Marketing Montana hay
by Raymond C Stack

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

Abstract:
In this study, an attempt was made to determine the adequacy of Montana's hay production relative to hay needs, describe the hay marketing practices within the present market structure, determine the relationship between hay prices and marketing factors, and consider the best way of evaluating hay for market purposes.

The annual production of hay in Montana is not enough to adequately meet the needs of the livestock industry, but very little hay is imported into the state, because of adjustments in hay use and the extent of shifting to alternative feeds.

Hay buyers did not reflect through prices paid any significant importance to quality, kind, or cutting of hay.

Hay is sold mostly in local markets, within a 15 to 20 mile radius by farmer-growers, to buyers who prefer to purchase hay at the time of immediate need. Neither buyers nor sellers have adequate market information to guide them in their transactions.

Sampling hay with a core sampler and analyzing the sample chemically is superior to the use of United States Grades as a method of evaluating hay.

MARKETING MONTANA HAY

by

Raymond C. Stack

A THESIS

Submitted to the Graduate Faculty

in

partial fulfillment of the requirements

for the degree of

Master of Science in Agricultural Economics

at

Montana State College

Approved:

J. J. Fischer
Head, Major Department

Elmer R. Hanston
Chairman, Examining Committee

Leroy H. Johnson
Dean, Graduate Division

Bozeman, Montana
March, 1961

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

ACKNOWLEDGMENT

The author wishes to express thanks to the members of his thesis committee -- Dr. Clive Harston, Chairman, Mr. William Ewasiuk and Mr. Art Shaw -- for their assistance and guidance throughout the study and the writing of this thesis.

Appreciation is also expressed for assistance and encouragement by Dr. John L. Fischer, Head, Department of Agricultural Economics at Montana State College, and his staff.

Errors of interpretation of data, presentation and omission are the full responsibility of the author.

ABSTRACT

In this study, an attempt was made to determine the adequacy of Montana's hay production relative to hay needs, describe the hay marketing practices within the present market structure, determine the relationship between hay prices and marketing factors, and consider the best way of evaluating hay for market purposes.

The annual production of hay in Montana is not enough to adequately meet the needs of the livestock industry, but very little hay is imported into the state, because of adjustments in hay use and the extent of shifting to alternative feeds.

Hay buyers did not reflect through prices paid any significant importance to quality, kind, or cutting of hay.

Hay is sold mostly in local markets, within a 15 to 20 mile radius by farmer-growers, to buyers who prefer to purchase hay at the time of immediate need. Neither buyers nor sellers have adequate market information to guide them in their transactions.

Sampling hay with a core sampler and analyzing the sample chemically is superior to the use of United States Grades as a method of evaluating hay.

PART I

INTRODUCTION

Historical Background

Montana is richly endowed as a favored environment for the raising of grass. It was only natural that stock-raising became a major industry early in the development of the state. The early stockgrowers found that the deep draws and coulees of the area offered natural protection for the cattle and that grazing was good all during the winter months as the native grasses retained much of their nutrients when cured. The livestock industry developed from an estimated 50,775 head of cattle in 1870 to 274,316 head of cattle in 1880, and by 1886 this number had been raised to 663,716.1/

The catastrophic winter of 1886-87 did much to change the manner of raising livestock in Montana when the decline of large-scale ranching on the open range was started. The losses of cattle during the winter were severe. Numbers dropped from 663,716 in 1886 to 471,171 in 1887.2/ In the spring of 1887 the carcasses of thousands of animals that were victims of starvation were strewn everywhere, especially in the draws and coulees which had been piled full of snow and caught the drifting cattle. A prominent cattleman, Granville Stuart wrote;

> "A business that had been fascinating to me before, suddenly became distasteful. I wanted no more of it. I never wanted to own again an animal that I could not feed and shelter."3/

1/ Merrill G. Burlingame, The Montana Frontier, Helena, Montana, State Publishing Company, 1942, p. 283.

2/ Ibid., p. 284.

3/ Granville Stuart, Forty Years on the Frontier, Cleveland, Ohio, The Arthur Clark Company, Volume II, 1925, p. 221.

What hay was available was given, as a general rule, only to the bulls so that they would be in an improved condition for the breeding season.[1] Changes in the methods of ranching in Montana were inevitably the result of the experiences of such winters as that of 1886-87 and of the coming of the homesteaders.

An early successful rancher, Pierre Wibaux, observed that if stock could be brought through the winter in good shape they would be ready for the market earlier in the fall. The firm of Grisby and Wibaux contracted to have hay put up in 1883.[2] This was during the time when most ranchers still believed that cattle should shift for themselves the year around. Wibaux's methods paid out and he often topped the Chicago market.[3]

Today, haying and livestock raising are almost inseparable in Montana. The value of Montana's hay production during the period 1947 to 1958 has averaged $63,011,400 per year.[4] Hay has grown from a humble start to the second most important place among crops in Montana.

The Problem Situation

According to Table I, the production pattern for hay has not changed significantly since 1947. In 1959, 61 per cent of all hay produced was

---

1/ Donald H. Welsh, Pierre Wibaux, Cattle King, Montana State University, Missoula, Montana, 1950, p. 50.

2/ The Glendive Times, Glendive, Montana, July 14, 1883.

3/ Welsh, op. cit., p. 51.

4/ Montana Department of Agriculture, Montana Agricultural Statistics, Helena, Montana, United States Department of Agriculture, Agricultural Marketing Service Cooperating, Volume VII, 1958, p. 19.

TABLE I. ALL HAY IN MONTANA, ACREAGE, PRODUCTION, PRICE, TOTAL VALUE, VALUE PER ACRE.*

Year	Acres Harvested	Production		Price per Ton Sold	Value of Production	Value per Acre
		Yield/Acre	Total			
		Tons			Dollars	
1948	2,203,000	1.23	2,704,000	21.60	58,406,000	26.51
1949	2,122,000	1.01	2,151,000	26.10	56,141,000	26.46
1950	2,432,000	1.12	2,730,000	24.20	66,066,000	27.17
1951	2,236,000	1.07	2,399,000	32.30	77,488,000	34.65
1952	2,510,000	1.12	2,804,000	28.50	79,914,000	31.84
1953	2,585,000	1.21	3,134,000	18.70	58,606,000	22.67
1954	2,436,000	1.20	2,921,000	20.00	58,420,000	23.98
1955	2,410,000	1.27	3,054,000	20.70	63,218,000	26.23
1956	2,230,000	1.21	2,700,000	22.70	61,290,000	27.48
1957	2,326,000	1.29	2,992,000	16.90	50,565,000	21.74

*Source: Montana Department of Agriculture, Montana Agricultural Statistics, Helena, Montana, United States Department of Agriculture, Agricultural Marketing Service Cooperating, Volume VII, 1958, p. 19.

alfalfa, 17 per cent was wild hay, 12 per cent was clover and timothy hay, 7 per cent was grain hay and 3 per cent was classified as other. The high alfalfa producing counties are Big Horn, Blaine, Carbon, Cascade, Fergus, Gallatin, Lake, Madison, and Park. These counties combined accounted for nearly 35 per cent of the total alfalfa production in 1959. Alfalfa is produced largely on irrigated land in Montana. Clover and timothy hay is grown mostly in the mountain meadows of Beaverhead, Carbon, Granite, Madison, Meagher, Powell and Ravalli counties. Wild hay is grown in the mountain meadows of Beaverhead, Madison, Powell and Meagher counties as well as the plains area of northern Montana comprised of Teton, Glacier, Blaine and Phillips counties. The wild hay in the mountainous areas is mostly bluegrass whereas the wild hay of the plains is largely western wheatgrass. Grain hay is, of course, grown mostly in the dryland crop areas of Blaine, Chouteau, Hill, Phillips, Roosevelt, Sheridan, and Valley counties. (See Figures 1-5.)[1/]

Hay is grown as the only possible crop in some areas of Montana because of soil or climatic factors. The Big Hole Valley of Beaverhead County is a good example of climatic limitations. In other areas hay is raised as an alternative crop grown in rotation with other, perhaps more important crops.

The question now arises. Is the production of hay in Montana adequate to meet the needs of stockgrowers within the state? To answer this question an attempt was made to compute a hay-livestock balance for each county

---

1/ United States Department of Commerce, 1959, Census of Agriculture -- Preliminary, State of Montana, Bureau of the Census, Washington, D.C., August, 1960.

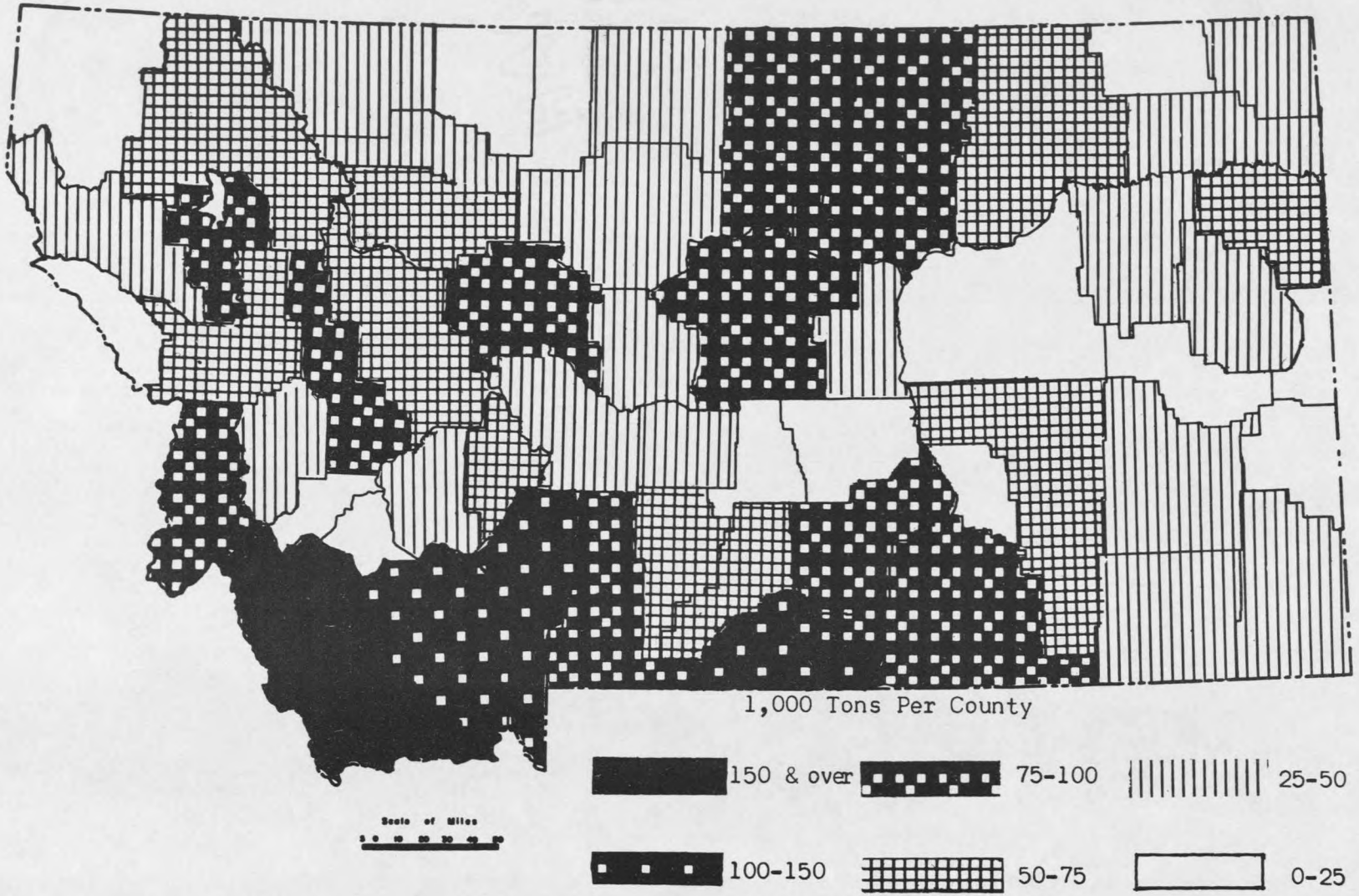

Figure 1. Annual Average Hay Production in Montana, 1947 to 1958.

Source: Montana Agricultural Statistics, op.cit.

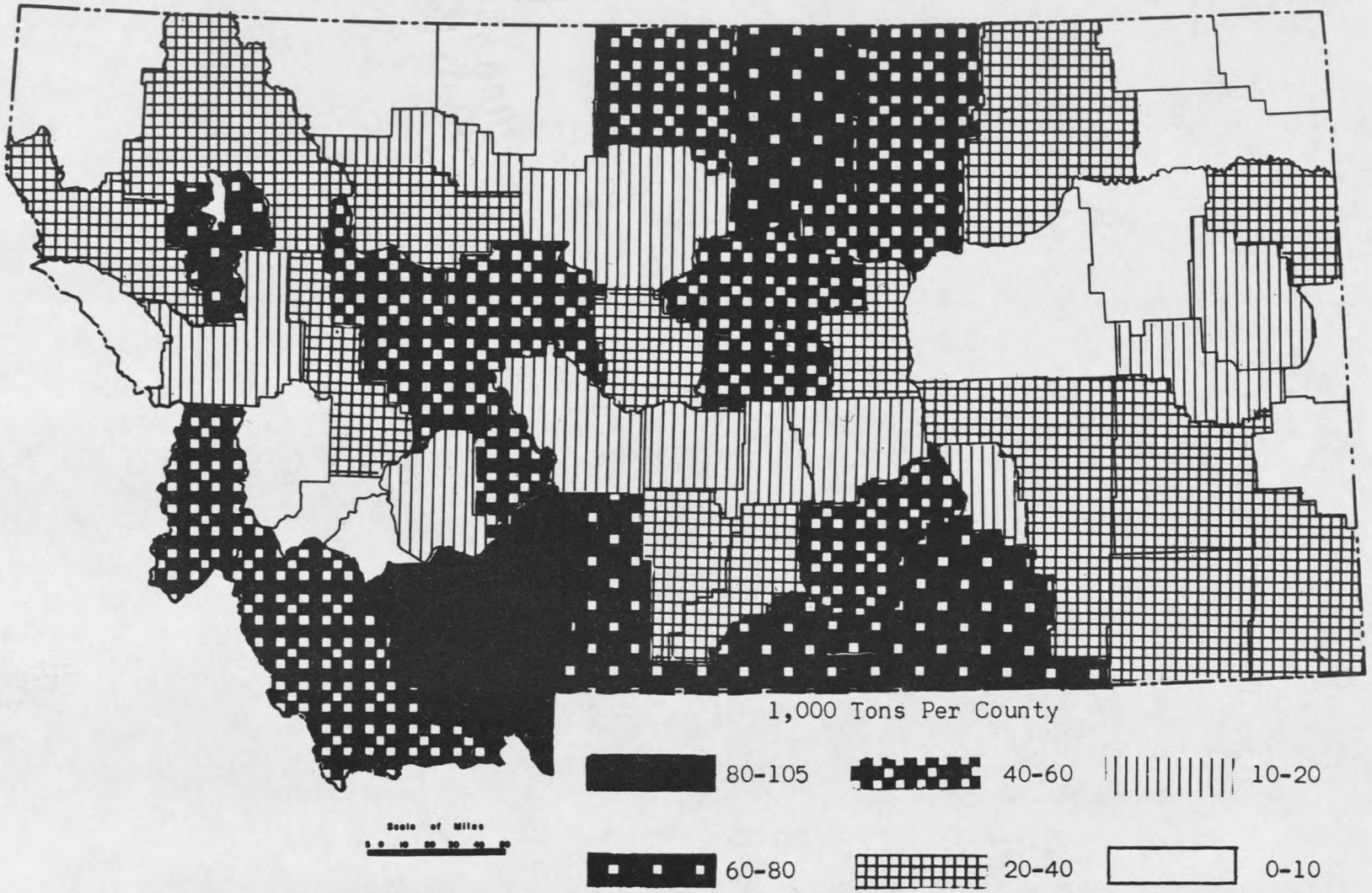

Figure 2. Alfalfa Production in Montana, 1959.

Sources: Census of Agriculture, op. cit.

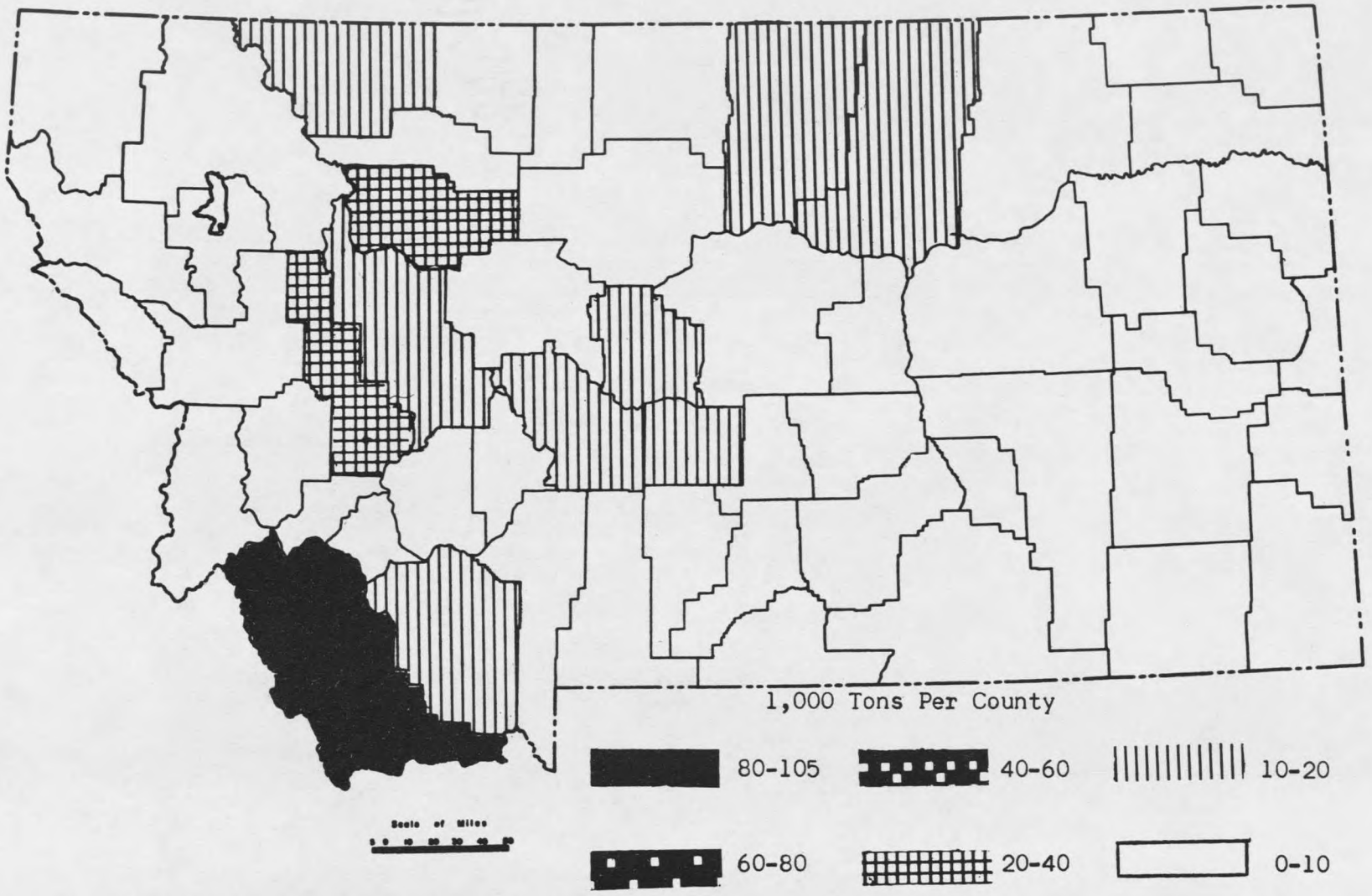

Figure 3. Wild Hay Production for Montana, 1959.

Source: Census of Agriculture, op.cit.

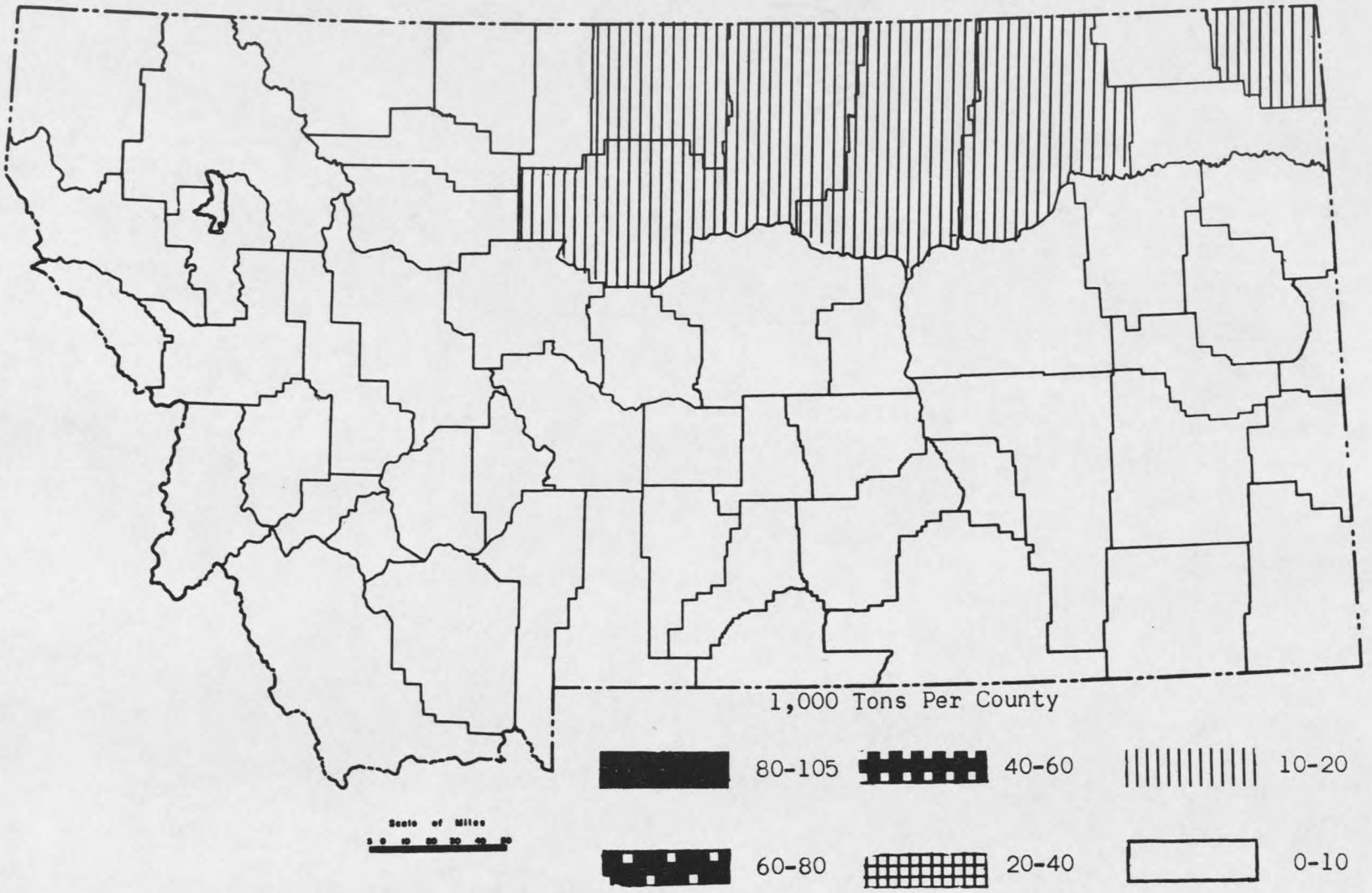

Figure 4. Grain Hay Production in Montana, 1959.

Source: Census of Agriculture, op. cit.

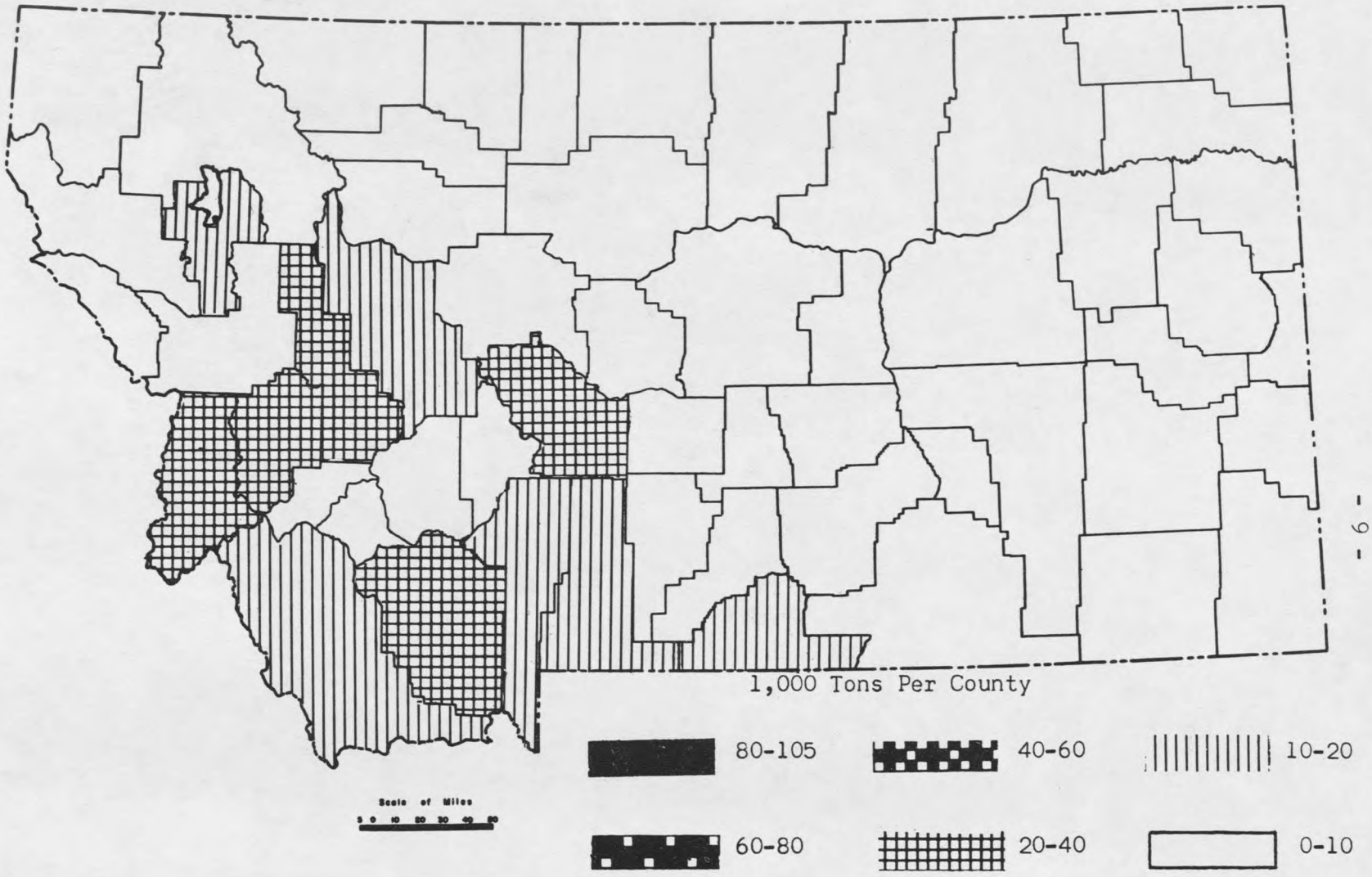

Figure 5. Clover and Timothy Production in Montana.

Source: Census of Agriculture, op. cit.

for the year 1959. Hay production data and livestock numbers were obtained from the 1959 Census of Agriculture Preliminary Report. Animal hay requirement rates, per unit of livestock, were obtained from various publications.[1/] These rates were not adjusted for each county, however. Consultation with Jacobsen and Orcutt[2/] provided a basis for adjusting the state hay requirement rates to each county. These rates are reported in Table I in Appendix B. The livestock-hay balance is reported in Table II and Figures 6 and 7.

Several factors must be considered in evaluating these balances. They are listed below although not necessarily in order of importance.

First, the animal feeding rates per unit of livestock for each county are only estimates which are based upon computed rates for the state and are, therefore, subject to error. These estimations are difficult to make because the hay requirements are highly dependent upon the length of the grazing season as well as the condition of winter range. Little or no data exist for these factors in Montana. Saunderson and Chittenden[3/] included some very general data on length of grazing season in their 1937 study. They concluded that the mountain valley ranches have 120 days of

---

1/ R.D. Jennings, Feed Consumed by Livestock, 1949-50, United States Department of Agriculture, Agricultural Research Service, Statistical Bulletin No. 145, Washington D.C., June 1954; p. 28; E.P. Orcutt, Do You Have Enough Feed? Montana Agricultural Extension Service, Circular 144, Bozeman, Montana, March 1944; J.R. Gray and C.B.Baker, Organizations, Costs and Returns on Cattle Ranches in the Northern Great Plains, 1930-52, Montana Agricultural Experiment Station, Bulletin 495, Bozeman, Montana, December, 1953, p. 52.

2/ Livestock Specialists, Montana Extension Service, Bozeman, Montana.

3/ Mont H. Saunderson and D.W. Chittenden, Cattle Ranching in Montana, Montana Agricultural Experiment Station, Bulletin 341, Bozeman, Montana, May, 1937, p. 17.

TABLE II. LIVESTOCK-HAY BALANCE FOR MONTANA.*

Year	Total Hay Requirements for Various Classes of Livestock: Tons for Milk Cows	Tons for All Other Cattle	Tons for All Sheep	Tons for Horses	Total Tons	All Hay Production Tons[a]	Balance	Per cent Deficit
1945	365,408[b]	1,815,251	678,318	298,022	3,156,999	2,426,030	-730,969	23
1950	311,699	1,756,485	311,965	185,774	2,565,923	1,898,876	-667,047	26
1954	276,405	2,597,505	399,968	123,938	3,397,816	2,784,349	-613,467	18
1959	205,514	2,472,319	422,102	112,294	3,212,229	2,905,350	-306,879	10

*Source: Hay requirements for each class of livestock were obtained from, Animal Units of Livestock Fed Annually, Statistical Bulletin No. 194, United States Department of Agriculture, Agricultural Research Service, October, 1956, and are as follows: milk cows 2.8 tons, all other cattle .999 tons, all sheep .2 tons, and horses 1.3 tons.

Livestock numbers and hay production data were obtained from the 1945, 1950, 1955 and 1959 Census of Agriculture Reports.

a/ Includes silage.

b/ 1944 data.

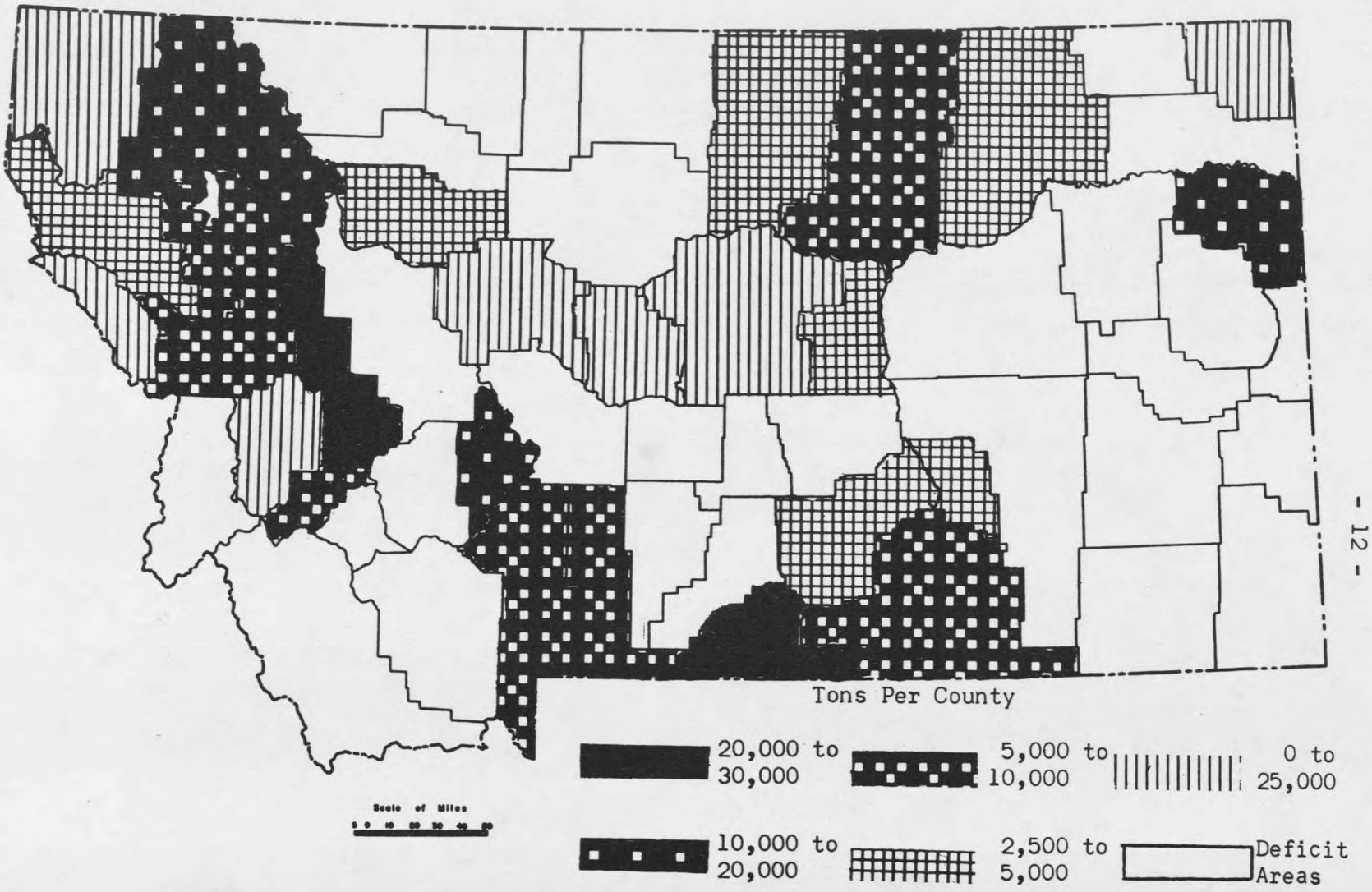

Figure 6. Hay Surplus Areas in Montana, 1959.

Source: Census of Agriculture, op. cit.

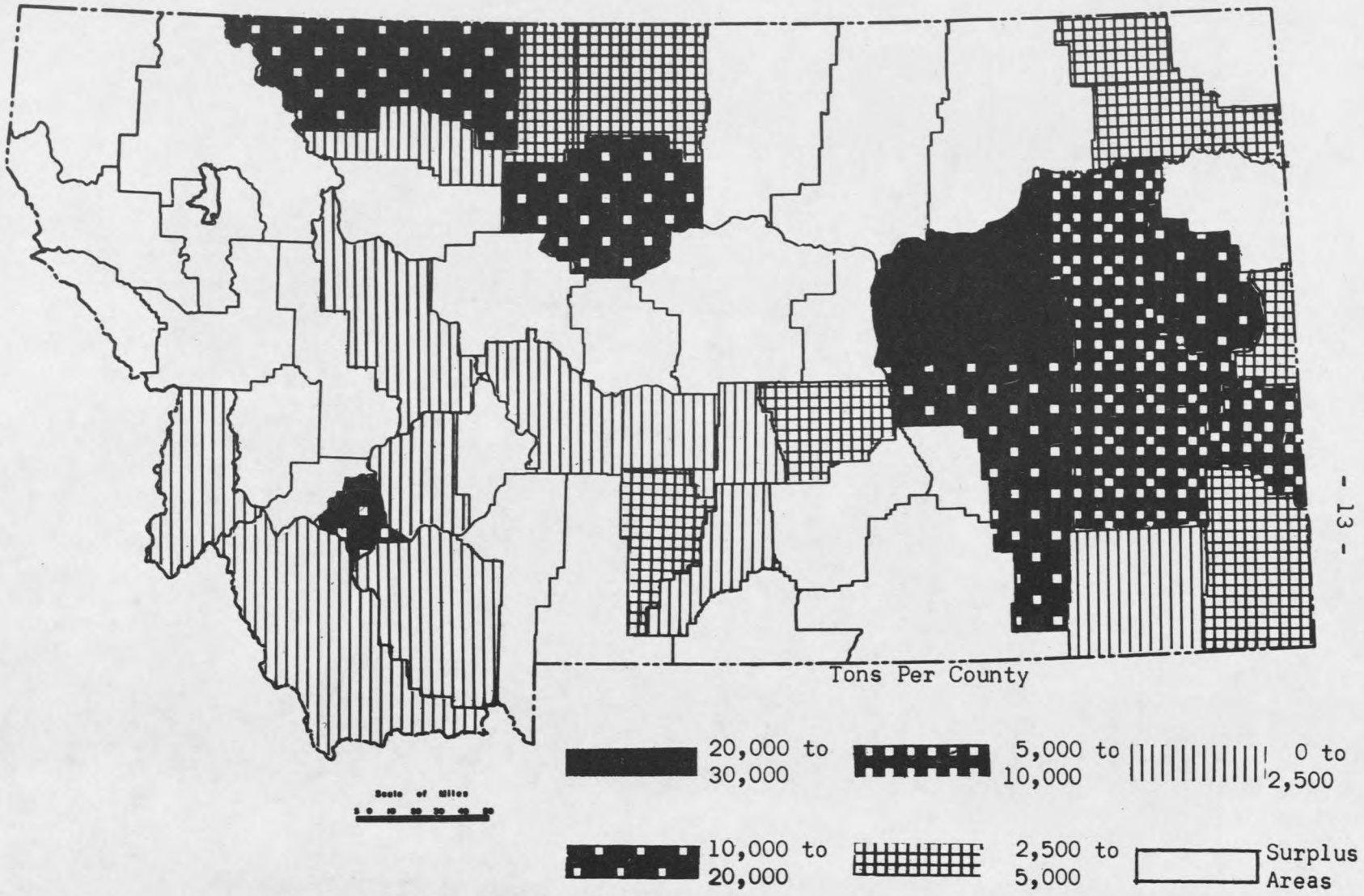

Figure 7. Hay Deficit Areas in Montana, 1959.

Source: Census of Agriculture, op. cit.

winter feeding, the foothill ranches, 100 days, and the plains ranches 90 days. These figures were used as guides to establish the requirement rates in this study.

Secondly, the management practices which affect hay feeding rates vary widely. For instance, many large ranch operators can afford to leave a substantial tract of range for winter use, while small operators lack sufficient range land to do the same. Also, some operators may choose to move cattle to hay supplies or vice versa, a practice made possible by modern transportation methods and baling of hay. Thus the range man is not now as vulnerable as he once was to highly variable local feed supplies. Hay is still important to him, but he may depend more on winter grazing knowing that emergencies can be handled effectively.

Finally, there are readily available substitutes for hay. For example, the production of corn for silage has increased 69 per cent the past five years.[1/] One reason for this increase is the expansion of the beef cattle feeding industry. This expansion may be partly due to finding an outlet for a large barley production. The need for a safe roughage to supplement barley in the fattening ration is satisfactorily accomplished with corn silage. Another is the development of new high yielding hybrid varieties of corn adapted to Montana conditions. In some areas of eastern Montana, corn is grazed in the fall. This practice substantially lowers hay requirements. With the advent of the automatic hay baler considerable baled straw is used as a substitute for hay in the dryland grain areas.

1/ 1959 Census of Agriculture, op. cit.

In that part of the northern Great Plains which lies south of the Missouri River, winter feeding of hay is usually intermittent or only during storm periods.[1] Saunderson reports that,

> ". . .the use of hay for wintering cattle in this part of the northern plains is, on well managed ranches, used essentially as a supplement to the range grazing."

He states that,

> "Full and continuous winter maintenance of hay for any length of time seldom becomes necessary with good range use."

In the low mountain and foothill region of Montana, Saunderson has observed that the winter hay requirement is about a ton per head on the average. He maintains that winter feeding in this area requires full and continuous maintenance of all or most of the cattle, and hay is fed for a period of about four months.

In the mountain valley areas, Saunderson designates two classes -- the high and low valley ranches. In the high mountain valleys Saunderson contends that a full five-month period of full and continuous maintenance on hay is required. The lower valleys would, of course, require somewhat less.

It becomes evident, therefore, that when a county is designated surplus or deficit according to the methods employed in this study that these counties may not necessarily attempt to import or export hay. Deficit counties may be in a position to use hay substitues or depend largely on winter grazing, whereas surplus counties may consider larger than normal carryover or heavier feeding rates.

1/ Mont H. Saunderson, Montana Stock Ranches and Ranching Opportunities, Agricultural Experiment Station, Montana State College, Bozeman, Montana.

The hay-livestock balance analysis does point out, however, the general areas of sufficient hay in contrast to areas where hay is generally short.

Of the total hay production in 1959, 13 per cent was involved in sales. Of this total percentage 10 per cent was alfalfa, 1 per cent was clover and timothy, 1/4 of 1 per cent was grain hay, 1 per cent was wild hay and 1/4 of 1 per cent was other hay.[1/] Of all hay marketed in Montana in 1959, 79 per cent was alfalfa. Figure 8 shows the percentage of hay involved in sales for each county.

The Research Problem

This study is concerned with an examination, description, and evaluation of the present hay market structure. Unlike the other major Montana commodities, wheat and cattle, the market organization for hay is almost entirely undeveloped. Hay buyers must look to supply sources without specific market information as to location of surplus hay, its price or its quality. Producers of surplus hay do not know the requirements of consumer markets at any given time because market information is not readily available.

With no common basis for quality pricing in effect, prices paid for different qualities or kinds of forage are not determined by feeding value or other reliably defined criteria. A study of hay pricing practices will become a major portion of this thesis.

1/ 1959 Census of Agriculture, op. cit.

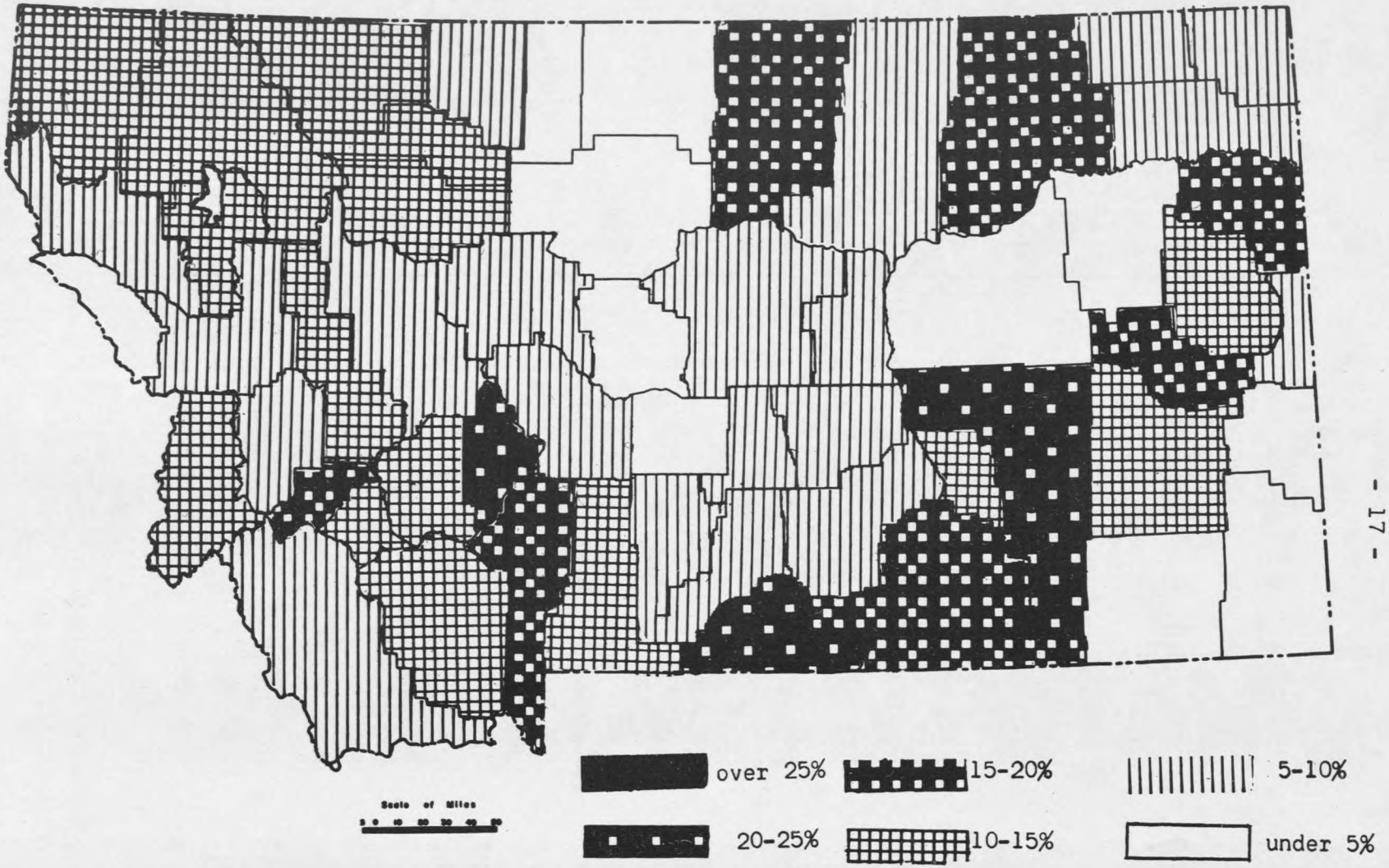

Figure 8. Per cent of Total Hay Production Involved in Trade in Montana.

Source: 1959 Census of Agriculture, op. cit.

Technical innovation in hay production and transportation methods have had some impact on hay marketing. An examination of these impacts with some predictions of future innovations and their subsequent impacts will be studied.

Objectives

The objectives will be to:

1. Describe the present market structure for hay in Montana.
2. Analyze the present hay production and use patterns together with associated marketing problems.
3. Analyze the prices and factors affecting the prices of hay in Montana.
4. Appraise the adequacy and acceptability of U.S. Standards and Grades for hay and to make recommendations for making them more effective.

Hypotheses

The marketing structure for hay in Montana is relatively undeveloped as compared to marketing structures for other commodities. Consequently, hay prices do not adequately reflect true supply and demand conditions or quality relationships.

The following hypotheses were used to guide the research effort of this study.

1. Although Montana does not produce enough hay to adequately meet hay needs, very little hay is imported into the state.
2. Hay is costly to transport which limits the marketing transactions to a small local area.
3. Market information concerning hay is non-existent.
4. There is no effective grading system now in use upon which to establish hay quality.

Procedure

Twenty-five prominent hay dealers, producers and users in four selected areas, namely Billings, Bitterroot Valley, Fairfield Bench and Glasgow-Saco Area, were interviewed as to their views on pricing determinants, technological innovations, market information and trends in hay marketing. Forty-nine county extension agents returned a mail questionnaire which contained similar questions. In addition the opinion of 32 producers in Lake and Ravalli counties was obtained as to the same factors. This information will be used to help describe and analyze the present practices and procedures of marketing hay in Montana.

Five thousand mail questionnaires were mailed to Montana producers through the Office of Crop and Livestock Reporting Service, Agricultural Marketing Service, Helena. Of this total 1,985 usable schedules were obtained. The information relates factors encountered in individual hay sales and will be used to relate kind, amount, cutting, month sold, quality, loose or baled, field or stack, at farm or delivered, farmer or dealer and in county or out, to price received.

Forty-three individual hay samples were collected from lots of hay in Lake and Ravalli counties which had recently been sold. These samples were tested for protein and phosphorus content and were officially graded by the United States Department of Agriculture, Agricultural Marketing Service, Grain Division at Portland, Oregon. From these samples price-quality relationship can be obtained.

PART II

METHODS OF SELLING HAY AND PRICE RELATIONSHIPS

The hay market may be described as the place where the forces representative of the demand for hay and the supply of hay meet. A market price is derived from the meeting of these forces.

The hay market is mostly local in nature in Montana; that is, most transactions involve hay which has been grown within a 15-to 20-mile radius. Some areas in Montana, such as Ravalli and Yellowstone counties, do ship in hay from areas which are 150 to 200 miles distant, but these are exceptions to the common practice.

The individual hay grower in Montana operates in a market that is neither competitive nor monopolistic, but which can, depending on supply and demand conditions, take on some characteristics of both models. Most often, the markets for hay are somewhat imperfect with a few major buyers or sellers having the most price influence. (See Methods of Marketing and Pricing Practices, section pp. 24 and 25.)

There are very few growers in Montana who derive the major portion of their income from the sale of hay. Hay, then, is either a supplementary or complimentary product. Supplementary in that it provides additional feed resources, adds to the farm income and utilizes unused farm resources, and complimentary in that it raises soil fertility, prevents erosion, and fits into the crop rotation. Hay is seldom competitive with other crop enterprises on the farm.

Short-run Market Situation

One of the phenomena in the present situation is that the set of forces affecting demand are somewhat the same as those that bring about a change in supply. Effective demand for hay is closely related to livestock numbers and climatic factors which necessitate the feeding of hay. The demand curve for hay shifts often depending upon changes in the factors which affect demand. The effective supply of hay is dependent upon biological and weather forces which have an influence on yields and also on the acreage of hay. Therefore, during a drought year the supply is curtailed and demand is usually increased due to a lack of grazing. On the other hand, when growth conditions are ideal for a large hay production, they are also ideal for the production of hay substitutes, such as grazing and silage.

A theoretical consideration of the short-run[1/] situation (Figure 9) would show that as supply is increased (S_1 to S_3) due to favorable growing conditions, that demand may actually be lowered (D_1 to D_2) due to the same weather factors. Price would then fall (P_1 to P_2) and quantity demanded would be somewhat less (Q_1 to Q_2). If, however, the favorable weather of the growing season was followed by unfavorable weather during the feeding season, then demand would increase (D_1 to D_3). Price would decrease some (P_1 to P_4) and the quantity put on the market would increase substantially (Q_1 to Q_4).

1/ The short-run is defined as one complete hay production and feeding season. In Montana the period June 1 to May 30 would most often apply.

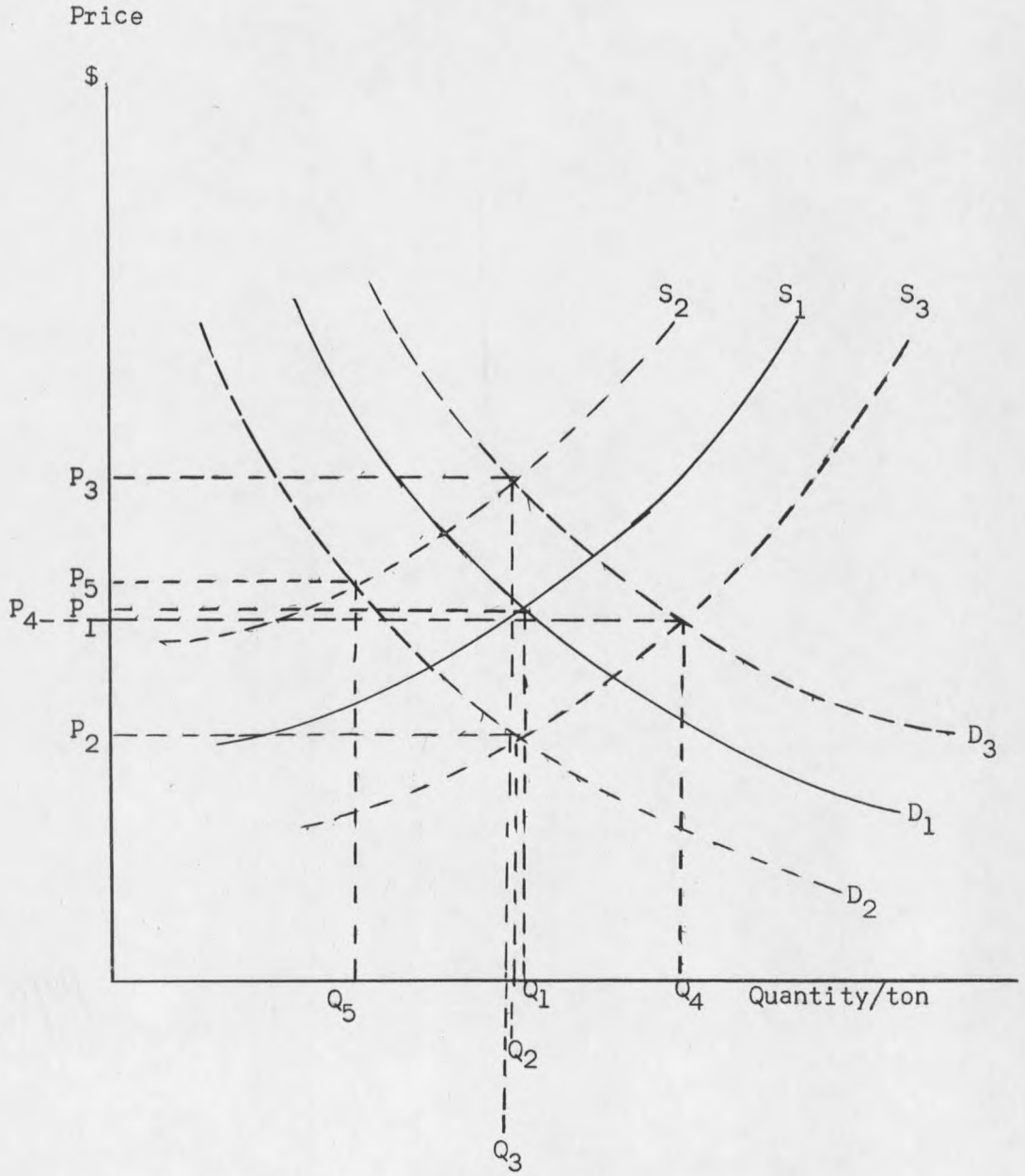

Figure 9. Shifts in Short-run Supply and Demand for Hay.

If drought conditions prevail during the growing season, supply is lowered (S_1 to S_2) and demand is most likely increased (D_1 to D_3) due to the cut-back in grazing resources. Price would now be raised to P_3 while quantity demanded would be about the same (Q_3). If, however, the winter feeding season is unusually mild, then demand may be lowered (D_1 to D_2). Here, price would not raise as much (P_5) and quantity would be cut back severly (Q_5). The production and feeding season of 1960 and 1961 illustrate this situation where a summer drought was followed by an exceptionally mild fall.

In the short-run, both curves would be inelastic at high price levels and elastic at lower prices. This would suggest that a certain amount of hay will be in demand regardless how high prices become, within reason, and that supply will not pass a certain output level in spite of high prices due to the complimentary and supplementary nature of hay. At the lower price levels, large changes in quantity will be offered for small price changes. There is a minimum price, below which little or no hay will be offered for sale, producers choosing to either store or utilize it themselves, perhaps even for bedding. Also, the demand will change toward hay and away from higher priced substitutes when hay is lower priced.

Long-run

In the long-run[1/] the set of forces that bring about a change in supply are different from those that change demand. Demand here is

---

1/ The long-run is defined as extending over a period of more than one year.

mostly related to livestock numbers and long-run supply conditions. Effective supply, in the long-run, is still dependent on acreage and weather and it is also dependent on long-run price conditions. As livestock numbers follow irregular cycles, an upswing in numbers creates a stronger demand for hay with the opposite being true for the low side of the cycle. As each grower faces an elastic demand curve he can sell all he grows for the market price without appreciably affecting the price level. Thus the pressure is always on each individual farmer to produce at optimum efficiency on his farm. He suffers no market penalty directed specifically to his own indiscretion. It's when all growers respond to demand pressure that prices rise and fall.

An examination of Figure 10 demonstrates that there is perhaps some minimum quantity supplied. The reasons for this situation are that hay is complimentary to other crop enterprises and also because some land is suitable only for hay production. Supply, then, is inelastic at both price extremities in the long-run.

Factors causing shifts in supply and demand are different in the long-run as was explained earlier. The shifts have the same effect on prices and quantities offered, however, as evidenced by Figure 11.

Methods of Marketing Hay and Pricing Practices

In Montana, hay prices are determined more around a kitchen table, pick-up cab, or other common "business" place of farmers, than in formal organized trading procedures. Hay buyers and sellers usually have a fairly good knowledge of local short-run supply and demand conditions, which is gained through the local communication system. This supply and

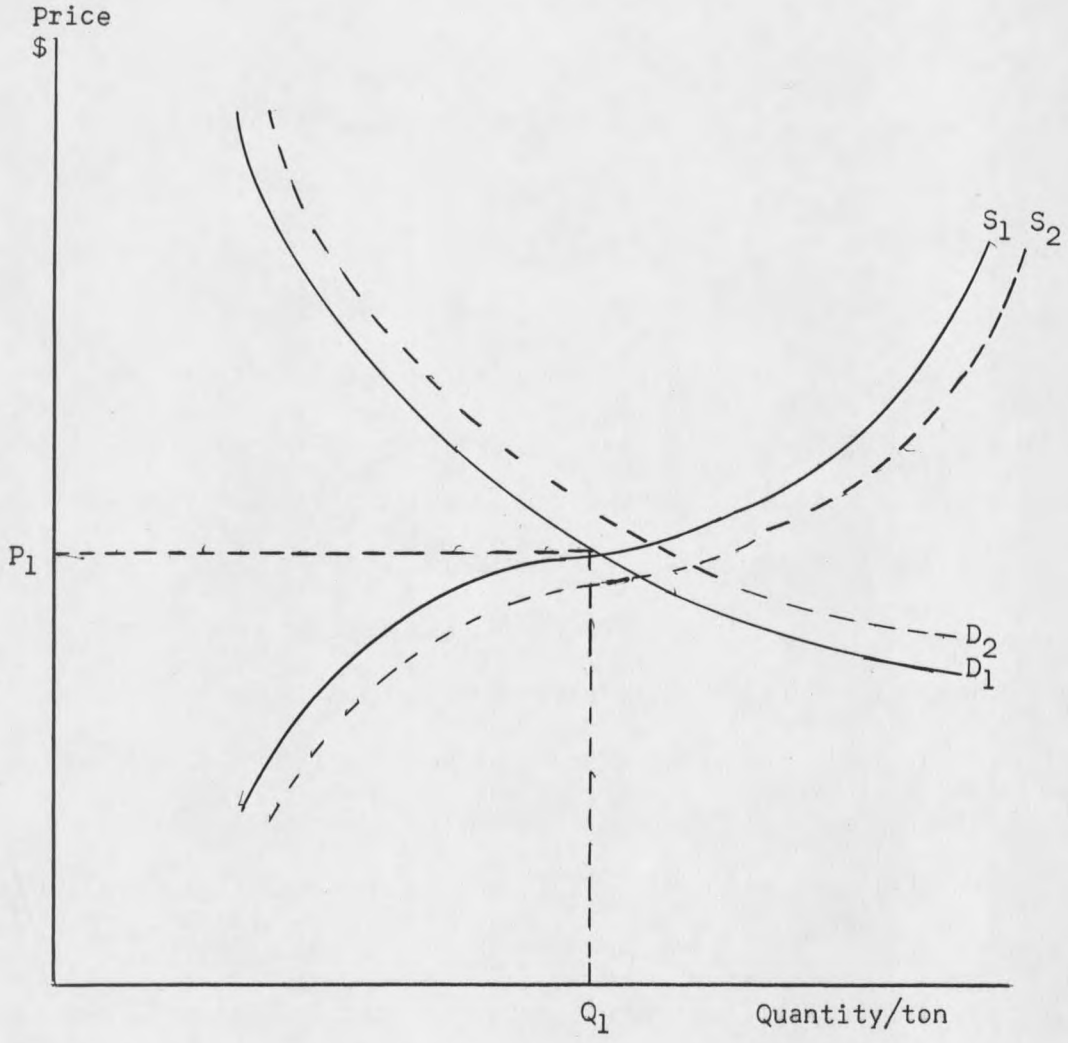

Figure 10. Shifts in Long-run Supply and Demand.

demand information together with the previous years' prices and the so-called "local current prices" provide the basis for establishing prices in each transaction.[1/]

1/ Based upon information obtained from interviews with dealers, hay users, and hay sellers in the Billings, Hamilton, Ronan, and Fairfield areas, and also from most Montana County Extension Agents.

In some areas of the state, stronger price setting influences exist. In the Billings area, for instance, two major livestock markets each buy approximately 1,500 tons of hay annually. It is generally believed by the dealers in this area that these two markets have an important price setting impact upon the hay sold in this locality.

Considerable hay is shipped into the Bitterroot Valley from the Mud Lake Area in Idaho. This area in Idaho has a dehydrating plant in operation which purchases considerable hay. Dealers bringing hay into Montana from Idaho believe this dehydrating plant to be a major factor in pricing the hay in Idaho and subsequently the hay brought into Montana. The imported Idaho hay, in turn, does much to set the price of local hay offered for sale in the Bitterroot Valley.

There is a dehydrating plant in the Gallatin Valley, which, undoubtedly, has price setting influences on the hay bought and sold in this part of Montana.

Price-Quality Relationship

It appears that hay buyers attach importance to quality factors when supplies are plentiful, but that quality is hardly considered in pricing hay during a short supply year. Table III, which is a record of prices for various estimated qualities, does show variation in prices for the different qualities of hay.[1/] The year these data were gathered was a

---

1/ The data in all of the tables in this chapter was gathered from a mail questionnaire survey conducted during the summer of 1958. Five thousand questionnaires were mailed out by the Crop and Livestock Reporting Service at Helena to various cooperators of this reporting agency. Of the 5,000 questionnaires, 1,937 were usable. Out of the usable questionnaires, 429, or 22 per cent had usable sales data recorded on them.

All of the prices quoted in the tables of this chapter are averages which have been weighted.

TABLE III. PRICES OF VARIOUS FARMER-SELLER ESTIMATED QUALITIES OF HAY SOLD IN MONTANA, 1958.*

Area	Top Quality Tons in Sample	Per cent of Sample for Top Quality	Average Price of Top Quality	Good Quality Tons in Sample	Per cent of Sample for Good Quality	Average Price of Good Quality	Fair Quality Tons in Sample	Per cent of Sample for Fair Quality	Average Price of Fair Quality	Poor Quality Tons in Sample	Per cent of Sample for Poor Quality	Average Price of Poor Quality
I	188	11	17.25	1,101	63	12.90	438	25	10.76	12	1	15.00
II	875	34	21.80	1,160	45	18.65	407	16	12.93	137	5	15.55
III	190	19	21.40	678	69	20.60	33	3	19.25	80	8	20.00
IV	140	12	13.95	892	78	16.65	100	9	15.35	17	1	10.00
V	212	11	12.85	1,189	60	13.30	595	30	13.00	0	0	0
VI	759	17	14.70	1,877	43	14.65	1,648	38	15.50	87	2	12.00
VII	155	13	14.55	1,014	85	18.15	31	3	10.15	0	0	0
State	2519	19	17.65	7,926	59	16.00	3,252	24	14.05	333	2	15.40

*Source: Based on information obtained from a survey questionnaire mailed to farmers by the Agricultural Marketing Service, Helena, Montana, in 1959.

year of plentiful supply. Areas I, II and III follow the expected pattern, that of decreasing price for decreasing quality. (For a location of the seven areas refer to Figure 11.) The unexpected increase in price for poor quality hay in some areas is unexplainable. In Areas IV, V and VII increases in price occur as quality decreases. In these areas, hay is used mostly to winter beef cows and range ewes. Therefore, transportation costs and kind (legume or grass) of hay would have much more price setting influence than quality.

In Area I, the large difference between top quality and good quality could be due to dairymen in the area giving recognition to quality factors. Another factors to consider in this analysis is that hay sellers tend to overestimate the quality of hay they are selling, and that the data in the tables were collected from hay sellers; therefore, some of the hay classified as top quality could, perhaps, be more accurately decribed as only good or fair quality. The state average figures follow a logical pattern and reflect all of the phenomena described above.

Thirty-four farmers located in Lake and Ravalli counties were asked to give an estimate of quality of hay they had recently sold and then a sample of hay was collected from the described lot. Twenty-six per cent of the samples were rated on the farms are top quality, 40 per cent as good quality, 31 per cent as fair quality and only 20 per cent as poor quality. The prices ranged from 15 to 30 dollars a ton with average price near 25 dollars a ton. The hay samples were then officially U.S. graded and a protein and phosphorus analysis obtained. The next step was to run a

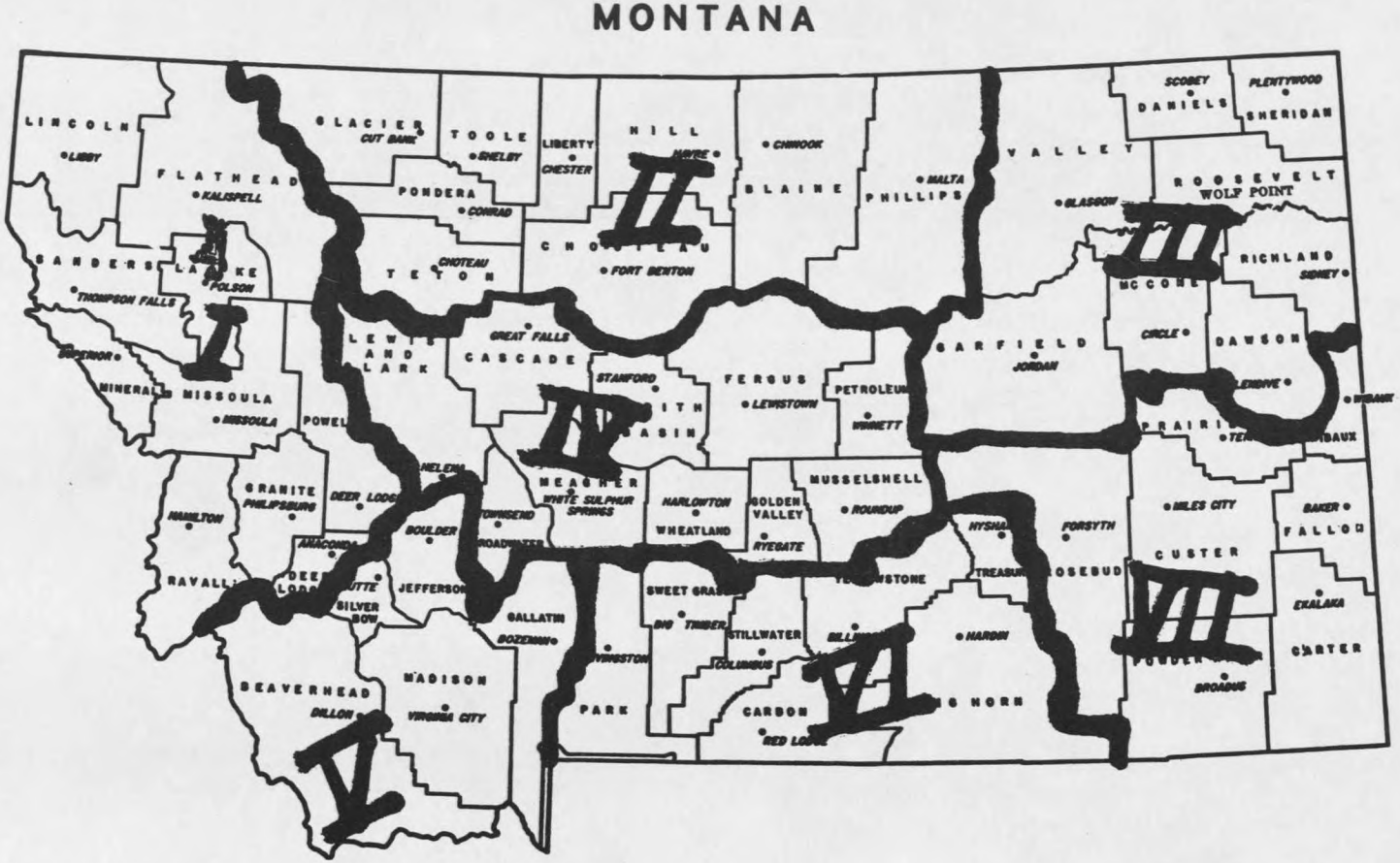

Figure 11. The Seven Marketing Areas in Montana.

multiple linear regression analysis using price as the dependent variable and green color, foreign material, grass content, protein, and phosphorus as the five independent variables.

Equation (1) represents the least squares estimates where items 1 through 5 are considered. The coefficient of multiple correlation appears to the left and below the equation and the standard error of the regression coefficients appears below the coefficients in parentheses.

$$(1)\ \hat{Y} = 12.66 + .1154\ X_1 - .6235\ X_2 + .0299\ X_3 - .2144\ X_4 + 32.296\ X_5$$

$$R = .5312 \quad (0.0575) \quad (0.3612) \quad (0.02678) \quad (0.3384) \quad (18.4949)$$

Variables in the above equation are defined as follows:

$\hat{Y}$ = Price of hay

X_1 = Per cent green color

X_2 = Per cent foreign material

X_3 = Per cent grass

X_4 = Protein content

X_5 = Phosphorus content

The above analysis (see equation (1) indicates that green color was significant in affecting price at the .05 confidence level. All of the other variables were not significant at this high a confidence level.

When using all five independent variables in the multiple regression analysis it was found that these variables accounted for only 28 per cent of the variation in the dependent variable. The F test for significance of the multiple correlation coefficient showed this figure to be highly significant at the .05 level. The variable X_1 green color explains about 9

per cent of the variation in price, the variable X_2 foreign material, 7 per cent, the variable X_3 grass content, 3 per cent, the variable X_4 protein content, 1 per cent and phosphorus content 8 per cent.

The conclusion to be drawn from the above is that according to the sample used, little relationship existed between price and quality. Of course, the year the samples were drawn, 1959, was a year of relatively short supply. Still, the data do point out a weakness which exists in the hay marketing structure -- that of not being able to price hay according to the nutritional value of the hay. The farmers' estimate of quality did correlate with prices, however. This would suggest that price is not a function of actual quality as determined through grading and chemical test, but is, instead, a function of the farmers estimate of quality which seems to have little relationship to actual quality.

One of the main weaknesses in the present system of pricing hay is the lack of a satisfactory manner of examining a lot of hay being offered for sale to establish quality. The most common practice is to break one or two bales only in each lot.[1/] Work done with a core sampler indicates a wide possible range of qualities within each stack. Meyer and Lofgreen showed that 19 bales of hay need to be sampled at random from each 50-ton lot in order for the sample to be representative.[2/] The number of samples

---

1/ Based upon information obtained from interviews with dealers, hay users, and hay sellers in the Billings, Hamilton, Ronan, and Fairfield areas, and also from most Montana County Extension Agents.

2/ J. H. Meyer and G. P. Lofgreen, Evaluation of Alfalfa Hay by Chemical Analysis, Animal Husbandry Department, University of California, Davis, California, p. 1.

that should be taken is a function of the variability in any lot of hay. The only opportunity a buyer has to inspect adequately the hay he has purchased is when he feeds it. The core sampler is perhaps the only practical manner of sampling hay for quality, although the sample so obtained is most valuable for chemical analysis only. The lack of a practical method of sampling hay adequately to determine color, leafiness, and softness places a real limitation upon the development of an adequate pricing system.

Only 55 per cent of the hay buyers interviewed indicated paying different prices for different qualities. The other half said they paid only one price, but tried to buy the best available for that single price. Perhaps a valid conclusion drawn from this observation is that buyers, in general, are not paying close attention to quality factors, but are somewhat satisfied with the quality being offered for sale. Dairymen, of course, are the outstanding exception as they do try to buy hay on a quality basis. The effort of dairymen to buy quality hay is having some effect on other hay buyers as well, in that dairymen are acting as informal educational agents to introduce the importance of quality in hay. This observation was quite prevalent in all areas where interviews were conducted. Even though dairymen are looking for quality hay, they do not usually employ satisfactory methods of examining and testing for quality. They rely mostly on the reputation of areas or single producers to supply them with quality, which of course, may be entirely satisfactory.

Demand for Different Kinds of Hay

Data in Table IV show little relationship between the price and the various kinds of hay sold in Montana. The kinds of hay indicated in the table are alfalfa, grass, clover and grain hay. Clover hay does seem to be lower in price, but only 0.15 per cent of the sample was clover hay so any conclusion would be invalid. Grass hay was significantly higher in price in Area II as compared to the other areas. There is considerable grass hay grown along the Milk River in Area II and many ranchers here prefer grass hay to alfalfa. This practice is based on the belief of the ranchers that grass hay is safer to feed and entails less wastage as compared to alfalfa. Sales yards in Montana usually demand only grass hay and will pay a premium for it. Safety in feeding and less wastage are the main considerations of the sales yards for this. Grass hay is also the choice for wintering horses. Many townspeople pay a premium for grass hay bought in small lots for wintering horses. Beef feeders and dairymen offer the greatest demand for alfalfa hay due to the superior nutritional content of alfalfa compared to grass. Also, alfalfa is usually more readily available than grass hay.

It is noted that Areas II, III and VII usually have higher prices for hay than the other areas. Areas I and V have the lowest prices indicated. An examination of Figure 7 which indicates the counties which were short of hay in 1959 shows that Areas II, III and VII were short supply areas. Perhaps the bests explanation for the differences in prices between the various areas is the shortness of supply in higher priced areas and surplus of supply in lower priced areas.

TABLE IV. PRICES OF VARIOUS KINDS OF HAY MARKETED IN MONTANA, 1958.*

Area	Alfalfa Tons in Sample	Percent of Sample Alfalfa	Average Price of Alfalfa	Grass Tons in Sample	Percent of Sample Grass	Average Price of Grass	Clover Tons in Sample	Percent of Sample Clover	Average Price of Clover	Grain Hay Tons in Sample	Percent of Sample Grain Hay	Average Price of Grain Hay
I	1,281	64	12.80	613	31	12.75	5	0.25	10.00	55	3	9.10
II	2,159	76	17.75	644	23	22.90	18	0.63	9.00	33	1	15.00
III	631	57	21.80	321	29	17.75	1	0.09	15.00	160	14	19.50
IV	966	76	15.75	217	17	16.25	0	0	0	86	7	16.60
V	1,821	83	12.60	375	17	13.90	0	0	0	0	0	0
VI	3,756	85	14.70	642	15	16.40	0	0	0	0	0	0
VII	968	53	18.50	796	44	12.70	0	0	0	60	3	15.50
State	11,597	74	15.55	3,608	23	15.95	24	0.15	9.45	394	3	16.40

*Source: Based on information obtained from a survey questionnaire mailed to farmers by the Agricultural Marketing Service, Helena, Montana, in 1959.

Preferences for Various Cuttings of Hay

The conclusion drawn from Table V, which includes prices of various cuttings, is that no significant difference exists between price and the three different cuttings. According to the table, first cutting was the most readily available accounting for almost one-half of the total hay fed. Very little third cutting, only 2.5 per cent of the sample, was sold since little third-cutting hay is produced. The high proportion of mixed cuttings, almost one-third of the sample, would indicate some indifference on the part of Montana hay buyers as to the cutting they purchase. The exception would be in Area I where buyers were more specific as to the cuttings they purchased. Choice second- and third-cutting alfalfa is sometimes rejected by hay buyers because of the danger of bloat in feeding it. Other hay buyers insist on well put first cutting because of its higher protein and phosphorus content. However, much first cutting is of inferior quality because of the wet season often encountered during its harvesting. The difference in prices between the different areas is again attributed to supply factors -- the deficit areas paying higher prices and surplus areas lower prices.

Seasonality Marketing Considerations

During the 1958 hay marketing year there was a definite relationship between prices of hay and the month during which it was sold. Most of the hay in the sample was sold during July, August, September, October, November, and December, when 82 per cent of the total sales took place

TABLE V. PRICES OF VARIOUS CUTTINGS OF HAY MARKETED IN MONTANA, 1958.*

Area	First Cutting Tons in Sample	Per cent of Sample First Cutting	Average Price of First Cutting	Second Cutting Tons in Sample	Per cent of Sample Second Cutting	Average Price of Second Cutting	Third Cutting Tons in Sample	Per cent of Sample Third Cutting	Average Price of Third Cutting	Mixed Cutting Tons in Sample	Per cent of Sample Mixed Cutting	Average Price of Mixed Cutting
I	463	49	13.55	360	38	13.85	35	4	11.4	84	9	8.45
II	1,472	58	19.95	552	22	19.45	0	0	0	510	20	15.30
III	404	50	20.75	137	17	20.25	56	7	23.0	206	26	21.10
IV	723	63	15.70	210	18	15.45	0	0	0	215	19	16.85
V	685	35	12.65	532	27	14.50	0	0	0	714	37	11.90
VI	1,660	41	14.35	565	14	14.65	167	4	15.60	1,642	41	15.55
VII	110	12	14.90	206	23	18.75	28	3	18.05	567	62	19.35
State	5,517	45	16.15	2,562	21	16.25	301	2	16.95	3,938	32	15.60

*Source: Based on information obtained from a survey questionnaire mailed to farmers by the Agricultural Marketing Service, Helena, Montana, in 1959.

(See Table VI). The 1958 data suggest that hay users do not attempt to purchase hay until definite need for hay has been established. For many ranchers an accurate prediction of hay needs is impossible because of its dependence on weather during the feeding season. During the dry summer of 1960, for example, some users attempted to buy hay early in anticipation of short supplies developing later in the feeding season. However, the excellent grazing weather through December did much to lessen demand for hay. A history of this kind of occurance has most likely made hay buyers reluctant to purchase hay supplies until they are in need of them. Also, laying in hay supplies early means an investment which may not be possible for some operators. As borrowed money may be necessary to buy hay early, interest costs are involved. Even if the operator has cash to make early purchases, his capital then becomes involved in stored hay, thereby making it unavailable for other uses.

Interviews with a few hay dealers revealed that hay is usually difficult to buy during the production months of June and July. Many producers desire to hold stocks of hay until later when anticipated demand will raise prices. This is especially true in drought years. Some hay buyers do try and buy hay during these months to attempt to gain a price advantage.

Figure 12 illustrates the seasonal marketing pattern and prices. Prices remain fairly constant throughout the year although they appeared to be lower during the time of low sales during March, April, May, June, July and August, and relatively higher during the period of higher sales during September, October, November, and December. Normally, prices should

TABLE VI. PRICES OF HAY, MARKETED DURING VARIOUS MONTHS IN MONTANA, 1958.*

Month		Area I	II	III	IV	V	VI	VII	State
January	Tons in Sample	213	327	50	110	212	72	0	984
	Per cent of Sample	12	13	6	9	10	2	0	7
	Average Price	14.60	20.35	21.30	13.60	11.20	13.75	0	15.95
February	Tons in Sample	45	225	23	0	0	205	0	498
	Per cent of Sample	3	9	3	0	0	4	0	4
	Average Price	15.00	16.65	12.00	0	0	22.80	0	18.85
March	Tons in Sample	200	11	13	50	35	20	0	329
	Per cent of Sample	11	0.5	1	4	2	0.5	0	2
	Average Price	12.95	13.65	15.00	20.00	12.30	16.00	0	14.25
April	Tons in Sample	39	23	0	1	6	18	15	102
	Per cent of Sample	2	1	0	0.08	0.27	0.4	1	1
	Average Price	10.40	14.10	0	20.00	16.00	10.00	15.00	12.25
May	Tons in Sample	42	11	22	0	8	0	7	90
	Per cent of Sample	2	0.5	2	0	0.5	0	0.5	0.5
	Average Price	15.25	20.00	16.00	0	8.00	0	12.00	15.10
June	Tons in Sample	41	117	0	0	126	119	0	403
	Per cent of Sample	2	5	0	0	6	3	0	3
	Average Price	9.60	11.40	0	0	10.00	11.45	0	10.80
July	Tons in Sample	148	175	62	193	153	439	0	1,170
	Per cent of Sample	8	7	7	16	7	9	0	8
	Average Price	13.55	12.40	20.95	17.85	7.65	13.80	0	13.80

TABLE VI. (Continued)

Month		Area I	II	III	IV	V	VI	VII	State
August	Tons in Sample	73	68	73	186	230	256	41	927
	Per cent of Sample	4	3	8	15	10	6	3	6
	Average Price	14.85	14.80	5.90	15.60	12.75	13.20	16.25	13.40
September	Tons in Sample	100	601	139	240	300	395	51	1,841
	Per cent of Sample	6	24	15	20	14	8	4	13
	Average Price	9.85	24.60	21.10	16.65	13.30	16.75	12.05	18.60
October	Tons in Sample	76	246	92	144	402	1,659	190	2,809
	Per cent of Sample	4	10	10	12	18	36	15	20
	Average Price	13.65	17.92	21.08	14.51	14.87	15.33	15.73	15.62
November	Tons in Sample	176	342	239	195	286	471	569	2,278
	Per cent of Sample	10	13	27	16	13	10	44	16
	Average Price	10.75	16.95	22.60	15.10	13.60	14.80	16.20	15.85
December	Tons in Sample	630	363	182	105	438	719	424	2,861
	Per cent of Sample	35	14	20	9	20	15	33	20
	Average Price	12.00	17.85	23.95	15.55	13.70	12.95	19.25	15.20

*Source: Based on information obtained from a survey questionnaire mailed to 5,000 Montana farmers by the Agricultural Marketing Service, Helena, Montana, in 1959.

decline during periods when large quantities are involved in trade. The increase in prices is not a result of the increase in supply marketed during the fall and early winter months, but is a result of a strong demand during this period. The demand for other commodities, such as wheat and

cattle, is fairly stable throughout the year. For this reason, increased marketings of these products are usually met with decreased prices.

The 1958 year was unusual in that little demand developed for hay during the spring months. Many years, a strong demand develops for hay during the spring months if weather conditions necessitate feeding hay. One reason for the price remaining fairly stable during the spring of 1958, even though marketings were down, was because supplies were most likely depleted by this time.

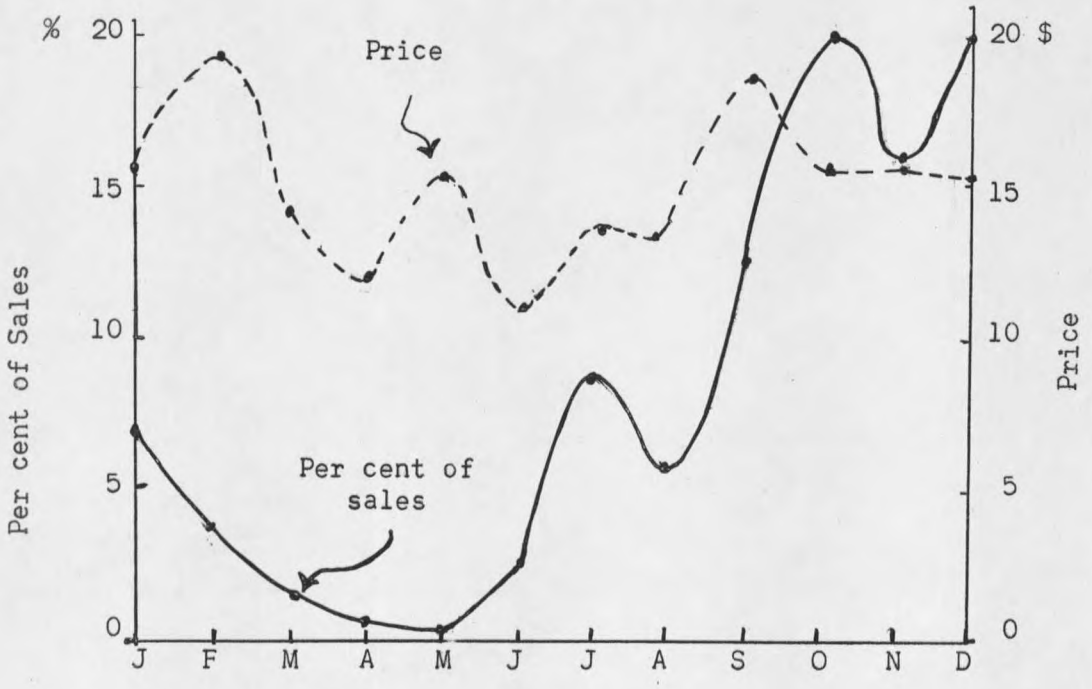

Figure 12. Seasonality and Prices of Hay Sales in Montana, 1958.*

*Source: Data from Table VI.

Selling Hay Loose or in the Bale

Loose hay was significantly lower in price than baled hay in Montana in 1958 (Table VII). Practically all of the hay, 86 per cent, was baled, according to the table. Some producers prefer loose to baled hay mainly because of quality considerations. They maintain that loose hay has better quality because it can be stacked with a higher moisture content than hay for baling. Sometimes hay is sold loose and then baled to facilitate transportation. The state average price for baled hay was only $3.70 above the price of loose hay. This is about equal to the cost of baling. The economic decision of whether to bale or stack loose hay depends upon the type of buyers in the area. If hay can be sold in the field and fed without moving, there would be no price advantage to baling. Another advantage to the seller in feeding hay he has sold in the field where it was grown is the value of the manure droppings to the hay ground.

In Area IV only a $2.20 difference existed between loose and baled hay. This would suggest that hay is not transported great distances but may even be fed in the field where it was purchased. Much of the hay in this area is put up on wild hay meadows which lend themselves to this practice.

In Area III, a $5.75 difference existed. Hay is usually moved into this area from greater distances than in Area IV which would account for the preference for baled hay and the resulting higher prices.

TABLE VII. PRICES OF LOOSE OR BALED HAY SOLD IN MONTANA, 1958.*

Area	Loose Hay Tons in Sample	Per cent of Sample Loose Hay	Average Price of Loose Hay	Baled Hay Tons in Sample	Per cent of Sample Baled Hay	Average Price of Baled Hay
I	292	15	10.60	1,637	85	13.10
II	305	14	15.40	1,950	86	20.25
III	136	15	17.10	700	79	22.85
IV	261	21	14.10	988	79	16.30
V	258	13	8.30	1,761	87	13.80
VI	408	9	11.40	3,908	91	15.30
VII	237	14	13.45	1,489	86	16.35
State	1,897	13	12.50	12,448	86	16.20

*Source: Based on information obtained from a survey questionnaire mailed to 5,000 Montana farmers by the Agricultural Marketing Service, Helena, Montana, in 1959.

Prices of Hay Sold in the Field or Stack

Twenty per cent of the hay sold was sold in the field (Table VIII). The prices of hay sold in the field are significantly lower than those sold in the stack. One reason more hay is not sold in the field is that many hay producers do not offer their hay for sale during the production period. Also, many hay producers do not concern themselves with hay needs until the actual time of need arises. Even though the prices of hay seem lower when purchased in the field there are two main considerations which need careful attention.

TABLE VIII. PRICES OF HAY SOLD IN THE FIELD OR STACK IN MONTANA, 1958.*

Area	Sold in Field Tons in Sample	Per cent Sample Sold in Field	Average Price Sold in Field	Sold in Stack Tons in Sample	Per cent of Sample Sold in Stack	Average Price Sold in Stack	Other Tons in Sample	Per cent of Sample Other	Average Price Other
I	321	21	11.80	975	64	13.00	223	15	12.92
II	223	11	12.15	1,743	88	17.80	16	0.80	10.00
III	197	22	15.05	673	76	22.10	15	2	10.00
IV	229	21	19.25	870	79	15.30	0	0	0
V	446	25	11.50	1,353	75	13.40	11	1	12.27
VI	952	29	14.60	3,249	77	15.05	0	0	0
VII	256	18	14.90	1,132	82	16.90	0	0	0
State	2,639	20	14.00	9,995	77	15.80	265	2	12.55

*Source: Based on information obtained from a survey questionnaire mailed to farmers by the Agricultural Marketing Service, Helena, Montana, in 1959.

First, hay shrinks considerably from the time it is first baled until it is stacked. Some buyers have estimated this shrink to be near 25 per cent although 10 per cent is usually assumed.

Secondly, it is cheaper to load hay from a stack than to pick up bales in the field. Therefore, if hay is worth 25 dollars per ton in the stack it should be worth 20 to 21 dollars per ton in the field if one assumes a 10 per cent shrink and from $1.50 to $2.50 per ton difference in loading costs.

It might be difficult to attribute costs directly to loading, since the hay buyer may not have immediate alternative uses for his time. Certainly the seller can afford to sell hay more cheaply in the field to avoid using time and effort in stacking hay during the busy summer season. The data in Table VII does not show the $4 to $5 difference. This is probably due to sellers holding back hay from sale in anticipation of higher prices developing later in the season.

In Area II, only 11 per cent of the hay was sold in the field. The reason for this low percentage is most likely the reluctance of sellers to offer hay for sale during the production season. In Area VI, 29 per cent was sold in the field. A dehydrating plant at Belgrade purchases considerable hay in the field which may account for the high percentage. Usually, buyers and sellers have imperfect knowledge of price, supply and demand, quality and other pertinent information upon which to adequately price hay early in the season.

Types of Buyers for Hay

Data presented in Table IX indicate that dealers in Montana had some influence in pricing the hay they bought. Factors which could enable dealers to achieve favorable pricing for themselves are wider knowledge of supply and demand conditions, better judgment of quality, and buying in large quantities. According to the table, very little hay, only 9 per cent, was sold to dealers. Areas I and VI had the largest proportions sold to dealers. There are active dealers in these areas which handle most of the hay coming from Red Lodge, northern Wyoming and Idaho. The two dealers in the Red Lodge area handle mostly grass hay which is bought mostly by the livestock markets in Billings. They do truck hay as far as Miles City and Jordan, however. Their main contribution is to assemble small lots of surplus hay from many growers in the area and provide hauling services. One of the dealers buys hay standing in the field and has men and equipment to harvest and bale it. The Wyoming dealers operate in the Heart Mountain Irrigation Project and deal in alfalfa. Beef feeders and dairymen in the Billings area represent the largest outlet. There are two alfalfa dealers in the Hamilton area who truck hay from Terreton, Idaho, into the Bitterroot Valley. Most of their hay is bought by dairymen.

The only explanation of why dealers pay more for hay in Areas VI and VII is that the hay handled by these dealers is of superior quality. In Area VI, where the Red Lodge and Wyoming dealers operate, this is certainly true. It is possible that the margin would have been more

TABLE IX. PRICES OF HAY AND TYPE OF BUYER IN MONTANA, 1958.*

Area	Farmer Buyer Tons in Sample	Per cent of Sample for Farmer Buyer	Average Price for Farmer Buyer	Dealer Buyer Tons in Sample	Per cent of Sample Dealer Buyer	Average Price for Dealer Buyer	Other Tons in Sample	Per cent of Sample Other	Average Price of Other
I	1,483	77	12.95	357	35	11.45	93	5	11.45
II	2,426	90	19.40	140	5	18.85	131	5	18.90
III	903	95	20.25	50	5	18.60	1	0.10	15.00
IV	1,119	100	16.05	0	0	0	0	0	0
V	1,924	88	13.10	82	4	8.10	185	8	11.80
VI	3,366	78	14.85	615	14	15.30	355	8	15.45
VII	1,685	95	15.80	86	5	16.80	1	0.06	15.00
State	12,921	86	15.85	1,330	9	14.40	766	5	14.65

*Source: Based on information obtained from a survey questionnaire mailed to farmers by the Agricultural Marketing Service, Helena, Montana, in 1959.

equitable, if it had been even wider than the 45 cents to $1.00 spread that did exist between dealers and farmer buyers in these areas. The "other" buyers designated in the table could include sales yards, meat packers, commercial feeders, and townspeople with horses.

Destinations of Sales

The farther hay is moved, the higher priced it becomes (Table X). The reasons for this occuring are higher transportation costs and that perhaps only the better quality hays are transported any distance.

TABLE X. PRICES OF HAY AND DESTINATION OF SALE IN MONTANA, 1958.*

Area	Same County Tons in Sample	Per cent of Sample Same County	Average Price for Same County	Adjoining County Tons in Sample	Per cent of Sample Adjoining County	Average Price for Adjoining County
I	1,352	70	12.55	500	27	12.35
II	1,695	61	17.60	1,071	39	21.15
III	533	64	20.65	271	33	23.85
IV	977	89	16.10	127	12	15.55
V	1,785	89	12.30	70	3	16.15
VI	3,998	94	15.00	252	6	14.70
VII	957	67	15.40	449	32	19.30
State	11,312	79	15.05	2,740	19	18.55

*Source: Based on information obtained from a survey questionnaire mailed to Montana farmers by the Agricultural Marketing Service, Helena, Montana in 1959.

Figure 13 is a theoretical consideration of what causes hay movements between two market areas. P_1 and P_2 are the two equilibrium prices in Markets I and II respectively. The distance W-t is the cost of transporting hay from Market I to Market II. As this transportation cost is less than the difference between the two market prices, hay is expected to move from Market I to Market II. Transport cost (W-t) can be nearly as much as the difference in price between the two markets (P_1 and P_2) for these movements to occur. Line a-b represents the supply in Market I that would be exported and c-d is the demand that would be fulfilled in Market II. Lines a-b and c-d must, of course, be equal.

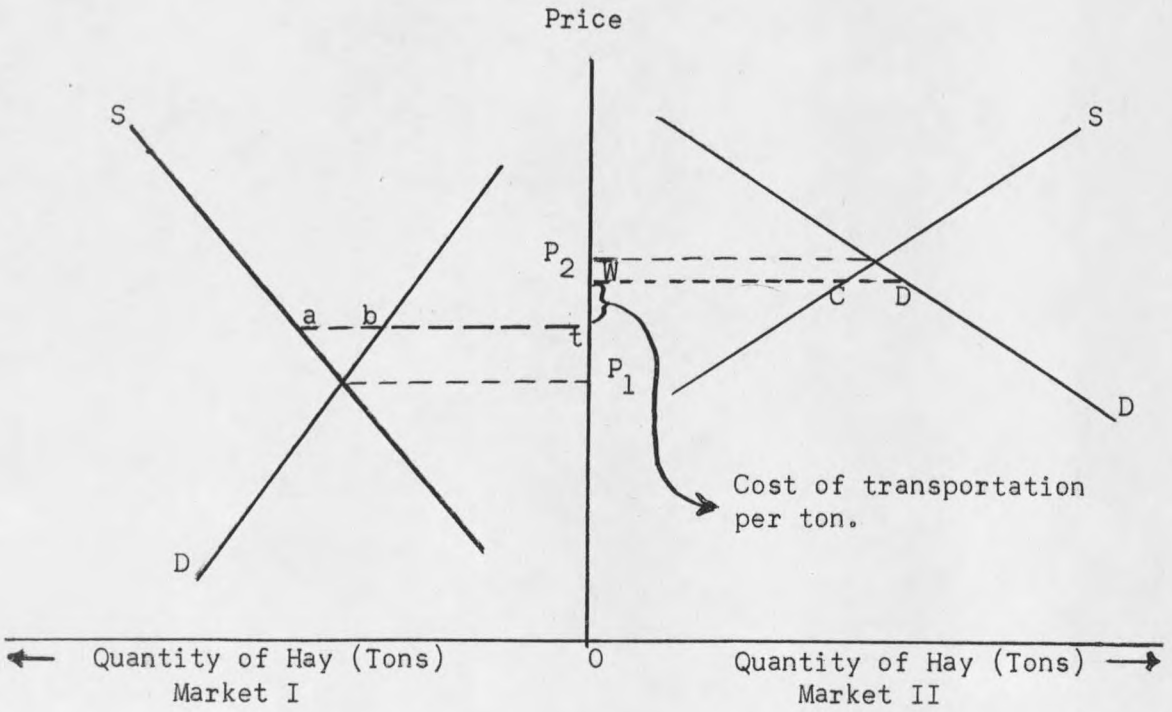

Figure 13. Partial-Equilibrium Price for Hay, Transport Costs.[a/]

a/ Charles P. Kindleberger, International Economics, Richard D. Irwin, Inc., Homewood, Illinois, 1953, p. 119.

In the case of hay, local producers can usually compete favorably with outside competition until supplies within the area dwindle. Then hay will be imported to the extent that outside prices plus transport costs are the same or lower than local prices. Local prices will, of course, rise considerably due to the shortages that will exist.

According to Table X, approximately one-fifth of the hay was sold outside of the county. This would indicate that because hay is difficult and costly to transport shortages are met mostly within the same county. It is known, however, from interviews with a few dealers and major producers and users in Montana that Carbon, Broadwater, and Teton counties do ship sizable tonnages to adjoining counties.

Clearly, the hay market is a series of small local markets located within the various counties. This is validated by the fact that 79 per cent of all hay was sold within the same county it was produced (Table X). In Area II only 61 per cent of the sales occurred within the same counties. These counties do ship in hay from the Fairfield area and from counties which include irrigated land along the Milk River. Also, some of these counties are large, which would make for considerable trading along the county boundaries. Smaller counties have, of course, smaller boundaries which cut down this practice relative to the large counties. In Area VI, on the other hand, 94 per cent of the hay supplies were obtained within the same county. In this area, each county produces considerable hay which allows for the adjustment between supply and demand to be made locally. As only 6 per cent of the supplies were obtained from outside the counties in Area VI the price differential is small.

Most likely these supplies were obtained near the border of the exporting county which could make transport costs even less than if supplies were purchased within the county. This is an explanation of the lower price for out-of-county hay in Area VI.

Technological Innovations

The technological innovations which have had the largest influence upon hay marketing include hay dehydrators, hay pelletors, automatic hay balers and improved highway transport trucks. These improved methods of transporting and packaging have made it possible to move hay considerable distances. Almost all producers, buyers, and dealers interviewed were expecting new developments to take place in the future concerning new packaging techniques such as pelleting and wafering. The dehydrating plant in Belgrade produces a product that is incorporated into range cubes. These cubes are shipped to many places in Montana, thereby enlarging considerably the market for hay. Hay pellets, for example, are shipped from Belgrade to the Oregon coast. One beef cattle feeder in the Billings area imports dehydrated alfalfa pellets from Colorado and uses them in the ration to replace local hay. If this practice grows among other cattle feeders and if the feeding industry is expanded in Montana and neighboring states, then the dehydrating industry could provide a greatly expanded market for hay. As transportation cost is the main barrier to extensive movements of hay, and because these new packaging techniques would appear to solve this dilemma, the development of

dehydrating plants and wafering machines could cause the whole hay market structure to be changed into an organized device which would adequately serve the hay industry.

Market Information

Little or no market information now exists to advise growers and buyers on supplies, needs or prices of hay. The only sources of published information cited by the growers and buyers were local newspapers, Montana Farmer-Stockman and the Farm Journal. The latter two references were valuable to the growers and buyers in a general way. All interviewees expressed a need for market information that is local in nature. The local newspaper is the only source of this kind of information. Some growers and buyers receive information from County Extension agents and Soil Conservation Service personnel. Although most interviewees were not satisfied with the present market information sources they were not deeply concerned about changing the situation. The growers and buyers interviewed felt that the nature of the present hay market does not lend itself to gathering reliable market information on a local basis.

As hay is sold primarily in small, local markets with well developed communication systems, the present system of providing market information perhaps serves the hay trade fairly well, when only a small amount of hay moves into trade. It is entirely inadequate, however, when large volumes of hay are involved.

PART III

COMPARISON OF THE UNITED STATES GRADES WITH CHEMICAL COMPOSITION

In evaluating hay, the important physical characteristics that can readily be judged are (1) stage of maturity, (2) percentage of leaves, (3) percentage of natural green color, (4) percentage of foreign material, (5) size and pliability of stems, and (6) aroma. The United States Standards utilize these factors in grading hay.

The main chemical components of hay that are usually tested for in evaluating hay are (1) protein, (2) phosphorus, (3) carotene, (4) calcium, and (5) crude fiber.

One of the main limitations of the physical examination technique of evaluating hay is the lack of a practical manner of obtaining a representative sample. A core sampler lends itself very well as a means of getting a sample for a chemical analysis.

The question now arises. Do both methods of evaluation, the U. S. Grade and the chemical test provide an adequate measure of the worth of the hay? Can one method be used to gain an approximation of the results obtained from the other method?

Table XI gives the average chemical composition of the several grades of hay which were grown in Lake, Ravalli and Gallatin counties. The Montana data do not indicate a strong relationship between U.S. Grade and the chemical composition. There is little relationship between grade and protein and phosphorus content but there seems to be a definite relationship between grade and carotene content. The Montana data also shows the sample grade to go up in chemical composition as compared to the other, higher grades. One explanation for this is that most of the sample grade samples were moldy. One of the precursors of mold is extreme leafiness of hay, making it more susceptible to mold, especially under

adverse baling conditions. Apparently, the mold did not lower the protein or phosphorus content, but did lower the carotene content.

The summary of a New Jersey study which analyzed 1,775 samples of hay was that U.S. No. 1 hay was generally superior to U.S. No. 2 and/or U.S. No. 3 in crude protein, ether extract, ash, and nitrogen-free extract and in fiber content. In predominantly grass hay classes, differences between numerical grades were limited to a higher nitrogen-free extract content of U.S. No. 1 and U.S. No. 2 hays.

Sample grade hay for all classes often compared favorably with higher grades in crude protein and ash content, but was generally lower in ether extract and nitrogen-free extract, and high in crude fiber.

The conclusion of the New Jersey study was that the U.S. Hay Standards can be used for obtaining good indication of the chemical composition or feed value of hay. Some classes of hay were found to overlap in terms of feed value based on chemical composition. The need for redefining the classes is thus indicated.[1/]

Even though the Montana data did not validate the conclusion of as strong a relationship between grades and chemical content as did the New Jersey study, still the chemical test appears to be the most useful. A lack of a good sampling procedure for U.S. grades limits this method of appraising hay. The sample for chemical tests, on the other hand, is made satisfactory through the use of a core sampler.

1/ R. C. Wakefield, et. al., Officially Graded Hay and Its Chemical Composition, Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Farm Crops, Rutgers University, New Brunswick, New Jersey, May 31, 1955.

TABLE XI. CHEMICAL COMPOSITION OF UNITED STATES GRADES OF HAY.

Grade	Crude Protein (per cent)	Phosphorus (per cent)	Carotene ug/g
		predominantly legume classes	
U.S. No. 1	13.62	.17	12.58
U.S. No. 2	13.79	.14	11.75
U.S. No. 3	13.27	.16	7.3
Sample	14.40	.18	9.5

Table XII gives the average chemical composition of the several grades from 16 classes of hay which were grown in New Jersey.

TABLE XII. CHEMICAL COMPOSITION OF UNITED STATES GRADES OF HAY.*

Grade	Crude Protein (per cent)	Ether Extract (per cent)	Crude Fiber (per cent)	Ash (per cent)	Nitrogen-free Extract (per cent)
			predominantly legume classes		
U.S. No. 1	14.1	2.6	28.8	6.5	38.0
U.S. No. 2	12.8	2.2	31.1	6.3	37.6
U.S. No. 3	12.6	2.2	33.8	6.1	35.3
Sample	13.1	2.0	32.5	6.8	35.6
LSD 0.05	.7	.3	1.1	0.4	0.8
0.01	N.S.	N.S.	1.5	0.5	1.0
			predominantly grass classes		
U.S. No. 1	7.8	2.2	33.4	5.2	41.4
U.S. No. 2	7.9	2.0	33.6	5.2	41.3
U.S. No. 3	8.1	2.0	33.8	5.6	40.5
Sample	8.3	2.0	35.6	5.7	38.4
LSD 0.05	N.S.	N.S.	1.3	N.S.	0.8
0.01	N.S.	N.S.	1.8	N.S.	1.1

*Source: R.C. Wakefield, et. al., Officially Graded Hay and Its Chemical Composition, Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Farm Crops, Rutgers University, New Brunswick, New Jersey, May 31, 1955.

PART IV

CONCLUSIONS

Montana is an important hay growing state with two to three million tons produced annually. The value of this production ranged from $50 million to $80 million during the period 1948-57. Hay is now the second most important crop in the state. Alfalfa accounts for near 60 per cent of the total production and wild hay near 20 per cent.

Usually, Montana is somewhat short of hay. These shortages ranged from 9 to 25 per cent the past 10 years. The deficit counties are usually in the north central and eastern portion of the state with the surplus counties located in the western and south central parts.

Approximately 12 per cent of the total hay production is involved in sales in Montana. The value of hay entering into trade annually ranges from $6 million to $10 million. Pricing of hay is done in an informal, unorganized manner, although strong price setting influences exist in a few areas.

Hay buyers do not show through prices paid any significant importance to quality factors. However, some dealers will refuse to handle poor hay. Farmers, generally, are not able to appraise adequately the value of hay on visual inspection except for wide differences in appearance. There is no satisfactory manner of sampling hay and evaluating it visually. The core sampler is a practical, satisfactory method of sampling hay for chemical analysis, but is not adequate for federal grading. Only about half of the hay buyers pay different prices for different qualities. Diarymen are the best informed and most

quality conscious of all hay buying groups. Transportation costs, number of tons in the lot, and kind (legume or grass) of hay have much more price setting influence than quality.

There is little relationship between price and kind of hay except in those areas where grass hay is a major percentage of total production. In these areas, grass hay is usually preferred and higher in price.

The higher prices for hay occur in the areas of short supply for the most part.

Hay buyers do not pay significantly different prices for the various cuttings of hay.

Most hay buyers do not lay in hay supplies until time of immediate need. The largest sales occur during September, October, November and January. Some buyers attempt to buy hay during the production months of June and July, but lack of offerings and incidence of shrink, cut back the practice.

Loose hay sells for less than baled hay, but only enough to cover baling costs. Most hay involved in trade is baled.

Only 20 per cent of the hay sold is sold in the field in Montana. Prices paid for field hay are lower than those for "in the stack" hay. Net prices are about the same, however, when shrink and hauling costs are considered.

Dealers apparently are able to buy hay more cheaply than farmer buyers. Only about 10 per cent of all hay sold in Montana is sold to dealers, however.

Most of the hay is sold locally. Only 20 per cent of hay sales were made outside of the county in which it was grown. The hay market is a series of small local markets located within the various counties.

There is little or no market information to advise growers and buyers on supplies, needs or prices of hay.

The automatic hay baler and the highway transport truck have had the greatest technological impact upon hay marketing. Pelleting and wafering offer the most potential for future developments in technology.

The chemical composition test appears to be a valid index of U.S. Grade, except for sample grade and as sampling limitations are imposed on grading hay the chemical test is superior.

The present hay market structure does not always provide an adequate system for buying and selling hay in Montana. In those areas in Montana where hay is used primarily as a feed for wintering livestock the present market structure is more adequate than in those areas where more specialized uses of hay exist such as for dairying and beef feeding. The present system of marketing hay fails most in that it does not provide a method for buying hay on a quality basis and it does not furnish adequate supply and demand information for local as well as distant markets. Improved production methods, such as crimping, artificial drying, and more timely cutting coupled with new and better packaging techniques, such as pelleting and wafering are all expected to be adopted more widely by the hay industry in the not too distant future. The impact on marketing as a result should be extremely favorable.

APPENDICES

APPENDIX A

The Multiple Linear Regression Analysis

The multiple linear regression analysis which was used to determine the price and quality factors of hay was computed using the following formulas:

(1) Regression coefficients = $b_j = \frac{a_{ij}\, s_i}{a_{ii}\, s_j}$

where a_{ij} is an element of the inverse of the correlation matrix and a standard deviation.

(2) Constant term of the regression equation = $b_i = \bar{X} - \sum_{j=2}^{n} \bar{x}_j b_j$

(3) Partial correlation coefficients = $r_{ij}\ (ij)1\ \frac{-a_{ij}}{\sqrt{a_{ii}\, a_{jj}}}$

(4) Unbiased standard error of regression coefficients =

$$S_{b_j} = \frac{b_j}{r_{ij}\ (ij)1} \frac{\sqrt{1 - r^2_{ij}\ (ij)1}}{N - n}$$

(5) Computed $t = t_j = \frac{b_j}{S_{b_j}}$

(6) Biased standard error of estimate = $S_e^1 = \frac{S_i}{\sqrt{a_{ii}}}$

(7) Unbiased standard error of estimate = $S_e = \frac{S_e^1 \sqrt{N}}{N - n}$

(8) Multiple correlation coefficients = $R = \sqrt{1 - \frac{1}{a_{ii}}}$

(9) Computed $F = \frac{R^2\ (N-n)}{(1-R^2)(n-1)}$

The following values were computed where Y = price, X_1 = green color, X_2 = foreign material, X_3 = grass, X_4 = protein, and X_5 = phosphorus.

Regression Coefficients	Computed c
b_1 = 0.11536237	t_1 = 2.0049951
b_2 = -0.62353391	t_2 = -1.7263567
b_3 = 0.029952058	t_3 = 1.1186155
b_4 = -0.21444223	t_4 = -0.63377813
b_5 = 32.296545	t_5 = 1.7462411

Constant Term of the Regression Equation

a = 12.662518

Partial Correlation Coefficients

r_1^2 = 0.09132484

r_2^2 = 0.06932689

r_3^3 = 0.03034564

r_4^2 = 0.0099420841

r_5^2 = 0.0780921

Unbiased Standard Error of Regression Coefficients

s_1 = 0.057537482

s_2 = 0.36118486

s_3 = 0.026776006

s_4 = 0.33835536

s_5 =18.494894

Biased Standard Error of Estimate = 3.4444321

Unbiased Standard Error of Estimate = 3.6937419

Multiple Correlation Coefficient = R^2 = .28217344

Computed F = 31.451911

The following values were computed where Y = United States grade and X_1 = protein, and X_2 = phosphorous.

Regression Coefficients

$b_1 = 0.056171766$

$b_2 = 1.9679594$

Constant Term of the Regression Equation

$a = 0.7261337$

Partial Correlation Coefficients

$r^2_1 = 0.01559$

$r^2_2 = 0.00453$

Unbiased Standard Error of Regression Coefficients

$s_1 = 0.068055462$

$s_2 = 4.4512322$

Computed t

$t_1 = 0.82538218$

$t_2 = 0.44211564$

Biased Standard Error of Estimate = 1.0380816

Unbiased Standard Error of Estimate = 1.0736832

Multiple Correlation Coefficient = $R^2 = 0.03256$

Computed F = 0.72385344

Regression Equation

$$Y = 0.7261337 + 0.056171766\ X_1 + 1.9679594\ X_2$$

APPENDIX B

TABLE I. ESTIMATED HAY REQUIREMENTS FOR EACH CLASS OF LIVESTOCK IN MONTANA.

County	Beef Cows Tons	Milk Cows Tons	Heifers & Heifer Calves Tons	Steers and Bulls Tons	Horses Tons	Sheep and Lambs Tons
Beaverhead	1.50	2.8	1.045	1.23	1.3	0.27
Big Horn	0.70	2.8	0.5125	0.575	1.3	0.125
Blaine	1.00	2.8	0.73	0.82	1.3	0.18
Broadwater	1.20	2.8	0.875	0.985	1.3	0.215
Carbon	1.20	4.0	0.875	0.985	1.3	0.215
Carter	0.6375	2.8	0.465	0.525	1.3	0.115
Cascade	1.00	4.0	0.73	0.82	1.3	0.18
Chouteau	1.00	2.8	0.73	0.82	1.3	0.18
Custer	0.6375	2.8	0.465	0.525	1.3	0.115
Daniels	1.00	2.8	0.73	0.82	1.3	0.18
Dawson	0.75	3.0	0.55	0.615	1.3	0.135
Deer Lodge	1.20	2.8	0.875	0.985	1.3	0.215
Fallon	0.80	2.8	0.585	0.65	1.3	0.1455
Fergus	1.0	2.9	0.73	0.82	1.3	0.18
Flathead	1.2	3.8	0.875	0.985	1.3	0.215
Gallatin	1.25	4.0	0.9125	1.025	1.3	0.225
Garfield	0.70	2.8	0.5125	0.575	1.3	0.125
Glacier	1.1	2.8	0.80	0.90	1.3	0.20
Golden Valley	0.70	2.8	0.5125	0.575	1.3	0.125
Granite	1.20	2.8	0.875	0.985	1.3	0.215
Hill	1.00	3.2	0.73	0.82	1.3	0.18
Jefferson	1.25	2.8	0.9125	1.025	1.3	0.225
Judith Basin	1.00	2.8	0.73	0.82	1.3	0.18
Lake	1.00	3.8	0.73	0.82	1.3	0.18
Lewis and Clark	1.1	2.8	0.80	0.90	1.3	0.20
Liberty	1.00	2.8	0.73	0.82	1.3	0.18
Lincoln	1.20	2.8	0.875	0.985	1.3	0.215
Madison	1.40	2.8	1.022	1.148	1.3	0.252
McCone	0.80	2.8	0.585	0.65	1.3	0.1455
Meagher	1.25	2.8	0.9126	1.026	1.3	0.225
Mineral	1.1	2.8	0.80	0.90	1.3	0.20
Missoula	1.20	3.9	0.875	0.985	1.3	0.215
Musselshell	0.65	2.8	0.475	0.575	1.3	0.115
Park	1.25	2.8	0.9125	1.025	1.3	0.225
Petroleum	0.80	2.8	0.585	0.65	1.3	0.1455
Phillips	1.00	2.8	0.73	0.82	1.3	0.18
Pondera	1.00	2.8	0.73	0.82	1.3	0.18
Powder River	0.6375	2.8	0.465	0.525	1.3	0.115

TABLE II. (Continued)

County	Beef Cows Tons	Milk Cows Tons	Heifers & Heifers Calves Tons	Steers and Bulls Tons	Horses Tons	Sheep and Lambs Tons
Powell	1.20	2.8	0.875	0.985	1.3	0.215
Prairie	0.70	2.8	0.5125	0.575	1.3	0.125
Ravalli	1.00	3.2	0.655	0.7375	1.3	0.1625
Richland	0.90	3.2	0.655	0.7375	1.3	0.1625
Roosevelt	1.00	2.8	0.73	0.82	1.3	0.18
Rosebud	0.6375	2.8	0.465	0.525	1.3	0.115
Sanders	1.00	2.8	0.73	0.82	1.3	0.18
Sheridan	1.00	2.8	0.73	0.82	1.3	0.18
Silver Bow	1.20	2.8	0.875	0.985	1.3	0.215
Stillwater	1.00	2.8	0.73	0.82	1.3	0.18
Sweet Grass	1.00	2.8	0.73	0.82	1.3	0.18
Teton	1.00	3.2	0.73	0.82	1.3	0.18
Toole	1.00	2.8	0.73	0.82	1.3	0.18
Treasure	0.90	2.8	0.655	0.7375	1.3	0.1625
Valley	1.00	3.1	0.73	0.82	1.3	0.18
Wheatland	0.90	2.8	0.655	0.7375	1.3	0.1625
Wibaux	0.90	2.8	0.655	0.7375	1.3	0.1625
Yellowstone	1.00	3.9	0.73	0.82	1.3	0.180
State Average	1.1	2.8	0.80	0.90	1.3	0.20

BIBLIOGRAPHY

Burlingame, Merrill G., The Montana Frontier, Helena, Montana, State Publishing Company, 1942.

Gray, J.R., and C. B. Baker, Organizations, Costs, and Returns on Cattle Ranches in the Northern Great Plains, 1930-52, Montana Agricultural Experiment Station, Bulletin 495, Bozeman, Montana, December, 1953.

Jennings, R.D., Feed Consumed by Livestock, 1949-50, United States Department of Agriculture, Agricultural Research Service, Statistical Bulletin 145, Washington D.C., June, 1954.

Meyer, J.H., and G. P. Lofgreen, Evaluation of Alfalfa Hay by Chemical Analysis, Animal Husbandry Department, University of California, Davis, California.

Montana Department of Agriculture, Montana Agricultural Statistics, Helena, Montana, United States Department of Agriculture, Agricultural Marketing Service Cooperating, Volume VII, 1958.

Orcutt, E. P., Do You Have Enough Feed? Montana Agricultural Experiment Station, Circular 144, Bozeman, Montana, March 1944.

Saunderson, Mont H., and D. W. Chittenden, Cattle Ranching in Montana, Montana Agricultural Experiment Station, Bulletin 341, Bozeman, Montana, May 1937.

Saunderson, Mont H., Montana Stock Ranches and Ranching Opportunities, Agricultural Experiment Station, Montana State College, Bozeman, Montana.

Stuart, Granville, Forty Years on the Frontier, Cleveland, Ohio, The Arthur Clark Company, Volume II, 1925.

The Glendive Times, Glendive, Montana, July 14, 1883.

United States Department of Commerce, 1959, Census of Agriculture -- Preliminary, State of Montana, Bureau of the Census, Washington, D.C., August, 1960.

Wakefield, R. C., et. al., Officially Graded Hay and Its Chemical Composition, Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Farm Crops, Rutgers University, Brunswick, New Jersey, May 31, 1955.

Welsh, Donald H., Pierre Wibaux, Cattle King, Montana State University, Missoula, Montana, 1950.