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AN ECONOMIC STUDY OF LIVESTOCK POSSIBILITIES IN THE RED RIVER VALLEY OF MINNESOTA

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UNIVERSITY FARM, ST. PAUL

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INTRODUCTION

Livestock ranching did not precede crop farming in the Red River Valley as it did in sections of the Great Plains farther south and west. Wheat farmers broke up the prairie sod in the Valley and established a system of grain farming, in the early seventies. During the period of development and expansion, large-scale wheat farming operations were conducted with profit and farmers were not inclined to divide their attention by adding livestock beyond the number of animals needed to supply the household with meat and milk. Moreover, farmers coming into the Valley generally lacked capital to finance livestock enterprises after they had equipped a grain farm with the machines necessary for extensive farming. After approximately thirty years of continuous wheat growing, however, weed pests and the other natural hazards to grain farming, developed largely by the one-crop system, together with the increased competition from newer areas, induced a movement toward more diversified cropping. Less wheat and more barley and oats were grown, and corn and legumes were introduced to control weeds and to improve soil conditions. Modification of the grain farming system by the introduction of feed crops carried with it a need for livestock to consume them; so along with the increase in the production of feeding crops, interest in livestock became general. During the last several years many agencies have urged an increase in production of various kinds of livestock products in the Valley. Some of these campaigns, conducted without an adequate study of the situation with respect to the requirements for a successful livestock enterprise, resulted in failure; others have been only partly successful.

NATURE OF THE STUDY

Throughout the Valley livestock production is carried on by certain farmers to a considerable extent. It was believed that these men had knowledge and experience in livestock production that would be of great value in helping to decide how and to what extent various kinds of livestock production would fit into farm organizations there. Accordingly, in the spring of 1926 the Minnesota Agricultural Experiment Station in co-operation with the Bureau of Agricultural Economics of the United States Department of Agriculture, began a study

of the agriculture of the area.¹ The study was continued during 1927 and 1928. A detailed study was made of the organization and operation of a group of representative farms in Polk County. Complete

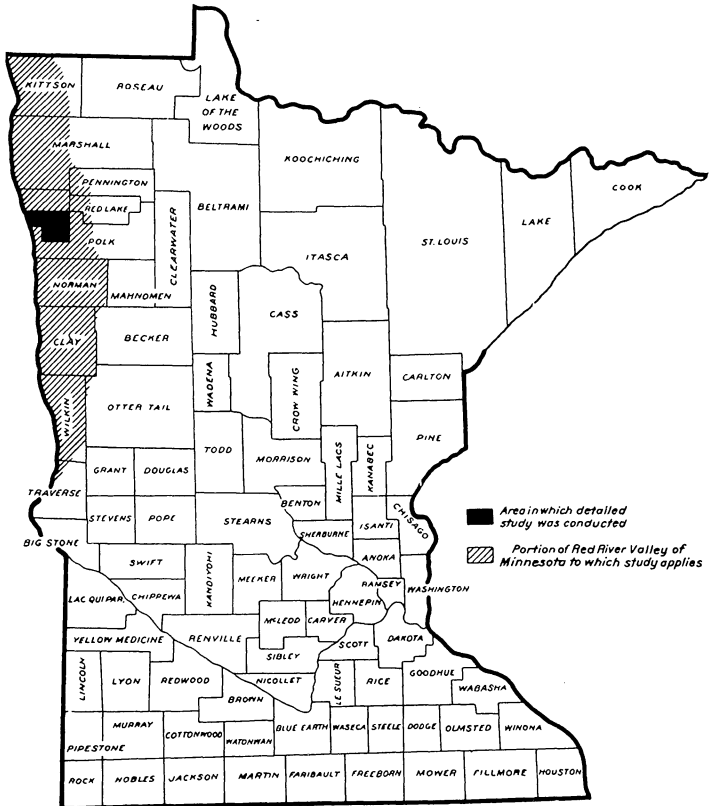


Fig. 1. Location of the Area Studied

The farms included in the detailed study were similar in type to the majority of farms located throughout the Red River Valley of Minnesota.

¹The authors wish to acknowledge the valuable assistance received from the chiefs and members of the staff of the divisions of Agricultural Economics, Minnesota Agricultural Experiment Station, and of Farm Management and Costs, Bureau of Agricultural Economics, in organizing and developing this study; and in reviewing and criticising the manuscript. Special credit is due to D. Curtis Mumford and Andrew T. Hoverstad, formerly members of the staff of the Division of Agricultural Economics, for their services in collecting and tabulating the data; to W. J. Roth of the Bureau of Agricultural Economics, for his assistance in outlining and criticising the manuscript; to A. A. Dowell, of the Northwest Experiment Station, Crookston, Minn., for his many helpful suggestions during the preparation of the manuscript; and to C. O. Ruud, who supervised the collection of the data in the field. The thanks of the authors and the divisions making this study are due the following farmers for their co-operation in furnishing the data upon which this bulletin is based: Ballantine Bros., John Bauer, Henry Beiswenger, William Beiswenger, Ole Bjorgo, W. F. Boltman, B. E. Bredlie, H. P. Briden, J. E. Briden, Roger Briden, A. P. Christiansen, Carl Christiansen, Arthur Eisert, Ole A. Flaas, G. L. Gibbons, Veral Gibbons, Andrew Hanson, Miner A. Helgeson, O. M. Kasburg, A. C. Lindem, LaPlante Bros., Herbert Nissen, John Perry, Oscar Quarberg, August Ross, Otto Ross, Herman Skyberg, J. P. Tierman, Harke Veldman, Martin Wagner, Earl Wardell, L. A. Wentzel, M. E. Wentzel, Wm. F. Wentzel, Wurden Bros.

records of the production, and the labor, power, equipment, and materials used in crop and livestock production, and the financial transactions of each farmer for each year were obtained to serve as the basis for judging the relative desirability of different combinations of crops and livestock, and for studying the best methods of handling the enterprises in these combinations.²

This bulletin is one of a series of three publications based upon an analysis of these farm records and the experimental work done at the Northwest Experiment Station, at Crookston, and the Central Station, at St. Paul; upon statistical information periodically available; and upon general observations and consultation with county agricultural agents and other men interested in agriculture in the Valley. Minnesota Experiment Station Bulletin 282, "An Economic Study of Crop Production in the Red River Valley of Minnesota," presents a study of the cropping systems and Minnesota Experiment Station Bulletin 284, "Planning Systems of Farming for the Red River Valley of Minnesota," presents the problems that make necessary readjustments in the present systems of farming and outlines and illustrates the method of using basic farm organization data in planning and in testing adjustments in the organization of individual farms.

DEVELOPMENT OF LIVESTOCK ENTERPRISES

Changes in Number and Kind of Livestock

The early settlers kept a few dual-purpose cows to supply the farm home with milk and used the calves for meat, with occasionally a few extra animals for sale. From this beginning the herds gradually increased until in 1910 there was an average of approximately 15 head per farm (Table 1). Mature cows constituted about half of the herd, on the average. No direct comparison can be made between the total number of cattle in 1910 and in 1920, because of the change in the census date from April 15, in 1910, to January 1, in 1920. The fact, however, that there was some decline in the number of cows per farm between 1910 and 1920 indicates that there was probably also some decline in the number of young stock. During the four-year period, 1920-24, there was a 50 per cent increase in the average number of cows per farm from 5.9 head to 8.9 per farm. The number of young stock decreased on an average of 2 head per farm, however, during the same period. Since 1924 the number of cows has decreased; the number of young cattle has increased slightly. The de-

² The complete cost route method was used in making the detailed study. Records were kept by the farmers whose business was studied under the supervision of a route man who visited each farm at regular intervals. This method is described in detail in Minn. Agr. Expt. Sta. Bull. 205, by G. A. Pond and J. W. Tapp; also issued as U. S. Dept. of Agr. Bull. 1271, 1923.

crease in the number of cows during the five-year period 1924-29 averaged about 2 head per farm. In 1929 the average size of herd was about 14 head, the number of cows and young cattle being about equal.

Table 1
Total Number of Different Classes of Livestock on
Farms in Red River Valley and the Average Number per Farm*

Year	Cattle		Cows		Sheep		Hogs	
	Total number	Average per farm	Total number	Average per farm	Total number	Average per farm	Total number	Average per farm
1880	13,800	4.4	....	..	1,089	0.3	4,808	1.5
1890	102,372	9.5	....	..	25,029	2.4	34,075	3.2
1900	141,155	9.7	52,668	3.8	49,163	3.4	53,389	3.7
1910	194,440	14.9	86,670	6.6	48,541	3.7	42,433	3.2
1920	214,383	13.8	91,959	5.9	74,503	4.8	66,039	4.3
1923	213,700	14.3	124,800	8.4	60,900	4.1	112,000	7.5
1924	219,700	14.8	132,100	8.9	58,300	3.9	111,000	7.4
1925	218,300	14.6	110,500	7.4	62,600	4.2	116,670	7.8
1927	203,500	13.7	111,600	7.4	95,300	6.3	121,800	8.6
1929	203,600	13.7	106,700	7.2	115,200	7.8	95,600	6.5

* Compiled from records of U. S. Census and Minnesota State Farm Census. Census dates were June 1 from 1880 to 1900; April 15, 1910; Jan. 1 from 1920 to 1929.

Sheep became fairly well distributed over the Valley about 1890 and the number increased just a little more rapidly than the number of farms until 1920 (see Table 1). During the four-year period, 1920-24, the average number of sheep per farm decreased from 4.8 to 3.9. The trend turned upward again in 1924, however, and there has been regular yearly increases in the number of sheep in the Valley since, particularly in the northern counties. The number in 1929 was double that in 1924. In 1929 there was an average of 7.8 per farm.

The increase in the number of hogs kept pace with the increase in the number of farms during the period 1890-1920, with an average of about 4 hogs per farm. From 1920 to 1927 the number of hogs per farm doubled. Following 1927, there was a turn in the opposite direction, however, the number decreasing from 8.6 in 1927 to 6.5 in 1929.

Reasons for Changes

Most of the significant changes in the number of livestock in the Valley have taken place since 1920. A movement toward more livestock was accumulating active support as early as 1910 because of the uncertainties of grain farming and was just getting under way when war-time prices drew farmers back into wheat growing. Following the war and with the drop in grain prices and the relatively better prices for livestock, shifts in the system of farming that had been contemplated earlier were carried out. More acres of feed crops and less of cash grain were grown. Dairy cows were shipped into

the Valley in carload lots from the older dairy sections of the state and from Wisconsin. Breeding ewes were brought from the West and distributed throughout the Valley, especially in the northern counties. Railroad companies, credit agencies, and landlords joined with the operators in active support of the movement to place more dairy cows and sheep on farms in the Valley. A special credit fund was made available through the Agricultural Credit Corporation for financing livestock in the Northwest. For four years, until 1924, the number of cows showed an increase each year over the previous year.

The decrease in the number of cows since 1924 is the result of a combination of factors. Improved grain prices had reduced the advantage of dairying over wheat growing as compared with that in 1921, 1922, and 1923. Farmers who were least inclined toward milking stopped when grain prices improved. The cows were not in all cases of the best quality and many of the beef type already on farms, which were milked during 1921 and the years immediately following, were not profitable dairy stock. Many of these poorer cows have been marketed and replaced with fewer cows of better quality.

Corn acreage was increased after 1920 and the number of hogs increased proportionately. Then a succession of bad seasons for corn, beginning in 1924, caused a considerable drop in the acreage of corn, especially in the northern counties, and the number of hogs decreased accordingly.

Sheep have been used more generally in recent years to aid in weed control, which accounts in part for the rapid increase in numbers in the northern end of the Valley where quack grass and sow thistle are very troublesome. Sheep consume a considerable amount of hay and forage and require the minimum amount of attention during the summer when the farmer is greatly rushed. Sheep have the additional advantage of requiring less shelter during the winter than cattle or hogs. Furthermore, farmers in the Valley are usually without much reserve capital and sheep not only require less capital than cattle for the initial investment, but also have a quicker turnover.

Present Livestock Systems

Livestock has not yet found a balanced place in the agriculture of the Valley. Some farmers have undertaken to establish dairying; others are interested in beef cattle production. Flocks of sheep, both large and small, are kept. Hogs are an important source of income in the southern end of the Valley and on individual farms in all parts. There is, therefore, no predominating system or systems of livestock production. Dairying and sheep raising are expanding most rapidly. The production of dairy products has expanded principally through

more careful feeding of the dual-purpose cows, with an enlargement of the herd in some instances. On the other hand, some excellent herds of the specialized dairy breeds are being developed. The expansion of sheep raising has been accomplished largely through the importation of western ewes, which are distributed mostly in small flocks. A few farms with large flocks are to be found in the northern half of the Valley.

Figures 2 and 3 indicate, respectively, the relative number of all cattle and the relative number of cows per 1,000 acres of farm land, by townships.³ In general the number of cows is about equal to the number of all other cattle. The average size of herd in different parts of the Valley range from 2 or 3 to 10 cows in the areas of heaviest concentration. The cows are more numerous where conditions are relatively more favorable to the production of feed crops as compared with cash crops. The number of cows per 1,000 acres of farm land is much smaller in all parts of the Valley, however, than in the area just to the east.

The dairy industry, in its present development in the Valley, is based upon the production of butter. With no large cities near, the production of fluid milk for bottle trade is of minor importance. Cream is separated from the milk on the farm and delivered to a co-operative creamery, or shipped as sour cream to large centralizer creameries.

The relative number of ewes per 1,000 acres of farm land, by townships, is indicated in Figure 4. Sheep are an important aid to weed control. They feed upon such weeds as quack grass and sow thistle during the pasture season and such crops as sweet clover hay during the winter. Sheep are being kept in greatest numbers in the northern end of the Valley, where the weed problem is probably most acute. The presence of considerable unclaimed land in the northern part of the Valley provides cheap grazing for some of the large flocks.

Hogs are distributed over the entire Valley, as indicated in Figure 5, but the areas of most intensive pork production conform in general to the areas of heaviest corn production.⁴ Surplus livestock is marketed directly to packing plants at Grand Forks and Fargo, North Dakota, or shipped to South St. Paul.

Poultry is not kept in large numbers. Figure 6 indicates the relative number of hens per 1,000 acres of all farm land. Turkeys are an additional source of income on many farms.

³ The charts in Figures 2 to 6, inclusive, are based upon tax assessors' reports to the Minnesota Tax Commission. The numbers of livestock reported may be somewhat lower than the actual numbers on farms, but the relative distribution of numbers is perhaps more accurately measured.

⁴ See Minn. Agr. Expt. Sta. Bull. 282, "An Economic Study of Crop Production in the Red River Valley of Minnesota," for location of areas of heaviest corn production.

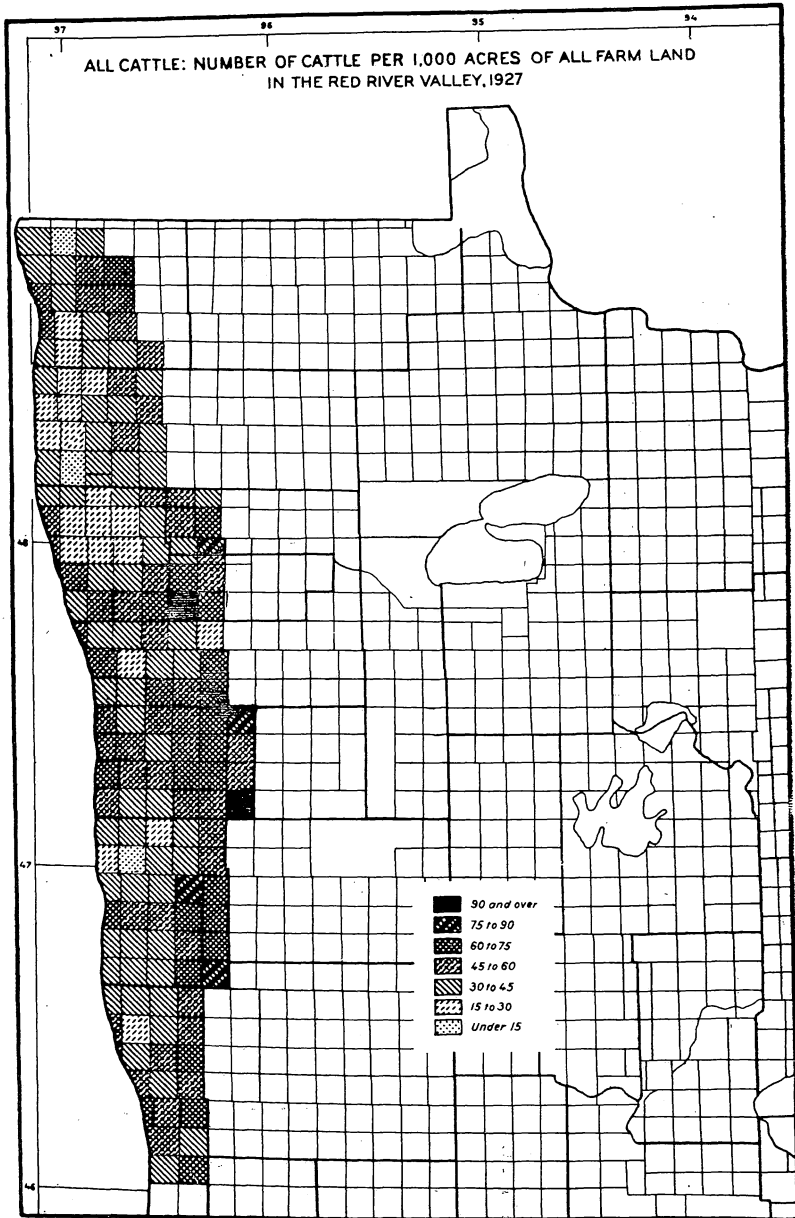


Fig. 2. Number of All Cattle per Thousand Acres of Farm Land in Red River Valley, 1927, by Townships

In general, cattle raising is associated with hay and pasture production.

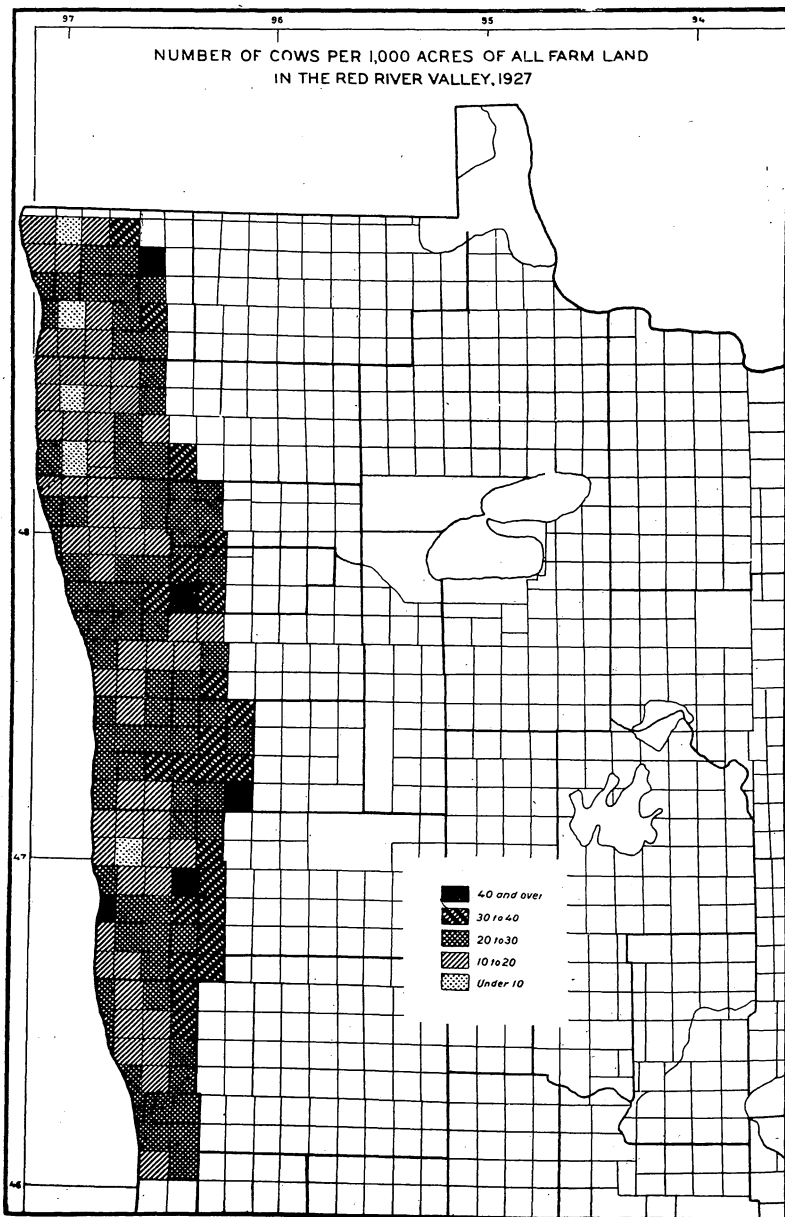


Fig. 3. Number of Cows per Thousand Acres of Farm Land in Red River Valley, 1927, by Townships

Dairying is practiced more generally along the eastern border and in the vicinity of the streams that cross the Valley. A larger proportion of the land in these sections, because of rough topography, poor drainage, or an encumbrance of stones or brush, is adapted only to pasture.

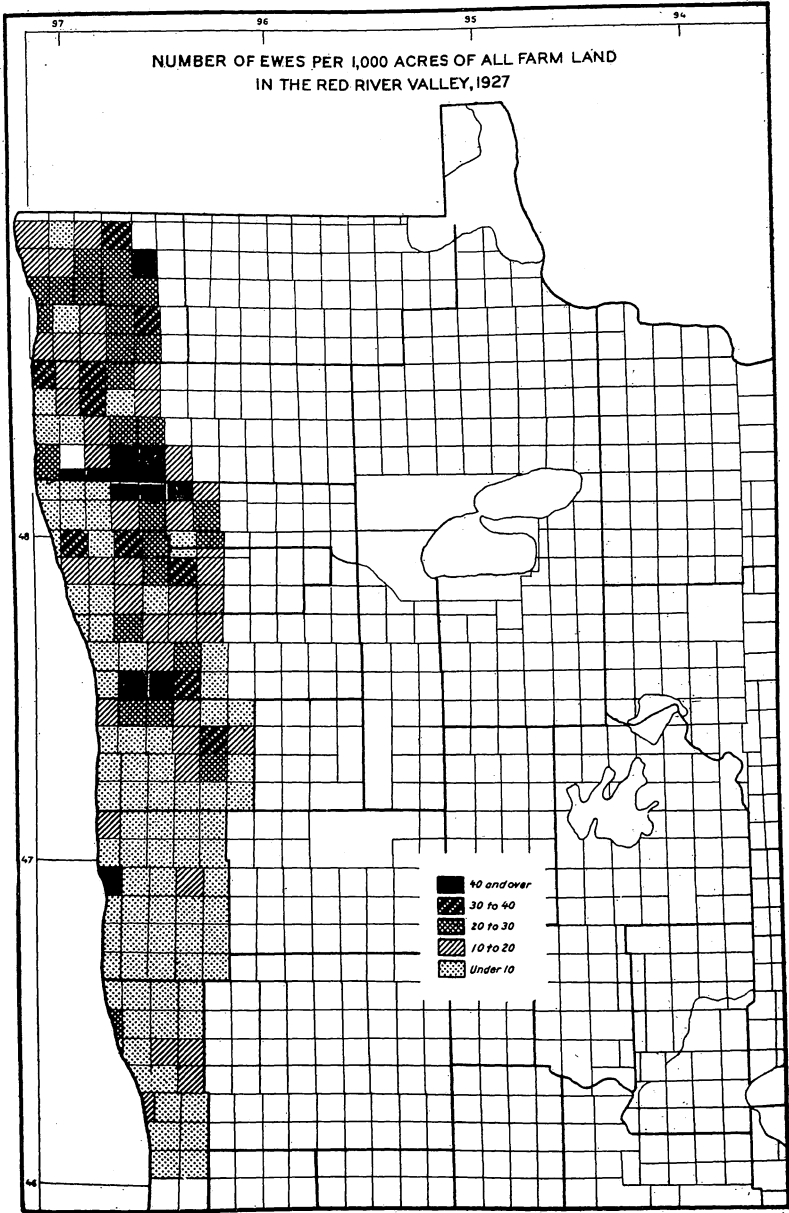


Fig. 4. Number of Ewes per Thousand Acres of Farm Land in Red River Valley, 1927, by Townships

Sheep are being kept in greatest numbers in the northern end of the Valley, where the weed problem is most acute. Unclaimed land there provides cheap grazing for large flocks.

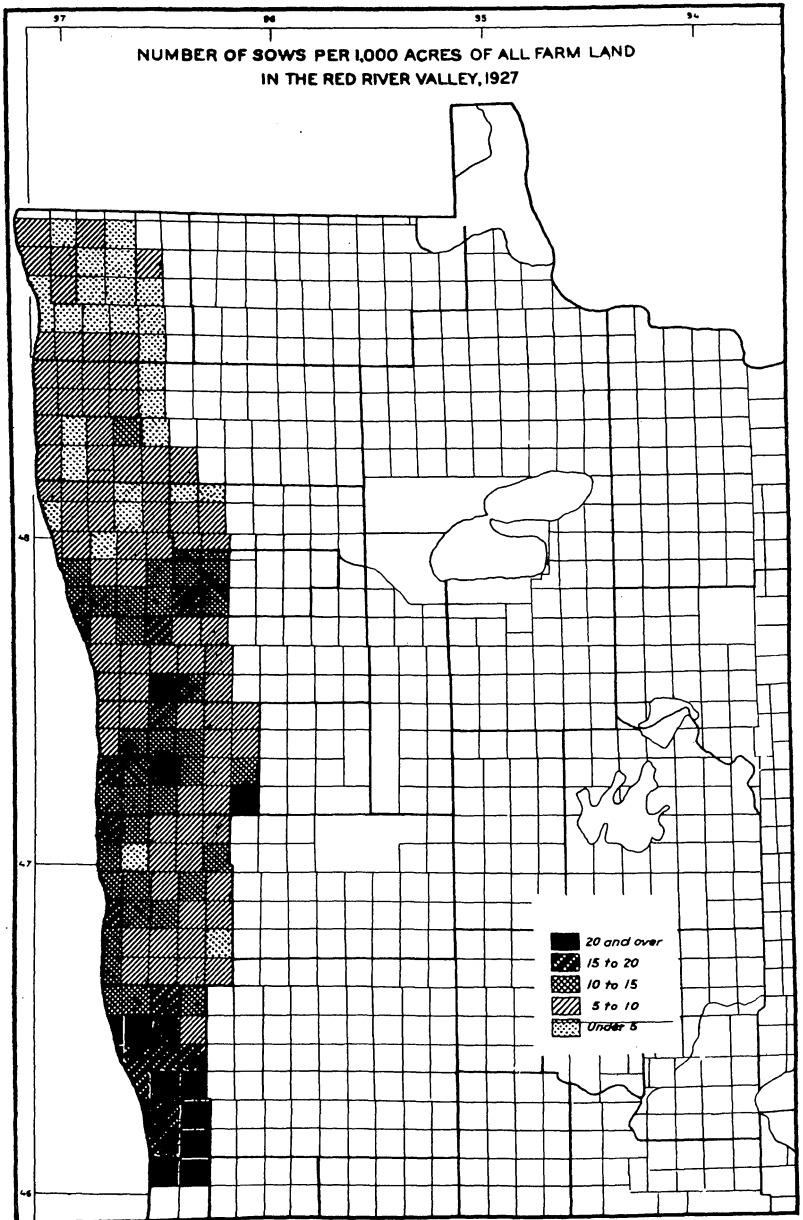


Fig. 5. Number of Sows per Thousand Acres of Farm Land in Red River Valley, 1927, by Townships

The heaviest concentration of hog production coincides with heaviest corn acreage.

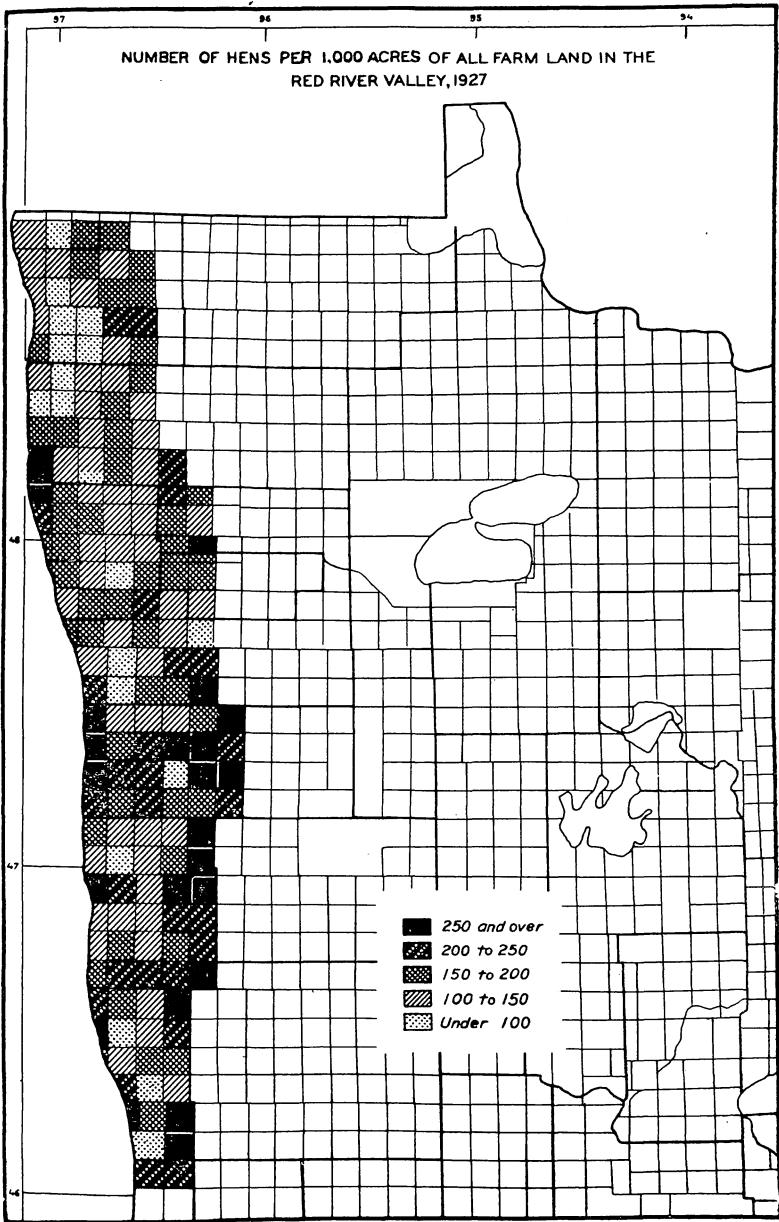


Fig. 6. Number of Hens per Thousand Acres of Farm Land in Red River Valley, 1927,
by Townships
In general, poultry raising is associated with dairying.

PASTURE AND FEED CROPS AS A BASIS FOR LIVESTOCK PRODUCTION

Throughout the Red River Valley a system of diversified cropping is gradually displacing the pioneer system under which the farmer gave his attention almost exclusively to the production of spring grains for the cash grain market. Less wheat and more barley and oats are being grown than formerly, and corn and legumes have been introduced to control weeds and to improve soil conditions. Feeds suitable for dairying, sheep raising, beef-cattle production, and hog raising and fattening are now being produced in abundance on many farms. This is evidenced by the records of the amounts of feed produced on the farms included in the special study in Polk County. The average amounts of each of the different kinds of feed produced on these farms during the three years of the study are presented in Table 2.

Table 2
Distribution of Crop Acreage and Amounts of the Different Kinds of Feed Produced on Farms Included in Study of Polk County*

Crop	Acreage†	No. of farms growing the crop	Average on farms growing the crops		
			Average	Yield	Amounts available for feed
Wheat	3,272	56	66	14.8 bu.	977 bu.
Oats	3,270	57	57	31.6 bu.	1,801 bu.
Barley	2,377	54	44	25.7 bu.	1,131 bu.
Flax	2,285	33	69	6.4 bu.	.....
Alfalfa	1,234	50	25	1.5 tons	37.5 tons
Corn—Fodder	779	39	20	2.0 tons	40.0 tons
Silage	433	30	14	3.7 tons	51.8 tons
Wild hay	1,186	28	31	0.9 tons	27.9 tons
Tame hay	932	43	22	1.0 tons	22.0 tons
Potatoes	817	56	15	90.6 bu.	.....
Summer fallow	942	30	31	.....	.....
Sugar beets (tops)...	381	14	27	1.0 ton	27.0 tons
Miscellaneous crops..	276	28	10	.....	.....
Pasture	2,999	57	52	.....	52 acres

* Records were obtained from 12 farms for the entire three-year period, 1926-1928, from 2 for the two years, and from 17 for one year—a total of 57 farm-record years.

† Acreage for 57 farm-record years, 1926-1928, inclusive.

Pastures

An abundance of nutritious pasture is essential for economical production of livestock and livestock products. Good pasture, as a rule, is the cheapest source of feed for cattle and sheep. Scarcity of good pasture was a serious handicap to successful livestock production in the Red River Valley until legumes, especially sweet clover, were introduced into the cropping systems. The Valley was covered with short-stemmed prairie grasses when the early settlers came, but either their plows or the prairie fires soon destroyed the original sod. The native grasses that have persisted are for the most part early maturing wild

cereal or wet-land grasses that do not form a turf and are not adapted to close grazing. Bluegrass and timothy are the two tame grasses most commonly found in pastures. These grasses furnish fairly good grazing early in the spring and again in the late fall. The general lack of moisture during late summer is a serious handicap to grass pastures. The use of brome grass as a pasture crop is increasing. It withstands dry weather better than bluegrass and is equal to it in feeding quality.

The great superiority of sweet clover as a pasture crop is rapidly becoming more and more appreciated by farmers in the Valley. Sweet clover makes an excellent pasture for all kinds of livestock, and can be grown on practically all soils without an application of limestone. At the Northwest Experiment Station sweet clover is so satisfactory that it has become practically the only pasture provided for cattle, sheep, and horses.⁵

When sown in the spring with small grain, sweet clover usually furnishes good pasture the same year from about September first until freezing weather. The usual grazing period of the second-year crop is from June first to September first. The roots of sweet clover grow very deep, thus enabling the plants to keep on growing during dry, hot weather when bluegrass and other non-legume pastures make little or no growth. In extremely dry weather a gap is likely to occur between the end of the grazing period of the second-year crop and the time when the new spring seeding can be heavily grazed without danger of serious injury to the development of the crop the following spring. A growing practice is to seed all spring grain to sweet clover, let the livestock graze over the entire seeding after the grain crop is removed, and the following spring set aside a sufficient acreage to provide the pasture required to carry the livestock through the grazing period of the second-year crop. Under these conditions, the new seeding is not grazed heavily enough seriously to retard its later development, and continuous pasture is provided throughout the growing season. An acre of second-year sweet clover provides feed for about 2 mature cattle or 15 to 20 head of sheep. First-year sweet clover can be used for pasturing hogs, as can also the second-year crop if it is closely grazed and not allowed to become too rank and woody.

Alfalfa makes an excellent pasture crop for hogs. Quick growing annuals can be grown to supplement alfalfa, among which are dwarf Essex rape, Canada field peas, oats, barley, and a mixture of them. Rye seeded in the fall furnishes early spring pasture for hogs for a short period. Rape seeded at the rate of from 5 to 8 pounds per acre makes a very quickly available pasture for the entire grazing season.

⁵ Kiser, O. M. and Peters, W. H. Sweet Clover Hay for Beef Cattle—Fattening Baby Beeves and Two-Year-Old Steers, Minn. Agr. Expt. Sta. Bull. 261.

It can be seeded early in the spring. Rape germinates at a low temperature and should be available for pasture by June 15.

Feed Crops for Livestock Production

In addition to pasture, large quantities of roughage are needed to carry livestock through the winter and periods of short grazing during the summer. Concentrates are essential for the production of dairy products and the finishing of meat animals for market. Under most conditions the feed used in the production of livestock should be grown as largely as possible on the farm where it is fed, since it is not economical to ship bulky feeds.

Roughages

It is desirable that at least a part of the winter roughage be legume hay. Fortunately, many of the hay crops that are best adapted to the Valley are legumes. Alfalfa is grown, without the use of

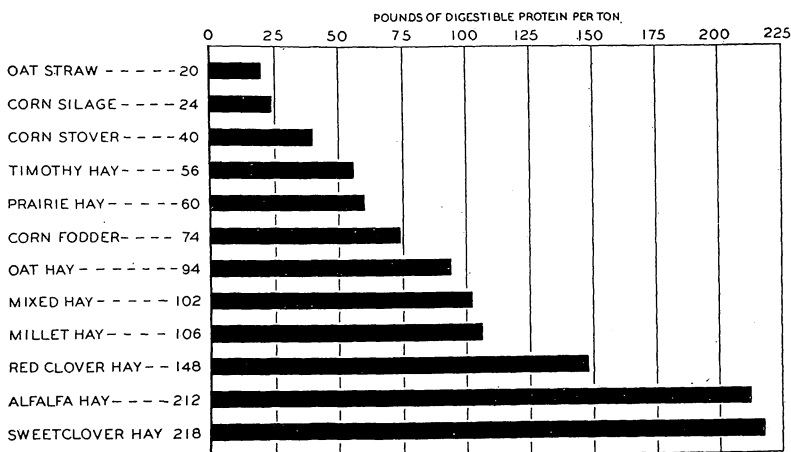


Fig. 7. Pounds of Digestible Protein per Ton of the Roughages Grown in the Valley
Roughages differ widely in digestible protein content. A knowledge of the composition of feeds is essential to intelligent feeding.

limestone, in all parts of the Valley except on alkali, peat, or very wet soils. Alfalfa yields more digestible nutrients per acre than any of the other hay crops, either legume or non-legume. This is partly on account of its greater tonnage per acre, but the great superiority of alfalfa in particular and legumes in general over non-legume crops as feed for animals adapted to consuming roughage is in their higher content of digestible protein (see Fig. 7). Sweet clover is more drought-resistant than alfalfa, less subject to winter-killing, and is more resistant to alkali. Properly cured sweet clover hay has a feeding value about equal to that of alfalfa. Unless cut in the bud stage

or earlier, however, the stems of sweet clover are usually so coarse that livestock refuse a large proportion of them. Then, too, sweet clover is difficult to cure into hay without the development of mold. Good sweet clover makes a satisfactory feed for wintering stocker cattle and sheep. It is fully equal to alfalfa in a ration for fattening lambs. Animals fed low-quality or moldy sweet clover frequently develop a disease commonly referred to as sweet clover sickness. This disease can generally be avoided, however, by feeding other hay, silage, or grain with the sweet clover hay.

In the sandy and wet-land regions of the Valley, considerable wild hay is available for feeding. This hay has low feeding value except for work horses, but as it is often obtainable from land that can be had for a low rent, it may be used to advantage to supplement legume hays for feeding cattle and sheep. Mixed clover and timothy, millet, and oat hay are commonly grown. All the corn grown in the Valley is cut, ordinarily, and the part not put in silos is shocked and fed as corn fodder. An abundance of oat and barley straw is available.

Silage is a good feed for dairy cows and for fattening beef cattle and may be produced in all parts of the Valley, but the yield is often small because of the short growing season. Sugar beet tops are another source of succulent roughage on farms growing sugar beets for market. Sugar beet tops have a feeding value about two-thirds that of corn silage.

Concentrates

The principal feed grains available for producing dairy products and for fattening livestock are barley, oats, and corn. Barley and oats are produced in abundance (see Table 2). Corn is produced for grain in the southern part of the Valley; in other parts it is fed largely as roughage in the form of either ensilage or corn fodder.

Barley is a valuable feed. It is nearly equal to corn in total digestible nutrients, and may be substituted for it, pound for pound, in concentrate mixtures for dairy cows. Results of feeding trials conducted at the West Central Experiment Station, at Morris, indicate that whole barley is approximately equal to ear corn, pound for pound, as a feed for fattening lambs.⁶ The lambs fed whole barley made practically the same daily gains as those fed ear corn and were appraised as having equal market value at the end of the feeding period. Barley is also an excellent feed for fattening cattle. In feeding trials conducted at the Northwest Experiment Station, comparing barley with shelled corn as the concentrate in rations for fattening baby beeves, the ration containing shelled corn as the farm-

⁶Jordan, P. S. and Peters, W. H. Fattening Lambs. Minn. Agr. Expt. Sta. Bull. 272, 1931.

grown concentrate produced slightly higher average daily gains and a somewhat higher finish than did the one containing barley.⁷ With the relative prices of the two grains considered, however, the barley-fed calves returned a larger margin of profit. Hog-feeding tests conducted by the Division of Animal Husbandry showed that shelled corn gave slightly greater daily gains than ground barley but, with the prevailing feed prices, the cost of grain was practically the same. Plump, full-weight barley, when ground, is on the average about 5 per cent less valuable, pound for pound, than shelled corn for raising pigs.

Oats are an excellent feed for horses, breeding ewes, colts, and calves, and are valuable in concentrate mixtures for dairy cows. When feed oats are underselling barley, pound for pound, by an appreciable difference, it is desirable to replace part of the barley with oats in rations for fattening baby beeves and lambs.

STANDARD QUANTITIES OF LABOR, FEED, AND MATERIALS FOR LIVESTOCK PRODUCTION IN THE RED RIVER VALLEY

A knowledge of the number of physical units of feed, man labor, and horse work, and the money value of medicines and veterinary services used to produce a unit of product of each class of livestock is essential to a study of the livestock phases of farm organization. With these data available, the farmer is in position to forecast the demands upon his resources of changes in his livestock production schedule and the effects of such changes on his returns. Furthermore, he can check his accomplishments with those of other farmers operating under similar conditions.

An essential part of the 3-year detailed study of representative farms in Polk County was the collection of information on the basic amounts of labor and feed, and the money value of medicines and veterinary services used in the production of units of each class of livestock. These data for each farm are given for 1927 with the group averages for 1926, 1927, and 1928.

Straw was not listed in the materials used as either roughage or bedding. On practically every farm in the Valley, all classes of livestock have access to all the straw they can consume. As several classes of livestock frequently eat from the same stack and much is trampled under foot, it is impracticable to determine quantities actually used as feed by the different classes.

A careful study of the feeds and labor used on different farms in production of any class of livestock reveals that there are variations

⁷ Kiser, O. M. and Peters, W. H. Sweet Clover Hay for Beef Cattle; Fattening Baby Beeves and Two-Year-Old Steers. Minn. Agr. Expt. Sta. Bull. 261. 1929.

between farms in the use of these factors. An attempt is made to explain some of the significant variations, so that a consideration of the causal factors will help the farmer to determine what quantities he should use with the conditions on his farm.

Following the analysis of the variations in amount of feed and labor used in producing various units of product, quantities are given that represent what may reasonably be used under careful management. They represent, approximately, the accomplishment of farmers who were 25 per cent above the average in the scale of efficiency, as measured by the expenditure for the production of a unit of product, and are suggested as standards with which farmers in the area may compare their own accomplishments and check the effectiveness with which they are utilizing their feed and labor in the production of livestock. These standards also serve as basic quantities, when properly adjusted to conditions at the particular farm, for use in budgeting the livestock enterprise in planning readjustments in the farming system.

Altho the farms studied were more heavily stocked than the average farm in the Red River Valley, livestock constituted a minor part of the farm business on most of these farms and was kept primarily to provide a means of marketing rough feeds. The variations from farm to farm in the amount of feeds used are not so significant as in other areas where more feeds of a marketable character are used. It has been necessary, therefore, in some cases to draw upon data from other areas in compiling the standards given.

Dairy Cows

Description of the Enterprise

The dairy enterprise on the farms studied varied in size from just enough grade cows of mixed breeding to supply the farm needs to herds of twenty or more cows of distinctly dairy breeding.⁸ With the exception of four farms, dairy products were sold in the form of cream. Three of these sold whole milk and the fourth sold butter. Most of the dairy cows showed evidence of either Holstein or Shorthorn breeding but only a few were purebred. Approximately 48 per cent of the cows used for milk production were classed as Holstein, 34 per cent as Shorthorn, 1 per cent as Guernsey, and 17 per cent as belonging to no particular breed. Only 37 per cent of the farms specialized in a single breed. The other farms kept more than one breed or various mixtures of different breeds.

Winter and spring freshening was the most common practice on the farms studied. Forty-seven and one-half per cent of the calves

⁸ On four farms for one year and one farm for two years, the cows were handled as beef cows and for that reason were excluded from the tabulations for the dairy enterprise.

were born in the months of January, February, March, and April; 22.5 per cent in May, June, July, and August; and 30 per cent in September, October, November, and December. February, with 13 per cent, showed the greatest number of births; August, with 3.5 per cent, the fewest.

Replacements for the herd were usually raised, only 25 per cent being purchased as cows.

The average expenditure of feed and labor, together with the average production per cow for each of the dairy herds studied in 1927, are presented in Table 3. The average for each of the three years is also given. Farm grains include corn, oats, barley, wheat, spelt, and

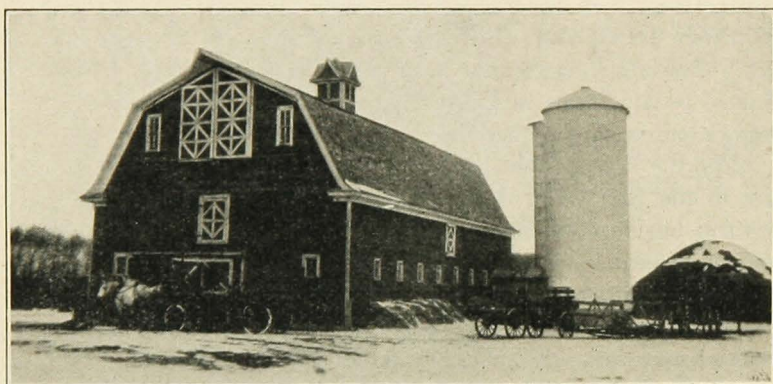


Fig. 8. Barn and Silo on a Dairy Farm in the Red River Valley

Dairy cattle require warmer and better equipped buildings than do other classes of livestock.

grain screenings. On the average, about 5 per cent of the grain was corn, 47 per cent oats, 27 per cent barley, 2 per cent wheat and spelt, and 19 per cent screenings. The term "millfeeds" includes bran, shorts, middlings, and commercial dairy feeds. The term "tame hay" includes all seeded hay other than alfalfa. Succulent roughage includes not only corn silage and sugar beet tops but also small quantities of sugar beets and potatoes. The pasture days represent the number of days on pasture regardless of the kind or quality of the pasture. It is not an adequate measure of the feed obtained from pasture but it is the best available. The nutritive ratio is based upon the quantities of digestible protein and total digestible nutrients in the feeds exclusive of pasture.⁹

The labor includes both the regular daily chores and the special labor, such as delivering cream, caring for sick cows, and testing for tuberculosis. The average production is based upon actual utilization

⁹ Analysis of feeds was from Minn. Agr. Expt. Sta. Bull. 218, Feeding the Dairy Herd, by C. H. Eckles and O. G. Schaefer; and Feeds and Feeding, by Henry and Morrison.

Table 3
Amounts of Feeds, Labor, and Materials Used per Year for a Dairy Cow, 1927

Farm No.	No. of cows	Farm grains, lb.	Mill feeds, lb.	Oil-meal, lb.	Tame hay, lb.	Wild hay, lb.	Alfalfa, lb.	Corn fodder, lb.	Total grain, lb.	Total dry roughage, lb.	Succulent feeds,* lb.	Pasture, days	Nutritive ratio	Man labor, hr.	Horse work, hr.	Veterinary services medicine, etc.	Butter-fat production, lb.
031	9.4	730	53	..	794	299	2,646	..	783	3,739	6,139	156	1: 5.7	224	3	\$0.35	109
032	4.3	131	..	..	2,655	..	1,346	..	131	4,001	..	173	1: 5.1	232	1	..	123
232	23.0	1,099	..	..	..	..	2,423	260	1,099	2,683	5,899	158	1: 6.4	106	..	0.97	133
233	8.3	522	..	..	..	494	3,432	1,624	522	5,550	..	182	1: 5.4	172	..	1.21	138
021	6.1	428	..	..	2,272	270	..	1,115	428	3,657	..	182	1: 6.5	137	2	0.36	143
024	30.3	102	..	..	1,266	70	266	1,612	102	3,214	3,745	201	1: 7.7	146	1	0.42	159
201	7.3	726	..	14	251	338	1,665	2,592	740	4,946	..	158	1: 7.1	166	..	1.67	164
081	22.4	696	160	..	..	..	3,398	1,470	856	4,868	5,839	187	1: 5.8	232	28	1.88	179
231	15.7	997	5	5	130	..	2,583	3,684	1,007	6,397	7,315	160	1: 7.5	198	2	0.60	191
023	7.3	1,356	..	..	1,229	..	3,279	1,567	1,356	6,075	8,778	161	1: 6.9	252	7	0.85	207
022	3.0	2,169	..	..	1,516	..	..	505	2,169	2,021	9,343	155	1:11.9	204	1	..	216
072	14.0	1,540	249	..	..	2,908	1,892	505	1,789	4,800	3,950	171	1: 8.1	166	1	..	216
051	10.6	1,316	486	..	728	..	4,090	1,724	1,802	6,542	538	139	1: 5.3	190	1	2.69	229
221	4.3	3,035	125	..	1,526	1,112	..	..	3,160	2,638	..	170	1: 6.5	236	12	1.62	240
025	4.8	1,530	..	..	689	42	1,173	2,769	1,530	4,673	..	175	1: 7.5	149	..	..	247
026	19.5	1,184	51	21	1,729	..	926	..	1,256	2,655	7,163	190	1: 8.4	119	1	0.13	259
161	13.5	2,386	428	152	..	485	2,565	..	2,966	3,050	9,042	142	1: 6.0	292	5	1.92	278
Average																	
1927	12.0	1,172	92	11	870	354	1,864	1,276	1,276	4,206	3,985	168	1: 6.9	189	4	0.86	190
1926	12.9	1,032	134	12	431	244	2,362	1,856	1,178	4,893	5,011	154	1: 6.5	190	7	0.38	165
1928	9.0	1,199	39	4	671	642	1,928	1,444	1,242	4,685	4,667	150	1: 6.7	172	1	0.97	188

* Succulent feeds include corn silage, sugar beet tops, and some sugar beets and potatoes.

and includes the butterfat sold as cream, milk, or butter; the butterfat in the milk, cream, and butter used in the house; and the butterfat in the whole milk fed to the calves.

Variation in Amount and Kind of Feed for Dairy Cows

The amount and kind of feed fed to the dairy cows varied with the amount and kind available, the plan of management, and the attempted intensity of production. Farms 031 and 032 were relatively small, with a limited supply of grain. This accounts, in part, for the low grain expenditure. The high expenditure of succulent roughage on Farms 022 and 023 was due to an attempt to utilize sugar beet tops that would otherwise have gone to waste.

In general, the farms with the low feed expenditures were those on which there was no special effort to obtain high butterfat production; those with high feed expenditures were those on which there was a distinct attempt to obtain higher production through liberal feeding. The data indicate a close relationship between amount of feed fed and butterfat production.

The amount, kind, and quality of pasture utilized also affected the amount of grain and roughage used. Altho pasture days, as calculated here, are not an entirely adequate measure of feed consumed, nevertheless the data for the three years indicate that the cows having less than 165 days of pasture received an average of 13 per cent more grain and 27 per cent more roughage than those receiving more pasture. There was no difference between the two groups in the average butterfat production. With less pasture, it was necessary to feed more grain and roughage.

Variation in Labor Expenditure for Dairy Cows

The amount of man labor used per cow varied in 1927 from 106 to 292 hours, with an average of 189. Several factors were responsible for this variation, one being the form of dairy products sold. The labor expenditure on Farm 161 was high because whole milk was delivered daily; on Farm 081 a large part of the dairy products were also sold in the form of whole milk.

Another factor influencing the amount of labor expended per cow was the relation between the available labor supply and the amount of livestock handled. On Farm 023 a relatively large supply of family labor was available but only a few cows were kept. As no other employment was available, more time was spent in caring for the cows than would have been otherwise.

Still another factor affecting the quantity of labor was the intensity of production. Where cows were pushed for high butterfat produc-

tion, more time was necessary to give them increased feed and better care and to handle the increased quantity of milk. The average labor expenditure per cow was 8.6 per cent higher on the farms where the average production was more than 200 pounds of butterfat than where it was under 200 pounds. However, the labor per pound of butterfat was 36 per cent lower for the high-producing herds.

The size of herd generally is a factor influencing the amount of labor expended per cow. Ordinarily, the labor is utilized more efficiently as the size of the herd increases up to the point where further additions would necessitate hiring additional labor. In the data from these farms, the effect of the size of the herd was obscured by the influence of the other factors.

Milking machines were used on only two farms, too few for drawing conclusions. However, other studies have shown a substantial reduction in the expenditure of man labor per cow when milking machines are used.

Variation in Production of Butterfat

The production of butterfat varied with the amount of feed fed, particularly the amount of grain. That this relationship was definite is clearly indicated in Table 3. The kind and quality of feed are also generally of considerable importance. Most of the farms studied were feeding fairly well balanced rations, due largely to the use of alfalfa hay. That the nutritive ratios were narrow indicates that low production on these farms was due more to a lack of feed than to a lack of balance.

Adequate feed and balanced rations are not sufficient to insure high production. Quality of cows is another factor of considerable importance in determining the butterfat production per cow. The low production on Farm 232 was due primarily to poor cows. On Farms 031 and 032, the low production was a result of the combination of low-producing cows and a low feed expenditure. The high production on Farms 026 and 161 was made possible by good cows. On Farm 026 the herd was composed of well-culled, high-grade Holsteins; that on Farm 161 of good milking Shorthorns. The amount of feed used on Farm 161 is high (1) because the cows were large, beefy animals that necessitated more feed for maintenance; and (2) because of a special market, which justified feeding the cows for maximum production.

Veterinary Services and Medicine

The expense for veterinary services and medicine includes minerals, dips, disinfectants, medicines, and testing for tuberculosis, as well as regular veterinary services. The expense varied from nothing

to \$2.69 per cow. The expense was high on Farm 051 because of unusually large expenses for testing for tuberculosis, drugs, and minerals. Very little mineral was fed on these farms.

Standards for Dairy Cows

Winter dairying offers less competition for labor resources than summer dairying, during the crop season. For this reason the standards were computed on the basis of fall freshening. The suggested standard expenditures of feed and labor for a dairy cow are the following:

Grain, pounds	2,100
Hay, pounds ¹⁰	5,500
Man hours	160
Horse hours	5
Cash costs (veterinary services, medicine, etc.), cents	70

These standards are based on the assumption that the cows are of good dairy breeding and produce an average of 250 pounds of butterfat per year; that the herds include at least ten cows and that reasonably convenient facilities for caring for them are provided; and that the cows will receive pasture during the entire season. The hay should be good quality legume hay, preferably alfalfa.

Distribution of Labor on Dairy Cows

The weekly expenditure of man labor on a herd of 19 dairy cows is presented in Figure 9. The shaded portion of each bar represents the regular daily work—milking, separating the milk, cleaning the dairy utensils, feeding, watering, cleaning the barn, and bedding—and the clear portion represents the time spent marketing cream, caring for sick cows, and any other jobs coming at irregular intervals. This distribution is typical for this community. The cows freshened in January, February, and March. They are turned onto pasture May 15 and received no supplementary feed from June 1 to September 1. Altho barn feeding started September 1, the cows were allowed the run of pasture and a field of cornstalks all through October. The labor expenditure was decreased when the cows were put on pasture the middle of May and was lowest during harvest season, the latter part of July and August. It increased again when barn feeding was started in September but the heaviest work did not come until after silo filling and potato harvest were completed.

¹⁰ When silage or beet tops are available, 5,000 pounds of these may be substituted for 1,700 pounds of hay.

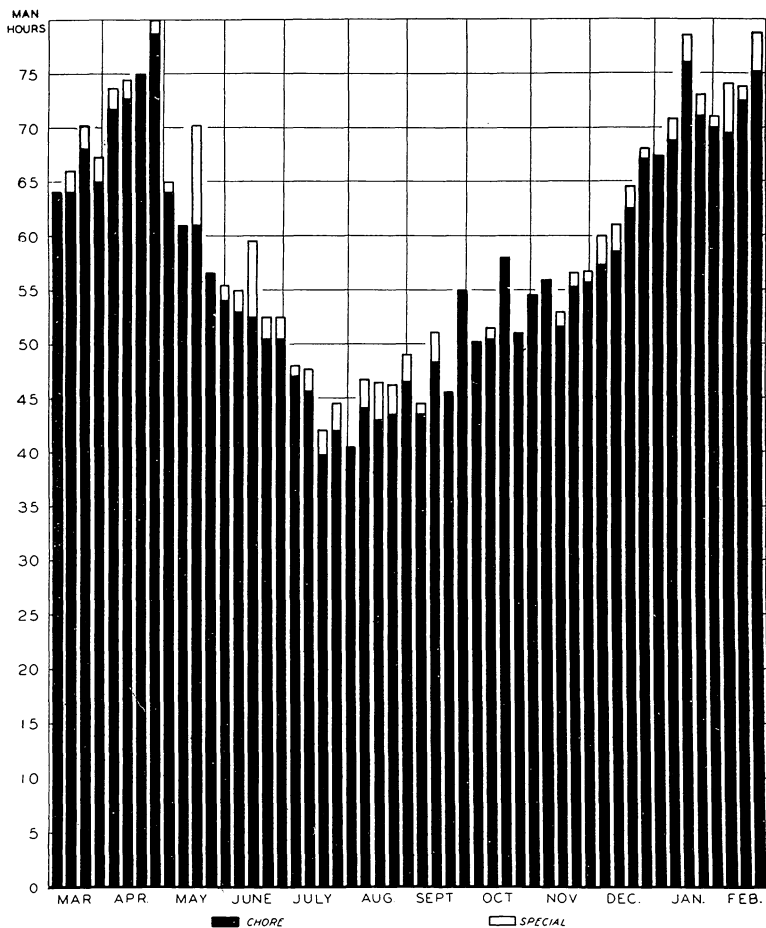


Fig. 9. Distribution of Labor on a Herd of 19 Dairy Cows

The most serious limitation to dairying in the Red River Valley is the competition of the enterprise with crops for labor during the crop growing season.

Young Dairy Cattle

Description of the Enterprise

The term "young dairy cattle" as used here includes all dairy cattle other than cows. It includes all heifers being raised for replacements, the bull, and all calves and market stock. Death losses of calves were approximately 10 per cent of all the calves born. Seventy per cent of the animals sold from this class, exclusive of sales of herd bulls, were marketed under one year of age. Most of them were sold as veals, but a few were disposed of at weights ranging up to 500 pounds. Twelve per cent of the animals sold were heifers over one year of

Table 4
Amounts of Feed, Labor, and Materials Used per Head per Year for Young Dairy Cattle, 1927

Farm No.	No. of head	Farm grains, lb.	Commercial feeds, lb.	Tame hay, lb.	Wild hay, lb.	Alfalfa, lb.	Corn fodder, lb.	Total grain, lb.	Total dry roughage, lb.	Succulent* feeds lb.	Whole-milk, lb.	Skim-milk, lb.	Pasture, days	Veterinary services	Man labor, hr.	Horse work, hr.
021	6.28	279	..	564	114	..	829	279	1,507	..	791	933	136	30.11	25	0.5
022	2.04	884	..	903	309	..	..	884	1,212	2,966	196	984	56	..	45	5.0
023	14.70	8	..	830	..	1,218	686	8	2,734	4,601	207	1,529	170	..	45	1.5
024	13.94	54	..	789	128	80	1,025	54	2,022	2,193	229	875	136	.52	33	..
025	2.12	167	..	429	..	1,018	1,485	167	2,932	..	1,680	832	33	..	42	0.5
026	23.32	5	..	32	1,313	46	..	5	1,391	3,243	309	2,321	167	..	23	0.2
031	13.16	21	..	1,851	..	351	..	21	2,203	2,336	160	1,007	84	..	24	0.3
032	5.00	13	..	1,490	..	653	..	13	2,143	..	186	1,445	196	..	30	..
051	19.92	63	1	995	..	1,136	354	64	2,485	15	364	629	201	..	13	..
081	18.12	174	..	..	..	1,533	72	174	1,605	2,699	121	578	150	..	26	0.5
161	17.86	312	37	..	424	2,310	..	349	1,734	655	100	136	134	..	26	0.2
201	9.58	7	1	314	53	1,122	922	8	2,411	..	189	181	101	..	24	..
221	6.08	146	..	1,300	57	..	947	146	2,305	..	26	1,338	81	..	25	..
231	18.10	28	..	104	..	1,812	2,910	28	4,817	2,707	103	1,779	128	..	27	..
232	18.72	143	..	267	289	737	91	143	1,384	2,996	641	1,174	105	..	23	0.3
233	10.36	..	..	..	10	1,979	..	..	2,680	..	265	677	143	..	22	..
072	26.14	74	..	3	1,984	43	..	74	2,030	1,023	83	427	178	..	16	0.2
Average																
1927	13.26	140	2	581	275	826	588	142	2,270	1,496	332	966	129	.04	27	0.5
1926	15.83	105	1	313	197	865	763	106	2,138	1,821	102	1,248	138	.04	24	1.1
1928	9.97	159	2	384	243	889	611	161	2,137	1,826	257	1,719	114	\$0.09	30	0.7

* Succulent feeds include corn silage, sugar beet tops, and some sugar beets and potatoes.

age, 1.5 per cent were young bulls, and 16.5 per cent were butcher steers and heifers.

The calves were usually weaned before they reached an age of two weeks and then hand-fed. In a few cases two calves were allowed to run with a low-producing or hard-milking cow.

The average annual expenditures of feed and labor per head of young dairy cattle for each of the farms studied in 1927 and the averages for each of the three years are given in Table 4. In the calculation of the number of head, the herd bull was considered equal to two head of others.

Variation in Feed Expenditure

As with the cows, the feed expenditures for young dairy cattle varied with the plan of herd management and with the amount and kind of feed available. The large amount of whole milk used on Farm 025 is explained by the fact that practically no replacements were being raised and that the calves received whole milk up to the time they were sold. The high grain expenditure on Farm 022 was, in part, the result of calves being born too late in the summer to utilize much pasture, thereby necessitating the feeding of more grain or hay; and, in part, the result of a shortage of hay being offset by a heavier feeding of grain. On Farm 161 the cattle that were sold were fed to heavy weights. The total amount of dry roughage fed on these farms was much more uniform than the total amount of grain fed.

Variation in Labor Expenditure

The labor expenditures per head of young dairy cattle varied from 16 to 45 man hours on the farms studied in 1927. These variations were the result of differences in the system of management and in the size of herds. The man labor expenditure was low on Farm 051 because the herd was large, all the calves were dropped at approximately the same time, and the calves were permitted to nurse instead of being fed by hand. The labor expenditure was high on Farm 022 primarily because the herd averaged only two head, but also partly because of heavy feeding of grain. The labor expenditure per head on Farm 025 was high, also, because of a small herd.

Veterinary Services and Medicine

Expenses for veterinary services and medicines were practically negligible and occurred on only a few farms. They averaged 4 cents per head in 1926 and 1927 and 9 cents in 1928. Altho the expenses were doubled in 1928, they still do not represent a very large item.

Standards for Young Dairy Cattle

The standard annual expenditures for a dairy heifer being raised for herd replacement are the following:

First year

Whole milk, pounds	200
Skimmilk, pounds	2,200
Grain, pounds	375
Hay, pounds	725
Cash costs, cents	10

Second year

Grain, pounds	400
Hay, pounds ¹¹	3,000
Cash costs, cents	10

These standards are based on the assumption that pasture will be furnished during the pasture season and straw during the winter. When surplus skimmilk is available, more of it may be used and the grain allowance reduced accordingly. Because the amount of labor expended per head varies so widely with the size of the herd and the available facilities, no standard expenditure is given. With fair facilities for handling the cattle and a herd numbering approximately 15 head, a standard labor expenditure would be an average of 35 hours per head.

The standard expenditure for a mature bull stabled the entire year is:

Grain, pounds	1,400
Hay, pounds	6,500
Man hours	65
Cash costs, cents	20

When a suitable bull pasture is available, these expenditures may be reduced accordingly.

Distribution of Labor on Young Dairy Cattle

The weekly distribution of man labor on a herd of young dairy cattle averaging 23 head, in addition to the bull, is given in Figure 10. This herd is larger than the average and the expenditures are slightly below the standard. However, the distribution throughout the season is representative for the farms studied. The expenditure is low through the crop season and higher during the winter period of barn feeding.

¹¹ When silage or other succulent roughage is available, one ton of such roughage may be substituted for 675 pounds of hay or other dry roughage.

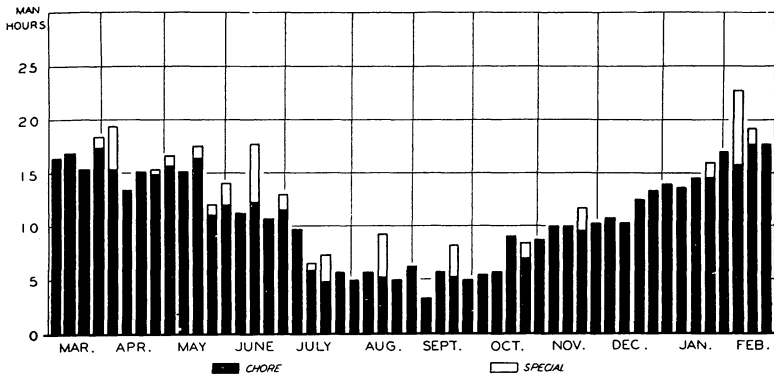


Fig. 10. Distribution of Labor on a Herd of 23 Young Dairy Cattle
Young dairy cattle use little labor during the busy crop season.

Beef Cattle

Description of the Enterprise

The production and feeding of beef cattle have been of minor importance. Too few beef cattle were raised or fed on the farms studied for comparisons between farms. However, the growing interest in raising and fattening baby beefs indicates the need for standards for maintaining a beef cow herd and for fattening the calves.

Standards for Beef Cows

The following standards are suggested as amounts which would be used per cow under reasonably favorable conditions with well bred stock and reasonably good management:

Hay, pounds	3,700
Man hours	25
Horse hours	1
Cash costs, cents	23

They are based upon results of experiment station investigations and data obtained in a study of beef cattle farms in southwestern Minnesota. The standards assume that calves would be dropped in the spring and put in the feed lot in the fall. They also assume that the cows would receive pasture during the pasture season and would be carried through the winter without grain but with free access to straw. When a good legume hay is not available, the standard would include 500 pounds more hay and 50 pounds of some high-protein feed. When sugar beet tops or silage is available, 5,100 pounds may be substituted for 1,700 pounds of the hay but in this event the feeding of a high-protein supplement, also, would be advisable.



Fig. 11. Beef Cattle on a Sweet Clover Pasture

The practice of growing more feed crops, especially alfalfa and sweet clover, to aid in weed control and soil improvement is rapidly expanding. These crops yield hay and pasture and, because of the distance of the Red River Valley from a market, use for most of the hay, as well as all the pasture, must be found on the farm. Livestock provide a market use for these legumes and other feed crops needed for crop rotation.

Standards for Baby Beeves

The following are suggested as standards for dry-lot feeding of a baby beef that has run on pasture with its mother during the summer and is put in the feed lot in the fall:

Grain, pounds	2,300
Protein supplement, pounds	330
Hay, pounds	750
Man hours	10
Cash costs, cents	10



Fig. 12. Baby Beeves in the Feed Lot

The raising and fattening of baby beeves should fit well into the organizations of the large grain farms in the Valley. The problem in balancing crops with livestock on large farms is primarily that of feed utilization as contrasted with labor utilization on the smaller farms. With the same expenditure of labor, beef cattle production utilizes approximately $3\frac{1}{4}$ times as much of both concentrates and roughages as do dairy cattle.

The amount of feed is based on a gain in weight of 500 pounds per head. Where sugar beet tops or silage is available, a small amount may be used early in the feeding period to replace part of the hay. The feeding of large quantities of these bulky feeds, however, tends to limit the amount of concentrates consumed and therefore to reduce the rate of gain.

Standards for Miscellaneous Beef Cattle

In addition to the breeding herd and the cattle actually being fattened, usually there are also calves and heifers raised for replacements. The standards for a calf up to one year of age, and for a yearling heifer are as follows:

	For a calf	For a yearling heifer
Grain, pounds	225	335
Hay, pounds	800	1,800
Man hours	12	12
Veterinary services, medicine, etc, cents	10	10

Sugar beet tops or silage might be substituted for part of the hay at a rate of approximately 3 pounds of beet tops or silage for each pound of hay replaced. In addition to the above feeds, it is assumed that the cattle will be on pasture during the pasture season and will have free access to straw during the winter. The man labor standard assumes that the cattle will run in an open lot or shed and will be fed in a group rather than stanchioned and fed individually.

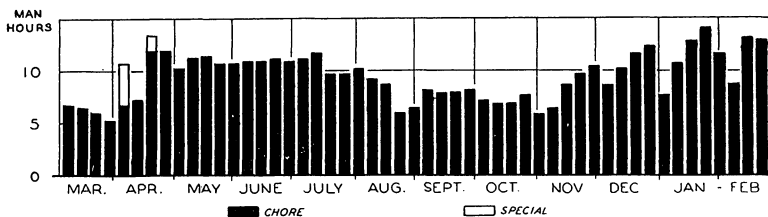


Fig. 13. Distribution of Labor on a Herd of 27 Beef Cows

The raising of beef cattle interferes less with work on crops during the harvest season than does dairying.

Distribution of Labor on Beef Cattle

The weekly distribution of man labor on a herd of 27 cows on a farm in Nobles County is presented in Figure 13. The calves were born in April and May.

The weekly distribution of man labor on 25 baby beeves on the same farm is presented in Figure 14. One lot of feeders was marketed in October and another started on feed the last week of November.

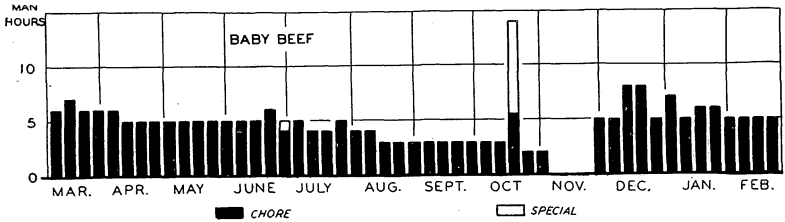


Fig. 14. Distribution of Labor on a Herd of 25 Baby Beefs
The weekly expenditure of labor on a herd of baby beefs is not large. The distribution is relatively uniform, but higher in winter than in summer.

The weekly distribution of man labor on a herd averaging 16 head of calves and heifers is presented in Figure 15. The young stock and miscellaneous cattle required no care during most of the pasture season and very little during the winter. The distribution of labor on beef cattle is probably typical of what would occur under conditions prevailing in the Red River Valley except that as a result of the shorter season the baby beefs would be put in the feed lot earlier and therefore would also be marketed earlier.

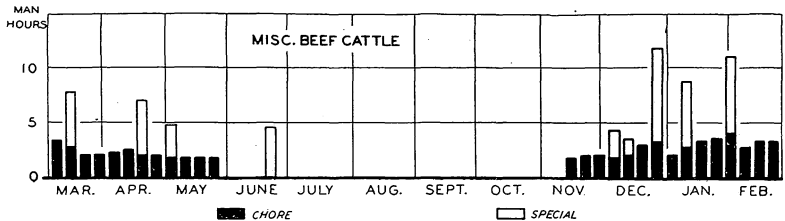


Fig. 15. Distribution of Labor on a Herd of 16 Beef Calves and Heifers
Beef calves and heifers kept for replacements to the cow herd are carried through the summer on pasture and require practically no attention during the crop season.

Sheep

Description of the Enterprise

The usual practice is to maintain a flock of ewes and raise the lambs. These lambs are ordinarily marketed off pasture in late summer or early fall. A few farmers buy feeder lambs and finish them on grain. Some use sheep for eradicating sow thistle or other weeds. In order to accomplish this purpose, enough sheep are put on a field that they eat the green vegetation as rapidly as it appears. Such a system is not conducive to maximum gains from the sheep but is often an economical means of eradicating weeds.

There was too great a variation in the sheep enterprise on the few farms having sheep to furnish comparable data for establishing significant comparisons in quantities of feed and labor expended.

Standards for Sheep Production

Standards are presented for a ewe in a farm flock and for a feeder lamb. In arriving at these standards, the records obtained on the farms studied were supplemented with data from the Northwest

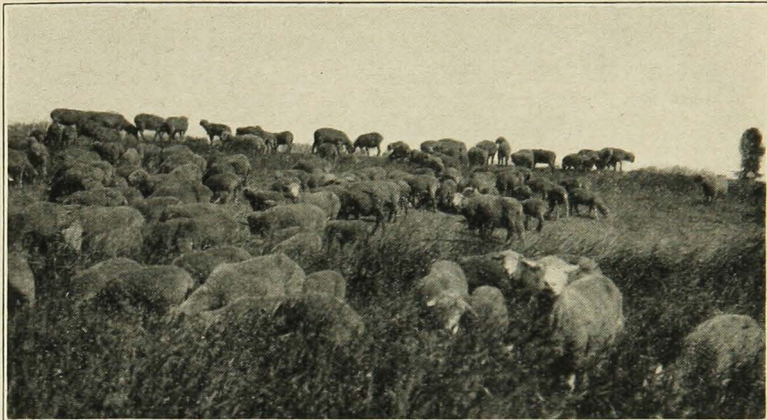


Fig. 16. A Farm Flock of Ewes

Most farm flocks in the Valley have been started with western-bred ewes. Sheep play an important part in weed control on many farms.

and West Central Agricultural Experiment Stations, at Crookston and Morris. The standards for a ewe in a farm flock are as follows:

Grain, pounds	128
Hay, pounds	500
Man hours	3
Horse hours	0.7
Veterinary services and shearing, cents ..	24

The standards are based upon the assumption that the ewe will be on pasture during the entire season and will have free access to straw in the winter.

It is assumed that the lambs raised will receive no feed other than pasture until they are either sold or put on feed for fattening. The standard for fattening either a home-raised or a purchased feeder lamb for 65 to 70 days, assuming a gain in weight of 25 pounds, is the following:

Grain, pounds	90
Linseed oilmeal, pounds	10
Hay, pounds	75
Man hours	1
Cash costs, cents	2

Linseed oilmeal is included in the standard because the feeding of it saves grain and hay, produces more rapid gains, and results in a higher sale price, owing to the better finish.

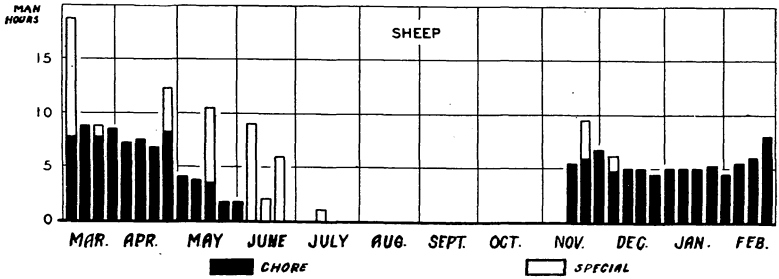


Fig. 17. Distribution of Labor on a Flock of 68 Ewes and Their Lambs
 Sheep have a decided advantage over other classes of livestock in that they require practically no attention during the cropping season.

Distribution of Labor on Sheep

The weekly distribution of man labor on a flock of 68 sheep and the 75 lambs they raised is given in Figure 17. The lambs were born in March and April. Practically no labor was expended on the flock from June 1 to November 1 except for docking and castrating. The lambs were sold in November. The distribution is probably representative for the farms on which lambs are raised, except that lambs sold from pasture ordinarily would be marketed earlier.

Swine

Description of the Enterprise

In general, the swine enterprise was of minor importance on the farms studied. The cash receipts from the sale of hogs averaged less than 13 per cent of the total cash income. However, hogs were maintained on all these farms and on 87 per cent brood sows were kept to farrow. The rest of the farmers bought a few pigs primarily to furnish their own meat supply. On the farms where sows were kept, the number of sows farrowing varied from one to 21, with 3 to 7 most common. A few farmers bought feeder pigs to fatten. Duroc Jersey and Chester White were the two common breeds. Two farmers had Yorkshires and a few had Poland Chinas. Few of the hogs were purebred. Fourteen per cent of the pigs were reported as farrowed in March, 27 per cent in April, 28 per cent in May, and 21 per cent in June. Less than 10 per cent of the pigs were fall farrowed. Approximately 15 per cent of the pigs farrowed died before reaching market weight. The number of pigs raised per litter averaged approximately 6 for the three-year period. No special attention was given to swine sanitation on the majority of these farms. The pigs were not vaccinated against hog cholera.

The marketing period was fairly well concentrated in November, December, and February. Over 51 per cent of the total sales took place in these three months. The percentage of the hog sales in each month was: March 7.2, April 4.7, May 5.2, June 5.6, July 4.6, August 3.2, September 2.8, October 10.0, November 19.1, December 15.8, January 5.4, and February 16.4.

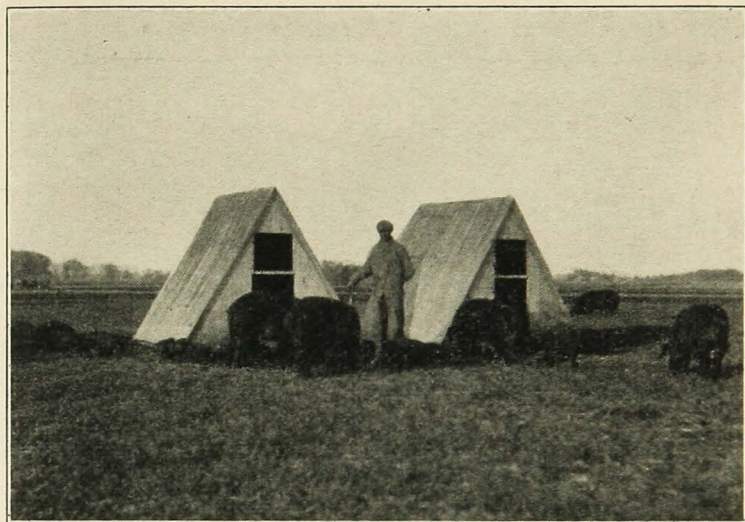


Fig. 18. Hogs in Sanitary Environment

Hogs, in limited numbers, fit well into most farm organizations in the Valley. Barley is a satisfactory substitute for corn in feeding hogs; but where barley is the only fattening grain grown, a large proportion of it is needed for balancing roughages which must be fed to cattle or sheep.

Market hogs usually were sold at a weight of 175 to 215 pounds altho in a number of cases they were either sold as pigs or fed to a much heavier weight. Practices varied a great deal. Sows quite commonly weighed 400 pounds or over when marketed. Enough heavy hogs were sold each month to result in a monthly average weight of over 200 pounds for every month except December, when it was 193, and an average weight of 227 pounds for all hogs sold during the three-year period.

Variation in Feed Expenditures

The average expenditures per 100 pounds of marketable hogs produced¹² for each of the farms studied in 1927 and the average for each of the three years is presented in Table 5. The data are for the entire

¹²The weight of marketable hogs produced is the difference between the sum of the weights of the hogs sold, butchered, and on the closing inventory and the sum of the weights on the opening inventory and bought. (Closing inventory + sales + butchered) - (opening inventory + purchase) = weight of marketable hogs produced.

swine enterprise and include the feed and labor expended on the breeding herd. The small grains include oats, barley, spelt, rye, wheat, and screenings. The relative proportions of the various grains included under this heading were barley, 72 per cent; oats, 24 per cent, screenings, 3 per cent; and wheat, rye, and spelt, 1 per cent. The mill feeds included bran, shorts, and middlings. Very little tankage or oilmeal was fed, therefore these feeds have been reduced to a skimmilk basis and included with skimmilk and buttermilk. One pound of tankage or 2 pounds of oilmeal were considered equal to 10 pounds of skimmilk or buttermilk.

In 1927 the total concentrates fed per 100 pounds of marketable hogs produced, varied from 320 to 859 pounds. The amount of skimmilk varied from nothing to 696 pounds. Variations in several factors were largely responsible.

Amount of feed available.—More corn was fed in 1926 than in either of the other two years, largely because more was available. The amount of skimmilk fed depended upon the amount produced. On Farm 032 calves, chickens, and the household used all the milk. On Farms 161 and 081 whole milk was sold and hence little skimmilk was available. On Farms 024 and 026 large dairy herds were maintained and therefore there was more skimmilk to feed.

Pigs raised per litter.—Since the feed for the breeding herd is charged to the pigs raised, the more pigs each sow raises the less will be the charge per pig or per 100 pounds of gain. The low feed expenditure on Farm 161 is explained largely by the large number of pigs raised per litter and by the shorter feeding period.

Length of feeding period.—Usually the longer the feeding period the greater is the amount of feed required for maintenance and the larger is the total amount of feed used per 100 pounds gain in weight. As previously mentioned, the low feed expenditure on Farm 161 was partly due to a short feeding period. The hogs on this farm were marketed at less than seven months of age and weighed considerably over 200 pounds. On Farm 021, pigs weighing approximately 70 pounds each were purchased in June and were still on hand the following March first and weighed approximately 275 pounds. As a result a large proportion of the feed went for maintenance rather than for a gain in weight.

Quality of the ration.—Ordinarily, gains were more economical when the feeds were those most suitable to pork production and were so combined as to furnish the proper proportion of protein. The large amount of feed used per 100 pounds gain in weight on Farm 032 was the result of feeding nothing but oats, a feed which, altho suitable for brood sows, is not desirable for fattening hogs.

Table 5
Amounts of Feed, Labor, and Materials Used for Production of 100 Pounds of Hogs, 1927

Farm No.	Weight of hogs produced, lb.	Corn, lb.	Small grains, lb.	Mill feeds, lb.	Concentrates, lb.	Skim-milk,* lb.	Pasture, days	Man labor, hr.	Horse work, hr.	Minerals, medicine, disinfectants
024	18,679	..	315	5	320	662	3	2.2	..	..
026	9,330	2	326	7	335	634	26	3.9	..	\$0.16
161	18,066	17	343	8	358	87	15	1.9	0.1	.07
221	6,195	..	390	50	440	101	4	3.7	0.4	.23
051	12,657	67	375	..	442	221	12	2.4	..	.02
201	10,513	30	420	5	455	141	7	4.1	..	..
025	4,824	82	379	..	461	169	..	3.5	0.3	..
231	7,493	..	479	4	483	142	20	4.3	0.1	..
071	7,840	1	491	..	492	691	32	5.2	0.3	.12
081	16,055	119	407	..	526	15	27	1.7	0.1	.04
023	7,922	14	529	9	552	99	..	3.8	0.5	..
022	952	503	86	11	600	696	..	11.0	0.3	..
082	7,049	61	537	5	603	145	17	8.2	0.4	.10
233	30,862	13	602	3	618	26	7	1.5	..	.01
031	7,134	226	370	28	624	75	28	4.5	0.4	.12
232	13,838	194	482	..	676	386	5	2.4	0.1	..
032	1,230	..	810	..	810	..	..	12.2	1.0	..
021	1,350	..	852	7	859	316	13	8.6	0.2	..
<hr/>										
Average										
1927	10,111	74	456	8	538	256	12	4.7	0.3	.05
1926	9,390	107	403	7	520	278	3	4.4	0.5	.00
1928	6,958	57	450	2	524	272	3	5.6	0.3	0.04

* Includes buttermilk and the skim milk equivalent of tankage or oilmeal fed.

Maintenance of a favorable combination of factors.—A favorable condition with regard to one factor may be entirely lost through an unfavorable condition in some one or more other factors. This was particularly evident in the hog enterprise on these farms. On Farm 021 the advantage of having plenty of skimmilk to feed was lost through prolonging the feeding period. On Farm 032 the advantage of a large number (9) of pigs saved per litter, was overshadowed by a failure to provide a desirable variety and balance in the feed. The advantage of having skimmilk was offset on Farm 071 by sickness and death losses resulting from lack of sanitation. Where all factors were favorable, the result was more economical gains.

Variation in Labor Expenditure

The amount of man labor used per 100 pounds of marketable hogs in 1927 varied from 1.5 to 12.25 hours, with a three-year average of 4.9 hours. These variations resulted from variations in size of the enterprise, in the convenience of the buildings and equipment, the length of the feeding period, and various special causes. Farms 024, 161, 051, 081, 233, and 232 had low labor expenditures largely because of high production and convenient arrangements for handling the hogs. The labor expenditures on Farms 022, 032, and 021 were high because of low production and a long feeding period. The labor on Farm 082 was comparatively high as a result of exhibiting at fairs and selling part of the hogs individually as breeding stock.

Veterinary Services, Minerals, Medicines, and Disinfectants

Only one of the farms studied had any veterinary expense and it amounted to but one dollar. None of the farmers vaccinated against hog cholera. On a number of the farms, minerals were used and the expense constituted the major portion of this item. There was a small expense for dip, oil, and grease. The total expense for these items per hundred pounds of marketable hogs produced averaged 5 cents in 1927, 4 cents in 1928, and less than one-half cent in 1926.

Standards for the Production of 100 Pounds of Marketable Hogs

The suggested standards for the production of 100 pounds of marketable hogs, assuming that good pasture is provided, are the following:

Grain, pounds	420
Skimmilk, pounds	200
Man hours	2½
Horse hours	¼
Veterinary services, minerals, medicine, etc., cents	8

These standards are based upon the assumption of an annual production of 10,000 pounds of hogs under a one-litter-per-year system, and reasonably convenient facilities for handling hogs. When more skim milk is available, it may be substituted for part of the grain; when less is available, tankage may be substituted at the rate of one pound of tankage for 10 to 11 pounds of skim milk.

Distribution of Labor on Swine

The weekly distribution of labor on the swine enterprise on a farm producing 12,650 pounds of marketable hogs is presented in Figure 19. The labor expenditure was heavy in May, at farrowing time, and again in July and August after the pigs were weaned and before the sows were sold.

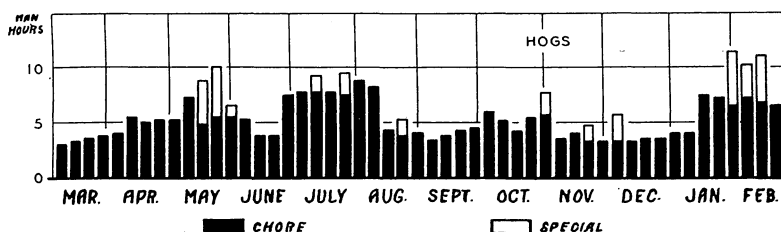


Fig. 19. Distribution of Labor Used in the Production of 12,650 Pounds of Hogs

Because of the cold winters and late springs in the Valley, pigs are usually farrowed only in the spring and then not ordinarily until in May. This system of handling hogs causes the heaviest demands on labor to occur at harvest time.

Poultry

Description of the Enterprise

Chickens were kept on all the farms studied. Flocks usually ranged from 100 to 200 birds but the number ran as low as 25 and as high as 500. The White Leghorn and Rhode Island Red were the most common breeds and were of about equal importance. Buff Oringtons, Barred Rocks, and White Rocks were less common. Some farms had various breeds. Very few farmers raised any poultry other than chickens. In general, they hatched their own chickens or hired others to hatch them. The purchase of baby chicks, however, was becoming more common and in 1928 over half the farmers bought baby chicks. The chickens ordinarily were given the run of the lots. This practice was conducive to the contraction of disease and internal parasites, which resulted in large death losses. The amounts of feed, labor, and materials used per 100 mature chickens are presented in Table 6. A division of feed and labor between laying hens and growing chickens was not possible. In computing the number of mature chickens, two chickens under six months of age were considered as equal to one

Table 6
Amounts of Feeds, Labor, and Materials Used, and Production per 100 Chickens, 1927

Farm No.	No. of chickens	Corn, lb.	Oats and barley, lb.	Wheat, lb.	Misc. grains and screenings, lb.	Mill feeds, lb.	Total grain, lb.	Skim-milk, lb.	Meat scrap, lb.	Man work, hr.	Horse work, hr.	Medicine, disinfectant etc.	No. of eggs laid	Poultry produced, lb.
081	68	82	1,587	..	..	..	1,669	..	..	179	..	..	2,950	843
025	86	..	783	1,099	1,012	406	3,300	1,335	..	112	13	\$3.31	2,198	413
024	99	460	6,344	..	42	..	6,846	1,174	..	160	..	..	7,038	-119*
161	100	400	1,986	1,277	1,077	225	4,965	..	..	161	4	2.40	3,684	268
201	111	..	2,055	..	2,495	113	4,663	5,542	..	262	..	7.21	3,739	813
032	116	..	4,262	..	..	172	4,434	2,483	..	152	7	..	4,251	303
023	139	..	1,348	2,590	380	45	4,363	..	..	281	14	6.47	6,285	105
232	144	..	2,896	..	139	..	3,035	1,017	..	76	..	..	3,726	81
071	160	144	1,824	94	188	56	2,306	3,950	..	97	..	..	1,491	121
022	182	699	601	1,200	95	..	2,595	1,679	..	148	22	1.02	1,643	316
231	202	127	3,163	2,296	..	134	5,720	2,227	49	210	6	3.44	7,609	479
051	221	..	3,518	..	354	343	4,215	2,714	..	143	2	10.59	1,505	1310
031	221	..	3,822	..	546	..	4,368	876	..	89	11	2.83	3,984	28
026	244	320	3,130	134	586	51	4,221	4,389	..	182	2	3.06	4,168	467
021	319	676	2,081	163	369	31	3,320	1,131	..	104	5	0.38	3,666	190
221	359	435	1,567	1,038	197	830	4,067	3,112	..	167	26	5.95	9,976	150
233	422	568	4,132	1,315	161	80	6,256	1,829	47	79	1	..	3,357	150
Average														
1927	188	230	2,654	659	449	146	4,138	1,968	7	153	6	2.60	4,192	335
1926	148	338	3,584	438	351	325	5,036	1,372	5	224	12	1.65	4,238	209
1928	193	127	2,892	1,415	559	336	5,329	1,816	21	188	5	2.67	4,751	270

* A minus sign (—) indicates a decrease in weight.

mature one. The feeds include only the amounts actually fed. Considerable additional feed was picked up about the farmstead and in the fields.

Variation in Feed Expenditure

The kind and amount of feeds varied widely from farm to farm, depending upon the size of the flock and the emphasis placed on the poultry enterprise. With large flocks the amount of waste grain and other feeds available per bird was smaller, therefore heavier feeding was necessary. Where the farmer had little interest in the poultry enterprise, the chickens were ordinarily fed very little marketable grain. Where he was interested in securing high egg production and making the poultry enterprise a paying proposition, more feed was usually provided. On Farms 024 and 231 the poultry enterprise was considered a definite part of the farm business and as a result the poultry received more feed and better care.

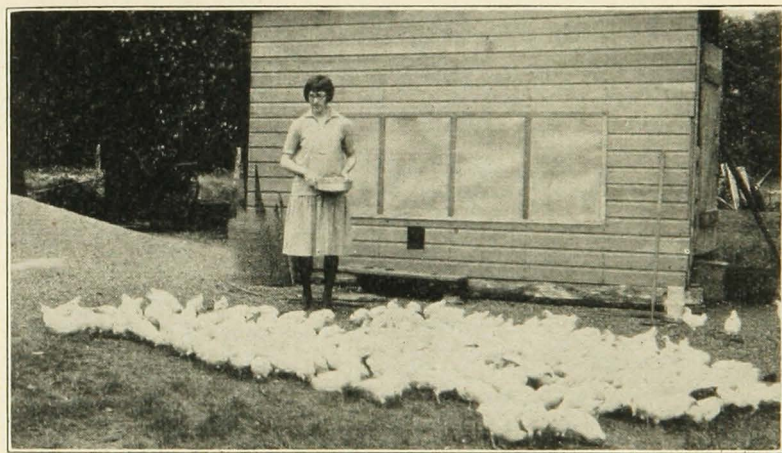


Fig. 20. A Promising Flock of Pullets
Poultry are a source of added income on most farms in the Valley.

Variation in Labor Expenditure

The amount of labor expended per 100 chickens was largely determined by the size of the flock, the use of labor-saving devices, and the relative importance the farmer attached to the poultry enterprise. The same care could be given to a large flock in less time per bird than to a small flock. Where the poultry enterprise was considered of some importance, the poultry received more attention. The use of self-feeders, and other labor-saving devices also helped to reduce the labor expenditure.

Variation in Egg Production

Egg production varied widely from farm to farm depending upon the quality of the chickens and the feed and care they received. When culling and proper care and feeding were practiced, egg production was higher. As all poultry are classed together, the number of eggs per 100 chickens was influenced also by the relative proportion which laying hens were of the flock. Where the number of hens per 100 chickens was low, egg production was generally lower and meat production higher than average. On Farms 081, 201, and 051 the number of laying hens and the number of eggs gathered per 100 chickens were much below the average and the meat production considerably above the average. Farm 221 had a greater number of hens per 100 chickens than the average and also a higher egg production.

Medicines, Disinfectants, and Miscellaneous Cash Expenses

The cash expense for medicines, disinfectants, minerals, and miscellaneous cash included medicine and tonics, oyster shell, grit, charcoal, minerals, and coal for brooder stoves. Coal was the largest item of these expenses on many farms, altho the prevalence of disease and internal parasites resulted in some expense for medicine.

Standards for Poultry

Varying conditions under which poultry are kept on the different farms make difficult the establishment of generally applicable standards. However, the following standards per 100 chickens are suggested for flocks of approximately 200 chickens producing 6,500 eggs and 325 pounds of meat per 100 birds. They assume the availability of warm but not expensive or elaborate housing and the provision of sanitary surroundings.

Grain, pounds	5,000
Skimmilk, pounds	2,500
Oyster shells and grit, pounds	150
Man hours	175
Horse hours	5
Medicine and disinfectants, cents	75

Distribution of Labor on Poultry

The weekly distribution of man labor on a flock averaging 244 chickens is presented in Figure 21. The labor expenditure increased in May when the baby chicks required attention and decreased as they required less care. As most of the labor was done by the women and children, the poultry enterprise did not interfere with crop work.

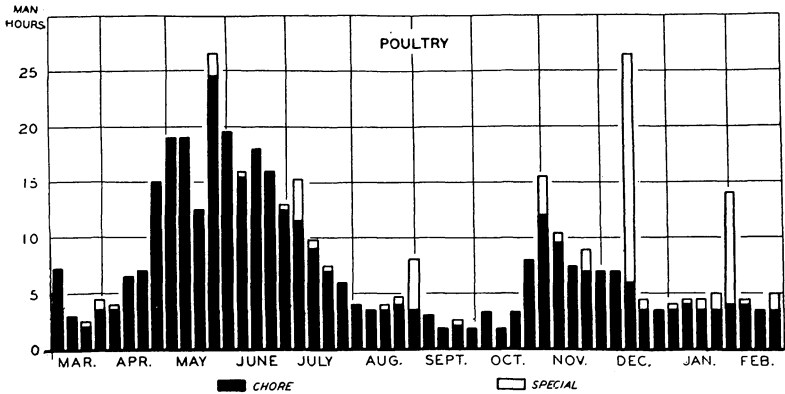


Fig. 21. Distribution of Labor on a Flock of 244 Chickens

Poultry require most attention in May and June. Since much of the labor caring for poultry is commonly performed by women and children, this enterprise may not compete seriously with crops for labor.

Work Horses

Description of the Enterprise

Work horses were the main source of motive power on the farms studied. Approximately half the farms, in 1928, had tractors but their use for field work was limited largely to plowing and quack grass digging. The horses were ordinarily of grade stock and weighed from 1,300 to 1,500 pounds. Few colts were raised. The expenditures per work horse on each of the farms studied in 1927 are presented in Table 7. Only the data for horses actually worked are included. No tabulations are presented for colts.

Variation in Feed for Work Horses

The feed expenditures per work horse varied from farm to farm largely as a result of variation in the number of hours worked. The farmers who worked their horses the largest number of hours were, generally speaking, also the ones who fed their horses the most. During the pasture season the horses were quite generally on pasture when they were not working, therefore there was a definite relationship between hours worked and days on pasture. The use of pasture saved grain and hay. The amount of hay fed on Farm 232 was high, largely because the horses were given more hay than they could eat and much was wasted. On Farm 024, grain was substituted for hay. On Farm 021, hay was substituted for grain. The figures on roughage do not include straw.

Variation in Labor on Work Horses

The expenditure of man labor per work horse depended upon the number of hours the horses worked, the amount of time they were

Table 7
Amounts of Feed, Labor, and Materials Used for a Year for a Work Horse, 1927

Farm No.	No. of horses	Tame hay, lb.	Wild hay, lb.	Fodder corn, lb.	Total roughage, lb.	Grain, lb.	Pasture, days	Man labor, hours	Shoeing, vet. serv. and medicine	Total hours worked
232	12.9	3,042	3,012	178	6,232	2,179	98	60	..	509
024	5.0	603	599	..	1,202	3,091	93	89	\$1.36	605
233	8.0	2,276	1,103	1,000	4,379	2,603	98	69	..	621
025	5.1	3,564	524	501	4,589	2,937	66	80	0.05	717
032	3.2	3,287	..	..	3,287	1,734	75	111	..	725
051	8.2	2,630	1,922	..	4,552	3,038	22	95	1.22	827
022	6.0	3,471	895	689	5,055	2,312	61	99	1.86	898
221	5.0	1,813	3,099	..	4,912	3,486	25	82	..	906
071	6.9	368	5,130	..	5,498	2,015	81	72	..	953
201	8.7	3,391	2,123	1,449	6,863	3,553	35	92	1.52	964
026	8.0	2,453	5,931	..	8,384	3,444	60	96	0.09	1,005
031	5.8	3,927	..	..	3,927	3,072	..	102	1.04	1,014
081	5.0	3,756	300	80	4,136	3,481	5	101	1.48	1,032
231	7.4	3,803	949	2,281	7,033	3,239	32	94	..	1,090
161	13.0	4,749	4,262	..	9,011	4,164	29	92	0.67	1,115
082	6.0	3,410	1,556	144	5,110	4,253	..	150	0.25	1,183
021	4.0	3,096	2,714	267	6,077	1,342	41	86	..	1,256
023	9.5	6,797	210	1,060	8,067	3,966	28	127	2.50	1,312
Average										
1927	7.1	3,135	1,907	425	5,462	2,995	47	94	0.67	930
1926	8.4	1,703	3,444	913	6,059	3,617	39	76	1.02	1,077
1928	7.5	3,956	1,765	943	6,664	2,906	41	104	1.05	934

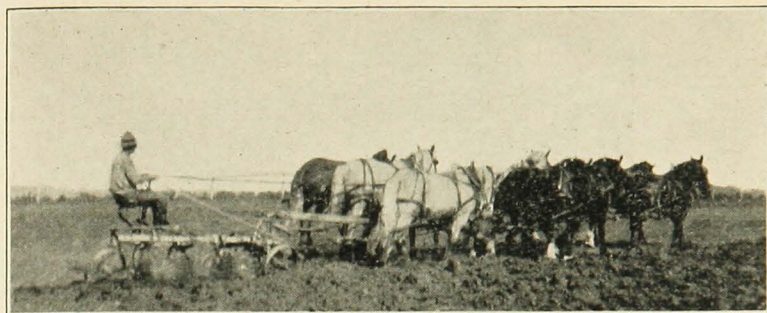


Fig. 22. The Use of Large Teams Helps to Save Man Labor

The system of "bucking in" and "tying back" enables one man to control 8, 10, or 12 horses with one pair of lines and at the same time eliminates side draft. This use of multiple horse-hitches makes possible the utilization of man labor to better advantage just as does the use of a tractor.

on pasture, the convenience of the arrangement of the buildings and equipment, and the care the horses received. The labor expenditure on Farms 232 and 233 was low because of the small number of hours worked, extensive use of pasture, and convenient facilities for handling the horses. It was high on Farm 032 because of very inconvenient facilities and on Farms 031, 081, and 082 because of barn feeding the entire year. When a convenient night pasture is available, its use usually will result in a saving of both labor and feed.

Veterinary Services and Horseshoeing

The annual expense for veterinary services and horseshoeing averaged 67 cents in 1927, \$1.02 in 1926, and \$1.05 in 1928. Some farmers kept one team shod throughout the winter.

Standards for Work Horses

The standards for a medium weight horse working 1,100 hours per year at the customary farm work are the following:

Grain, pounds	3,000
Hay, pounds	5,000
Pasture, days	43
Man hours	82
Veterinary services, and shoeing	\$1.00

In addition to the above, it is assumed that some straw will be fed during the winter.

Labor Distribution on Work Horses

The weekly distribution of man labor on 13 horses averaging 1,115 hours of work is presented in Figure 23. The labor expenditure is greatest during the busy seasons, when the horses are being worked most regularly.

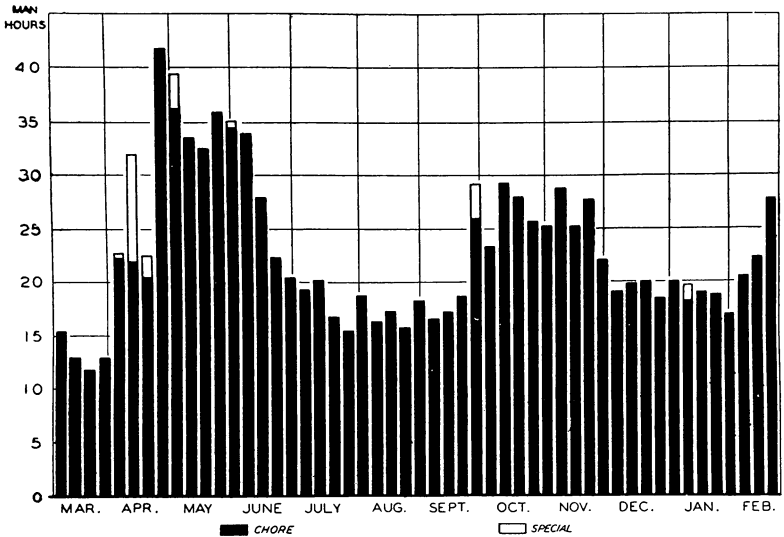


Fig. 23. Distribution of Labor on 13 Work Horses

The man labor expenditure on work horses is greatest when the horses are working regularly.

Miscellaneous Labor on Livestock

In addition to the regular daily chore work and such irregular work as caring for sick animals and buying and selling, which has already been presented, there was also a considerable quantity of indirect labor—shelling corn, grinding feed, hauling bedding and feed, pumping water, and other maintenance work—which benefited more than one class of livestock. On the farms studied, this indirect livestock labor amounted to 10 per cent of the total man labor and 86 per cent of the total horse work for livestock. Most of the horse work for livestock is of this indirect nature; only a tenth of the man labor is of this class.

RELATIONS BETWEEN LIVESTOCK ENTERPRISES

The previous section was devoted to an analysis of the demands of units of the different livestock enterprises for the use of the farmer's productive resources. This analysis involved the computation of basic amounts, or standards, of feed, man labor, horse work, and materials and services used in the production of units of livestock or livestock products. It involved also a study of the time distribution of the use of these factors. In this section attention is directed to an analysis of the relationships between the different classes of livestock in the use of these factors.

Proportional Demands for Use of Labor and Feed

A knowledge of the relative amounts of man labor and feed used per animal by different classes of livestock for a given production is essential to a consideration of the kinds and numbers that should be kept to give the best utilization of the feed and labor available on the farm. The data presented in the previous section on standard amounts of feed, man labor, horse work, and cash outlay used in the production of units of the various kinds of livestock or livestock products are summarized in Table 8. Since silage is not available on all farms, only the standards for feeding with dry roughage are summarized. Adjustments in the standards for the substitution of succulent roughage for a part of the dry roughage in the ration may be made on the basis of substituting 3 pounds of ensilage or sugar beet tops of good quality for one pound of hay. When sweet clover pasture is not available, the standards for pasture are increased by the difference in the carrying capacity of sweet clover pasture and the pasture available. The individual farmer can make all of the comparisons set up in Table 8 more useful to himself by adjusting the standards given to the conditions on his farm, including his own ability as a feeder and husbandman of livestock.

For the purpose of comparison of the amounts of each of the productive factors expended on different kinds of livestock, animals of each of the various classes have been grouped in Table 9 into composite units of such size, in numbers of animals, that all composite units have approximately the same man-labor expenditures. Under a system of extensive crop farming, such as is practiced in the Valley, the amount of man labor available for caring for livestock is often the limiting factor in organizing the livestock phase of the farm business. The comparisons in Table 9 indicate that the amount of man labor expended on one dairy-cattle unit, consisting of 1.00 cow, 0.25 heifer, 0.25 calf, and 0.07 bull, was approximately equal to the amount expended on (1) one beef-cattle unit, consisting of 4.25 cows, 3.33 baby beesves, 0.67 heifer, 0.67 calf, and 0.14 bull; (2) one sheep unit, consisting of 60 ewes and their suckling lambs; (3) one hog unit, consisting of 5 brood sows and their spring litters; or (4) one poultry unit, consisting of 50 hens and 100 chicks.

The amount of feeds used by each of these composite units varied widely. Hogs are by far the heaviest users of farm grains per unit of labor expended. They are also the heaviest consumers of skim-milk. Sheep, on the other hand, are the heaviest consumers of roughage and pasture per unit of labor expended. A beef-cattle unit ranks next to hogs in respect to the quantities of concentrates consumed and next to sheep in respect to the amounts of roughage and pasture utilized

Table 8
Standards for Livestock Production in the Red River Valley

No. and kind of livestock	Production	Feed per unit*						Man labor per unit, hours	Horse work per unit, hours	Materials and services per unit, dollars
		Farm grown concentrates, pounds	Commercial protein supplement, pounds	Dry roughage, pounds	Skim milk, pounds	Whole milk, pounds	Sweet clover pasture, acres			
1 dairy cow	250 lb. butterfat	2,100	..	5,500	..	..	0.50	160	5.0	0.70
1 veal calf	160 lb. gain	..	..	..	..	700	..	24	..	..
1 dairy calf	325 lb. gain	375	..	725	2,200	200	0.12	35	..	0.10
1 dairy heifer	350 lb. gain	400	..	3,000	..	..	0.30	35	..	0.10
1 bull †	....	1,400	..	6,500	..	..	..	65	..	0.20
1 beef cow	350 lb. gain (calf)	..	..	3,700	..	..	0.50	25	1.0	0.23
1 baby beef	500 lb. gain	2,300	330	750	..	..	..	10	..	0.10
1 beef calf	400 lb. gain	225	..	800	..	..	0.12	12	..	0.10
1 beef yearling	350 lb. gain	335	..	1,800	..	..	0.30	12	..	0.10
1 ewe	70 lb. gain (lamb)	128	..	500	..	..	0.10	3	0.7	0.24
1 feeder lamb	20 lb. gain	90	* 10	75	..	..	..	1	..	0.02
1 sow and litter ‡	1,450 lb. gain	6,090	(290)	..	2,900	..	0.15	36	3.8	1.16
100 mature chickens	335 lb., 540 doz. ||	5,000	(250) §	..	2,500	..	..	175	5.0	2.65
1 work horse	1,100 hours work	3,000	..	5,000	..	..	0.12	82	..	1.00

* For a period of one year for cows, bull, young cattle over one year of age, ewes, and mature chickens; otherwise for the gain in weight indicated.

† Mature bull stable-fed.

‡ Includes feed for breeding herd and fattening sow after spring litters are weaned.

§ These amounts of commercial protein supplement will be used if skim milk is not available.

|| Production based on 54 mature birds and 92 chicks.

Table 9

Comparison of Composite Units of Different Classes of Livestock, Using Approximately Equal Amounts of Man Labor,
in Amounts of Other Factors Used*

Units	Man labor per unit, hr.	Horse work per unit, hr.	Materials and services per unit	Feed per unit				
				Farm grown concentrates, lb.	Commercial protein supplement, lb.	Dry roughage, lb.	Skim milk, lb.	Sweet clover pasture, acres
Dairy-cattle unit: †								
1.00 dairy cow	160	5.0	\$0.70	2,100	..	5,500	..	0.50
0.25 dairy heifer	9	..	0.03	100	..	750	..	0.08
0.25 dairy calf	9	..	0.02	94	..	181	550	0.03
0.07 dairy bull	5	..	0.01	105	..	441	..	0.61
Total	183	5.0	0.76	2,399	..	6,872	550	0.61
Beef-cattle unit: ‡								
4.50 beef cows	112	4.50	1.03	..	..	16,650	..	2.25
3.33 baby beefs	33	..	0.33	7,659	1,320	2,500	..	..
0.67 beef heifer	8	..	0.07	224	..	1,200	..	0.21
0.67 beef calf	8	..	0.07	151	..	536	..	0.10
0.14 beef bull	11	..	0.03	210	..	882	..	..
Total	172	4.50	1.53	8,244	1,320	21,768	..	2.56
Sheep unit:								
60 ewes §	180	42.0	14.40	7,680	..	30,000	..	6.00
Hog unit:								
5 sows and litters ||	180	19.0	5.80	30,450	1,450 ¶	..	14,500	0.75
Poultry unit:								
50 hens and 100 chicks	175	2.5	1.82	2,500	125 ¶	..	1,250	..
Work-horse unit:								
2 horses	164	..	2.00	6,000	..	10,000	..	0.24

* Adapted from Table 8 and based upon the same production per animal.

† Assumes that calves other than heifer calves needed for replacements (1 heifer a year per 4 cows) would be vealed.

‡ Assumes 1 heifer a year per 6 cows for replacements and approximately 12 per cent death loss of calves.

§ Assumes lambs would be marketed without finishing with a grain ration.

|| Assumes sows would be fattened after spring litters are weaned.

¶ Amounts of commercial protein supplement used if skim milk is not available.

per unit of labor expended. A dairy-cattle unit is slightly heavier user of roughage, proportionately to grain, than a beef-cattle unit; but dairy cattle provide a market for a much smaller quantity of total feed, including pasture, per unit of labor expended than do either beef cattle or sheep. Poultry are primarily a means for marketing labor rather than feeds.

Seasonality of Demands Upon Man Labor

While the composite units of the various classes of livestock make approximately equal total demands upon man labor, they vary widely

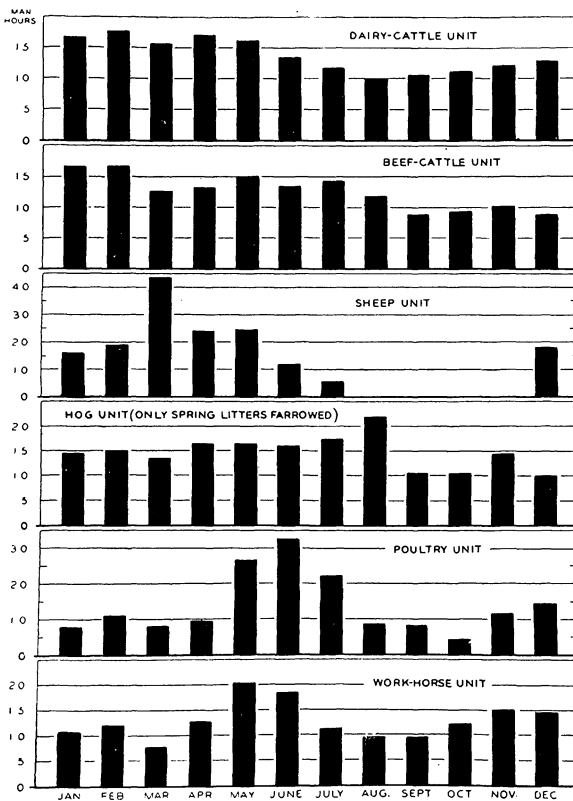


Fig. 24. Distribution of Labor, by Four-Week Periods, Expended on Composite Units of Various Classes of Livestock

Different classes of livestock vary widely in respect to the seasons of the year when they require most attention.

in respect to the seasons of the year when they require most attention. It is important, in the interests of economy, from the standpoint of the farm business as a whole, that the farmer have as nearly as possible full-time productive employment for his labor for the maximum

portion of the working year. Hence it is essential that he select the classes of livestock that tend to supplement rather than compete too seriously with crops in the use of labor.

Sheep raising utilizes labor during the winter season, but requires little or no attention during the cropping season (see Figure 24.) Beef cattle raising and beef cattle feeding interfere less with work on crops during the harvest season than does dairying. Dairy cows require more constant attention throughout the year than any other class of livestock. Hogs require most attention during the summer. When only spring litters are raised, the peak of the labor load comes in August. (see Fig. 24). Poultry, likewise, require most attention during the early summer. As much of the labor for poultry is commonly performed by the women and children, this enterprise may not compete seriously with crops for labor.

LIVESTOCK PRODUCTION AS A PART OF FARM ORGANIZATION IN THE RED RIVER VALLEY

Advantages of Livestock in the Farm Organization

The rapid development of the practice of growing more feed crops, especially alfalfa and sweet clover, to aid in weed control and soil improvement has already been referred to. Incidentally, these crops yield hay and pasture and, because of the distance from a market, use for most of the hay as well as all the pasture, must be found on the farm. Livestock provide a use for these legumes and other feed crops needed for crop rotation. Likewise, other roughages produced as a by-product of grain production, and grain that is of low grade are converted into marketable products through feeding them to livestock.

Converting marketable feed grains into equivalent values in livestock reduces their weight by at least 70 per cent. Thus livestock and livestock products have a higher specific value than the grains upon which their production depends. Consequently marketing charges, particularly transportation charges, are relatively less when crops are marketed through livestock. Other things being equal, it is always more profitable for the farmer at a great distance from market to keep livestock and convert his feeds into livestock products than it is for the farmer near the market who may, with profit, sell his crops directly.

The addition of livestock to crop farming is an effective way of increasing the volume of the farm business. On most farms man labor and horse work are not productively employed throughout the year unless some livestock are kept. Generally speaking, the care of livestock involves considerably more labor during the winter than in the crop-growing season. If properly arranged, this supplementary relationship between livestock and crops in the use of labor can be estab-

lished and maintained to the distinct advantage of the farmer as reflected in his earning. Even tho livestock enterprises may give only a small return above the market value of the feed used, granting it is all of marketable quality, they may add much to the total farm income in the future through increased crop yields and something to the present farm income. The direct benefit to the farm business as a whole is obtained through the livestock making some return for the labor and equipment that would otherwise not be fully used.

While it is possible to maintain the productivity of the soil without animal manures by using mineral fertilizers and by plowing under legumes, it is poor economy on most farms to grow the acreage of legumes necessary to maintain the productivity of the soil and then not use them for feeding livestock. If the manure is carefully handled and returned to the crop land, a large proportion of the essential fertilizing elements are returned to the soil. At the same time some current income is obtained through feeding the legume crops. The fertilizing value lost through feeding legumes to livestock, as contrasted with plowing them under directly, is more than offset by the additional plant food in the manure derived from feeding grain to the livestock. When commercial high-protein feeds are used to supplement farm-grown rations, the fertilizing value of the manure is further increased. For many years farmers in some of the older agricultural regions have been attempting to restore the productivity of their soil through the purchase of feed grains from newer areas. Farmers of the Red River Valley, where soils are showing reduced productivity, may well consider the experience of these older regions.

Another consideration favoring a better balance between crops and livestock has been the relation of the price of crops, which are both feedable and directly marketable to the price of livestock and livestock products into which they may be converted. In recent years livestock products have enjoyed a relatively higher price in the market than have marketable feeds. This situation may be temporary, yet there is no strong evidence to dispel the belief that it may continue during the next few years.

Possibilities and Limitations of Expanding Livestock Production

The Red River Valley is without serious limitations in so far as pastures, feed crops, and marketing and transportation facilities are prerequisite to the successful production of dairy products, beef cattle, sheep, and poultry products. The water supply is adequate and of satisfactory quality in most parts of the Valley. In limited areas the presence of alkali in the ground water makes it unfit for drinking purposes for both man and animals. In these areas it is necessary to impound either melted snow or rain water in cisterns or reservoirs.

This situation can be overcome in some instances by sinking deep wells; otherwise, it is a handicap to the keeping of livestock. While many farms are adequately improved with fences and buildings for pasturing and sheltering livestock, some would require additional improvements in the way of fences and buildings before the present numbers of livestock could be increased materially. Since a majority of the farms that are under-improved with buildings and fences are owned by men of limited capital and credit resources, the keeping of livestock on these farms is definitely limited to the equipment now on the farms or to additional equipment that can be constructed with a small cash outlay.

In the present unfavorable economic situation, credit for the purchase of additional breeding stock is not readily available. Local bankers are operating on a very conservative credit policy. In practically every case borrowers are required to provide tangible security other than the breeding stock purchased and their probable increase. The Agricultural Credit Corporation, which was organized at Minneapolis in 1924 as a special aid to farmers of the Northwest in securing loans for purchasing livestock for foundation herds and flocks, has assisted in bringing a considerable number of ewes and dairy cows into the Valley. This organization provides funds on a long-loan period basis, thus making it possible to repay the loan after the products from the original herd or flock have been marketed. Here again the farmer must have a part of the purchase price to be eligible for a loan on breeding stock. Rediscount corporations are not accepting much, if any, livestock paper in the Northwest. The credit situation is a serious handicap to a general increase in livestock production in the Valley.

Lack of experience with livestock is not so serious a handicap as lack of capital. The man without experience, however, will do well to avoid the mistake of investing too heavily in the beginning, before he has had an opportunity to prove his ability in handling different classes of livestock. There are farm operators in the Red River Valley who are not interested in farming with livestock. They do not like to give the continuous care which most kinds of livestock require. These men will perhaps act wisely in continuing to confine their farming operations largely to crop production. In doing so, however, they can not expect as large earnings as those who produce livestock with average efficiency and are equally efficient in crop production.

While it is clear that livestock have a place on general farms in the Valley, the answer to the question of what kinds and how many can be carried to advantage on a particular farm depends upon many circumstances. Farms vary in their need for the performance of the various functions of livestock and no one kind of livestock performs

all of them equally well. Generally speaking, the possibilities on individual farms of each of the livestock enterprises already mentioned depend upon the total quantity of feedable crops grown; the proportion between concentrates, roughages, and pasture; the amount of labor available for caring for livestock; and upon the capacity of the class of livestock for performing the various functions of livestock. They depend also upon the amount of equipment in the way of buildings and fences; and this is an important factor since, as already has been noted, funds for constructing fences and buildings frequently are not available. Then, too, the operator's aptitude for handling various kinds of livestock may be a very important factor influencing the success of the enterprise.

Sheep Production

Sheep raising is expanding at a more rapid rate than any other livestock enterprise (see Table 1). This is especially true in the northern end of the Valley. Sheep are primarily consumers of pasture and roughages. They use sweet clover pasture to good advantage and can be wintered satisfactorily on either sweet clover or prairie hay if alfalfa is not available. While they grow better when given good feeds, they thrive relatively better on low quality pastures and hays than any other class of livestock. Farmers in the Valley find that they can use sheep to control such weeds as quack grass and sow thistles through close pasturing. Sheep, therefore, fit well into a weed control program both as eradicators of weeds directly and as consumers of large quantities of weed-control crops. Another distinct advantage is their ability to take care of themselves during the crop-growing season (see Fig. 24). They have the additional advantage of requiring less shelter than either dairy cattle or hogs and no more than beef cattle. Their chief disadvantage, as compared with cattle, is that they require a more expensive type of fence.

The expansion of sheep raising has been accomplished largely through the importation of western ewes, which have been distributed mostly in small flocks. The medium-sized farm flock, kept for raising lambs for marketing in the autumn off pasture, appears best fitted to Valley conditions. It is desirable to keep the flocks small enough to change the sheep from one pasture to another at frequent intervals to minimize the danger from internal parasites. The finishing of lambs on grain is a highly specialized enterprise involving considerable risk, for which the Red River Valley has no particular advantages.

Another type of sheep raising that is common in parts of the Valley is what may be called a range system. This type is common in the sparsely settled regions of the northern and northeastern sections of the Valley, where many of the farms are surrounded by large acreages of unclaimed land. The general plan is to allow the sheep

free range without much attention. Where the conditions are such that sheep can be handled in this way, it is a very economical method of sheep production, for there is practically no cost for pasture. The owner of the sheep seldom pays rent for the land over which they graze.

Dairy Production

Dairying fits well into the organization of small or medium-sized farms having diversified cropping systems. Dairy cattle utilize fairly large quantities of both roughages and concentrates and provide productive employment for large amounts of labor per unit of feed and equipment used (see Table 9). They provide a steady cash income at short and regular intervals, thus minimizing the risk involved in marketing the product on an unsteady market. When practiced with cows of the dual-purpose type, dairying is adaptable to somewhat larger farms, since all of the calves ordinarily would be raised and the surplus marketed as beef cattle. The young stock under this system would provide use for additional pasture and roughage. The most serious limitation to dairying in the Red River Valley is the competition of the enterprise with crops for labor during the growing season. Dairy cattle require warmer and better equipped buildings than do other classes of livestock. Very few farms are properly equipped for dairying. Other limiting conditions are the absence of local creameries and the general lack of cows of good quality.

Beef Cattle Production

Beef cattle fattening has been practiced to a very limited extent in the Valley. There seems to be no reason, however, why the practice of raising and fattening beef cattle should not become more general. It has already been noted that, in feeding trials at the Northwest Experiment Station, at Crookston, comparing barley with shelled corn as the concentrate in rations for fattening baby beeves, the ration containing corn as the farm-grown concentrate produced only slightly higher average daily gains and finish than did the one containing barley, and with the relative market prices of the two grains considered, the barley-fed calves returned a larger margin of profit. The raising and fattening of baby beeves seems particularly well adapted to the large grain-growing farms in the Valley. The problem of balancing crops with livestock on large farms is primarily that of feed utilization as contrasted with labor utilization on the smaller farms. With the same expenditure of labor, beef cattle production utilizes approximately three and one-half times as much of both concentrates and roughage as do dairy cattle (see Table 8). The same is true of sheep, and sheep have the advantage of requiring practically no attention during the crop growing season. Yet it would be some-

what difficult to depend upon sheep as the only class of livestock on the farm, as it is desirable to change pastures for sheep at frequent intervals to avoid the danger of stomach worms. Beef cattle have the same advantage as sheep in their adaptation to farms with limited building equipment in that they can be maintained satisfactorily in straw sheds or other inexpensive shelter.

Hog Production

Hogs, in limited numbers, fit well into most farm organizations in the Valley. The southern end of the Valley is better adapted to hog production than the area farther north. Corn is better adapted in the southern counties, where the climate is less severe. Barley is a satisfactory substitute for corn in feeding hogs, but where barley is the only fattening grain grown, a large proportion of it is needed for balancing roughages which must be fed to cattle or sheep. Hence the amount of feed available for hogs, which consume only concentrates, may be somewhat limited. Hogs are desirable on dairy farms producing skimmilk and insofar as practicable should be kept in sufficient numbers to consume in balanced rations all the skimmilk available over and above the amounts needed for calves and poultry. While the hogs require much less labor per animal than cattle, the distribution of the labor is less favorable (see Figure 24). Because of the cold winters and late springs, pigs are usually farrowed only in the spring, ordinarily not until in May. This system of handling hogs causes the heaviest demands on labor to fall in August just at harvest and threshing time (see Figure 24), but it has the advantage of not requiring any considerable investment for housing. A straw shed will provide all the shelter needed throughout the winter.

Poultry Production

When provided with warm, well ventilated houses for protection during the winter, chickens are as profitable in the Red River Valley as in any other section of the state. The warm dry summers and the wide areas available for unmolested ranging adapt the Valley to turkey raising. Poultry raising, more than the keeping of a small flock, fits into the more intensive type of organization to best advantage.

Suggested Livestock Organizations

Operators of small farms, if the ratio of their concentrates to roughages is high and if they have considerable labor not needed for the growing and harvesting of crops, would find it to their advantage to utilize their resources through dairy cattle, hogs, and poultry. Dairy cattle and poultry make heavy and fairly constant demands upon labor

and use less feed per unit of labor than sheep or beef cattle (see Table 9 and Figure 24). Hogs and poultry use only concentrates, and dairy cattle use proportionately larger amounts of concentrates than sheep.

The following livestock organization is suggested for one of the small farms included in the three-year study in Polk County. The distribution of the crop acreage on this farm would be 40 acres of wheat, 40 of oats, 36 of barley, 20 of potatoes, 20 of sugar beets, 25 of alfalfa hay, 15 of wild hay, and 15 of sweet clover pasture.

Livestock Organization for a 224-Acre Farm

Kind of livestock	Number
Work horses	6
Dairy cows	10
Yearling heifers	2
Heifer calves	2
Veals	6
Bull	1
Sows, with spring litters	5
Hens	150

The farmer on the medium-sized farm having more feeds, especially more roughages and pasture, but practically the same amount of labor available for caring for livestock during the growing season would find it to his advantage to combine sheep raising with dairying and hog production.

The following livestock organization is suggested for a 400-acre farm included in the special study in Polk County. The distribution of the crop acreage would be 70 acres of wheat, 70 of oats, 40 of barley, 30 of flax, 35 of potatoes, 35 of corn, 20 of alfalfa hay, 25 of sweet clover hay, 45 of sweet clover pasture, and 9 of permanent pasture.

Livestock Organization for a 400-Acre Farm

Kind of livestock	Number
Work horses	8
Dairy cows	14
Yearling heifers	2
Heifer calves	2
Veals	10
Bull	1
Ewes	120
Sows, with spring litters	10
Hens	75

On the other hand, the farmer on the large farm with large amounts of pasture and roughage to market through livestock and a scarcity

of labor compared to the amount of feed available would likely find beef cattle, sheep, and hogs suited to his farm.

The following livestock organization is suggested for a large farm included in the special study in Polk County. The distribution of the crop acreage on this farm would be 140 acres of wheat, 70 of oats, 70 of barley, 70 of flax, 40 of potatoes, 30 of corn, 35 of alfalfa hay, 20 of sweet clover hay, 50 of sweet clover pasture, and 34 of permanent pasture.

Livestock Organization for a 547-Acre Farm

Kind of livestock	Number
Work horses	12
Beef cows	31 ¹⁸
Baby beeves	25
Yearling heifers	4
Heifer calves	4
Bull	1
Ewes	100
Sows, with spring litters	8
Hens	100

It is expected that these livestock organizations will be used only as a guide by farmers interested in balancing their cropping systems with livestock enterprises. In choosing his livestock combinations the farmer must have in mind the various relationships between different classes of livestock and between crops and livestock. In considering these inter-relationships, different farmers will find that they have widely varying significance to them because situations on different farms are never quite the same. Not only do farms vary in size and in their needs for the performance of the functions of livestock, but farmers vary in their aptitudes for handling different kinds of livestock.

With conditions varying so widely from farm to farm, more specific suggestions on the selection of livestock enterprises must take into account the individual farmer's productive resources and the possibilities of these resources in the productive processes. **Application of the general conclusions and data previously set forth in this bulletin to the task of balancing crops and livestock as a part of the undertaking of planning a more profitable utilization of all the resources on individual farms is discussed and illustrated in Minnesota Agricultural Experiment Station Bulletin 284, "Planning Systems of Farming for the Red River Valley of Minnesota."**

¹⁸ The total of 35 cows and heifers would be available for raising calves since the cows culled from the herd each year would not be sold until after calving time.