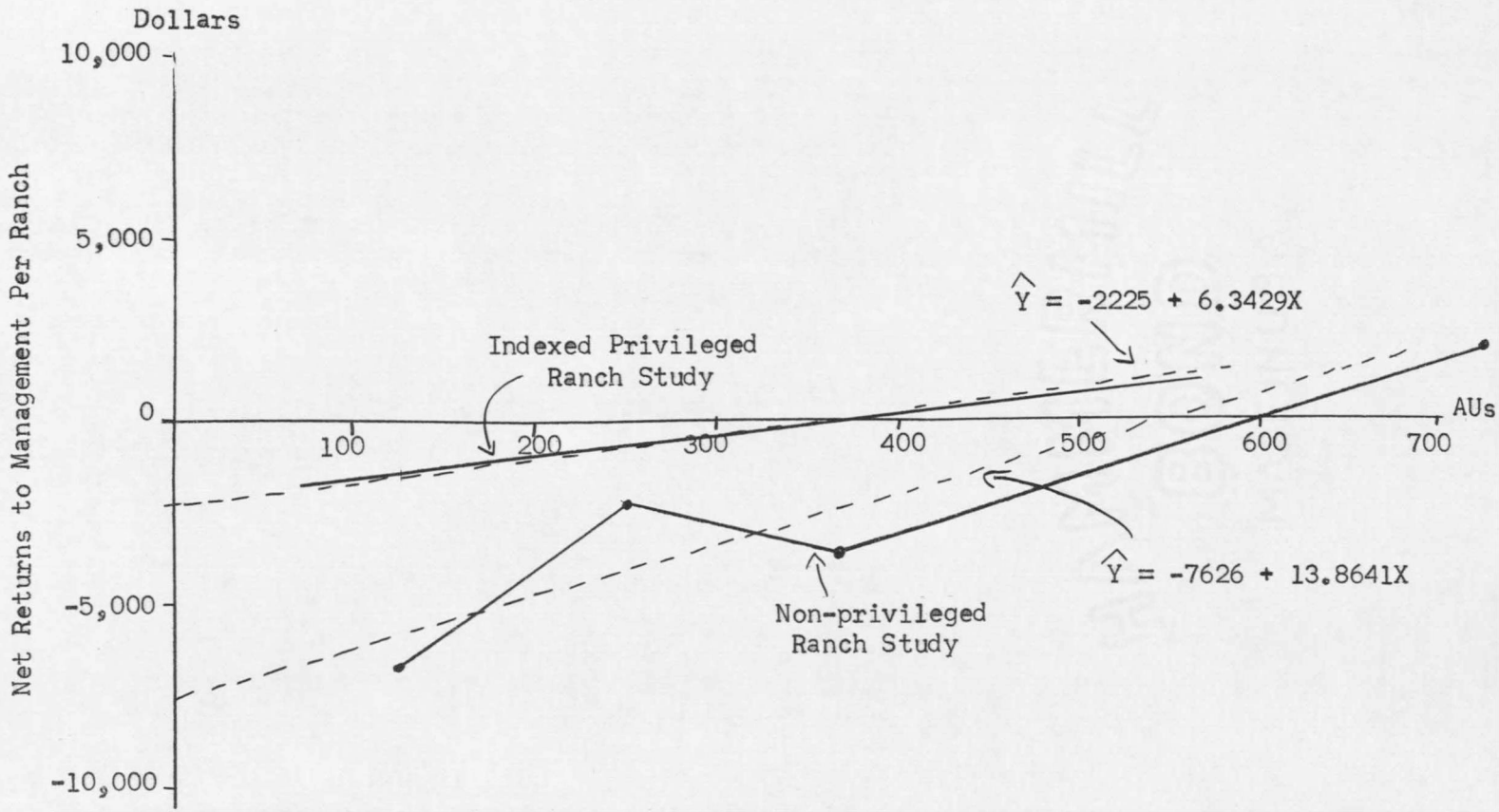

Figure 18. Net returns to management, size category averaged and trend lines for privileged and non-privileged ranch studies. Area "E".

TABLE XXXVII. ANNUAL AND CAPITALIZED FEDERAL AUM GRAZING PERMIT VALUES DETERMINED BY TWO METHODS, BY AREA.

Area and Net Return Differences Measured	Ranch Size (AUs) 100 Annual	100 Cap. Value a/	200 Annual	200 Cap. Value a/	500 Annual	500 Cap. Value a/
	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.
Area "W"						
All Factors (FS)	24.15	483	15.85	317	10.65	213
All Factors (BLM)	11.58	232	8.47	169	6.36	127
All Factors (BLM & FS)	11.36	227	6.95	139	3.04	61
Management (FS)	19.73	387	14.75	295	11.63	232
Management (BLM)	9.25	185	8.28	166	7.65	153
Management (BLM & FS)	10.53	211	7.23	145	4.29	86
Area "E"						
All Factors	17.32	346	10.33	207	3.91	78
Management	17.54	351	9.30	186	1.81	36

a/ Capitalized at 5 percent.

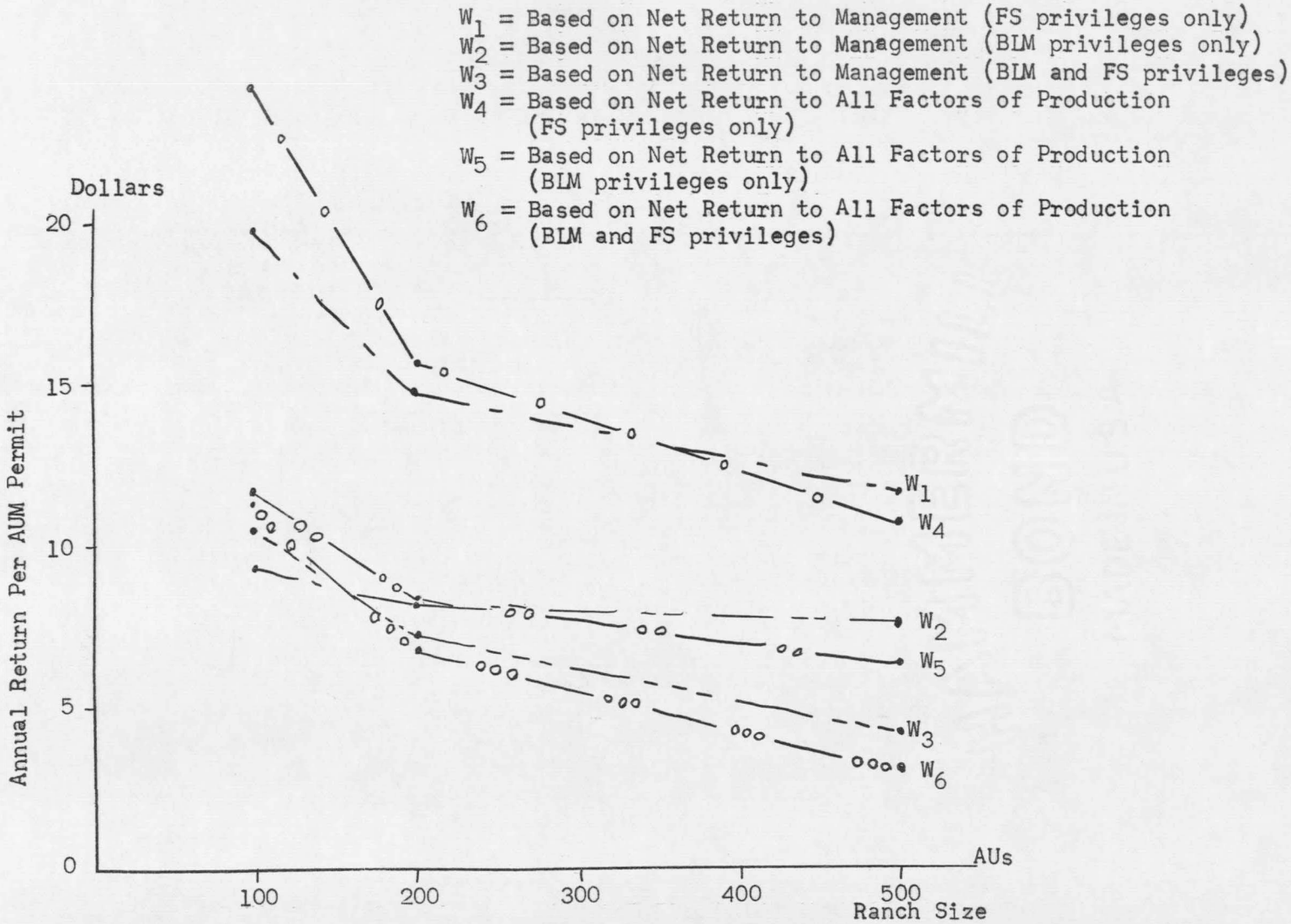

Figure 19. Annual returns to permits derived by the two methods outlined in the discussion. Area "W".

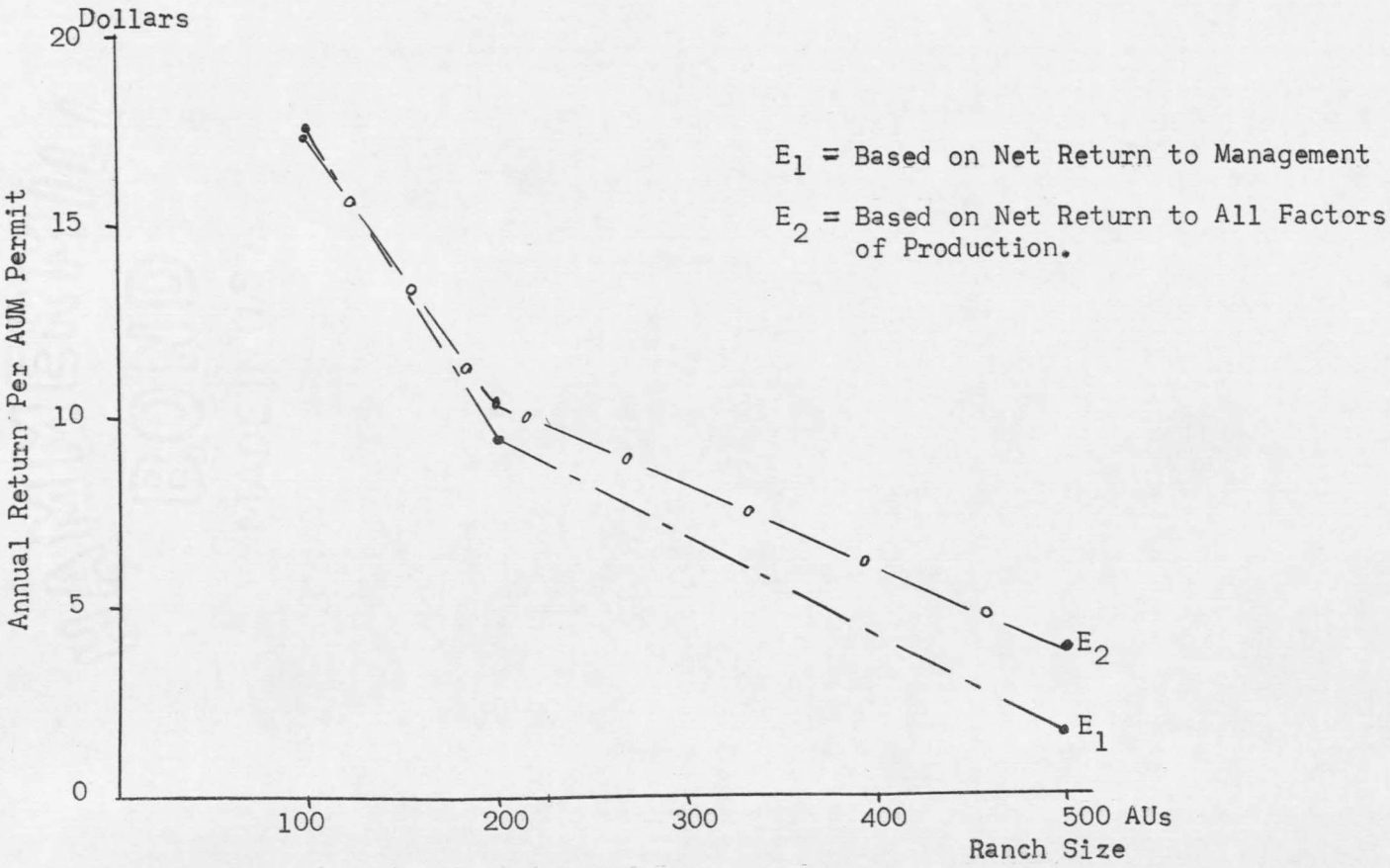

Figure 20. Annual returns to permits derived by the two methods outlined in the discussion. Area "E".

All net returns comparisons indicated greater permit values to smaller ranch operators than to large ranch operators. Nearer to optimum input factor balance gained through the possession and use of federal grazing permits of the small ranches in the privileged ranch category is the probable explanation for the high permit values of these categories. Additional grazing land, through federal grazing permits, apparently gave the ranchers in the small size category of the privileged ranch study, advantages over the comparable size group in the non-privileged study through better land use and nearer to optimum ranch organization. This greater difference between net returns of the small size categories of the two studies resulted in high permit values. To exemplify, ranchers dependent upon small irrigated pasture acreages for their feed supply might well be expected to raise output of livestock disproportionately with the addition of small amounts of dry range (federal grazing permits) to relieve the grazing load on the irrigated pasture.

The larger size groups of the non-privileged ranch study on the other hand were apparently more readily able to achieve good input balance without the aid of federal grazing permits. This resulted in smaller differences between the net returns of the two studies and therefore smaller AUM permit values.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

As a means of determining costs and returns of Montana cattle ranches that were not utilizing federal grazing lands, a survey of ranch operators was conducted. The costs and returns data were used first of all in a description of the non-privileged segment of the Montana cattle ranching industry and secondly in derivation of monetary values of federal grazing permits by a comparison to a previous study of cattle ranches that did utilize federal grazing.

Two geographical areas were studied, described, compared to the previous study, and finally compared to each other. Area "W" is a mountain area located in the extreme southwestern corner of Montana, Area "E" is in the plains area of southeastern Montana.

Ranch Organization

A comparison of ranch organization between the two study areas revealed few significant differences. Acreage requirements per AU were about three times as high in the plains study area as in the mountain area, but investment in land was almost identical per AU for the two study areas. Machinery investment per AU was not significantly different between the areas but the composition of the machinery investment was somewhat different. The mountain area had more haying equipment while the plains area had more grain equipment and more trucks. Purchased feed and veterinary costs were significantly higher in the plains study area, primarily because of greater wintering

pellet purchases. All other receipts, costs of production and net returns comparisons were almost identical between the two study areas, thereby showing that costs of producing cattle are similar in the two areas.

Results of the comparison of size category means within an area (economy of size study) revealed several important points. First among these was the extreme difference between the small size category of each area and the larger sizes. The smallest ranches had per AU machinery investments that were approximately three times higher than that of the largest of each area. 36/ The resulting annual depreciation was also very much higher for the small sizes. Total costs per AU for the small size groups were also significantly higher than the other size groups while the three larger sizes in each area were not significantly different from each other. This pattern was again repeated in total labor use per AU. Net returns to investment and management per AU displayed extreme variance within each group but despite this variance the small size category again stood out as an extreme. The small size ranches in each area showed negative returns to capital and management, -$10.97 per AU for Area "W" and -$34.87 for Area "E". The other sizes all showed positive returns to capital and management. Expressed as a percentage rate of return to investment and management, Area "W" returned 3.54 percent, 1.77 percent, 0.35 percent and -1.58 percent for the large to small size categories respectively. The corresponding percentages for Area "E" were 3.49, 1.29

36/ Larger percentages of cropland in the small size categories are accountable for part of these higher machinery inventories.

1.88 and -3.53. When an opportunity cost to investment was included as a cost item, all ranch sizes in each area showed a negative net return to management.

Why are the small sizes (those with 150 AUs and under) so extreme in lack of income? Much of the observed inefficiency was attributable to the poor input balance of these small ranches. Many of the more advanced technological practices in ranching require machinery and improvements that are not available to the small ranch operator in practical sizes. Many ranchers in the small size categories have tried to mechanize, but failed to increase their output sufficiently to justify the increased capital expenditures. Another major factor in the inefficiency of the small size categories that was observed was the extremely high labor use of these ranches. The major portion of this labor was of course from family sources, and the immobility of this production factor was responsible for the high labor costs per AU. Other factors contributing to inefficiencies in the small size categories that were probably in existence but were more difficult to observe were: Lack of knowledge of ranchers to better opportunities and new technology, capital rationing (both internal and external) which prevented their achieving optimum input balance, unstable product prices and poor bargaining power at the input markets.

A <u>second</u> important point in the economy of size phase of the study was the low levels of significance found in comparisons of the net ranch income (net return to land, unpaid labor, capital and management) of both areas. However, when an opportunity cost allowance for unpaid family labor

was included as a cost much higher levels of significance were found. This was especially true for comparisons of the small size category in each area with the other size categories of the respective areas where significance level of 1 percent and 5 percent were found. This can be emphasized by looking at the high degree of significance found in the family labor per AU comparisons in Chapter IV.

A third point of importance in the low level of significance among the various size groups in respect to gross income per AU. This implies that all size groups were earning approximately the same amount of receipts per animal unit. The total costs per AU, however, were found to be significantly different among size categories. It was the small size category that was significantly higher in cost of production and was again the size group that stood out as an extreme.

A fourth detail in the economy of size phase of this study revealed extreme variation of net return per AU within the size categories. This emphasized, as observed in data analysis, that there was indeed ranchers in the small size categories, as well as in the large size categories, that were making a positive net return to capital and management. The high variation indicates that the possibility does exist for ranches of any size to improve efficiency by overcoming some of the obstacles listed above. The fact that some ranchers in each size group were much more efficient than the category averages presented in this study, should point the way for the less efficient operators in the adoption of better methods of ranch organization and operation.

Permit Values

In comparing the study of ranches with federal grazing permits to the study of the ranches without federal grazing permits, it was found that these permits do have a monetary value to the Montana cattle rancher. By using the net return to all factors of production method outlined in Chapter V, the annual return per AUM permit for hypothetical 100, 200 and 500 AU size ranches ranged from $24.15 for the 100 AU ranch in Area "W" that used FS privileges only, to $3.04 for the 500 AU ranch in Area "W" that used both FS and BLM privileges. This is the method that included not only the segment of permit value that was termed sales value in Chapter I but also the part of permit value that needs to be retained by the rancher for risk of tenure, that part capitalized into the base property and that part that was brought about by machinery and equipment differences between the two studies.

By using the permit value determination method that employed differences in the net returns to management, the return per AUM permit ranged from $19.73 for the 100 AU ranch in Area "W" (FS) to $1.81 for the 500 AU ranch of Area "E". This method shows the following segments of total permit value: Sales value, risk of tenure and values brought about by organizational differences between the studies, but excludes the segment of permit value that is already capitalized into the base property.

All comparisons by both methods indicated greater permit value to smaller ranch operators than to large ranch operators. The additional

grazing land, through federal grazing permits, apparently gave the ranchers in the small size category of the privileged study considerable advantage over the comparable size group in the non-privileged study through better land use and nearer to optimum ranch organization. The larger groups of the non-privileged study, on the other hand, were apparently more able to achieve good input factor balance without the aid of federal grazing permits.

Application of Study Results

The application of the results of this study depend upon the attitudes and values of the general public. Not until the public demands payment from the ranchers for the full amount of the MVP of the federal grazing permits will the grazing fees be raised to even closely approximate the above permit returns. It should be re-emphasized that the analyses of this study includes segments of total permit value that cannot be charged the rancher without modifications of existing grazing policy. For instance, the risk of tenure of the permits must be removed before this segment of permit value could justifiably be charged to the rancher. It must be remembered that this study includes the amount of permit value needed by the rancher to protect himself from possible loss of the permit. Similarily, that part of permit value which is already capitalized into the base ranch property could not justifiably be charged as increased grazing fees without imposing a penalty upon the present users who have already paid for their grazing permits through the purchase of their base properties; consideration of this is important in making policy decisions.

Recommendations for Further Research

Further research leading to the discovery of more of the reasons for the apparent extremely improved ranch organization brought about by the utilization of federal grazing permits in the small size category would shed light on this phenomenon.

Research to determine and isolate the management practices and the ranch organizational features that lead to the extremely high variation in net ranch income among ranchers in the small size category would give clues to the increasing of efficiency in cattle ranching. If the reasons for the ability of some ranches in this size category to show relatively high net income can be discovered, other ranchers in this size category could adopt these superior practices and thereby increase their efficiency.

Research to determine costs and returns (direct, indirect, tangible and intangible) for other uses of federal grazing lands would aid in determining the practicability of the expansion of other uses or multiple uses of these lands.

APPENDICES

APPENDIX A

ANNUAL DEPRECIATION AND AVERAGE INVESTMENT FOR EQUIPMENT AND IMPROVEMENTS TYPICALLY FOUND IN MONTANA FARMS AND RANCHES IN 1962

Equipment and improvements used on Montana ranches are not necessarily typical of those found in other areas of the country because of climatic and geographical differences. Montana has a short haying season, which necessitates larger and better equipment to hurry the haying operation along before the season is over. Greater distances from ranch to market, and rougher road conditions than is typical of most areas, make heavy-duty trucks a necessity. Buildings must be constructed to withstand high winds and have utility in cold temperatures.

The equipment and improvements included in the following schedule of depreciation and average investment are based on the quality and size that was observed during the field study. Estimated life of equipment was based primarily on the sources indicated in the last column and in the footnotes of the following schedule of depreciation and average investment, with respondent information influencing the choice of estimated life to a lesser extent.

An average life was used in determination of investment for all ranch size categories for simplicity and ease of handling. In so doing the assumption was made that the inventory items were, on the average, depreciated to one-half of their original value.

The straight line method of depreciation was used. This method is the simplest and usually the most satisfactory. 37/

37/ John A. Hopkins and Earl O. Heady, Farm Records and Accounting, 4th Edition, Ames, Iowa: The Iowa State College Press, 1955, p. 73.

Average investment of equipment was calculated using the following formula:

$$\frac{\text{1962 initial cost plus 10\% salvage value}}{2}$$

which gives the same results as the definition formula:

$$\frac{\text{initial cost minus 10\% sal. val.}}{2} + \text{sal. val.}$$

Average investment of buildings, grain bins, fences and wells was calculated without salvage value (cost of removal will approximate salvage value) using the following formula:

$$\frac{\text{1962 initial cost}}{2}$$

Machinery depreciation was calculated by the straight line method with a 10 percent salvage value using the following:

$$\frac{\text{1962 cost minus 10\% sal. val.}}{\text{Expected Life}}$$

No salvage value was used for fences, buildings and other permanent type improvements in determining depreciation because removal costs cancel salvage value. The formula is as follows:

$$\frac{\text{1962 cost}}{\text{Expected Life}}$$

APPENDIX TABLE I. DEPRECIATION AND AVERAGE INVESTMENT SCHEDULE, 1962.

Item	Size	Life	Typical New 1962 Cost	Average Investment	Annual Depreciation	Source
		Yrs.	Dols.	Dols.	Dols.	
Vehicles						
Pickup	½ ton	10	2,314.00	1,261.00	206.00	a/
Truck (box & hoist)	2 ton	12	5,106.00	2,808.00	383.00	c/
Jeep		10	2,605.00	1,433.00	234.00	a/
4 wheel drive pickup	½ ton	10	3,334.00	1,834.00	300.00	a/
Auto Class I		8	2,717.00	1,495.00	306.00	b/
Auto Class II		8	3,174.00	1,746.00	357.00	b/
Auto Class III		8	4,284.00	2,356.00	482.00	d/
Wheel Tractors						
Gasoline						
1-2 plow	20 hp.	12	2,523.00	1,388.00	189.00	a/
2 plow	30 hp.	12	2,836.00	1,560.00	213.00	b/
3 plow	40 hp.	12	3,830.00	2,106.00	287.00	b/
4 plow	50 hp.	12	4,578.00	2,518.00	343.00	b/
5 plow	60 hp.	12	5,613.00	3,087.00	421.00	b/
Wheel Tractors						
Diesel						
4 plow	50 hp.	12	4,934.00	2,714.00	370.00	b/
5 plow	60 hp.	12	6,456.00	3,551.00	484.00	b/
6 plow	70 hp.+	12	7,793.00	4,286.00	584.00	b/
Track Tractor						
Diesel						
(D-2)(old D-4)	50 hp.	10	8,762.00	4,819.00	789.00	a/
(D-4)(old D-6)	60 hp.	10	11,794.00	6,486.00	1,062.00	a/
(D-6)(old D-7)	70 hp.	10	18,122.00	9,968.00	1,631.00	a/
(D-7)	100 hp.	10	23,280.00	12,804.00	2,095.00	d/
Tool Bar	8 ft.	15	695.00	382.00	42.00	b/

APPENDIX TABLE I. (continued) DEPRECIATION AND AVERAGE INVESTMENT SCHEDULE, 1962.

Item	Size	Life	Typical New 1962 Cost	Average Investment	Annual Depreciation	Source
		Yrs.	Dols.	Dols.	Dols.	
	10 ft.	15	1,035.00	569.00	62.00	b/
	12 ft.	15	1,212.00	667.00	73.00	b/
	14 ft.	15	1,325.00	729.00	79.00	b/
	16 ft.	15	1,394.00	766.00	83.00	b/
Tandem disk (wheel carrier)	8 ft.	15	774.00	425.00	46.00	c/
	10 ft.	15	937.00	515.00	56.00	c/
	12 ft.	15	1,170.00	644.00	70.00	c/
Plow (mold board)	2 bottom	15	405.00	223.00	24.00	b/
	3 bottom	15	685.00	377.00	41.00	b/
	4 bottom	15	932.00	512.00	56.00	b/
	5 bottom	15	1,195.00	657.00	72.00	b/
Spinner (2 way)	2 bottom	10	810.00	445.00	73.00	c/
	3 bottom	10	1,070.00	588.00	96.00	c/
Spike Harrow w/evener	5' sec.	20	58.00	32.00	2.00	c/
Spring Tooth	8 ft.	15	209.00	115.00	12.00	a/
Grain Drill (double disk)	10 ft.	20	911.00	501.00	41.00	b/
	12 ft.	20	1,030.00	566.00	46.00	b/
Shoe Drill (deep furrow)	12 ft.	20	1,223.00	673.00	55.00	b/
	14 ft.	20	1,308.00	719.00	59.00	b/
Grass Seeder Attach.	10 ft.	20	88.00	48.00	4.00	c/
Grass Seeder Attach.	12 ft.	20	108.00	59.00	5.00	c/
Fertilizer Spreader	12 ft.	20	417.00	229.00	19.00	c/
Beet, Corn & Bean Drill	6 row	15	1,046.00	576.00	63.00	c/

APPENDIX TABLE I. (continued) DEPRECIATION AND AVERAGE INVESTMENT SCHEDULE, 1962.

Item	Size	Life	Typical New 1962 Cost	Average Investment	Annual Depreciation	Source
		Yrs.	Dols.	Dols.	Dols.	
Cultivator Beet, Corn, Bean	6 row	12	894.00	492.00	67.00	c/
Harvestors						
Ensilage Hrvstr. PTO	1 row	10	2,205.00	1,213.00	198.00	c/
Ensilage Hrvstr. motor	1 row	10	2,833.00	1,558.00	255.00	c/
Ensilage Hrvstr. PTO	2 row	10	3,196.00	1,758.00	288.00	c/
Beet Harvestor	1 row	8	3,800.00	2,090.00	427.00	c/
Beet Harvestor	2 row	10	6,344.00	3,489.00	571.00	c/
Combine (pull)	5 ft.	10	2,397.00	1,318.00	216.00	a/
Combine (SP)	12 ft.	10	7,080.00	3,894.00	637.00	c/
Pickup Attach		10	427.00	235.00	39.00	c/
Grain Auger w/motor	36 ft.	15	550.00	302.00	33.00	c/
Hay Equipment						
Mower	7 ft.	12	505.00	278.00	38.00	a/
Side rake (basket)	8 ft.	12	604.00	332.00	45.00	a/
Side rake (wheel)	9 ft.	12	749.00	412.00	56.00	b/
Dump rake	12 ft.	12	287.00	157.00	22.00	a/
Dump rake	21 ft.	12	938.00	516.00	70.00	a/
Baler PTO Twine		10	2,159.00	1,199.00	194.00	a/
Baler PTO Wire		10	2,778.00	1,528.00	250.00	a/
Baler Motor HD Wire		10	3,969.00	2,183.00	357.00	a/
Bale Elevator	36 ft.	15	475.00	262.00	28.00	a/
Swather (HD)	12 ft.	10	4,105.00	2,258.00	369.00	c/
Hay Conditioner for swather		10	795.00	437.00	71.00	c/
Farmhand (3 baskets and pushoff)		10	1,502.00	826.00	135.00	c/
Beaverslide Stacker		12	505.00	278.00	38.00	Est.
Miscellaneous						
Leveler	9 ft.	12	1,026.00	565.00	77.00	c/

APPENDIX TABLE I. (continued) DEPRECIATION AND AVERAGE INVESTMENT SCHEDULE, 1962.

Item	Size	Life	Typical New 1962 Cost	Average Investment	Annual Depreciation	Source
		Yrs.	Dols.	Dols.	Dols.	
Ditcher	6 ft.	10	358.00	197.00	32.00	c/
Manure Spreader	100 bu.	12	648.00	356.00	48.00	c/
Feeder box w/running gear	6 ton	12	1,959.00	1,077.00	147.00	c/
Wagon (with box)		15	417.00	229.00	25.00	a/
Backfill Blade		15	211.00	116.00	13.00	c/
Sprayer (boom & Tank) PTO	20 ft.	10	447.00	246.00	40.00	c/
Sled		15	333.00	183.00	20.00	a/
Posthold Auger		15	425.00	233.00	24.00	d/
Scales		20	1,563.00	860.00	71.00	a/
Squeeze Chute		15	340.00	187.00	21.00	a/
Calf Table		15	224.00	123.00	14.00	a/
Feed Grinder-mixer		10	1,768.00	972.00	159.00	c/
Carryall Scraper	2½ yd.	12	1,129.00	621.00	85.00	c/
Fuel Tanks	300 gal.	10	156.00	86.00	14.00	a/
Fuel Tanks	500 gal.	10	182.00	100.00	16.00	a/
Welder (180 Amp Arc.		20	221.00	122.00	10.00	d/
Saddle		25	160.00	88.00	6.00	d/
Grain bins, steel floor	1000 bu.	20	460.00	230.00	23.00	d/
Grain bins, steel floor	2250 bu.	20	725.00	362.00	36.00	d/
Fence (barbed)/mi.	3 wire	15	560.00	280.00	37.00	d/
Fence (barbed)/mi.	4 wire	15	610.00	305.00	41.00	d/
Fence 2 barb, 36" woven wire/mi.	-	15	765.00	382.00	51.00	d/
Fence (barbed)/mi.	3 wire	25	560.00	280.00	22.00	d/
Fence (barbed)/mi.	4 wire	25	610.00	305.00	24.00	d/
Fence 2 barb, 36" woven wire/mi.		25	765.00	382.00	31.00	d/

APPENDIX TABLE I. (continued) DEPRECIATION AND AVERAGE INVESTMENT SCHEDULE, 1962.

Item	Size	Life	Typical New 1962 Cost	Average Investment	Annual Depreciation	Source
		Yrs.	Dols	Dols.	Dols.	
Shallow well, elect. pump & tank (50' or less)		25	600.00	300.00	24.00	Est.
Deep well, windmill, pump & tank	(over 50')	30	1,500.00	750.00	50.00	d/
Corral Fence (cattle per foot		15	2.00	1.00	0.13	d/
			Dols./Sq. Ft.	Dols./Sq. Ft.	Dols./Sq. Ft.	
Dwelling House		40	14.00	7.00	0.35	d/
Min. Dwelling or modern labor house		40	10.00	5.00	0.25	d/
Labor House--minimum		30	5.50	2.75	0.18	d/
The following sheds & shop with dirt floors.						
Open shed - Steel RW, wood frame	3 walls	30	1.85	0.93	0.06	d/
Open shed - Wood RW, wood frame	3 walls	30	2.05	1.02	0.07	d/
Shed - steel RW, wood frame	4 walls	30	2.25	1.12	0.08	d/
Shed - all wood	4 walls	30	2.45	1.22	0.08	d/

APPENDIX TABLE I. (continued) DEPRECIATION AND AVERAGE INVESTMENT SCHEDULE, 1962.

Item	Size	Life	Typical New 1962 Cost	Average Investment	Annual Depreciation	Source
		Yrs.	Dols/Sq. Ft.	Dols./Sq. Ft.	Dols./Sq.Ft.	
Concrete Block shop steel roof		40	2.95	1.47	0.07	d/
Concrete Floor 4" Reinforced		30	0.60	0.30	0.02	d/

a/ W. G. Kearl and John Story, "Machinery and Improvement Reference Guide for Use in BLM Study", ERS, USDA, University of Wyoming, Laramie, Wyoming, 1961 (mimeographed), (indexed to 1962).

b/ LeRoy Rude, "Montana Machinery Prices", ERS, USDA, Montana State College, Bozeman, Montana, (unpublished reference notebook).

c/ Schedule of seven Billings and Hardin farm equipment dealers. (1963 prices, indexed to 1962).

d/ Interview of Bozeman building and farm supply dealers. (1963 prices, indexed to 1962).

APPENDIX TABLE II. DEPRECIATION & AVERAGE INVESTMENT FOR LIVESTOCK.

Class	Useful Life	Typical a/ 1962 Value	Average Investment	Annual Depreciation	Salvage Valueb/
	Yrs.	Dols.	Dols.	Dols.	Dols.
Cow	7	175.00	125.00	14.00	75.00
Bull	3	350.00	275.00	50.00	200.00
Yearling	-	158.00	158.00	-----	------
Calf	-	98.00	98.00	-----	------
Ewe	5	20.00	12.50	3.00	5.00
Buck	3	40.00	22.50	11.00	5.00
Yrlg. Sheep	-	16.00	16.00	-----	----
Horses	10	200.00	120.00	16.00	40.00
Milk Cows	7	250.00	162.00	25.00	75.00
Sows	3	36.00	33.00	2.00	30.00
Chickens	2	1.50	1.00	0.50	0.50

a/ January 1, 1962, Billings, Montana average prices.

b/ Includes death loss where applicable.

APPENDIX B

COEFFICIENT OF VARIATION

The coefficient of variation (CV) is useful in measuring the variability of the observations within a particular category or stratum of a sample. CV is actually a percentage expression of the variation and is useful in comparing the variation among different tested items. This measure has the advantage of being a relative measure of variation, in contrast to the standard deviation (s) or the variance (s^2). Since it is the ratio of two averages, it does not depend upon the unit of measure used in the study. For instance in this study the CV's can be compared directly in a comparison of variance of a size category whether the units of measure are dollars or acres.

In using CV, a low percentage indicates that the stratum under study has relatively low variation about the mean, while a high CV indicates greater variation.

The formula used when the standard deviation of a sample has been calculated is as follows: 38/

$$CV = \frac{100s}{\bar{X}}$$

A more direct formula which may be used when the standard deviation has not been calculated is:

$$CV = \frac{\sqrt{\Sigma x^2 - \frac{+(\Sigma x)^2}{N}}}{\bar{X}} (100)$$

38/ Robert G. S. Steel and James H. Torrie, Principles and Procedures of Statistics, New York: McGraw-Hill Book Co., Inc., 1960, pp. 20-104.

APPENDIX C

ANALYSIS OF VARIANCE AND "F" TEST

The analysis of variance procedure is used to derive the most accurate possible estimation of the true variance (σ^2) of the population from the particular sample that was taken. All strata of a sample are analyzed in this one simple procedure. The error mean square (MSE) in the following symbolic table represents this best estimate.

The test criteria "F" is calculated by dividing the treatment mean square by the error mean square. This calculated "F" value must then be compared to the tabular "F" value to determine the level of significance. An "F" that is declared significant implies that the study data has given evidence that the observations in the various categories do not belong to populations with a common mean. However, it does not show which category mean differences are significant without further testing.

The formulae used in analysis of variance are shown in the following symbolic analysis of variance table. 39/

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	"F"
Among Categories (treatment)	t - 1	$\sum_i \frac{X_{i.}^2}{r_i} - \frac{X_{..}^2}{rt}$	$\frac{SSTr}{df} = (MSTr)$	$\frac{MSTr}{MSE}$
Within (error) Categories	t (r-1)	SSTot - SSTr	$\frac{SSE}{df} = (MSE)$	
Total	rt - 1	$\sum_{i,j} X_{ij}^2 - \frac{X_{..}^2}{rt}$		

39/ Ibid., pp. 103-104, 112-114.

APPENDIX D

TESTING SIGNIFICANCE BETWEEN MEAN DIFFERENCES

In comparing difference between the means of the strata of a sample, the test used is in reality a test to determine whether the means of the two categories being compared are common.

As a method of testing samples with several strata or categories, Duncan has devised a short cut method.

When the number of observations per category are not equal, as is the case in this study, the first step in his procedure is to find an (s) value by taking the square root of the MSE of the analysis of variance. Next the appropriate tabular significant studentized ranges must be multiplied by the derived (s) to obtain a set of intermediate significant ranges. Thirdly, for any desired comparison of category means, multiply the appropriate intermediate significant range by the results of the following formula: 40/

$$\sqrt{\frac{1}{2}\left(\frac{1}{r_1} + \frac{1}{r_2}\right)}$$

Finally, the difference between the two means that are to be compared are tested against the value derived above. If the test statistic is less than the difference between the two means, the particular comparison is significant at the significance level being tested for. If the test statistic is greater than the mean difference, the comparison is not significant.

40/ Ibid., pp. 107-114.

As a final result, this testing procedure compares every category mean with every other mean in the sample. Exact location of significance can thereby be isolated.

APPENDIX E

TEST OF SIGNIFICANCE BETWEEN THE TWO STUDY AREAS

In testing for significance between two means with unpaired observations and unequal variances, as is the case in this study, a test statistic (t') was calculated to be used in substitution of the tabular (t) that is usually used in testing differences between two means.

To derive the (t') from the information of previous tests the following formula was used: 41/

$$t' = \frac{\frac{s_1^2}{n_1} t_1 + \frac{s_2^2}{n_2} t_2}{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

Where:

s^2 = MSE from the appropriate analysis of variance table.

t = Tabular test criteria.

n = Number of observations per sample.

The mean differences were then compared to this test statistic by first calculating a (t) value by the following formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

and then comparing these two (t) values. If the (t) value derived from

41/ Ibid., p. 81.

the mean differences is greater than the (t') value, the difference is significant; the comparison is not significant if the converse is true.

APPENDIX TABLE III. COSTS AND RETURNS OF PRIVILEGED AND NON-PRIVILEGED RANCH STUDIES. AREA "W" (FS only).

Item	Units	Non-privileged Ranch Study				Privileged Ranch Study a/		
Ranch Size	AUs	104	197	314	656	65	180	451
Gross Ranch Income Per Ranch	$	10,759	18,330	25,076	55,153	10,940	16,757	45,814
Expenses:								
Cash Costs	$	5,711	10,447	13,065	29,658	3,336	6,484	19,048
Depreciation	$	3,019	4,508	4,139	6,992	1,438	2,308	4,056
Family Labor	$	3,250	3,250	3,250	3,250	3,250	3,250	3,250
5 Percent Opportunity Cost	$	3,598	6,331	10,710	22,528	3,552	6,003	14,819
Income, Net of:								
Cash Costs	$	5,048	7,883	12,011	25,495	7,604	10,273	26,766
Cash Costs & Depreciation	$	2,029	3,375	7,872	18,503	6,166	7,965	22,710
Cash Costs, Depreciation & Family Labor	$	-1,221	125	4,622	15,253	2,916	4,715	19,460
Cash Costs, Depreciation, Family Labor & Opportunity Cost	$	-4,819	-6,206	-6,088	-7,275	-636	-1,288	4,641
Total Investment Per Ranch	$	71,958	126,614	214,211	450,557	71,040	120,063	296,382

a/ Indexed to 1962.

APPENDIX TABLE IV. COSTS AND RETURNS OF PRIVILEGED AND NON-PRIVILEGED RANCH STUDIES. AREA "W" (BLM only).

Item	Units	Non-privileged Ranch Study				Privileged Ranch Study a/		
Ranch Size	AUs	104	197	314	656	61	181	592
Gross Ranch Income Per Ranch	$	10,759	18,330	25,076	55,153	6,137	15,677	50,982
Expenses:								
Cash Costs	$	5,711	10,447	13,065	29,658	3,159	6,499	24,140
Depreciation	$	3,019	4,508	4,139	6,992	1,328	2,383	4,695
Family Labor	$	3,250	3,250	3,250	3,250	3,250	3,250	3,250
5 Percent Opportunity Cost	$	3,598	6,331	10,710	22,528	2,489	6,186	18,906
Income, Net of:								
Cash Costs	$	5,048	7,883	12,011	25,495	2,978	9,178	26,842
Cash Costs & Depreciation	$	2,029	3,375	7,872	18,503	1,650	6,795	22,147
Cash Costs, Depreciation & Family Labor	$	-1,221	125	4,622	15,253	-1,600	3,545	18,897
Cash Costs, Depreciation, Family Labor & Opportunity Cost	$	-4,819	-6,206	-6,088	-7,275	-4,089	-2,641	-9
Total Investment Per Ranch	$	71,958	126,614	214,211	450,557	49,788	123,716	378,121

a/ Indexed to 1962.

APPENDIX TABLE V. COSTS AND RETURNS OF PRIVILEGED AND NON-PRIVILEGED RANCH STUDIES, AREA "W" (BLM-SpF) (FS-S).

Item	Units	Non-privileged Ranch Study				Privileged Ranch Study a/		
Ranch Size	AUs	104	197	314	656	73	185	522
Gross Ranch Income Per Ranch	$	10,759	18,330	25,076	55,153	9,812	18,028	44,997
Expenses:								
Cash Costs	$	5,711	10,447	13,065	29,658	3,414	6,627	22,380
Depreciation	$	3,019	4,508	4,139	6,992	1,181	2,168	3,917
Family Labor	$	3,250	3,250	3,250	3,250	3,250	3,250	3,250
5 Percent Opportunity Cost	$	3,598	6,331	10,710	22,528	3,084	5,767	15,917
Income, Net of:								
Cash Costs	$	5,048	7,883	12,011	25,495	6,398	11,401	22,616
Cash Costs and Depreciation	$	2,029	3,375	7,872	18,503	5,217	9,233	18,699
Cash Costs, Depreciation & Family Labor	$	-1,221	125	4,622	15,253	1,967	5,983	15,449
Cash Costs, Depreciation, Family Labor & Opportunity Cost	$	-4,819	-6,206	-6,088	-7,275	-1,117	216	-468
Total Investment Per Ranch	$	71,958	126,614	214,211	450,557	61,678	115,332	318,346

a/ Indexed to 1962.

APPENDIX TABLE VI. COSTS AND RETURNS OF PRIVILEGED AND NON-PRIVILEGED RANCH STUDIES. AREA "E".

Item	Units	Non-privileged Ranch Study a/				Privileged Ranch Study b/		
Ranch Size	AUs	121	246	368	936	64	181	564
Gross Income Per Ranch	$	11,479	20,175	35,733	87,575	8,851	17,020	48,011
Expenses:								
Cash Costs	$	6,508	8,467	19,881	44,208	2,982	5,932	19,307
Depreciation	$	3,192	3,966	5,335	9,262	1,556	2,528	6,038
Family Labor	$	3,500	3,500	3,500	3,500	3,500	3,500	3,500
5 Percent Opportunity Cost	$	5,055	6,549	10,660	25,203	2,697	6,054	17,834
Income, Net of:								
Cash Costs	$	4,971	11,708	15,852	43,367	5,869	11,088	28,704
Cash Costs & Depreciation	$	1,779	7,742	10,517	34,105	4,313	8,560	22,666
Cash Costs, Depreciation & Family Labor	$	-1,721	4,242	7,017	30,605	813	5,060	19,166
Cash Costs, Depreciation, Family Labor & Opportunity Cost	$	-6,776	-2,307	-3,643	5,402	-1,884	-994	1,332
Total Investment Per Ranch	$	101,104	130,982	213,199	504,061	53,941	121,077	356,673

a/ Adjusted for drought.

b/ Indexed to 1962.

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