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PLANNING SYSTEMS OF FARMING FOR THE RED RIVER VALLEY OF MINNESOTA

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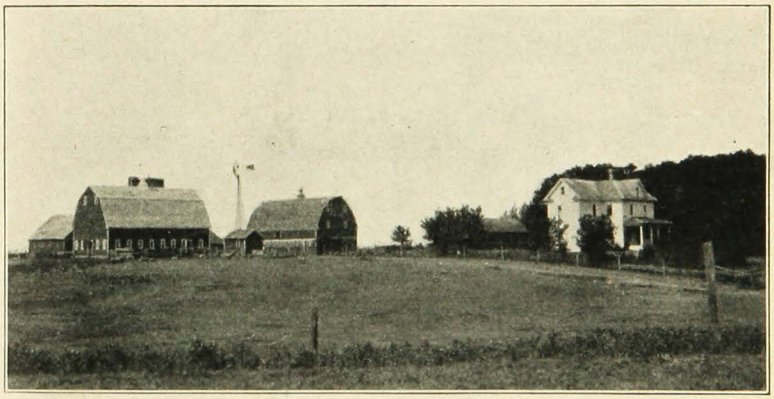

UNIVERSITY FARM, ST. PAUL

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PLANNING SYSTEMS OF FARMING FOR THE RED RIVER VALLEY OF MINNESOTA

C. W. CRICKMAN, GEORGE A. POND, and GEORGE A. SALLEE

INTRODUCTION

The Red River Valley in Minnesota is one of the important agricultural regions of the state. It forms a part of the great northwest spring wheat area. Wheat was the chief crop grown by the first settlers coming into the Valley following 1870 and it continues to be the dominant cash crop. The dominance of wheat, however, has been on the decline during the last thirty years, with a marked decrease in acreage since 1920.

The one-crop system, followed so persistently during the first thirty years of farming in the Valley, developed the usual hazards that are inevitable with single-crop farming—weed pests, plant diseases, insects, and poor physical condition and lowered fertility of the soil. Wheat became a crop of uncertain yield, except as it was grown in a crop rotation. As early as 1910 wheat acreage in the Valley had decreased fully 40 per cent below that recorded in 1900. Cropping systems were diversified in an attempt to control the adverse natural conditions until war-time prices for bread grains influenced farmers to grow larger acreages of wheat again, notwithstanding the risks of low yields and crop failures.

Following the World War the many natural hindrances to the growing of small grains, the intense inter-regional competition in wheat production, and the changed economic conditions favoring the marketing of feedable crops through livestock unfavorably affected returns from cash grain farming in the Valley. Farmers were confronted as never before with the problem of shifting from continuous grain cropping into better balanced systems of farming. Some progress has been made. Relatively more barley and oats have been grown during recent years and corn, potatoes, sugar beets, and legumes have been introduced to control weeds and crop diseases and to improve soil conditions. With the increase in the production of feed crops, interest in livestock has become general. Weed pests and the many other natural hazards are still troublesome in varying degrees on individual farms, however, and the returns are affected accordingly.

The present handicaps to more profitable farming in the Valley are for the most part subject to control. Fortunately, the soil is not yet greatly depleted. More progress in the transition to better balanced systems of farming, together with good farming practices, will do much

to eliminate the handicaps or at least materially to reduce their effects. The results obtained on the Northwest Experiment Station farm, at Crookston, indicate that weeds can be controlled through crop rotation, coupled with late summer fallowing of sweet clover meadow or pasture,

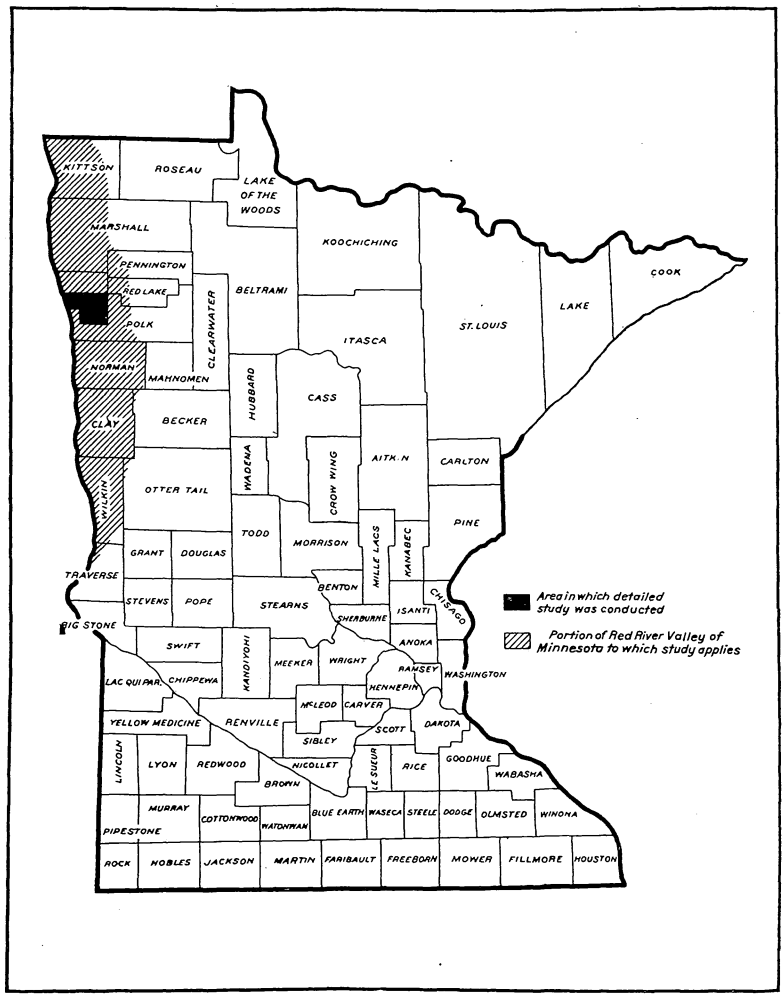

Fig. 1. Location of the Area Studied

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

and the use of good seed. Results at the Station indicate, also, that the yield of wheat, oats, barley, and potatoes can be increased materially by the use of sweet clover and other legumes in a rotation of crops.[1]

[1] Annual reports of the Northwest Experiment Station, Crookston, 1917-27.

These findings are confirmed by the experience of farmers. The advantages of more systematic farming in the Valley are recognized quite generally, but individual farmers hesitate to make changes in their systems of farming because of lack of adequate information on (1) the readjustments that are essential to meet changing physical and economic conditions; (2) the enterprise substitutions that are possible from the standpoint of adaptation to soil and climate, feed supply, and availability of markets; (3) the changes that are practical from the standpoint of physical organization, involving labor, power, and equipment; and (4) the returns that can reasonably be expected from the entire farm should any one of the various programs open to them be put into effect.

NATURE OF THE STUDY

With a view to helping the farmers of the Red River Valley with the many questions that arise during this period of adjustment to changing physical and economic conditions, a study of the agriculture of the region was made during the three-year period 1926-28 by the Minnesota Agricultural Experiment Station and the Bureau of Agricultural Economics of the United States Department of Agriculture.[2] A detailed study was made of the organization and operation of a group of representative farms in Polk County. Complete records of the production obtained, the labor, power, equipment, and materials used in crop and livestock production, and the financial transactions of each farmer for each year were secured 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.[3]

[2] The 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 R. S. Dunham, of the Northwest Experiment Station, 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. Flaat, 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. Tiernan, Harke Veldman, Martin Wagner, Earl Wardell, L. A. Wentzel, M. E. Wentzel, Wm. F. Wentzel, Wurden Bros.

[3] 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.

This bulletin is one of a series of three 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. Bulletin 282 "An Economic Study of Crop Production in the Red River Valley of Minnesota," presents a study of crop production, and Bulletin 283, "An Economic Study of Livestock Possibilities in the Red River Valley of Minnesota,"

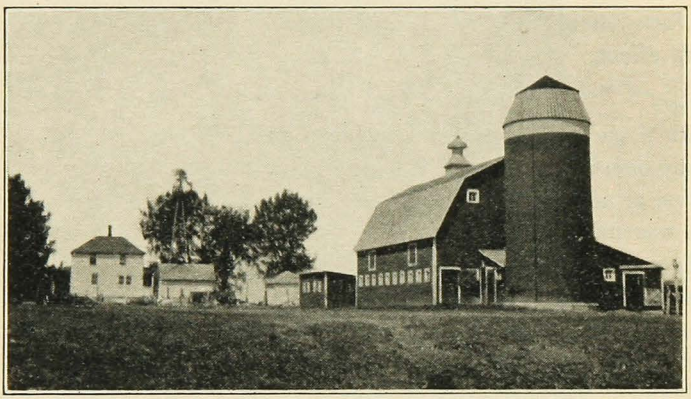

Fig. 2. A Typical Farmstead in the Red River Valley
Warm barns and plenty of storage space for feeds are essential to livestock farming, especially dairying, in the Valley.

presents a study of livestock production in the Valley and its possibilities.

The discussion of the data in this bulletin is presented in five parts:

1. A description of the present organization of farms.
2. A statement of the returns from the present system of farming.
3. An enumeration of the major farming problems of the area.
4. Suggestions on the solution of the major farming problems.
5. A discussion and illustration of the method of using basic farm organization data in planning and testing both major and minor readjustments in the organization of individual farms.

PRESENT ORGANIZATION OF FARMS

Farms of approximately 320 acres are the most common in size throughout the greater portion of the Valley (see Table 1). Farms ranging about 160 acres in size rank second in number, where the half-section size leads, and predominate in Pennington, Red Lake, and Polk Counties. There is considerable variation from both these groups, but

this variation is confined largely between a lower limit of 100 acres and an upper limit of 500 acres. Few are either very small or very large.

Table 1

Percentage Size Distribution of the Farms Studied in Polk County, 1926-28, and of All Farms in the Red River Valley, by Counties, According to the 1925 Federal Census

Size group, acres	Farms studied in Polk County	County							
		Wilkin	Clay	Norman	Polk	Marshall	Pennington	Red Lake	Kittson
Under 50	...	1.3	4.3	9.2	8.1	4.5	5.9	3.8	4.3
50– 99	5.2	2.1	5.1	8.2	9.6	5.7	6.3	10.0	7.0
100– 174	12.0	17.9	27.2	26.8	35.7	31.7	39.4	41.0	26.5
175– 259	13.8	20.0	21.9	23.0	15.6	17.8	16.2	14.3	16.9
260– 499	41.4	47.5	34.9	28.0	25.2	33.0	29.1	27.2	33.7
500– 999	25.9	10.2	6.2	4.5	5.5	6.5	3.0	3.7	10.5
1,000–4,999	1.7	0.9	0.3	0.3	0.4	0.7	...	...	1.2
Average	335	320	265	227	228	261	226	222	293

Farm values in the Valley, according to the 1925 census, averaged from $47 per acre in Pennington County to approximately $82 per acre in both Clay and Wilkin Counties (see Table 2). Most farms are improved with substantial buildings.

A majority of the farmers are owner-operators. Most owner-operated farms were heavily mortgaged in 1925, however. The ratio of debt to value of owned farms exceeded 40 per cent in all counties in the Valley and was 47.5 per cent in Pennington County (see Table 2). The percentage of tenancy has increased rapidly since 1910 (see Table 2). During the interval 1910-25 it increased from 11.3 per cent to 19.7 per cent in Pennington County, where the percentage was lowest in 1925; and from 36.8 per cent to 49.2 per cent in Wilkin County, which had the highest percentage of tenancy in 1925.

Table 2

Value of Land and Buildings per Acre, Ratio of Debt to Value of Owner-Operated Farms, and Percentage of Tenancy, by Counties, as Shown by the 1925 Federal Census

County	Value of land and buildings per acre	Ratio of debt to value	Percentage of tenancy		
			1910	1920	1925
Kittson	$58.43	41.2	11.2	18.1	25.1
Marshall	56.67	44.6	12.5	17.9	21.4
Polk	70.39	43.2	17.8	26.5	29.0
Pennington	47.31	47.5	11.3	14.4	19.7
Red Lake	56.08	44.6	18.8	21.9	29.8
Norman	74.38	40.8	20.4	31.2	35.0
Clay	81.57	40.5	24.3	34.8	38.9
Wilkin	82.47	39.0	36.8	43.7	49.2

The typical Red River Valley farm is level (see Fig. 3). A high proportion of the land is tillable, and much of that now in native prairie could be tilled with better drainage. The level surface causes drainage through the natural water courses to be poor, and artificial drainage, which is accomplished by ditching, is inadequate on many farms. The soils are dark clay, silt, or fine sandy loams, high in humus content and underlain with a highly calcareous subsoil.[4]

The proportion of the farm used by different crops varies according to the location in the Valley and depends primarily upon the type of soil and drainage. In Figure 4 the Valley is divided somewhat roughly into cropping areas on the basis of first and second choices of crops in 1927. The crop with the largest acreage is named first, followed by the crop next in importance. Wheat is the principal crop

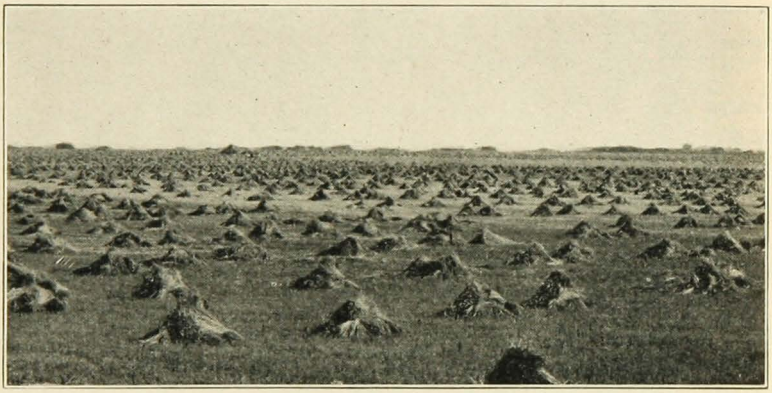

Fig. 3. A View of the Level Red River Valley
Level land is an advantage in the use of labor-saving machinery, but it makes drainage difficult.

grown on farms located on the better drained, dark, clay soils. On the sandy loam soils with a subsoil heavy enough to withstand drought, oats are the principal crop. On the fine sandy soils, rye is the principal crop other than wild hay. Barley can be grown profitably on poorer soils than wheat and has the additional advantage of later seeding, which makes it better adapted to poorly drained, heavy soils that remain wet until late in the spring; hence barley ranks next to wheat on the heavy soils along the river and shares first place with wheat and tame hay at the northern end of the Valley, where natural drainage of the gumbo soils is poor and artificial drainage is not so well developed as farther south. Barley is also second to oats on land too sandy for profitable wheat production.

[4] For a fuller description of the physical factors affecting agricultural production in the Red River Valley, see Minn. Agr. Expt. Sta. Bull. 282, "An Economic Study of Crop Production in the Red River Valley of Minnesota," by George A. Pond, George A. Sallee, and C. W. Crickman.

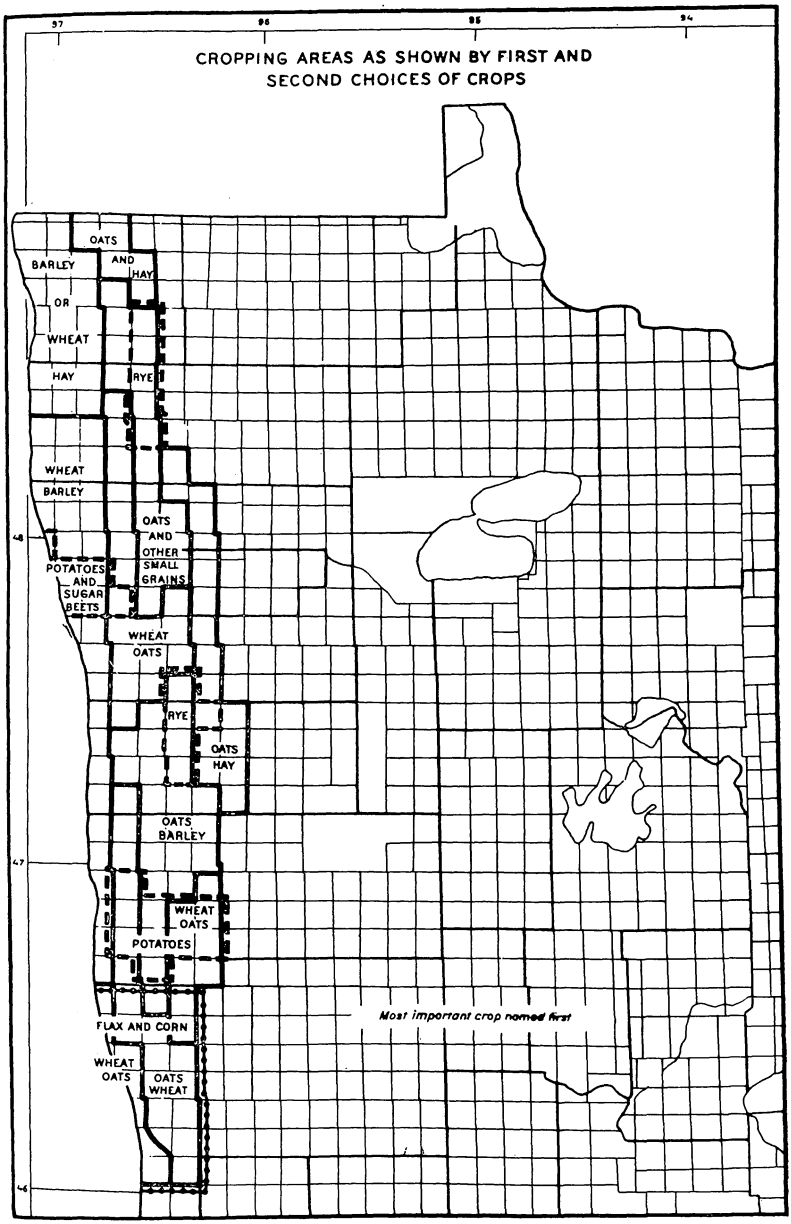

Fig. 4. Cropping Areas in the Red River Valley

Areas having identical first and second choices are bounded by heavy lines. Areas of minor crops are indicated by broken lines.

The location of areas of extensive production of minor crops is shown in Figure 4 by the broken lines. Potatoes are an important crop in Clay County, in a small area along the river in Polk County, and, to a lesser degree, in Norman County, where the rich clay soils have a liberal admixture of sand. Flax is an important crop on old land cleaned of weeds and in areas still having new land to break each year. Corn is an important crop in Wilkin County but it declines in importance toward the north because of the limitations of climate. Sugar beet growing is scattered along the Red River in Marshall, Polk, Norman, and Clay Counties. It is most extensive near the beet sugar plant at East Grand Forks, in Polk County. Tame hay is second to oats along the eastern edge of the Valley and ranks as a leading crop in small areas in other parts. Alfalfa is the most important hay crop and is grown in all parts of the Valley except on alkali, peat, or very wet soils. An additional use of land is summer fallow.[5] In 1925 summer fallow was practiced on 4.4 per cent of the farm area in Wilkin County, 7.2 per cent in Polk County, and 13.6 per cent in Kittson County, according to the Federal census.

Wild hay is cut from a significant portion of the farms located on the light sandy areas and in extensive, poorly drained regions. The percentage of farm land in wild hay in 1927 is shown in Figure 5.

Pasture is an important use of land along the streams where the topography is broken, particularly along the eastern edge of the Valley where drainage is poor and gravel and some boulders are mixed in the soil. The percentage of farm land used for pasture, by townships, is shown in Figure 6. The distribution of the pasture area between tillable and untillable land, by counties, is indicated in Table 3.

Table 3

Percentage of All Farm Land in Red River Valley in Pasture, 1927, by Counties

County	Per cent in all pasture	Per cent in tillable pasture	Per cent in untillable pasture
Kittson*	15.0	4.5	10.5
Marshall*	13.4	5.8	7.6
Polk*	12.4	6.0	7.7
Pennington*	21.7	3.4	18.3
Red Lake*	19.5	4.1	15.4
Norman	16.5	6.2	10.3
Clay	14.8	3.5	11.3
Wilkin	11.7	5.3	6.4

* Includes only the townships within the Red River Valley as outlined in the map in Fig. 1.

In general, farms along the eastern border and near the Red River or its tributaries have more livestock than those in the middle part of

[5] The cropping systems are more fully described in Minn. Agr. Expt. Sta. Bull. 282, "An Economic Study of Crop Production in the Red River Valley of Minnesota," by George A. Pond, George A. Sallee, and C. W. Crickman.

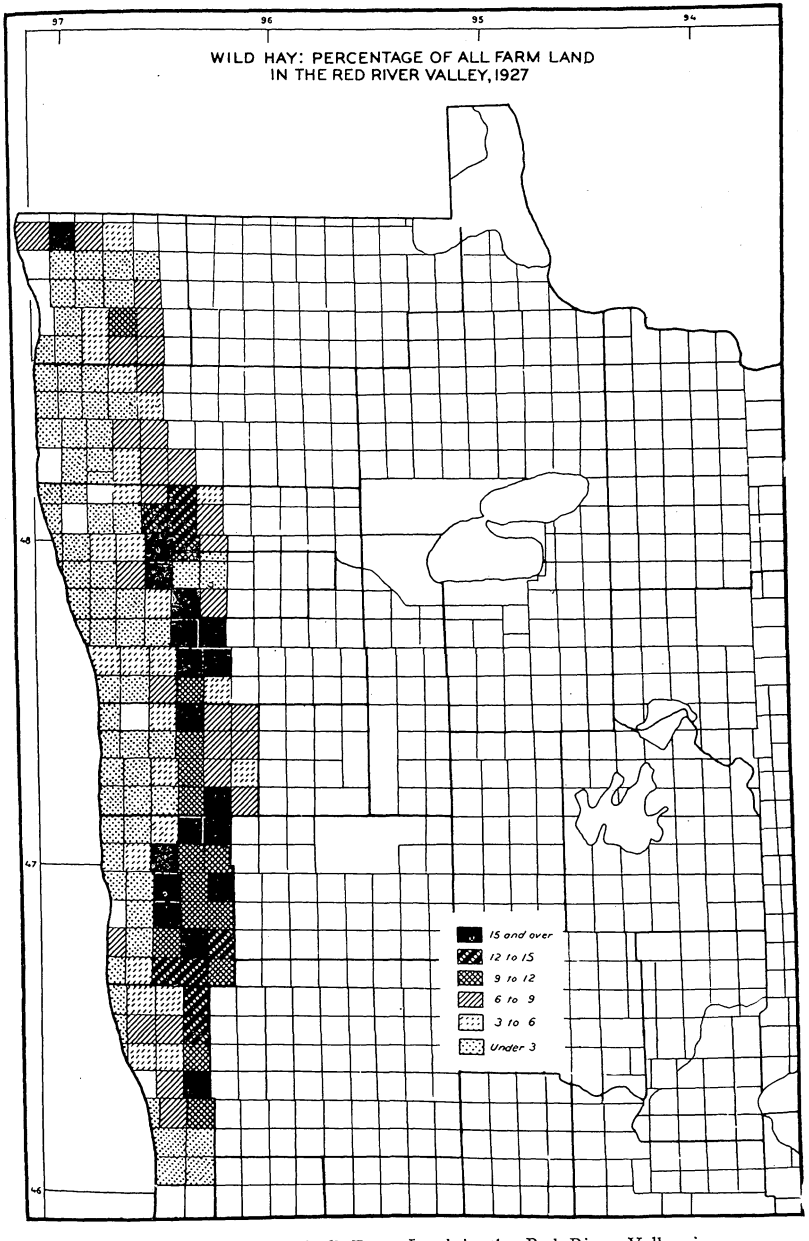

Fig. 5. Percentage of all Farm Land in the Red River Valley in Wild Hay, 1927, by Townships

Wild hay is harvested from land which, because of lack of drainage or low fertility, would otherwise be waste.

Fig. 6. Percentage of all Farm Land in the Red River Valley in Pasture, 1927, by Townships

Rough land or stones or brush are responsible for the relatively large acreage of pasture along the eastern border of the Valley.

the Valley. Figure 7 shows, by townships, the areas having an average of 20 or more cows, 10 or more ewes, and 10 or more sows per thousand acres of farm land.[6] Cattle are the most widely distributed class of livestock. The herds are made up of about equal numbers of cows and young stock. The cows are mostly dual-purpose in type and are milked on most farms. Cream is separated from the milk on the farm and shipped as sour cream to large centralizer creameries. The townships having an average of 10 or more ewes per thousand acres are located in the northern end of the Valley and, in general, are the same areas having 20 or more cows per thousand acres of farm land. Sheep are kept mostly in small flocks. A few specialized sheep farms have been developed. Sheep and cattle are found in greatest numbers in areas where hay and pasture are an important use of land. The concentration of hogs tends to follow the areas having the largest corn acreage.[7]

The utilization of the farm land and the number of different kinds of livestock on each of the farms included in the detailed study in Polk County in 1928 are shown in Figure 8. The organization of individual farms varies greatly from farm to farm.

The sources of gross income on the 12 farms co-operating throughout the entire period of the study are shown in Table 4. The percentages shown are a three-year average. Here again the variations between individual farms are quite noticeable.

Table 4

Sources of Gross Income on Each of 12 Farms, Polk County, Yearly Average, 1926-28

Farm No.	Percentage of gross income from											
	Wheat	Flax	Sugar beets	Potatoes	Other crops	Dairy products	Cattle	Sheep	Swine	Poultry	Outside labor	Miscellaneous
1.....	4	4	..	..	8	34	13	..	26	7	2	2
2.....	7	11	..	..	2	33	15	..	17	10	2	3
3.....	10	14	44	3	5	11	2	..	1	3	5	2
4.....	14	..	..	..	4	17	6	5	22	7	12	11
5.....	18	19	..	1	23	8	5	7	15	2	1	1
6.....	18	3	..	15	3	11	18	..	21	3	4	4
7.....	19	6	..	29	2	1	13	..	24	1	3	2
8.....	19	6	..	3	7	5	7	1	35	7	4	5
9.....	21	..	..	2	1	9	6	..	16	5	35	5
10.....	23	2	25	12	4	8	8	1	9	1	3	5
11.....	24	20	..	1	6	13	15	..	14	1	2	4
12.....	25	4	..	2	9	30	9	1	6	9	2	3
Average..	15	8	6	6	6	15	10	1	5	5	6	4

[6] Based upon tax assessor's 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.

[7] For a more complete discussion of the livestock system see Minn. Agr. Expt. Sta. Bull. 283, "An Economic Study of Livestock Possibilities in the Red River Valley of Minnesota," by George A. Sallee, George A. Pond, and C. W. Crickman.

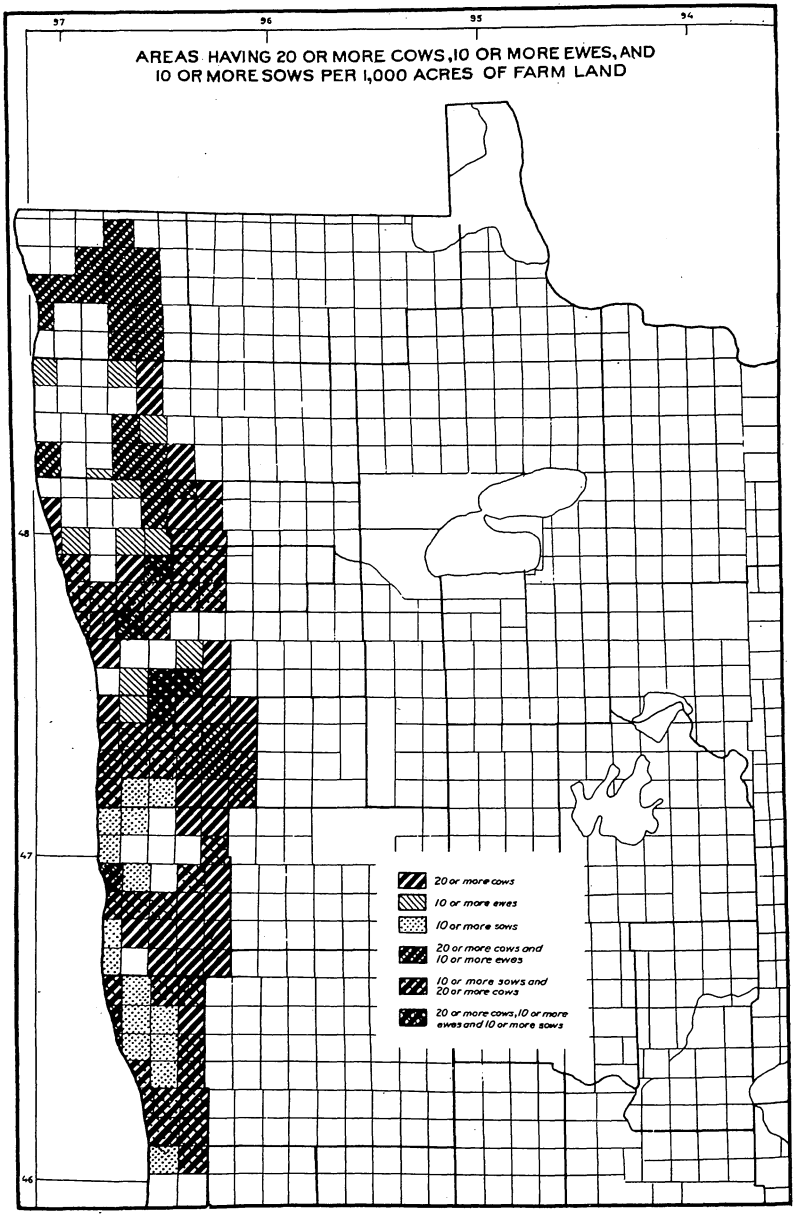

Fig. 7. Location of Areas of Heaviest Livestock Production

Sheep and cattle are found in greatest numbers in areas where hay and pasture are a principal use of the land. The concentration of hogs tends to follow the areas having the largest corn acreage.

RETURNS FROM FARMS STUDIED

The earnings produced by the farms included in the detailed study are an indication that for the most part the present systems of farming in the Valley are bringing low returns to the operators. The average operator's earnings for the three-year period, 1926-28, of each of the

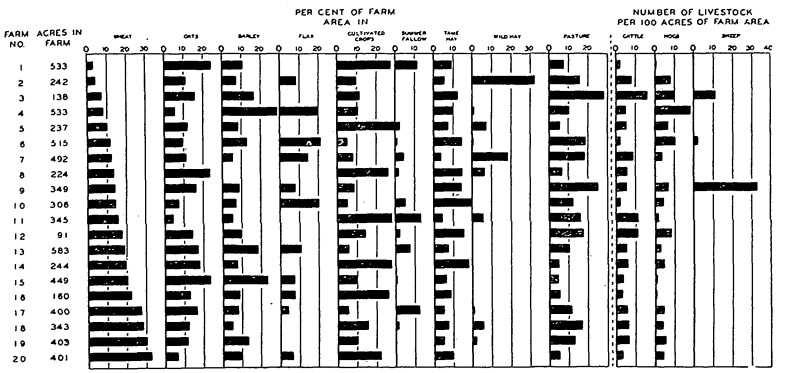

Fig. 8. Distribution of Crops and Livestock on Farms Studied in 1928
Each line gives the organization of one farm. Variations in individual farm organizations are greater in areas such as the Red River Valley, which is still experimenting with a type of farming, than in long-settled communities.

farmers who co-operated throughout the entire period of the study are shown in Table 5.[8] All the items shown are averages for the three-year period. The average earnings obtained by the operator for his

Table 5

Yearly Average Operator's Earnings on Each of 12 Farms, Polk County, 1926-28

Farm No.	Acres in farm	Capital investment	Cash receipts	Non-cash receipts	Inventory change	Cash expense	Non-cash expense	Operator's earnings
1.....	547	$38,803	$7,607	$ 465	$ 48	$3,986	$2,425	$1,709
2.....	306	21,909	3,299	639	34	2,278	1,152	542
3.....	146	17,936	2,465	671	—345	1,606	828	357
4.....	246	10,548	1,669	435	—492	1,000	321	291
5.....	393	43,974	7,387	710	—710	3,872	3,278	237
6.....	545	53,810	6,239	1,029	1,319	5,820	2,698	69
7.....	610	60,012	7,318	1,149	404	6,184	2,627	60
8.....	375	33,321	3,612	371	1,155	3,530	1,693	—85
9.....	170	17,395	2,528	466	371	2,320	1,290	—245
10.....	440	49,428	4,599	1,306	270	4,414	2,270	—509
11*.....	233	25,196	3,663	536	—746	2,161	2,027	—735
12.....	306	29,245	2,874	384	284	2,793	1,513	—764

* Average for 1926 and 1927.

[8] Operator's earnings is the difference between total income from the farm, which includes cash receipts, value of products from the farm used in the home, a credit for the use of the farm house, and net increase in inventory value and total expense which includes current cash expenses, interest on farm investment at 5 per cent, a charge for unpaid family labor, and any net decrease in inventory.

labor and management ranged from a minus quantity of $819 to $1,710. Four of the twelve farmers not only failed to make their farm business reimburse them for their labor and management, but failed, in varying degrees, to make it earn a market rate on the capital invested. Eight farms earned 5 per cent on the investment and paid the operator something for his labor and management; but the amount was below a hired-man wage on six out of the eight farms.

MAJOR FARMING PROBLEMS IN THE RED RIVER VALLEY

It has already been stated that the exceedingly low returns from farming operations in the Red River Valley during recent years have been largely the result of the many natural hindrances to the growing of small grains, the intense inter-regional competition in wheat production, and the economic conditions favoring the marketing of feedable crops through livestock. The elements of this unfavorable situation have become increasingly greater handicaps to the continuance of systems of farming in which the small grains, especially wheat, constitute the principal crops grown and in which very little livestock is kept. They constitute major farming problems in the Valley. Only a brief statement of these problems is presented here as the problems of crop production and the limitations to increased and more efficient livestock production, together with the best methods of controlling or overcoming them, are analyzed in Bulletins 282 and 283. The reader is urged to secure copies of these two bulletins for study in connection with the analysis presented in this bulletin.

Weed Control

One of the problems of outstanding importance in the Valley is the management of the soils so as to control weeds. No figures are available as to the extent of the total annual damage caused by weeds to crops in the Valley, but it varies all the way from none or very slight damage on some farms to an infestation so heavy as to cause the crops to be abandoned on others, depending upon the effectiveness of the control measures used. In late years, sow thistle, Canadian thistle, and quack grass have been the most widespread and the most destructive weeds in the Valley. These weeds thrive in grain fields, especially on damp soils. The ordinary wild oat is prevalent also in grain fields and spreads rapidly under continuous cropping. Other weeds of less economic importance are the common wild mustard, wild garlic, wild pea or vetch, French weed, wild millet, and wild rose. In some cases these

weeds may become a great nuisance; in most instances, however, their injury is slight.

Bare fallowing a part of the land in the farm each growing season is practiced extensively, primarily as a means of weed control. While this method is effective when properly done, it materially increases the unit cost of crop production and reduces the amount of land available for the growing of crops.

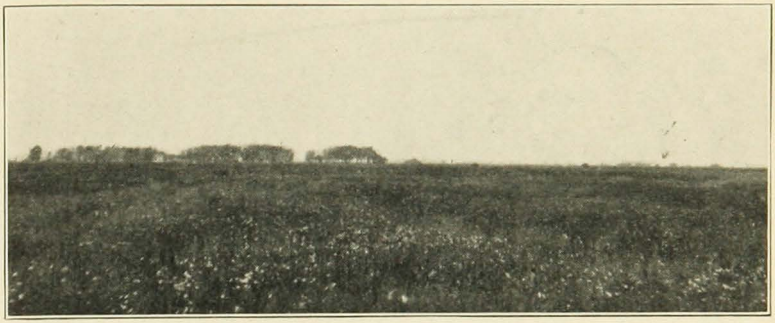

Fig. 9. A Field of Flax Almost Completely Smothered by Weeds
One of the farming problems of outstanding importance in the Valley is the control of weeds.

Disease Control

Paired with the weed problem is the heavy annual toll taken by the diseases attacking the various crops, especially wheat. The annual damage to wheat from black stem rust ranges as high as 30 per cent in seasons favorable to rust development. Wheat root-rot causes heavy damage on the older wheat lands that have not been farmed with a rotation crop. The annual damage to oats from black stem rust ordinarily amounts to from 2 to 5 per cent of the crop, and during recent years has amounted to as much as 15 per cent. Crown rust (leaf rust) on oats is not nearly so serious as black rust, altho a considerable amount of it appears each year. The smuts of wheat, oats, and barley cause serious damage. Fields of these grains in which from 10 to 35 per cent of the heads have been ruined by smut are not uncommon. Barley stripe is destructive to barley. The damage to potatoes by such common diseases as scab, blackleg, mosaic, blight, and fusarium wilt has been increasing in recent years in the Valley and has prevented a more rapid expansion of the potato acreage.

Soil Improvement

Records of the annual yields of crops in the Valley are not available previous to 1919, hence it is impossible to determine the actual trend of yields over a period of time. However, it is the general opinion of

farmers that the continuous growing of spring grains has gradually lowered the yields of these crops and that the reduced yields are partly due, in addition to the effects of weeds and diseases, to the gradual depletion of the physical condition and to some extent the fertility of the soil. Results obtained at the Northwest Experiment Station from different methods of cropping substantiate the belief that continuous cropping reduces yields. As an average for the seventeen-year period 1910-27, wheat grown continuously at the Station yielded only 14.7 bushels as compared to 24.9 bushels in a three-year rotation, 25.6 bushels in a five-year rotation, and 22.8 bushels in a seven-year rotation.[9] This means that 100 acres of land seeded to wheat continuously would eventually produce 24 bushels less each year than 60 acres of wheat grown in a three-year rotation.

The clay soils of the Valley originally contained a liberal supply of partially decayed organic matter which made them friable, but heavy cropping with spring grains and in many instances careless preparation of the land for seeding have lowered the humus content on many farms. These soils have become compact and need loosening by good cultural practices and the addition of humus-forming materials. Getting the soils back into good physical condition is the most important soil problem in the Valley.

A deficiency in available food elements is a problem in some instances on the sandy soils and with certain crops on the heavy soils.

Drainage

The drainage problem has never been satisfactorily solved in the Valley. In some respects it is increasing in importance rather than diminishing, nothwithstanding the fact that more surface drains are being opened each year. It has never been possible, however, to drain away all the surface water on account of the flatness of the land and the presence of depressions that are lower than the ditch levels. As the heavy soils have become more compact with the gradual depletion of the humus that they contained as virgin prairie soils, they have become more difficult to drain.

It is doubtful if tile drainage will prove profitable for some time on account of the difficulty and the expense of reaching an outlet and because of the relatively high cost of drainage, due to the closeness with which the tile lines must be laid. In the heavy clay soils, tile must be laid near the surface in order to draw satisfactorily, and the range of a line of tile depends upon the depth at which it is laid. Better drainage for the most part, therefore, must be accomplished through

[9] Report of Northwest Experiment Station, Crookston, 1927, p. 23.

more surface drains, use of deep-rooted crops, and the restoration of the humus content of the soil—making it better adapted to cultivation.

Increased Inter-regional Competition in Wheat Production

The substantially lower costs of wheat production made possible in extensive areas by recent improvements of the tractor, the combine, and tillage machinery have resulted in a substantial increase in the acreage of spring wheat in the regions west and northwest of the Valley in both the United States and Canada. These lower costs, coupled with increased production in other wheat producing countries resulting from a combination of influences, have tended to increase the total output, to lower the price at which wheat can be continuously supplied, and to intensify inter-regional competition, thus making changes necessary in the agriculture of the Valley, where the lower-cost methods are less applicable. Moreover, further developments in this direction are to be expected.

Adjustment to Progress in Farming Practice

The problem of adjusting farming practices to keep abreast with recent progress in the fields of mechanical invention and plant and livestock breeding, especially plant breeding, is important in the Valley. The Northwest Experiment Station, working in co-operation with the Central station, at St. Paul, has accomplished much in the last few years in developing higher-yielding disease-resistant varieties of grain crops. Mechanization is proceeding at a fairly rapid rate. The increase in the number of tractors is bringing with it a larger use of the combine for harvesting small grain and flax. The general-purpose tractor, which is being generally adopted, is occasioning a considerable modification of machinery for the handling of potatoes and sugar beets, looking toward a greater use of mechanical power and a reduction of man labor. Higher-yielding varieties of small grains lower the cost of production of these crops, and the developments in machinery increase the capacity of the individual worker for the production of crops yielding high returns per unit of land.

Balancing Crops With Livestock

The rapid development of the practice of growing more feed crops, especially alfalfa and sweet clover, to aid in weed control and soil improvement already has been mentioned. Incidentally, 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 of the pasture, must be found on the farm. More livestock is needed on the farms to provide a use for the legumes and other feed crops essential

to a good rotation; also to convert other roughages, produced as a by-product of grain production, and grain that is of low grade, into marketable products.

Converting marketable feed grains to 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 to 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 is kept. Generally speaking, the care of livestock involves considerably more labor in the winter than during the crop-growing season. If properly arranged, this supplementary relationship between livestock and crops in the use of labor can be established and maintained to the distinct advantage of the farmer, as reflected in his earnings. 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 yielding some return for the labor and the equipment that otherwise would 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 handled carefully and returned to the crop land, a large proportion of the essential fertilizing elements are returned to the soil. At the same time 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 soils 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 agricultural 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.

SUGGESTIONS ON THE SOLUTION OF THE MAJOR FARMING PROBLEMS

Problems of Crop Production

The solution of the major difficulties in the way of greater crop returns is largely in the addition of more legumes and inter-tilled crops to the cropping systems. A cropping system containing a liberal acreage of sweet clover and cultivated crops, when supplemented with late summer fallow following the second-year crop of sweet clover and early fall plowing of the stubble fields, will control weeds and many of the crop diseases that carry over in the soil. Alfalfa can be depended upon to eradicate weeds if allowed to stand on the same field for several years. Furthermore, legumes in the cropping system, especially sweet clover, assist in securing better drainage and aeration of the soil through their deep roots.

The clay soils, altho non-acid and naturally rich in plant food, have become compact through misuse and are benefited by good cultural practices and the addition of humus-forming material. Rotation experiments at the Northwest Experiment Station and experience of farmers have demonstrated that the turning under of a legume, especially sweet clover, once in each rotation is beneficial to future crops through its loosening effects on the soil. The liberal use of manure is effective, also, but the benefits are not equal to those from sweet clover. Additional benefits are obtained by following the legume crop and the application of manure with a cultivated crop, such as potatoes, sugar beets, or corn, to give the soil an extended period of aeration and to incorporate thoroly the humus material in the soil. Phosphate applied in the form of superphosphate generally is profitable with alfalfa, clover, and sugar beets. In seasons of normal rainfall, phosphate fertilizers increased the yields of potatoes from 12 to 50 bushels and sugar beets from one to 2 tons per acre at the Northwest Experiment Station. They have returned a good profit every year when applied to sugar

beets. With potatoes, however, the added yields have not covered the added cost except in years of better than average prices.[10] Complete fertilizers carrying small amounts of nitrogen and potash in addition to phosphate have given additional yields of potatoes on some farms in the sandy areas. A small amount of potash with phosphate in an 0-16-4 combination has benefited sugar beets in some places. In general, however, if second-year sweet clover is plowed under in preparing the land for sugar beets and potatoes, or if manure is applied, phosphate alone is all that is needed.

The adjustment of crop acreages to the low level of wheat prices would be taken care of automatically by the modifications in the cropping systems discussed above. In adding more acres of legumes and intertilled crops, the acreage available for wheat and other small grains is decreased and conditions favorable to lower costs of production for wheat would be provided. With a smaller proportion of the farm devoted to wheat, the risk from occasional low prices would be lessened and, with better yields, wheat grown in the Valley could compete on a much more favorable basis with that grown in the regions adapted to lower-cost methods of production, but returning lower yields.

Thus far, greatly reduced costs in wheat production have not been experienced in the Red River Valley of Minnesota through the use of machines in large units in large-scale operation. A considerable further development in the use of power machinery, especially the combine, may be expected in the Valley whenever large tracts of land particularly well adapted to wheat are under the control of one operator. Under these conditions, a fairly high degree of specialization in wheat growing in conjunction with other small grains is economically desirable. On the other hand, in other parts of the Valley less favorably adapted to large-scale wheat growing, limiting the acreage to the portion of the farm that can be maintained on a high-yielding basis through crop rotation offers a better solution to the problem of intensified interregional competition and lowering prices of wheat.

Most of these problems of crop production ordinarily can be met most effectively through a crop rotation—a program extending over a series of years that provides for approximately equal acreages of selected crops, or groups of crops, each year, and the shifting of these crops from field to field in a regular order so that each portion of the cultivated area of the farm is used at least once for each crop or group of crops in the period of the rotation. The principal crop of the area frequently appears more than once in the rotation. The number of years required to complete the rotation cycle corresponds to the number

[10] Reported by R. S. Dunham, T. M. McCall, and E. R. Clark in Crops and Soils Handbook for the Red River Valley, Northwest Experiment Station, Crookston. 1929.

of crops and groups of crops in the rotation. On the completion of one rotation cycle, the succession is repeated. The rotation usually includes at least one inter-tilled crop, one small-grain crop, and one grass or legume crop. Four different crop rotations, each containing at least one field of legumes and one of cultivated crops in the course of the rotation, are recommended by the Northwest Experiment Station for farms in the Valley of different sizes and keeping different amounts of livestock.[11]

Suggested Crop Rotations for the Red River Valley

For the medium-sized livestock farm—

1. Wheat
2. Sweet clover pasture
3. Corn, potatoes, and sugar beets
4. Oats or barley, or both
5. Alfalfa for hay*

For the medium-sized farm with less livestock—

1. Wheat
2. Sweet clover for hay and pasture
3. Corn, potatoes, and sugar beets
4. Flax
5. Oats or barley, or both

For the large farm with livestock—

1. Barley
2. Wheat
3. Oats
4. Sweet clover pasture
5. Corn, potatoes, and sugar beets
6. Flax
7. Alfalfa*

For the large farm with less livestock—

1. Barley
2. Durum wheat
3. Oats
4. Sweet clover
5. Corn, potatoes, and sugar beets
6. Flax
7. Common bread wheat

* The alfalfa is left until necessary to plow it. It is then started upon one of the other fields and the crops from that field are transferred to the old alfalfa field.

Possibilities and Limitations of Expanding Livestock Production

The Red River Valley is without serious limitations insofar as pasture and feed crops are prerequisite to the successful production of hogs, beef cattle, sheep, and dairy and poultry products. Feeds suitable for these enterprises are now being produced in abundance on

[11] Crops and Soils Handbook, 1929, Northwest Experiment Station, Crookston, Minn.

many farms. This is evidenced by the records of feed produced on the farms included in the special study in Polk County. The average amounts of each of the different feeds produced on these farms during the three years of the study are presented in Table 6. Moreover, each of the suggested rotations outlined on page 23 would provide sufficient feed for livestock enterprises.

Table 6

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

Crop	Acreage†	No. of farms growing the crop	Average on farms growing the crop		
			Acreage	Yield	Amount available for feed
Wheat	3,722	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	38	31	0.9 ton	27.9 tons
Tame hay	932	43	22	1.0 ton	22.0 tons
Potatoes	817	56	15	91.0 bu.	.....
Sugar beets (tops)	381	14	27	1.0 ton	27.0 tons
Miscellaneous crops	276	28	10	.....	.....
Summer fallow	942	30	31	.....	.....
Pasture	2,999	57	52	.....	52 acres

* Records were obtained from 12 farms for the entire three-year period 1926-28, from 2 farms for two years, and from 18 farms for one year—a total of 58 farm-record years.

† Acreage for 58 farm-record years, 1926-28, inclusive.

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-stem prairie grasses when the early settlers came, but either their plows or the prairie fires soon destroyed them. 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 tame grasses most commonly found in pastures. They furnish fairly good grazing early in the spring and again in the late fall. The general lack of moisture during the 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. Sweet clover makes an excellent pasture for all kinds of livestock, and can be grown on all soils without an application of limestone. The Northwest Experiment Station reports that the use of sweet clover has proved so satisfactory that it has

become practically the only pasture provided for the cattle, sheep, and horses maintained at the station.[12]

When sown in the spring with small grain, sweet clover usually furnishes good pasture from about September first until freezing weather in the fall. The usual grazing period of the second-year crop is from June first to September first. The roots of sweet clover penetrate deeply, 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 pasture is provided throughout the growing season. An acre of second-year sweet clover provides feed for about two mature cattle or 15 to 20 head of sheep. First-year sweet clover makes an excellent pasture for hogs, as does also the second-year crop when it is closely grazed and not allowed to become too rank and woody.

Alfalfa makes an excellent pasture crop for hogs. Quick growing annuals—dwarf Essex rape, Canada field peas, oats, barley, and a mixture of these can be grown to supplement it. 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 quickly available pasture for the entire grazing season. It can be seeded early in the spring. Rape germinates at a low temperature and should be available for pasture by June 15.

Roughages of high feeding value are available. Alfalfa is grown without the use of limestone in all parts of the Valley except on alkalki, peat, or very wet soils. Alfalfa hay yields a larger amount of total digestible nutrients per acre than any of the other hay crops, either legume or non-legume. Sweet clover is more drought-resistant than alfalfa, less subject to winter killing, and more resistant to alkali. Properly cured sweet clover hay has a feeding value about equal to 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

[12] 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.

without the development of mold. Good quality 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 poor or moldy sweet clover frequently develop a disease commonly referred to as "sweet clover sickness." This disease generally can be avoided, however, by feeding other hay, silage, or grain with the sweet clover hay.

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

Silage may be produced in all parts of the Valley, but the yields are often small, because of the short growing season. Sugar beet tops are another source of succulent roughage on farms growing sugar beets for market. They have a feeding value about two-thirds that of corn silage.

Barley, oats, and corn are available for producing dairy products and for fattening livestock. Barley and oats are produced in abundance (see Table 6). 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 silage 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.[13] 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, at Crookston, comparing barley with shelled corn as the concentrate in rations for fattening baby beeves, the ration containing shelled corn as the farm-grown concentrate produced slightly higher average daily gains and a somewhat higher finish than did the one containing barley.[14] With the relative prices of the two grains considered, however, the barley-fed calves returned a larger margin of profit. Hog feeding tests conducted

[13] Jordan, P. S. and Peters, W. H. Fattening Lambs. Minn. Agr. Expt. Sta. Bull. 272.

[14] 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.

by the Division of Animal Husbandry showed that shelled corn gave slightly greater daily gains than did 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.[15]

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

The water supply is adequate and of satisfactory quality in most parts of the Valley. In limited areas the alkali in the ground water makes it unfit for drinking. 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 in the areas affected.

While many farms are adequately improved with fences and buildings for pasturing and sheltering livestock, some require additional improvements of that nature before the numbers of livestock could be increased. As a majority of the farms that are underimproved with buildings and fences are owned by men of very limited capital and credit resources, the keeping of livestock is definitely limited to the present equipment or to such additional equipment as 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 for obtaining 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.

[15] Ferrin, E. F. and McCarty, M. A. Feed Requirements and Cost of Gains of Spring and Fall Pigs. Minn. Agr. Expt. Sta. Bull. 213.

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 before he has an opportunity to prove his ability in handling different classes of livestock. Some farm operators in the Red River Valley are not interested in farming with livestock. They do not like to give the continuous care which most livestock requires. 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 to obtain as large earnings as other farmers who produce livestock with average efficiency and are equally efficient in crop production.

Farms vary in their need for the various functions of livestock and no one kind of livestock performs all equally well. Generally speaking, operators of small farms having available a high proportion of concentrates to roughages and considerable labor not needed for the growing and harvesting of crops will 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. Hogs and poultry use only concentrates and dairy cattle use proportionately larger amounts of concentrates than sheep. Farmers on medium-sized farms having more feeds, especially roughages and pasture, but practically the same amount of labor available for caring for livestock during the crop-growing season will probably find it to their advantage to combine sheep raising with dairying and hog production. On the other hand, farmers on the large farms with large amounts of pasture and roughage to market through livestock and a scarcity of labor compared to the amount of feed available may find beef cattle, sheep, and hogs the solution of their problem.

USE OF BASIC FARM ORGANIZATION DATA IN PLANNING PRODUCTION PROGRAMS

The factors outlined in the previous section indicate the considerations that must be kept in mind in planning cropping systems and livestock combinations that provide in a general way for the solution of the major farming problems of the Red River Valley. These principles can be used as a guide by those interested in making readjustments in their farming systems as a means of obtaining higher returns. But the farmer's problem as a manager of a farm business extends beyond his interest in weed control and the maintenance of the productivity of his soil. He is interested, also, in arranging his cropping system and in choosing kinds and numbers of livestock to have the balance between enterprises that will give maximum returns

from the use of his productive resources, that is, his land, equipment, labor, materials, and managerial attention. The arrangement of this balance involves a consideration of the relationships between the various crop and livestock enterprises in their demands for the use of his resources. It involves also a consideration of the production obtainable from different enterprises as well as price and cost inter-relationships.

In considering these inter-relationships, different farmers 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 adaptation to different enterprises with reference to soils and markets, but farmers have different amounts of labor, power, and equipment at their command; and they vary in their aptitude for handling different crops and different kinds of livestock.

With conditions varying so widely from farm to farm, the study of readjustments that promise to provide a better utilization of the productive resources of the individual farm, and thereby greater returns, must be made by the farmer himself or his personal advisers, as any plan of reorganization must be based upon conditions on his own farm.

Selection of Rotations

A farmer in the Red River Valley may have a farm the earnings of which he believes could be improved by re-planning the system of farming. His first step in the study of the possibilities of improving the present system should be an examination of his cropping system.

In addition to the considerations of weed control and the maintenance of soil fertility, which suggest the inclusion of legumes and inter-tilled crops, a good crop rotation should provide, as a general principle, maximum productive use of the available supply of labor, power, and equipment by spreading the demands for the use of these factors as widely as possible over the crop-growing season. Basic data presented in Minnesota Agricultural Experiment Station Bulletin 282 on: (1) the amounts of labor, power, equipment, and materials used in the production of units of the different crops under careful management with conditions ordinarily prevailing; (2) the variations between farms in the amount of the factors used and the causes for the significant variations; and (3) the seasonal distribution of the demands of each crop for labor and power, and the probable number of work days available for each of the crop operations should be helpful to him in this connection. These data are summarized in Tables 7, 8, and 9, and in Figure 10.

Table 7

Standards for Field Operations on Crops Performed with Horse Power in Red River Valley

Field operation	Size of implement	No. of horses	No. of men	Hours per acre (once over)	
				Man	Horse
Seedbed preparation					
Plowing	28-in.	5	1	2.0	10.0
Disking	8-ft.	4	1	0.5	2.0
Spring-tooth harrowing	10-ft.	4	1	0.5	2.0
Harrowing or dragging	22-ft.	4	1	0.2	0.8
Small grain					
Seeding	10-ft.	4	1	0.5	2.0
Cutting	8-ft.	4	1	0.7	2.8
Shocking, wheat and oats	....	..	1	0.9	..
Shocking, barley	....	..	1	1.0	..
Threshing, wheat and barley	....	..	..	2.1	3.7
Threshing, oats	....	..	..	1.9	3.3
Flax					
Seeding	10-ft.	4	1	0.5	2.0
Cutting	8-ft.	4	1	0.8	3.2
Shocking	....	..	1	0.8	..
Threshing	....	..	..	1.9	3.1
Sugar beets					
Seeding	4-row	2	1	0.8	1.6
Cultivating	4-row	2	1	1.3	2.6
Lifting	1-row	3	1	2.6	7.8
Hauling	....	2	1	8.8	17.6
Corn					
Planting	40-in.	2	1	0.7	1.4
Cultivating	1-row	2	1	1.3	2.6
Cutting	1-row	3	1	1.4	4.2
Cutting	1-row	4	1	1.3	5.2
Shocking	....	..	1	2.0	..
Silo filling	....	..	..	7.2	7.5
Potatoes					
Cutting seed	....	..	1	3.5	..
Planting	1-row	2	1	1.8	3.6
Cultivating	1-row	2	1	1.3	2.6
Spraying	....	..	..	0.9	1.8
Digging	1-row	4	1	1.8	7.2
Picking and hauling	....	..	..	13.0	5.0
Hoeing, weeding, and sorting	....	..	..	3.8	..
Alfalfa					
First cutting (1-ton yield)*					
Mowing	5-ft.	2	1	1.0	2.0
Raking	10-ft.	2	1	0.5	1.0
Cocking or bunching	....	..	1	1.2	..
Hauling to barn, with loader	....	..	..	1.6	2.1
Hauling to barn, without loader	....	..	..	3.0	4.9
Stacking, with stacker	....	..	..	2.0	2.8
Stacking, without stacker	....	..	..	3.2	3.5

* Same standards would apply to sweet clover.

Table 7—Continued

Standards for Field Operations on Crops Performed with Horse Power in Red River Valley

Field operation	Size of implement	No. of horses	No. of men	Hours per acre (once over)	
				Man	Horse
Second cutting (¾-ton yield)					
Mowing	5-ft.	2	1	0.9	1.8
Raking	10-ft.	2	1	0.4	0.8
Cocking or bunching	....	..	1	1.0	..
Hauling to barn, with loader	....	..	..	1.5	1.7
Hauling, without loader	....	..	..	2.3	3.8
Stacking, with stacker	....	..	..	1.7	2.1
Stacking, without stacker	....	..	..	2.6	2.9
Wild hay					
Mowing	5-ft.	2	1	1.0	2.0
Raking	10-ft.	2	1	0.5	1.0
Hauling to barn, with loader	....	2	3	1.6	2.1
Stacking, with stacker	....	2	3	2.0	2.8

To obtain productive employment for his labor and equipment for the maximum portion of the crop-growing season, without the necessity of hiring extra day laborers at intermittent periods, he should select such crops as will dovetail together without serious conflict insofar as their demands for the use of these factors are concerned. By considering the distribution of the demands for the use of labor and equipment (see Figure 10), the supplementary relation can be determined and crops chosen that fit well together. For example, the preparation for oats and the seeding follows that of wheat in the spring. Similarly, barley follows oats and flax follows barley. At harvest time, barley ripens ahead of all other grains, wheat is ready to harvest ahead of oats, and flax follows oats. The grain crops interfere little with seedbed preparation and planting of the cultivated crops—corn, potatoes, and sugar beets. Following through the season, the cultivation of these crops is completed ahead of grain harvest and they are harvested after the usual threshing period.

On the other hand, most crops are, to a degree, competitive. While the preparation of the land for oats and the seeding follow those of wheat, the seasonal demands for labor and equipment for these two operations are so nearly identical that an increase in the acreage of one without an increase in the labor supply must be accompanied by a decrease in the acreage of the other (see Figure 10). Corn and potatoes compete directly for labor and equipment. Harvesting alfalfa, sweet clover, and wild hay may conflict with the work of cultivating corn, potatoes, and sugar beets; but the hay crops provide the basis for employment of labor in feeding livestock in the winter. Hence. he will usually find it desirable to hire extra day help for a short time during hay harvest.

Table 8

Standards for Field Operations on Crops Performed with Tractor Power in Red River Valley

Field operation	Size of implement	No. of men	2-Plow tractor		3-Plow tractor	
			Man hours per acre	Tractor hours per acre	Man hours per acre	Tractor hours per acre
Plowing	28-in.	1	1.40	1.40	...	...
	42-in.	1	...	...	1.00	1.00
Disking	8-ft.	1	0.42	0.42	0.33	0.33
	10-ft.	1	0.36	0.36	0.29	0.29
Spring-tooth harrowing	8-ft.	1	0.48	0.48	...	...
	10-ft.	1	0.38	0.38	0.34	0.34
	12-ft.	1	...	...	0.29	0.29
Harrowing	20-ft.	1	0.16	0.16	0.15	0.15
	26-ft.	1	0.13	0.13	0.11	0.11
Drilling seed	10-ft.	1	0.36	0.36	...	...
	14-ft.	1	...	...	0.25	0.25
Cultivating	2-row	1	0.50	0.50	...	...
Cutting grain, with one binder	8-ft.	1	0.42	0.42	0.40	0.40
	10-ft.	1	0.33	0.33	0.32	0.32
Cutting grain, with two 8-ft binders	16-ft.	3	...	...	0.72	0.24
Cutting grain, with windrower	12-ft.	1	0.26	0.26	...	...
	16-ft.	1	...	...	0.20	0.20
Harvesting grain, with combine*	8-ft.	3	...	...	1.08	0.48
	10-ft.	3	1.23	0.40	...	...
	12-ft.	4	...	...	1.29	0.32
	16-ft.	4	...	...	1.06	0.25

* Man hours include hauling grain; 1.20 horse hours should be added for this operation.

Table 9

Standard Quantities of Materials and Values of Contract Services Used for Crop Production in the Red River Valley

Crop	Production per acre	Materials per acre		Contract services	
		Kind	Quantity	Kind	Cost
Wheat	18 bu.	Seed	1½ bu.	Threshing, per bu.	$ 0.06
		Twine	2½ lb.		
Oats	42 bu.	Seed	2 bu.	Threshing, per bu.	0.04
		Twine	2¾ lb.		
Barley	35 bu.	Seed	2 bu.	Threshing, per bu.	0.04
		Twine	2¾ lb.		
Flax	10 bu.	Seed	½ bu.	Threshing, per bu.	0.12
		Twine	2 lb.		
Potatoes	125 bu.	Seed	14 bu.*	Picking, per bu.	0.05
		Superphosphate, 16 per cent	250 lb.		
		Paris green	2 lb.		
		Lime	4 lb.		
		Copper sulphate	4 lb.		
Sugar beets, roots	10 tons	Seed	16 lb.	Thinning and blocking, per acre	8.00
tops	1 ton	Superphosphate, 16 per cent	120 lb.	Hoeing, per acre	6.00
		Paris green	½ lb.	Harvest, per acre	10.00
		Bran	12 lb.	Tonnage bonus, per acre	0.60‡
Corn, grain	25 bu.	Seed, checked	9 lb.		
stover	1¼ tons	Twine	2½ lb.		
Silage	4¼ tons	Seed	12 lb.		
		Twine	3 lb.		
Alfalfa hay	2 tons	Seed	12 lb.†		
Sweet clover hay	1¼ tons	Seed	12 lb.		
Wild hay	1 ton				

* Potato growers near East Grand Forks commonly plant 22 to 23 bushels per acre.

† The amount per year would be only 2.4 pounds on the basis of the stand remaining on the same field five years.

‡ Computed on a base-yield of 9.2 tons per acre and a rate of 75 cents per ton.

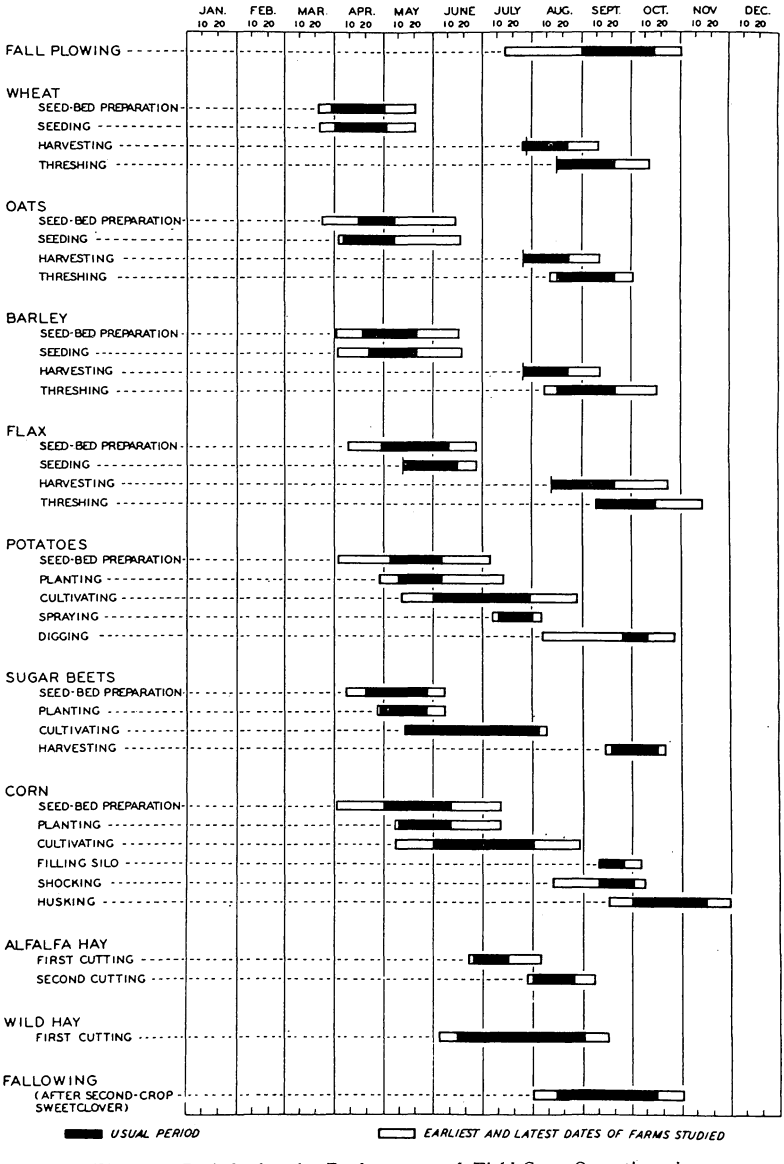

Fig. 10. Periods for the Performance of Field-Crop Operations in the Red River Valley

Different crops use labor at different periods during the year. The small-grain crops conflict with each other some, but interfere little with the performance of labor on the cultivated crops.

Table 10

Assumed Relative Prices for Products To Be Sold and for Expense Items

Products to be sold		Expense items	
Item	Price	Item	Price
Cash crops		Feed	
Wheat, bu.	$ 0.90	Bran, cwt.	$ 1.40
Flax, bu.	1.90	Cottonseed meal, cwt.	2.50
Oats, bu.	0.30	Oilmeal, cwt.	2.75
Barley, bu.	0.45	Tankage, cwt.	3.50
Sugar beets, tons	6.50	Poultry mash, cwt.	3.60
Potatoes, bu.	0.65	Meat scrap, cwt.	4.50
Alfalfa hay, tons	10.00	Oyster shells, cwt.	1.00
Livestock and livestock products		Salt, cwt.	1.25
Butterfat, lb.	0.40	Seeds	
Cows, lb.	0.04	Alfalfa, lb.	0.35
Veal, lb.	0.10	Sweet clover, lb.	0.10
Heifers, lb.	0.06	Timothy, lb.	0.06
Baby beef, lb.	0.09	Corn, bu.	5.00
Hogs, lb.	0.07½	Sugar beet, lb.	0.15
Ewes, lb.	0.03	Fertilizer	
Lambs, lb.	0.08	Superphosphate, 16 per cent, cwt.	1.75
Wool, lb.	0.20	Contract services	
Chickens, lb.	0.15	Potato picking, bu.	0.05
Eggs, doz.	0.25	Blocking and thinning sugar beets, acre	8.00
		Hoeing sugar beets, acre	6.00
		Harvesting sugar beets, acre	10.00
		Tonnage bonus (beets), ton	0.75
		Threshing: Wheat, bu.	0.06
		Oats, bu	0.04
		Barley, bu.	0.04
		Rye, bu.	0.06
		Flax, bu.	0.12
		Miscellaneous	
		Twine, lb.	0.13
		Paris green, lb.	0.35
		Copper sulfate, lb.	0.25
		Lime, lb.	0.01

A good crop rotation should also give preference to crops that yield the highest market or feeding value per acre, insofar as it can be done without too seriously neglecting the two important requirements of the rotation just mentioned, namely, labor distribution and maintenance of soil fertility. A consideration of the standard crop yields for the Red River Valley presented in Table 9, with the assumed relative prices presented in Table 10, should be helpful.

For the comparison of market or feeding value yielded per acre of the different crops, the data in Tables 9 and 10 are summarized in Table 11. Wheat, flax, potatoes, and sugar beets are raised almost exclusively as cash crops. Altho oats and barley are grown primarily for feed, there is commonly a surplus over feeding requirements that is marketed as cash grain. On the basis of the yields and prices used, the figures in Table 11 indicate that among the four crops—flax, wheat,

oats, and barley—flax yielded the largest cash value per acre, after direct costs were deducted. The difference in favor of flax was $3.14 per acre as compared with wheat, $3.50 as compared with barley, and $6.63 as compared with oats. The four crops made approximately equal demands upon man labor, horse work, and equipment. Potatoes and sugar beets used about equal amounts of man labor. Potatoes, however, yielded a 70 per cent greater cash value per acre than sugar beets. The returns were higher from potatoes than from small grains, with the differences in the amounts of man labor and horse work considered. The cash-value relations between potatoes and flax were favorable to potatoes. Potatoes yielded higher returns than flax per unit of labor expended, and both potatoes and sugar beets yielded considerably higher returns per unit of land. With varied crop yields and with prices changed, the per-acre cash values of the various crops would change accordingly.

Table 11

Cash Value Yielded per Acre by Various Red River Valley Crops

Item	Wheat	Oats	Barley	Flax	Potatoes	Sugar beets
Standard yield, bu. or ton	18.0	42.0	35.0	10.0	125.0	10.0
Amount seeded, bu.	1.5	2.0	2.0	0.5	14.0	...
Net yield, bu. or ton	16.5	40.0	33.0	9.5	111.0	10.0
Relative sale price	$ 0.90	$ 0.30	$ 0.45	$ 1.90	$ 0.65	$ 6.50
Gross cash value	14.85	12.00	14.85	18.05	72.15	65.00
Direct cash costs						
Threshing	1.08	1.68	1.40	1.20	...	...
Picking	...	...	...	...	6.25	...
Thinning and blocking	...	...	...	...	...	8.00
Hoeing	...	...	...	...	...	6.00
Topping and piling	...	...	...	...	...	10.00
Tonnage bonus	...	...	...	...	...	0.60
Twine	0.32	0.36	0.36	0.26	...	...
Seed	...	...	...	...	...	2.40
Superphosphate, 16 per cent.	...	...	...	...	4.38	2.10
Copper sulphate	...	...	...	...	1.00	...
Paris green	...	...	...	...	0.70	0.18
Lime	...	...	...	...	0.04	...
Bran	...	...	...	...	...	0.17
Total cash costs	$ 1.40	$2.04	$ 1.76	$ 1.46	$12.37	$29.45
Cash value after deducting direct cash costs	$13.45	$9.96	$13.09	$16.59	$59.78	$35.55
Hours of man labor used*	7.10	6.9	7.2	6.9	24.0	23.8
Hours of horse work used*	22.1	21.8	22.1	21.9	42.8	59.8

*Based on Table 48, Minn. Agr. Expt. Sta. Bull. 282.

In planning for the feed crops not only the differences in amount of feeds that can be grown on an acre must be considered, but also differences in the feeding value of the crops as measured by unit-content of digestible nutrients. The feeding value, based on standard yields per acre and average analyses, is indicated in Table 12. Alfalfa leads

in yield of total digestible nutrients per acre, partly on account of its greater tonnage. Its superiority in particular and of legumes in general, over non-legume crops, is in the higher content of digestible protein. Sweet clover hay ranks below corn silage in total digestible nutrients, but the difference in favor of an acre of silage is largely, if not entirely, offset by the larger amount of digestible protein yielded by the hay. An acre of corn and an acre of barley have approximately equal feeding value. Both are markedly better than oats and wheat. A 33-bushel crop of barley contains 38 per cent more digestible nutrients than a 40-bushel crop of oats and 61 per cent more than a standard crop of wheat.

Table 12

Feeding Value Yielded per Acre by Various Red River Valley Crops

Crop	Yield per acre less seed*	Pounds of feed	Digestible matter available†		Production costs		
			Total digestible nutrients	Digestible protein	Man labor, hr.‡	Horse work, hr.‡	Direct cash costs
Barley							
Grain	33 bu.	1,584	1,256	142	...	...	...
Straw§	1 ton	2,000	...	...	...	...	...
Total			1,256	142	7.1	22.1	$1.76
Oats							
Grain	40 bu.	1,280	910	124	...	...	...
Straw§	1¼ tons	2,500	...	...	...	...	...
Total			910	124	6.9	21.8	2.04
Wheat							
Grain	16½ bu.	990	784	87	...	...	...
Straw§	1 ton	2,000	...	...	...	...	...
Total			784	87	7.1	22.1	1.40
Corn fodder							
Grain	25 bu.	1,600	1,297	114	...	...	...
Stover‖	1¼ tons	2,500	385	18	...	...	...
Total			1,682	132	12.6	32.6	1.15
Corn silage	4¼ tons	8,500	1,428	102	17.8	40.1	1.50
Sugar beet tops	1 ton	2,000	146	14	...	...	...
Alfalfa hay	2 tons	4,000	2,064	436	10.3	14.2	0.84¶
Sweet clover hay	1¼ tons	2,500	1,267	268	5.7	7.8	1.20
Wild hay	1 ton	2,000	964	60	4.5	7.8	...

* Based on data in Table 9.

† Based on average analyses given in Feeds and Feeding, by Henry and Morrison.

‡ Based on Table 48, Minn. Agr. Expt. Sta. Bull. 282.

§ Barley straw, oat straw, and wheat straw furnish so little digestible matter that they are seldom used as feeds except to allow livestock access to the stacks in addition to regular feeding; for this reason their digestible nutrients are disregarded here.

‖ The original feeding value of stover has been adjusted for losses occasioned by weathering under the usual methods of handling the crop, and by failure of the animals to consume the whole plant. The figures given here for digestible matter available as feed in the stover are not more than one-third of the original feeding matter.

¶ Seed cost based upon the assumption that the stand will remain on the same field for five years.

In addition to the considerations already discussed, it is important for the rotation to provide the variety and amount of feeds needed for a suitable combination of livestock, thus reducing to a minimum the necessity for purchasing feeds. Also each crop should follow the one preceding with the most favorable conditions for yield and the minimum amount of labor for seedbed preparation.

Balancing Crops and Livestock

The functions of livestock enterprises in farm organizations are (1) to increase the volume of business, (2) to concentrate feed crops into products that are less expensive to ship, (3) to distribute the demand for labor, power, and equipment over a greater part of the year than can be done with the production of crops alone, (4) to convert into usable forms products that otherwise would be wasted, and (5) to aid in maintaining the productivity of the soil. Farms vary in their need for these functions, depending upon the amount of feedable crops grown; the proportion between concentrates, roughages, and pasture; and the amount of labor available for caring for livestock. Furthermore, no one class of livestock performs all equally well.

The first step in choosing the probable numbers and kinds of livestock that can be kept to best advantage is to estimate the amount of feed and labor that would be used by different combinations and then compare this with the feed crops likely to be produced with the cropping system that will be followed and the amount of labor available for caring for livestock. The basic data presented in Minnesota Agricultural Experiment Station Bulletin 283 on: (1) the 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 and (2) the time distribution of the man labor should be helpful. These data are here summarized in Tables 13 and 14 and in Figure 11. Feed requirements can be worked out more definitely by taking into account the adaptation of different rations for different kinds of livestock. The data in Table 13 are based on standard farm practice in feeding the different crops grown in the area. No doubt better results could be obtained by altering some of the feeding practices in accordance with the findings of Experiment Station investigators.[16]

Generally speaking, the possibilities on individual farms for different classes of livestock depend upon the amount of feedable crops grown; the proportion between concentrates, roughages, and pasture; the amount

[16] See the fol'owing Minnesota Agricultural Experiment Station bulletins: Sweet Clover Hay for Beef Cattle: Fattening Baby Beeves and Two-Year-Old Steers (Bull. 261); Feed Requirements and Cost of Gains of Spring and Fall Pigs (213); Tankage and Buttermilk as Protein Supplements for Growing Pigs (221); Feeding the Dairy Herd (218); Fattening Lambs (272). See also Feeds and Feeding, published by Henry and Morrison.

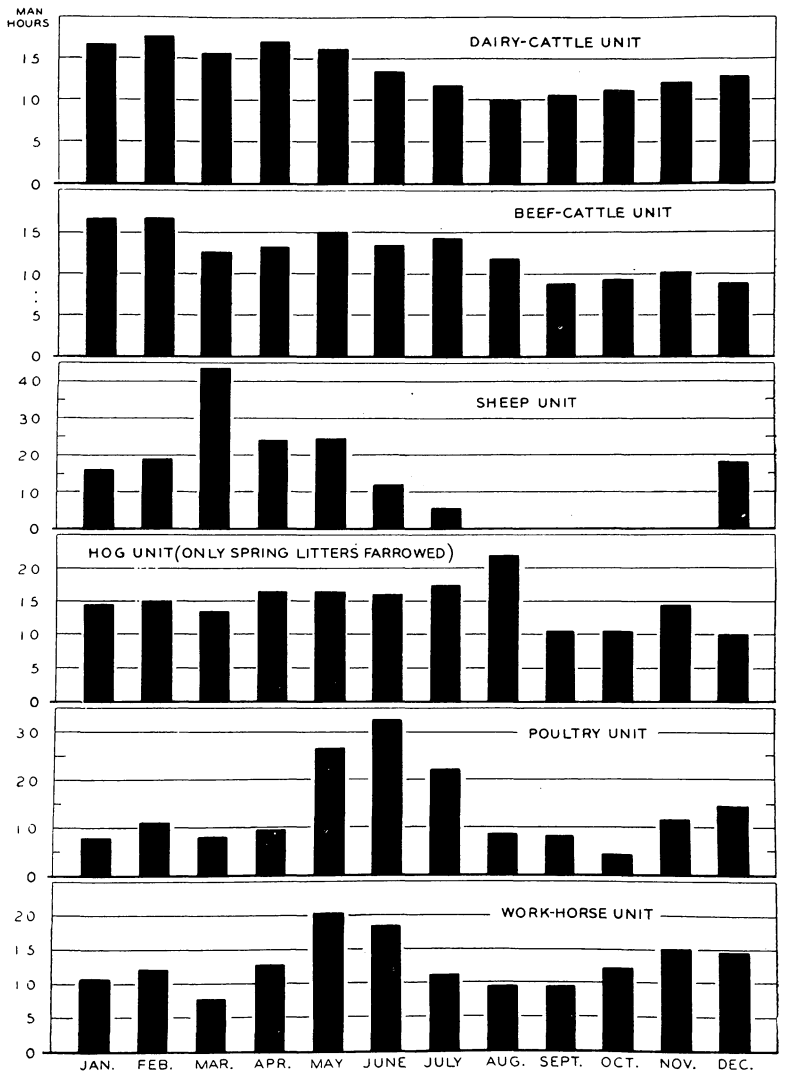

Fig. 11. Distribution of Man Labor, by Four-Week Periods, Expended on Composite Units of Various Classes of Livestock

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

of labor available for caring for livestock; and the capacity of the class of livestock for performing their various functions. They depend, also, upon the buildings and fences. 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 the various kinds of livestock may be a very important factor influencing the success of the enterprise.

Table 13

Standards for Livestock Production in Red River Valley

No. and kind of livestock	Production	Feed per unit*						Man labor per unit, hr.	Horse work per unit, hr.	Materials and services per unit
		Farm-grown concentrates, lb.	Commercial protein supplement, lb.	Dry roughage, lb.	Skimmilk, lb.	Whole milk, lb.	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	...	...	0.12	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...	325 lb. 540 doz. eggs‖	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 pigs are weaned.

§ These amounts of commercial protein supplement would be used if skimmilk is not available.

‖ Production based on 54 mature birds and 92 chicks.

Table 14

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	...	...
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 beeves	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 13 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.

¶ These amounts of commercial protein supplement would be used if skimmilk is not available.

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. They thrive relatively better on low quality pastures and hay than any other class of livestock. They can be used to control such weeds as quack grass and sow thistle 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. They require less shelter than either dairy cattle or hogs and require no more shelter than beef cattle. The medium-sized farm flock, kept for raising lambs to market off pasture in the autumn, appears best fitted to Valley conditions. It is desirable to keep the flocks small enough to change them from one pasture to another at frequent intervals to minimize the danger from internal parasites. Where conditions are such that sheep can be ranged on unclaimed land, it is a very economical method of sheep production, for there is practically no expense for pasture. Finishing lambs on grain is a highly specialized enterprise involving more risk than the average Valley farmer is willing to assume.

Dairying fits well into the organizations 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. They provide a steady cash income at short and regular intervals, thus minimizing the risk involved in marketing the product on an unsteady market. With dual-purpose cows, dairying is adaptable to larger farms, as all the calves ordinarily would be raised and the surplus marketed as beef cattle. The young stock would provide use for additional pasture and roughage. The most serious limitation to dairying in the Red River Valley is the competition with crops for labor during the crop-growing season. Dairy cattle also require warmer and better equipped buildings than any other class of livestock. Few farms are properly equipped for dairying at the present time. Other limiting conditions are the absence of local creameries and the general lack of good cows. Both the creameries and the cows will be provided, however, if interest in the development of dairying becomes general.

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 con-

taining corn as the farm-grown concentrate produced only slightly higher average daily gains and higher 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 roughages as do dairy cattle. While the same is true of sheep, and sheep have the advantage of requiring practically no attention during the crop-growing season, it would be somewhat difficult to depend upon sheep as the only class of livestock on the farm, since 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, as they can be maintained satisfactorily in straw sheds or other inexpensive shelter.

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 when barley is the only fattening grain grown, a large proportion of it is needed for balancing roughages that must be fed to cattle or sheep. Hence the amounts of feed available for hogs, which consume only concentrates, may be somewhat limited. Hogs are desirable on dairy farms producing skimmilk and insofar as practical should be kept in sufficient numbers to consume all the skimmilk available over and above the amounts needed for calves and poultry. While hogs require much less labor per animal than cattle, the distribution of labor is less favorable. Because of the cold winters and the late springs, pigs are usually farrowed only in the spring and then 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; but it has the advantage of not requiring any considerable investment for shelter. A straw shed will provide all the shelter needed through the winter.

When provided with warm housing facilities for protection during the winter season, 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 make the Valley well adapted to turkey raising. Poultry raising, more than the keeping of

a small flock, fits into the more intensive types of organization to best advantage.

Budgeting Production Programs

Having investigated the possibilities of various rotations and different combinations of livestock, the farmer should now fit them together into as many organization plans as appear, on the basis of the general information available, to be possible alternative production programs. The next step is to budget each program to determine the distribution of the demands of each on his labor, power, and equipment; the approximate amount of cash outlay involved in each; the probable production to be obtained; and, finally, to arrive at an estimate of the returns from each program above cash expenses that vary with changes in organization. (The application of the budget method is illustrated in a later section.)

In using the standards presented in Tables 7 to 14, inclusive, as basic data for preparing a budget, a farmer should adjust them to his conditions. The standards represent the quantities of the production factors that may reasonably be expected to be used for the production of the different crops and classes of livestock under careful management with conditions ordinarily prevailing in the Red River Valley. Many farmers with unusually favorable conditions can expect to obtain even better yields; those less favorably situated may be making the best of their opportunities when obtaining lower yields. If they have kept records in previous years of the amounts of labor, feed, and materials used, these will be helpful in making the adjustments if the enterprises conducted in the past are included in the projected program. The arrays presented in Minnesota Agricultural Experiment Station Bulletins 282 and 283, showing the variations from farm to farm of the production factors used in the same year and the difference between the averages for three years, indicate the variations that can reasonably be expected as a result of differences in seasons, farms, and farmers.

Normal or average crop yields and livestock production on the farm for which the budget is made usually should be used. The farmer should review such records as are available for his farm; study the results on other farms and data showing the results of experimental trials; then consider all these in the light of conditions on his own farm; and, finally, estimate what production he can reasonably expect.

While the conclusions as to prices presented in Table 10 were reached after a careful study of prices that have prevailed in the Valley during recent years, they are not price forecasts. They represent, as nearly as could be estimated, a normal relationship between prices. Prices are changing constantly, however, and here again it will be

necessary for the farmer to make his own price assumptions, basing his conclusions upon the best information available regarding the probable trend of prices over the period into which he is projecting his program.

With the budgets of the various tentative programs before him for comparison, he can select the program which appears most promising.

APPLICATION OF BASIC FARM ORGANIZATION DATA TO SELECTED FARMS

Planning a Long-Time System of Farming

The following examples will illustrate the use of farm organization data as the basis for budgeting the use of the productive resources on three selected farms according to suggested long-time plans, and for arriving at an estimate of the returns which may reasonably be expected from the plans suggested. Three common sized farms have been selected, viz., one in the group of 240-acres, one in the group of 400-acres, and one in the group of 640-acres. While they are typical of many farms throughout the Valley and the suggested systems might, if put into practice, increase the returns from a great many farms, it must be remembered that, as no two farmers' resources are exactly alike and any plans for the reorganization of different farms must take into consideration their differences, the suggestions are intended merely as a guide to the farmer working with his own problem of reorganization.

In presenting the records of these three farms, normal crop yields for the particular farm have been substituted for the actual yields of the year of the record in order to avoid the effect of seasonal variations. Actual livestock production for the year studied is presented. Livestock production is not greatly influenced by variations in weather.

Table 15

Distribution of Crop Acreage, Production, and Disposition of Crops

Crop	Acreage	Yield per acre, bu. or tons	Total production, bu. or tons	Disposal		
				Seed, bu.	Feed, bu.	Sales, bu.
Wheat	110½	15	1,658	165	97	1,396
Oats	65½	35	2,292	168	1,433	691
Barley	32½	30	975	54	251	670
Flax	15½	9	140	8	...	132
Spelt	12	25	300	...	33	267
Corn fodder	15	2	30	...	30	...
Potatoes	6	105	630	84	36*	510
Alfalfa hay	12	2	24	...	24	...
Timothy hay	7½	¾	5½	...	5½	...
Wild hay	4½	1	4½	...	4½	...
Summer fallow	51	...	...	...	...	...
Total crop area	332	...	...	...	...	...

* Used in the home.

Illustration No. 1

The record of the resources and productive organization as they existed in 1928 on one of the farms included in the special study in Polk County is as follows:

Inventory of Resources

Real estate	Acres
Total crop area	332
Permanent pasture	47
Farmstead, road, and waste	21
Total	400

Labor supply
- The operator's labor for the entire year
- One hired man for the entire year
- The assistance of the operator's wife in chores and care of chickens
- Extra help as needed—46 days

Power and equipment
- Eight horses throughout year
- One 15-30 tractor
- All the machinery needed for the crops grown

The farm is equipped with buildings sufficient to take care of the work stock, 15 cows, 20 young cattle, 10 brood sows and their pigs, and 100 chickens.

Table 16

Number, Production, and Disposal of Livestock and Livestock Products

Kind of livestock	No.	Production		Disposal		
		Kind	Amount	Fed to livestock	Used in home	Sales
Dairy cows...	14	3 cull cows	2,750 lb.	.....	...	2,750 lb.
		Butterfat	2,226 lb.	194 lb.	148 lb.	1,884 lb.
		Skimmilk	49,503 lb.	49,503 lb.	...	....
Bull	1					
Young cattle..	7	12 veal calves	1,545 lb.	.....	...	1,545 lb.
		2 heifers	1,620 lb.	.....	...	1,620 lb.
		3 springers	....	.....	...	....
Brood sows ...	5	Marketable hogs	8,450 lb.	.....	175 lb.	8,275 lb.
Chickens	70	Eggs	371 doz.	.....	201 doz.*	170 doz.
		Meat	46 lb.	.....	46 lb.	....

* Includes 18 dozen set.

Normmal Amounts of Man Labor, Power, Materials, and Feeds for the Production of Crops and Livestock

Reasonable labor and power rates for crop production on this farm, based upon the amount of labor and power used for the different crop operations in 1928 and upon a comparison of these amounts with the standards presented in Tables 7 to 14 are shown in Table 17. The amounts of materials for an acre of each crop, obtained in a similar

manner, are presented in Table 18. These rates are considered to be normal for this farm.

Table 17

Normal Amounts of Labor and Power per Acre for Crops

Field operation	Man hours	Horse hours	Times over
Seedbed preparation			
Plowing	2.15	10.75	..
Disking	0.50	2.00	..
Spring-tooth harrowing	0.55	2.20	..
Harrowing	0.25	1.00	..
Wheat operations			
Plowing	2.15	10.75	..
Disking	0.50	2.00	1.0
Spring-tooth harrowing	0.55	2.20	1.0
Harrowing	0.25	1.00	1.0
Seeding	0.50	2.00	..
Cutting	0.80	3.20	..
Shocking	1.00	...	..
Threshing	2.00	3.50	..
Oats operations			
Plowing	2.15	10.75	..
Disking	0.25	1.00	0.5
Spring-tooth harrowing	0.55	2.20	1.0
Harrowing	0.25	1.00	1.0
Seeding	0.50	2.00	..
Cutting	0.80	3.20	..
Shocking	1.00	...	..
Threshing	1.90	3.35	..
Barley operations			
Disking	0.50	1.00	1.0
Spring-tooth harrowing	0.55	2.20	1.0
Harrowing	0.25	1.00	1.0
Seeding	0.50	3.20	..
Cutting	0.80	...	..
Shocking	1.00	3.50	..
Threshing	2.00	...	..
Flax operations			
Plowing	2.15	10.75	..
Disking	0.25	1.00	0.5
Spring-tooth harrowing	0.55	2.20	1.0
Harrowing	0.25	1.00	1.0
Seeding	0.50	2.00	..
Cutting	0.85	3.80	..
Shocking	0.80	...	..
Threshing	1.90	3.10	..
Corn operations			
Disking	1.00	4.00	2.0
Harrowing	0.75	3.00	3.0
Planting	0.70	1.40	..
Cultivating	5.25	10.50	4.0
Cutting	1.50	4.50	..
Shocking	2.50	...	..
Potato operations			
Disking	2.00	8.00	4.0
Spring-tooth harrowing	0.55	2.20	1.0
Harrowing	0.50	2.00	2.0
Cutting seed	3.50	...	..
Planting	1.90	3.80	..
Cultivating	7.00	14.00	5.0
Spraying	2.00	4.00	2.0
Digging	1.80	7.20	..
Picking	10.00	...	..
Hauling	2.50	5.00	..
Alfalfa operations			
First cutting			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Cocking or bunching	1.25	...	..
Hauling to barn	2.00	2.70	..
Second cutting			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Cocking or bunching	1.00	...	..
Hauling to barn	1.60	2.15	..
Sweet clover			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Cocking or bunching	1.25	...	..
Stacking	3.25	6.00	..
Summer fallow after sweet clover			
Plowing	2.25	11.25	..
Spring-tooth harrowing	1.65	6.60	3.0
With tractor		Tractor hr.	
Plowing	1.10	1.10	1.0
Disking	0.35	0.35	1.0
Spring-tooth harrowing	0.35	0.35	1.0
Harrowing	0.15	0.15	1.0
Cutting grain	0.45	0.45	1.0
Seeding grain	0.40	0.40	1.0

The normal amounts of labor and feed, and materials and services for livestock production, obtained in the same manner as above, except for sheep, are shown in Table 19. Standard amounts taken from Table

13 are shown for sheep, as sheep were not included in the present organization.

Table 18

Normal Amounts of Materials and Contract Services per Acre for Crops

Crop	Materials per acre		Contract services	
	Kind	Quantity	Kind	Cost
Wheat	Seed	1½ bu.	Threshing, per bu.	$0.06
	Twine	2¼ lb.		
Oats	Seed	2½ bu.	Threshing, per bu.	0.04
	Twine	2½ lb.		
Barley	Seed	1¾ bu.	Threshing, per bu.	0.04
	Twine	2½ lb.		
Flax	Seed	½ bu.	Threshing, per bu.	0.12
	Twine	1¾ lb.		
Corn	Seed	9 lb.		
	Twine	2½ lb.		
Potatoes	Seed	14 bu.	Picking, per bu.	0.05
	Paris green	2 lb.		
	Lime	4 lb.		
	Copper sulfate	4 lb.		
Alfalfa hay	Seed	2½ lb.		
Sweet clover hay	Seed	12 lb.		

Distribution of Man Labor

The weekly distribution of man labor for this farm in 1928 and the supply of labor available for use are shown in Figure 12. The supply of regular man labor is shown by the dotted line on the chart. It was estimated by assuming that the usual full day's work

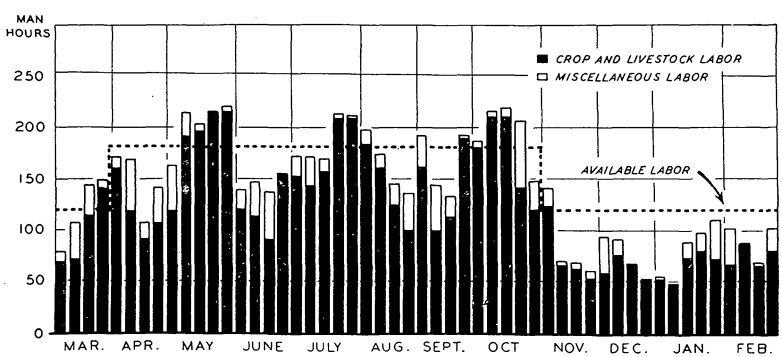

Fig. 12. Utilization of the Man Labor on a 400-Acre Farm by the Present System

In planning the farm production program, the distribution of the labor on the different enterprises is of prime importance.

performed by the regular laborers on this farm could be maintained throughout the season. Strictly speaking, the supply of regular man labor is rather flexible because of the speeding up or lengthening of the

Table 19

Normal Amounts of Labor and Feed and Materials and Services for Livestock

Kind of livestock	Barley, lb.	Oats, lb.	Corn, lb.	Wheat, lb.	Legume roughage, lb.	Non-legume roughage, lb.	Milk, lb.	Skim-milk, lb.	Veterinary services and medicine	Man labor, hr.	Horse work, hr.
Colt	...	1,000	...	...	2,000	1,500	...	...	$0.10	56	..
Dairy cow	425	950	425	...	2,700	2,860	...	...	1.00	160	5.0
Veal calf	...	...	...	...	....	....	700	...	...	5	..
Dairy calf	96	128	...	...	500	500	60	1,800	0.10	25	0.5
Dairy heifer	144	192	...	...	500	2,500	...	...	0.10	25	0.5
Dairy bull	480	800	...	...	2,000	2,000	...	...	0.10	25	0.5
Ewe and lamb.....	...	128	...	...	450	....	...	...	0.24	3	0.8
Sow and litter.....	1,242	...	4,306	...	....	....	...	5,620	1.16	36	3.5
100 mature chickens..	3,280	2,760	...	1,885	....	....	...	4,500	0.75	175	5.0
Work horse	...	3,000	...	...	2,500	2,500	...	...	1.00	106	..

day during periods of heavy demands for labor. This speeding up usually is followed by a decline in the amount of work done during other periods.

The demand for labor exceeded the supply during harvest and threshing, and made it necessary to hire extra day help for a short time. Following threshing, however, and during the winter, there was insufficient work to keep two men completely occupied. There were other short periods during the spring and early summer when the productive enterprises did not require sufficient labor to provide employment for all the labor available.

Financial Returns

A statement of the returns from the present organization, based on normal yields and prices, previously described, is presented in Table 20.

The indicated returns of $2,742 represent the normal returns above those out-of-pocket expenses which vary directly with changes in the organization. In this and the following illustrations the primary objective is to show how the returns to the farm business as a whole are affected by the choice and combination of enterprises. For this purpose it is necessary to consider only the expenses that vary directly with changes in the organization. In comparisons between organizations that include the same crops and livestock but in somewhat different proportions, the cash expenses for such items as hired labor, threshing, and feed are most important. In making a comparison between essentially different types of farming, other expense items must be considered. For example, in comparing the returns on a cash-grain farm with those on a livestock farm, the difference in the livestock, building, and equipment investments on the two farms may be an important item. If the objective were to indicate whether the returns that could be expected from this farm were as large as might be obtained on another containing more acres, consideration would have to be given to other items, such as the additional taxes and other land charges involved.

This organization, consisting largely of wheat, other small grains, summer fallow, and mixed cattle enterprises, is a type common in this area on medium-sized farms. With so large a part of the crop area growing small grains each year, weeds are not controlled properly. The use of summer fallow in an attempt to control weeds holds too large a part of the farm out of production each year. Furthermore, provision for maintaining soil productivity has not been adequate with the result that yields are below what might reasonably be expected with better treatment of the soil and better control of weeds. Sufficient roughage and pasture of high quality is not provided to supplement

the feed grains as the basis for livestock enterprises to utilize the farmer's time productively outside the cropping season.

Table 20

Normal Returns from Present Organization

Crop and Livestock Sales				
Crop sales				
Wheat	1,396 bu. at $0.90	$1,256		
Oats	691 bu. at 0.30	207		
Barley	670 bu. at 0.45	301		
Flax	132 bu. at 1.90	251		
Spelt	267 bu. at 0.35	93		
Potatoes	546 bu. at 0.65	355*		
Total crop sales			$2,463	
Livestock and livestock product sales				
Butterfat	2,032 lb. at $0.40	$ 813*		
3 cows	2,750 lb. at 0.04	110		
12 veals	1,545 lb. at 0.10	155		
2 heifers	1,620 lb. at 0.06	97		
Hogs	8,450 lb. at 0.07½	634*		
Poultry	46 lb. at 0.15	7*		
Eggs	353 doz. at 0.25	88*		
Total livestock sales			1,904	
Total crop and livestock sales				$4367
Direct Cash Costs				
Cost of materials and services for crops				
Twine	592 lb. at $0.13	77		
Threshing		269		
Picking potatoes	630 bu. at 0.05	32		
Copper sulfate (potatoes)	48 lb. at 0.25	12		
Paris green (potatoes)	12 lb. at 0.35	4		
Timothy seed	90 lb. at 0.06	5		
Alfalfa seed	30 lb. at 0.35	10		
Seed corn	1 bu. at 5.00	5		
Total cash crop costs			414	
Cost of materials and services for livestock				
Veterinary services and medicine		30		
Screenings		37		
Protein supplement		52		
Mineral and grit		14		
Salt		3		
Total cash livestock costs			136	
Fuel, oil, and repairs for tractor			86	
Hired labor			996	
Total cash costs of extra labor, power, and materials				1,632
Returns to the organization (above cash costs, which vary with changes in organization)†				$2,735

* Includes produce used in the home.

† Returns as presented here should not be compared with operator's earnings as presented on page 15, as none of the overhead expense such as taxes, insurance, and equipment have been here considered.

Reorganization Plan

In reorganizing this farm business, three things should be accomplished: (1) More adequate weed control should be effected without holding a field in idle fallow each year; (2) improved drainage and

soil conditions should be provided; and (3) more complete utilization of available farm resources such as labor, work horses, equipment, and feeds should be obtained by selecting crops and adding kinds of livestock that are supplementary to spring grains in their demand for attention.

With these objectives in mind an organization is outlined in Tables 21 and 22 using the conclusions and data previously set forth.

Table 21

Suggested Reorganization of Cropping System

Crop	Acreage	Yield per acre	Total production
Wheat	70	15 bu.	1,050 bu.
Oats	70	35 bu.	2,450 bu.
Barley	40	30 bu.	1,200 bu.
Flax	30	9 bu.	270 bu.
Potatoes	35	105 bu.	3,675 bu.
Corn, grain	35	25 bu.	875 bu.
Stover	(35)	1 ton	35 tons
Alfalfa hay	20	1¾ tons	35 tons
Sweet clover hay	25	1 ton	25 tons
Sweet clover pasture	45		
Permanent pasture	9		
Farmstead and road	21		
Total farm area	400		

To provide for soil improvement, better drainage, and more adequate control of weeds, it is suggested that sweet clover be seeded with barley and used the second year either for hay or pasture, but plowed after the first crop, or in July if pastured, and fallowed until the ground freezes in the autumn. It is planned that cultivated crops should follow the late summer fallow to aid further in weed control and soil improvement. Increasing the acreage of potatoes and corn has the additional advantage of diversifying the cash-crop income and better utilizing labor, power, and equipment. The alfalfa acreage would be increased to provide additional hay to supplement the increased carrying capacity of pasture resulting from substituting sweet clover for permanent pasture. In substituting potatoes for a part of the acreage of wheat, more acres of a crop yielding a higher return from units of both land and labor are included in the cropping system. With the increased yields of grain, which should result from the benefits to the land of a better balanced rotation, more economical production of wheat should be obtained on the remaining acreage.

To utilize effectively the roughage and feed grains of the suggested cropping system and at the same time supplement the labor demands it is proposed that 120 breeding ewes be added and that the number of brood sows be increased from five to ten. In order that shelter room may be available for the sheep and brood sows added, it is suggested

that all the calves be vealed each year except two heifers, which would be kept for replacements in the dairy herd.

Table 22

Suggested Reorganization of Livestock System

Kind of livestock	Number	Production
Colts	2	....
Dairy cows	14	2,800 lb. butterfat
Heifer calves	2	....
Yearling heifers	2	....
Bull	1	....
Ewes	120	120 lambs (75 lb. each)
		840 lb. wool
Sows, with spring litters	10	14,500 lb. gain
Chickens, mature birds	70	371 doz. eggs
chicks	60	46 lb. meat
Work horses	8	8,800 hours of work

The cows are well bred and capable of higher production if given more feed of better quality. It is assumed, therefore, that the substitution of sweet clover pasture for permanent pasture and the use of more alfalfa hay in the winter ration, with a slightly heavier feeding of grain, will increase the production per cow 20 per cent. Equally high production was being obtained from herds of similar quality during the years of the study.

The labor distribution of the new system, based upon the normal amounts of labor used per acre, as indicated in Tables 17 and 19, and upon the seasonal distribution of the use of labor on crops, as presented in Figure 10, is shown in Figure 13. The seasonal distribution of the use of labor on livestock was based upon the record of the use of labor on this farm during the period of the study. The regular labor supply,

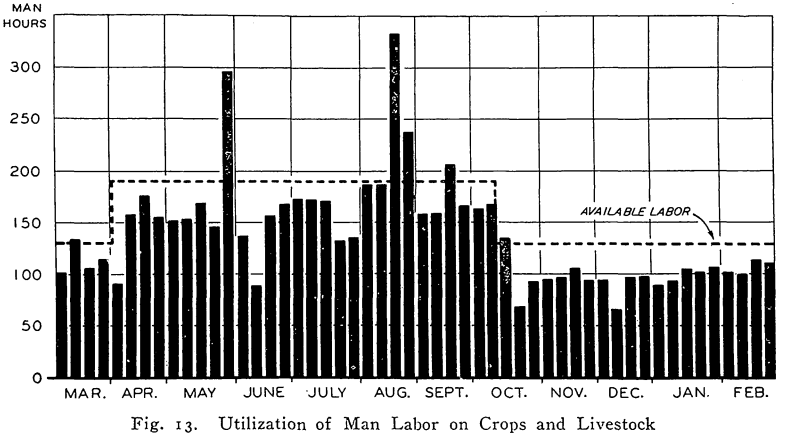

Fig. 13. Utilization of Man Labor on Crops and Livestock on a 400-Acre Farm by Suggested System

Many tasks of a miscellaneous character can be done at any time and so made to fit in with the variations in the labor demands of crops and livestock.

which is increased by the addition of a third man for six and one-half months, is utilized more completely during the crop-growing season through increasing the acreage of potatoes, corn, and alfalfa.

Table 23

Budget for Suggested System (400-Acre Size Group)
Section A. Crops: Acreage, Production, and Disposition

Crop	Acres	Yield per acre	Total production	Farm use		Sales	
				Seed	Feed	Quantity	Value
Wheat	70	15 bu.	1,050 bu.	105 bu.	31 bu.	914 bu.	$ 823
Oats	70	35 bu.	2,450 bu.	175 bu.	1,933 bu.	342 bu.	103
Barley	40	30 bu.	1,200 bu.	70 bu.	471 bu.	659 bu.	297
Flax	30	9 bu.	270 bu.	15 bu.	.....	255 bu.	484
Potatoes	35	105 bu.	3,675 bu.	490 bu.	.....	3,185 bu.*	2,070
Corn, grain	35	25 bu.	875 bu.	.....	875 bu.	.....	....
Stover	(35)	1 ton	35 tons	.....	35 tons	.....	....
Alfalfa hay	20	2 tons	40 tons	.....	35 tons	.....	....
Sweet clover hay	25	1 ton	25 tons	.....	25 tons	.....	....
Sweet clover pasture	45						
Permanent pasture	9						
Farmstead and roads	21						
Total	400						$3,777

* Includes 30 bushels used in the home.

Table 23—Continued

Budget for Suggested System (400-Acre Size Group)
Section B. Crops: Man Labor, Horse and Tractor Work, and Material for Production

Crop	Farm labor and power			Contract services		Materials		
	Man hr.	Horse hr.	Tractor hr.	Kind	Value	Kind	Quantity	Cost
Wheat	459	973	77	Threshing	$ 63	Seed	105 bu.	Farm*
						Twine	157 lb.	$20.00
Oats	444	962	77	Threshing	98	Seed	175 bu.	Farm*
						Twine	175 lb.	$23.00
Barley	224	516	..	Threshing	48	Seed	70 bu.	Farm*
						Twine	100 lb.	$13.00
Flax	153	393	33	Threshing	31	Seed	15 bu.	Farm*
						Twine	52 lb.	$ 7.00
Potatoes	799†	1,617	38	Picking	184	Seed	490 bu.	Farm*
						Paris green	70 lb.	$24.00
						Lime	140 lb.	1.00
						Copper sulfate	230 lb.	35.00
Corn	448	819	37			Seed	6 bu.	30.00
						Twine	89 lb.	12.00
Alfalfa hay	177	217	..			Seed	50 lb.	18.00
Sweet clover hay	150	225	..			Seed	275 lb.	38.00
Sweet clover pasture	...	...	..			Seed	495 lb.	50.00
Fallow after sweet clover	74	...	74					
Total	2,938	5,722	336		$424			$261.00

* Produced on the farm.
† Does not include labor of picking.

Table 23—Continued
Budget for Suggested System (400-Acre Size Group)
Section C. Livestock: Number, Feed, Man Labor and Horse Work and Materials for Livestock Production

Kind of livestock	No.	Feeds										Veterinary services, medicine, and miscellaneous	Man labor, hr.	Horse work, hr.
		Barley, bu.	Oats, bu.	Corn, bu.	Wheat, bu.	Alfalfa hay, tons	Sweet clover hay, tons	Stover, tons	Beet tops, tons	Milk, lb.	Skim-milk, lb.			
Colts	2	...	62	...	..	2	..	1	..	...	...	$ 0.20	112	...
Dairy cows	14	123	520	115	..	19	..	20	20	...	...	14.00	2,440	50
Young cattle and bull	17	20	35	...	..	2	..	4	..	8,520	3,600	0.40	185	2
Ewes and lambs	120	...	480	...	..	2	25	..	..	...	...	28.80	360	90
Sows and litters	10	260	...	760	..	..	..	..	..	...	56,200	11.60	360	35
Chickens, Mature birds	70	68	86	...	31	..	..	..	..	...	4,500	5.00	170	4
Chicks	60	...	...	...	..	..	..	..	..	...	...	....	...	..
Work horses	8	...	750	...	..	10	..	10	..	...	...	8.00	848	...
Total		471	1,933	875	31	35	25	35	20	8,520	64,300	$68.00	4,475	181

Table 23—Continued

Budget for Suggested System (400-Acre Size Group)
Section D. Livestock: Production and Disposition of Products

Kind of livestock	Production	Disposal				
		Fed to livestock	Used in home		Sales	
			Amount	Value	Amount	Value
Dairy cattle						
Butterfat	2,800 lb.	298 lb.	148 lb.	$ 59	2,354 lb.	$942
Skimmilk	64,900 lb.	64,900 lb.	...	..	....	...
Veal	12 calves	.....	...	..	1,920 lb.	192
Cull cows	2 cows	.....	...	..	1,800 lb.	72
Lambs	9,000 lb.	(30 lambs to breeding flock)	...	..	6,750 lb.	540
Sheep						
Cull ewes	30 sold	.....	...	..	3,750 lb.	112
Poultry						
Wool	840 lb.	.....	...	..	840 lb.	168
Hogs	14,500 lb.	.....	175 lb.	13	14,325 lb.	1,074
Eggs	371 doz.	.....	201 doz.*	46	170 doz.	42
Meat	46 lb.	.....	46 lb.	7	....	...
Total				$125		$3.142

* Includes 54 dozen set, in quantity column but not in va'ue column.

Table 23—Continued

Budget for Suggested System (400-Acre Size Group)
Section E. Summary of Returns and Cash Costs of Labor and Materials, with Comparative Data for Present Organization

	Suggested system		Present organization	
Crops and Livestock Returns				
Crop returns (Section A)	$3,777		$2,463	
Livestock returns (Section D)	3,267		1,904	
Total crop and livestock returns		$7,044		$4,367
Direct Cash Costs				
Cost of materials and services for crops:				
Contract services (Section B)	424		301	
Materials (Section B)	261		113	
Total cash crop costs	$ 685		$414	
Cost of materials and services for livestock:				
Vet. serv., med., and misc. (Section C)	68		136	
Fuel, oil, and repairs for tractor	319		86	
Hired labor	1,442		996	
Interest on additional investment	35		...	
Total cash cost of extra labor, power, and materials		2,549		1,632
Returns to the organization (above cash costs, which vary with changes in organization)		$4,495		$2,735
Probable difference in favor of suggested system				$1,760

The suggested system requires additional day labor during potato planting to cut the seed, at haying time, and during threshing and potato harvest. By adding sheep and increasing the number of hogs, labor will be utilized on productive enterprises to a greater extent during the winter season than was possible under the present system.

A complete budget of the suggested system is shown in Table 23.

The budget in Table 23 shows the expected returns from the suggested system, not taking into consideration the increased yields that can be presumed to result from the better balanced cropping system. Comparisons between different systems of farming, however, must be made on the basis of long-time net returns to the farm resources, after the cash costs that vary with changes in organization have been deducted. After sufficient time has elapsed for fully establishing the new system, it seems reasonable to expect that standard yields for the area should be obtained on this farm. The additional return from larger crops resulting from the increased yield per acre would give the suggested system an additional advantage of approximately $1,000 without any material increase in costs aside from the additional cost of harvesting the larger yields.

Illustration No. 2

The record of the resources and productive organizations as they existed in 1927 on another of the farms included in the special study in Polk County is as follows:

Inventory of Resources

	Acres
Real estate	
Total crop area	507½
Sweet clover pasture	43½
Permanent pasture	34
Farmstead and roads	23
Waste	9
Total	617
Labor supply	
The operator's labor for the entire year	
Two hired men for the entire year	
Extra help as needed—128 days	
Power and equipment	
Twelve horses throughout the year	
One 15-30 tractor	
All machinery needed for crops grown	

The farm is equipped with buildings to house the work stock, 35 cows, 35 young cattle, 100 sheep and their lambs, 10 brood sows and their pigs, and 100 chickens. The farm is equipped also with a silo.

Table 24
Distribution of Crop Acreage, Production, and Disposal of Crops

Crop	Acreage	Yield per acre, bu. or tons	Total production, bu. or tons	Disposal		
				Seed, bu.	Feed, bu. or tons	Sales, bu.
Wheat*	62½	18	1,197	103	...	1,094
Oats†	50	35	1,750	117	1,546	87
Barley	134	30	4,020	268	1,559	2,193
Flax	86	9	774	43	...	731
Corn, grain	30	25	750	...	750	...
fodder	2½	2	5	...	5	...
silage	20½	4	82	...	82	...
Potatoes	3½	105	367	56	47‡	264
Alfalfa hay	38½	1¾	67	...	67	...
Wild hay	48	1	48	...	48	...
Summer fallow	28	..	...	...	...	...
Total crop area	507½	..	...	...	...	...

* 12½ acres seeded to alfalfa.
† 27½ acres seeded to alfalfa; 17½ acres to sweet clover.
‡ Used in the home.

Table 25
Number, Production, and Disposal of Livestock and Livestock Products

Kind of livestock	No.	Production		Disposal		
		Kind	Amount	Fed to livestock	Used in home	Sa'es
Cows	23	7 cull cows	.....	.....	...	7,905 lb.
		Butterfat	3,064 lb.	439 lb.	228 lb.	2,397 lb.
		Skimmilk	76,798 lb.	76,798 lb.	...	....
Bull	1					
Young cattle	17	23 veal calves	3,598 lb.	.....	...	3,598 lb.
		Butcher stock	800 lb.	.....	800 lb.	....
Brood sows	4	Marketable hogs	13,838 lb.*	.....	1,425 lb.	12,413 lb.
Chickens	96	Eggs	392 doz.	.....	176 doz.†	216 doz.

* Additional feeder pigs were purchased.
† Includes 5 dozen set.

Normal Amounts of Man Labor, Power, Materials, and Feeds of the Production of Crops and Livestock

Labor and power rates for crop production, which may be considered normal for this farm, are shown in Table 26. These rates are based upon the amount of labor and power used for the different crop operations in 1927 and upon a comparison of these amounts with the standards presented in Tables 7 to 14. The materials for an acre of each crop, obtained in a similar manner, are presented in Table 27.

Normal amounts of feed and labor for livestock production on this farm are shown in Table 28. These rates are based upon a comparison of amounts of feed and labor used for the production of livestock on this farm in 1927 with the standard amounts presented in Table 13. Sheep and beef cattle were not included in the present organization.

Table 26

Normal Amounts of Labor and Power per Acre for Crops

Field operation	Man hours	Horse hours	Times over
Seedbed preparation			
Plowing	2.10	10.50	..
Disking	0.50	2.00	..
Spring-tooth harrowing	0.55	2.20	..
Harrowing	0,20	0.80	..
Wheat operations			
Plowing	2.10	10.50	..
Disking	0.50	2.00	1
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.20	0.80	..
Seeding	0.50	2.00	..
Cutting	0.75	3.00	..
Shocking	1.00	...	..
Threshing	2.10	3.70	..
Oats operations			
Plowing	2.10	10.50	..
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.40	1.60	2
Seeding	0.50	2.00	..
Cutting	0.75	3.00	..
Shocking	1.00	...	..
Threshing	2.00	3.50	..
Barley operations			
Disking	0.50	2.00	1
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.20	0.80	1
Seeding	0.50	2.00	..
Cutting	0.75	3.00	..
Shocking	1.00	...	..
Threshing	2.10	3.70	..
Flax operations			
Plowing	2.10	10.50	..
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.40	1.60	2
Seeding	0.55	2.20	..
Cutting	0.85	3.80	..
Shocking	0.84	...	..
Threshing	1.95	3.20	..
Corn operations			
Disking	1.00	4.00	2
Harrowing	0.60	2.40	3
Planting	0.75	1.50	..
Cultivating, 2-row	3.00	12.00	4
Cutting	1.50	4.50	..
Silo filling	6.50	8.50	..
Potato operations			
Disking	2.00	8.00	4
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.40	1.60	2
Cutting seed	3.50	...	..
Planting	1.90	3.80	..
Cultivating, 2-row	3.75	15 00	5
Spraying	2.00	4.00	2
Digging	1.80	7.20	..
Picking	11.00	...	..
Hauling	2.75	5.50	..
Alfalfa			
First cutting			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Cocking or bunching.	1.25	...	..
Hauling to barn	2.00	2.70	..
Second cutting			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Cocking or bunching.	1.00	...	..
Hauling to barn	1.70	2.25	..
Sweet clover			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Cocking or bunching	1.25	...	..
Stacking	3.25	6.00	..
Wild hay			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Stacking	2.50	3.50	..
Summer fallow after sweet clover			
Plowing	2.25	11.25	..
Spring-tooth harrowing	1.65	6.60	3
With tractor		Tractor hr.	
Plowing	1.00	1.00	1
Disking	0.35	0.35	1
Spring-tooth harrowing	0.35	0.35	1
Harrowing	0.15	0.15	1
Seeding	0.35	0.35	1
Cutting grain	0.40	0.40	1
Windrowing grain	0.25	0.25	1
Combining grain*	1.20	0.28	1

* Man hours include hauling grain; 1.40 horse hours should be added for this operation.

It was necessary, therefore, to base the amounts for these two enterprises upon the standard amounts and the operator's efficiency in handling other classes of livestock.

Distribution of Man Labor

The weekly distribution of the man labor used on this farm in 1927 and the supply of labor available for use are shown in Figure 14. The

demand for labor exceeded the supply during seeding, harvest, threshing, and other short periods, making it necessary to hire extra day help. At other times, however, there was insufficient work on the productive enterprises to keep three men completely occupied.

Table 27

Normal Amounts of Materials and Contract Services per Acre for Crops

Crop	Materials per acre		Contract services	
	Kind	Quantity	Kind	Cost
Wheat	Seed	1½ bu.	Threshing, per bu.	$0.06
	Twine	2½ lb.		
Oats	Seed	2¼ bu.	Threshing, per bu.	0.04
	Twine	2½ lb.		
Barley	Seed	2 bu.	Threshing, per bu.	0.04
	Twine	2½ lb.		
Flax	Seed	½ bu.	Threshing, per bu.	0.12
	Twine	1¾ lb.		
Corn	Seed	9 lb.		
	Twine	3 lb.		
Potatoes	Seed	15½ bu.	Picking, per bu.	0.05
	Paris green	2 lb.		
	Lime	4 lb.		
	Copper sulfate	4 lb.		
Alfalfa hay	Seed	2½ lb.		
Sweet clover hay	Seed	12 lb.		

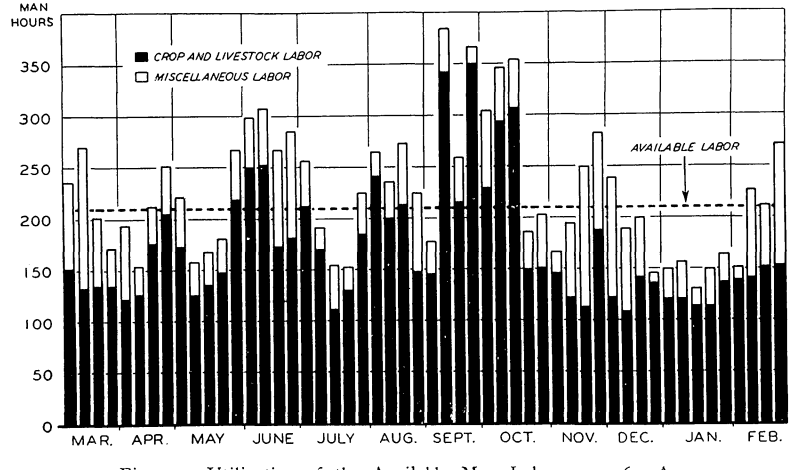

Fig. 14. Utilization of the Available Man Labor on a 617-Acre Farm by Present System

The demands for labor exceed the regular supply at frequent intervals, making it necessary to hire large amounts of day help. The wage rate for day labor is relatively higher than the rates for month or year, and the day laborers obtainable are usually inefficient.

Financial Returns

A statement of the returns from the present organization, based on normal yields and prices as previously described, is given in Table 29.

Table 28

Normal Amounts of Feed and Materials, Services and Labor for Livestock

Kind of livestock	Feeds										Veterinary services and medicine	Man labor, hr.	Horse work, hr.
	Barley, lb.	Oats, lb.	Corn, lb.	Wheat, lb.	Legume roughage, lb.	Non-legume roughage, lb.	Silage, lb.	Protein supplement, lb.	Milk, lb.	Skim-milk, lb.			
Beef cow	...	...	..	..	2,000	...	5,000	...	..	...	$0.13	25	1
Beef calf	96	128	..	..	500	...	1,000	...	60	1,800	...	..	..
Beef heifer	144	192	..	..	500	500	2,500	...	..	...	...	25	½
Beef bull	240	256	..	..	2,000	...	4,000	...	..	...	...	25	½
Baby beef	1,600	800	..	..	500	...	2,000	330	..	...	0.10	10	..
Ewe and lamb	...	128	..	..	450	...	...	...	..	...	0.25	3	¾
Sow and litter	6,000	...	..	..	...	...	...	250	..	...	1.25	36	3
100 mature chickens	2,830	210	..	..	...	...	...	...	..	1,100	1.00	80	..
Work horse	...	3,000	..	..	2,500	2,500	...	...	..	...	1.00	61	..

Table 29

Normal Returns from Present Organization

Crop and Livestock Sales				
Crop sales				
Wheat	1,094 bu. at $0.90	$ 985		
Oats	87 bu. at 0.30	26		
Barley	2,193 bu. at 0.45	987		
Flax	731 bu. at 1.90	1,389		
Potatoes	311 bu. at 0.65	202*		
Total crop sales			$3,589	
Livestock products				
Butterfat	2,625 lb. at $0.40	$1,050*		
7 cows	7,905 lb. at 0.04	316		
23 veal calves	3,598 lb. at 0.10	360		
1 heifer	800 lb. at 0.06	48*		
Hogs	13,838 lb. at 0.07½	1,038*		
Eggs	387 doz. at 0.25	97*		
Total livestock sales			2,909	
Total crop and livestock sales				$6,498
Direct Cash Costs				
Cost of materials and services for crops				
Twine	814 lb. at $0.13	$106		
Threshing		395		
Hauling wheat		7		
Cutting flax		40		
Seed corn	8½ bu. at 5.00	42		
Alfalfa seed	80 lb. at 0.35	28		
Sweet clover seed	460 lb. at 0.10	46		
Total cash crop costs			$ 664	
Cost of materials and services for livestock				
Veterinary services and medicine		$ 50		
Salt		8		
Feeder pigs, 3,560 lb. at $0.085		303		
Total cash livestock costs			361	
Fuel, oil, and repairs for tractor			460	
Hired labor			2,016	
Total cast costs of extra labor, power, and materials				3,501
Returns to the organization (above cash costs, which vary with changes in organization)				$2,997

* Includes produce used in the home.

This organization, into which has been already introduced soil building and weed control crops, secures reasonably good yields of small grain and especially good yields of wheat. Sufficient roughage and pasture of good quality is provided for supplementing feed grains as the basis for livestock enterprises. With the present distribution of the crop acreage and the present selection of number and kinds of livestock; however, the land, feed crops, and labor supply are not being used to the best advantage. Moreover, it is necessary to hire too much extra day labor at high wages. The cattle enterprise, as organized on the dairy basis, uses the feeds inefficiently because of the low produc-

tion of the cows. Furthermore, a dairy enterprise on a crop farm as large as this interferes seriously with labor on the crops during the summer. Wheat yields relatively better than either barley or oats on the land in this farm and potatoes yield relatively better than corn.

Reorganization Plan

In reorganizing this farm business the primary objective is a better utilization of the regular supply of labor, thus avoiding the necessity of hiring so large an amount of extra day labor. The wage rate for day labor is relatively higher than that for month or year labor and the day laborers ordinarily are inefficient. A second consideration is the substitution of higher income-per-acre crops insofar as it will conform with a satisfactory labor adjustment. A third objective is the utilization of the pasture and roughage and as much of the feed grains as possible with livestock enterprises without competing too seriously with the crops for man labor.

With these objectives in mind an organization is outlined in Tables 30 and 31 using the conclusions and data previously set forth.

Table 30

Suggested Reorganization of Cropping Systems

Crop	Acreage	Yield per acre	Total production
Wheat	140	18 bu.	2,520 bu.
Oats	70	35 bu.	2,450 bu.
Barley	70	30 bu.	2,100 bu.
Flax	70	9 bu.	630 bu.
Potatoes	40	105 bu.	4,200 bu.
Corn silage	30	4 tons	120 tons
Sweet clover hay	20	1 ton	20 tons
A'lfalfa hay	35	1¾ tons	61 tons
Wild hay	26	1 ton	26 tons
Sweet clover pasture	50		
Permanent pasture	34		
Farmstead and roads	23		
Waste	9		
Total farm area	547		

To utilize the land with crops yielding higher cash or feeding values and at the same time to correct maladjustments in the time distribution of the demands of crops for the use of man labor, it is suggested that the wheat acreage be increased to 140 acres and the barley acreage be reduced to 70 acres. Rather than hold 28 acres in summer fallow, it is suggested that a cultivated crop be planted which, in connection with the annual late summer fallowing of the sweet clover field, would pro-

vide adequate weed control and avoid the loss of a crop. Potatoes yield a higher return from units of both land and labor than corn, and as potatoes, even tho they make heavier demands upon labor than do corn, can be cared for by the regular labor supply, it is suggested that they take the place of summer fallow and be substituted for corn except 30 acres for silage. With the wheat acreage increased and potatoes added as a cash crop, it is suggested that the acreage of flax be reduced and that of oats be increased so as to have fields of equal size. A part of the acreage in wild hay can be brought into the rotation. It is suggested that this be done and that 20 acres of sweet clover be cut for hay each year. The addition of potatoes would diversify the cash-crop income.

It has already been pointed out that the land in this farm returns relatively better yields of wheat than of any of the other small grains. Under these conditions and with a large tract of land available, this operator is in a favorable position to obtain lower production costs in wheat growing through an increased acreage with the use of labor-saving power machinery and equipment. It is suggested that a ten-foot combine and a twelve-foot windrower be added to the farm equipment.

Table 31

Suggested Reorganization of Livestock System

Kind of livestock	No.	Production
Beef cows	31*	29 calves (300 lb. each)
Baby beeves	25	21,875 lb. gain
Heifer calves	4	.....
Yearling heifers	4	.....
Bull	1	.....
Ewes	100	100 lambs (75 lb. each) 700 lb. wool
Sows, with spring litters	8	11,600 lb. gain
Chickens, mature birds	96	392 doz. eggs
Work horses	12	13,200 hours of work

* A total of 35 cows and heifers would be available for raising calves, as the cows culled from the herd each year would not be sold until after calving.

To utilize the pasture, roughage, and feed grains of the suggested system with a minimum demand upon the labor supply, particularly during the cropping season, it is proposed that the cow herd be used to raise calves, which would be fattened and marketed as baby beeves. The number of cows would be increased to 31 to provide a carload of baby beeves, heifer calves for replacements, and allow a margin of six calves to cover losses from various causes. To aid in weed control and to utilize the sweet clover hay provided in the suggested cropping system, it is proposed that 100 breeding ewes be added. The

number of brood sows would be increased to eight in order to utilize more fully the barley.

The present cow herd is of mixed breeding, but by using a pure-bred bull of the beef type, calves of fair feeding quality would be obtained. The cow herd would be gradually improved through the use of better heifers for replacements.

The distribution of man labor of the new system is shown in Figure 15. It is calculated on the basis of adding a combine harvester-thresher to the present equipment. The regular labor supply is utilized more completely during the crop-growing season as a result of the substitution of wheat for a part of the barley and the addition of potatoes. The use of the combine makes it possible to avoid almost

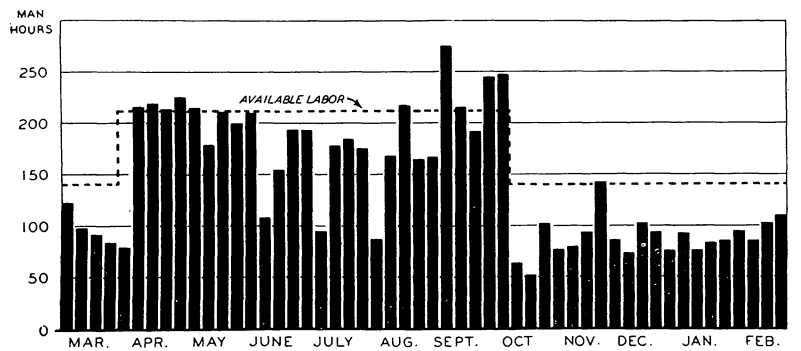

Fig. 15. Utilization of Man Labor on Crops and Livestock on a 617-Acre Farm by the Suggested System

The crops and livestock produced should be chosen to provide the farmer with the most profitable means of using his time and equipment. The returns usually are higher when the farm enterprises provide regular employment for labor and equipment.

entirely the use of extra day labor at harvest time. Moreover, the shift from dairying to beef production makes it possible to dispense with the services of one of the regular hired men for five and one-half months during the winter season. Thus, considerable saving is effected in the labor account with a considerable increase in the gross income from both crops and livestock.

A complete budget of the suggested system is shown in Table 32.

Table 32

Budget for Suggested System (640-Acre Size Group)
Section A. Crops: Acreage, Production, and Disposition

Crop	Acres	Yield per acre	Total production	Farm use		Sales	
				Seed	Feed	Quantity	Value
Wheat	140	18 bu.	2,520 bu.	210 bu.	....	2,310 bu.	$2,079
Oats	70	35 bu.	2,450 bu.	158 bu.	1,830 bu.	462 bu.	139
Barley	70	30 bu.	2,100 bu.	140 bu.	1,918 bu.	42 bu.	19
Flax	70	9 bu.	630 bu.	35 bu.	....	595 bu.	1,130
Potatoes	40	105 bu.	4,200 bu.	620 bu.	....	3,580 bu.*	2,327
Corn silage	30	4 tons	120 tons	....	120 tons	....	....
Alfalfa hay	35	1¾ tons	61 tons	....	61 tons	....	....
Sweet clover hay	20	1 ton	20 tons	....	20 tons	....	....
Wild hay	26	1 ton	26 tons	....	26 tons	....	....
Sweet clover pasture	50						
Permanent pasture	34						
Farmstead and roads	23						
Waste	9						
Total	617						$5,694

* Includes 47 bushels used in the home.

Table 32—Continued

Budget for Suggested System (640-Acre Size Group)
Section B. Crops: Man Labor, Horse and Tractor Work, and Materials for Production

Crop	Farm labor and power			Contract services		Materials		
	Man hours	Horse hours	Tractor hours	Kind	Value	Kind	Quantity	Cost
Wheat	615	1,366	217	.....		Seed	210 bu.	Farm*
						Twine	350 lb.	$46
Oats	284	585	109	.....		Seed	158 bu.	Farm*
						Twine	175 lb.	23
Barley	214	448	62	.....		Seed	140 bu.	Farm*
						Twine	175 lb.	23
Flax	424	1,253	108	.....		Seed	35 bu.	Farm*
						Twine	122 lb.	15
Potatoes	786†	1,892	40	Picking	$210	Seed	62 bu.	Farm*
						Paris green	80 lb.	28
						Lime	160 lb.	2
						Copper sulfate	160 lb.	40
Corn silage	502	951	50	.....		Seed	5 bu.	25
						Twine	90 lb.	12
Alfalfa hay	313	383	...	.....		Seed	98 lb.	34
Sweet clover hay	120	180	...	.....		Seed	240 lb.	24
Sweet clover pasture	...	...	...	.....		Seed	600 lb.	60
Fallow after sweet clover	116	462	...					
Total	3,374	7,520	586		$210			$332

* Produced on the farm.

† Does not include the labor of picking.

Table 32—Continued

Budget for Suggested System (640-Acre Size Group)

Section C. Livestock: Number, Feed, Materials, Man Labor, and Horse Work for Livestock Production

Kind of livestock	No.	Feeds									Veterinary services, medicine, and miscellaneous	Man hours	Horse hours
		Barley, bu.	Oats, bu.	Alfalfa hay, tons	Sweet clover hay, tons	Wild hay, tons	Silage, tons	Protein supplement, lb.	Milk, lb.	Skim-milk, lb.			
Beef cows	31	...	...	31	..	..	78	...	...	...	$ 4.00	775	31
Baby beeves	25	833	625	6¼	..	..	25	8,250	...	...	2.00	250	..
Young cattle and bull	9	25	48	3	..	1	15	...	240	7,200	...	125	2
Ewes and lambs	100	...	400	2½	20	..	..	...	...	...	25.00	300	75
Sows and litters	8	1,000	...	..	..	..	..	2,000	...	...	10.00	288	24
Chickens, mature birds	96	60	7	..	..	..	..	...	...	1,100	1.00	77	..
Work horses	12	...	750	15	..	15	..	...	...	...	12.00	732	..
Total	..	1,918	1,830	57¾	20	16	118	10,250	240	8,300	$54.00	2,547	132

Table 32—Continued
Budget for Suggested System (640-Acre Size Group)
Section D. Livestock: Production and Disposition of Products

Kind of livestock	Production	Disposal				
		Fed to livestock	Used in home		Sales	
			Amount	Value	Amount	Value
Beef cattle						
Baby beef	24,375 lb.	....	...	..	24,375 lb.	$2,193
Cull cows	4 cows	....	...	..	4,000 lb.	160
Butterfat	400 lb.	172 lb.	228 lb.	$ 91	....	...
Skimmilk	6,300 lb.	6,300 lb.	...	..	....	...
Sheep						
Cull ewes	25 sold	....	...	..	3,125 lb.	94
Lambs	7,500 lb.	(25 lambs to breeding flock)	...	..	5,625 lb.	450
Wool	700 lb.	....	...	..	700 lb.	140
Hogs	11,600 lb.	....	1,425 lb.	107	10,175 lb.	763
Poultry						
Eggs	392 doz.	....	176 doz.*	43	216 doz.	54
Total				$241		$3,854

* Includes 5 dozen set, in the quantity column but not in the value column.

Table 32—Concluded
Budget for Suggested System (640-Acre Size Group)
Section E. Summary of Returns and Cash Costs of Labor and Materials, with Comparative Data for Present Organization

	Suggested system		Present organization	
Crop and livestock returns				
Crop returns (Section A)	$5,694		$3,589	
Livestock returns (Section D)	4,095		2,909	
Total crop and livestock returns		$9,789		$6,498
Direct cash costs				
Cost of materials and services for crops				
Contract services (Section B)	210		442	
Materials (Section B)	332		222	
Total cash crop costs	$ 542		$664	
Cost of materials and services for livestock				
Vet. serv., med., and misc. (Section C)	54		50	
Tankage, 800 lb. (Section C)	28		..	
Oilmeal, 9,050 lb. (Section C)	249		..	
Alfalfa meal, 400 lb. (Section C)	8		..	
Grit, 170 lb.	2		..	
Salt	10		8	
Feeder pigs, 3,560 lb.	...		303	
Total cash livestock costs	351		361	
Fuel, oil, and repairs for tractor	469		460	
Hired labor	1,406		2,016	
Interest on additional investment	300		...	
Total cash cost of extra labor, power, and materials		3,068		3,501
Return to the organization (above the cash costs, which vary with changes in organization)		$6,721		$2,997
Probable difference in favor of suggested system				$3,724

Some increase in yields can be supposed to result from the better balanced cropping system after sufficient time has elapsed fully to establish the new system. Any increase in yields will result in additional returns without any material increase in costs aside from the additional cost of harvesting the larger yields.

Illustration No. 3

The record of the resources and productive organization as they existed in 1928 on a smaller farm included in the special study in Polk County is as follows:

Inventory of Resources

Real estate	Acres
Total crop area	196½
Sweet clover pasture	15
Farmstead and roads	11
Waste	1½
Total	224

Labor supply

- The operator's labor for the entire year
- One hired man for entire year
- Operator's father and mother who assisted with poultry and dairy chores; father also assisted with field work during rush periods
- Extra day help as needed—10 days

Power and equipment

- Eight horses throughout the year
- All machinery needed for crops grown

The farm is equipped with buildings sufficient to take care of the work horses, 10 cows, 15 young cattle, 5 brood sows and their pigs, and 250 chickens.

Table 33

Distribution of Crop Acreage, Production, and Disposition of Crops

Crop	Acreage	Yield per acre, bu. or tons	Total production, bu. or tons	Disposal		
				Seed, bu.	Feed, bu. or tons	Sales, bu.
Wheat*	31	17	496	53	90	353
Oats†	55	40	2,200	161	661	1,363
Corn fodder	9	2	18	...	18	...
Potatoes	33	125	4,125	435	65‡	3,625
Sugar beets	17½	10¾	188	...	...	188
Alfalfa hay	5	1¾	8¾	...	8¾	...
Sweet clover hay	27	1	27	...	27	...
Wild hay	15	1	15	...	15	...
Summer fallow	4	..	...	...	...	...
Total crop area	196½					

* Nine and one-half acres seeded to sweet clover.

† Nine acres seeded to sweet clover.

‡ Used in the home.

Table 34

Number, Production, and Disposal of Livestock and Livestock Products

Kind of livestock	No.	Production		Disposal		
		Kind	Amount	Fed to livestock	Used in home	Sales
Dairy cows...	6	1 cull cow	910 lb.	.....	...	910 lb.
		Butterfat	676 lb.	55 lb.	203 lb.	418 lb.
		Skimmilk	10,084 lb.	9,114 lb.	970 lb.	....
Bull	1					
		3 yearlings	1,440 lb.	.....	...	1,440 lb.
Young cattle..	6	2 veal calves	285 lb.	.....	...	285 lb.
		1 springer	.....	.....	...	....
Hogs	1	1 hog	189 lb.	.....	...	189 lb.
Chickens	143	Eggs	2,116 doz.	.....	276 doz.*	1,840 doz.
		Meat	692 lb.	.....	85 lb.	607 lb.

* Includes 54 dozen set.

Table 35

Normal Amounts of Labor and Power per Acre for Crops

Field operation	Man hours	Horse hours	Times over
Seedbed preparation			
Plowing	2.20	11.00	..
Disking	0.52	2.08	..
Spring-tooth harrowing	0.55	2.20	..
Harrowing	0.28	1.12	..
Wheat operations			
Plowing	2.20	11.00	..
Disking	0.52	2.08	1
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.28	1.12	1
Seeding	0.55	2.20	..
Cutting	0.80	0.40	..
Shocking	1.00	...	..
Threshing	2.00	3.50	..
Oats operations			
Plowing	2.20	11.00	..
Disking	0.26	1.04	½
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.28	1.12	1
Seeding	0.55	2.20	..
Cutting	0.80	3.20	..
Shocking	1.00	...	..
Threshing	1.90	3.35	..
Barley operations			
Disking	0.52	2.08	1
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.28	1.12	1
Seeding	0.55	2.21	..
Cutting	0.80	3.20	..
Shocking	1.00	...	..
Threshing	2.00	3.50	..
Potato operations			
Disking	2.08	8.32	4
Spring-tooth harrowing	0.52	2.20	1
Harrowing	0.56	2.24	2
Cutting seed	3.50	...	..
Planting	2.00	4.00	..
Cultivating	7.00	14.00	5
Spraying	2.00	4.00	2
Digging	1.90	7.60	..
Picking	10.00	...	..
Hauling	2.50	5.00	..
Sugar beet operations			
Disking	2.08	8.32	4
Spring-tooth harrowing	0.55	2.20	1
Harrowing	0.56	2.24	2
Seeding	1.00	2.00	..
Cultivating	5.30	10.60	4
Lifting	2.80	8.40	..
Hauling	10.00	20.00	..
Alfalfa			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Cocking or bunching.	1.25	...	..
Hauling to barn	2.00	2.70	..
Wild hay			
Mowing	1.00	2.00	..
Raking	0.50	1.00	..
Stacking	2.50	3.50	..
Summer fallow after first crop alfalfa and sweet-clover pasture			
Plowing	2.20	11.00	..
Spring-tooth harrowing	1.10	4.40	2

Normal Amounts of Man Labor, Power, Materials, and Feeds for the Production of Crops and Livestock

Reasonable labor and power rates for crop production on this farm, based upon the amount of labor and power used for different crop operations in 1928 and a comparison of these amounts with the standard rates presented in Tables 7 to 14, are shown in Table 35. The amounts of materials for an acre of each crop, obtained in a similar manner, are presented in Table 36. These rates are considered to be normal for this farm.

Table 36

Normal Amounts of Materials and Contract Services per Acre for Crops

Crop	Material per acre		Contract services	
	Kind	Quantity	Kind	Cost
Wheat	Seed	1¾ bu.	Threshing, per bu.	$0.06
	Twine	2¼ lb.		
Oats	Seed	2¾ bu.	Threshing, per bu.	0.04
	Twine	2½ lb.		
Barley	Seed	1¾ bu.	Threshing, per bu.	0.04
	Twine	2½ lb.		
Flax	Seed	½ bu.	Threshing, per bu.	0.12
	Twine	1¾ lb.		
Potatoes	Seed	13¼ bu.	Picking, per bu.	0.05
	Paris green	2 lb.		
	Lime	4 lb.		
	Copper sulfate	4 lb.		
Sugar beets	Seed	19 lb.	Thinning and blocking, per acre	8.00
	Superphosphate, 16%	100 lb.	Hoeing, per acre	6.00
			Harvesting, per acre	10.00
			Tonnage bonus, per a.	1.13
Alfalfa hay	Seed	2½ lb.		
Sweet clover pasture	Seed	12 lb.		

The normal amounts of feed and labor for livestock production obtained in the same manner as above are shown in Table 37.

Distribution of Man Labor

The weekly distribution of man labor for this farm in 1928 and the supply of labor available are shown in Figure 16. The present organization draws heavily upon labor during seedbed preparation and planting of potatoes and sugar beets in May, grain harvest in July and August, and sugar beet and potato harvest in October. The labor of three men was required to take care of these peak loads, but there was insufficient work to keep them employed on crops and livestock at other times.

Table 37

Normal Amounts of Feed, Materials, Veterinary Services, and Labor for Livestock

Kind of livestock	Feeds										Veterinary services, medicine, and miscellaneous	Man hours	Horse hours
	Wheat, lb.	Barley, lb.	Oats, lb.	Mash, lb.	Legume roughage, lb.	Non-legume roughage, lb.	Beet tops, lb.	Protein supplement, lb.	Milk, lb.	Skim-milk, lb.			
Dairy cow	...	1,050	1,050	...	4,000	...	4,000	...	..	...	$1.00	158	1
Veal calf	...	...	...	...	...	...	...	...	700	...	0.10	5	..
Dairy calf	...	96	128	...	500	500	...	...	60	1,800	0.10	25	..
Dairy heifer	...	144	192	...	500	2,500	...	...	..	...	0.10	25	..
Dairy bull	...	480	800	...	2,000	2,000	...	...	..	...	...	25	..
Sow and litter	...	7,200	...	...	...	...	...	...	..	3,000	1.25	36	3½
100 mature chickens	2,200	1,436	1,000	765	...	...	...	275	..	830	12.00	200	1½
Work horse	500	...	2,500	...	2,500	2,500	...	...	..	...	1.00	138	..

Financial Returns

A statement of the normal returns from the present organization, based on normal yields and prices as previously described, is presented in Table 38.

Table 38

Normal Returns from Present Organization

Crop and Livestock Sales						
Crop sales						
Wheat	353	bu.	at	$.090	$ 318	
Oats	1,363	bu.	at	0.30	409	
Potatoes	3,690	bu.	at	0.65	2,398*	
Sugar beets	188	tons	at	6.50	1,222	
Total crop sales						$4,347
Livestock and livestock produce sales						
Butterfat	621	lb.	at	0.40	250*	
1 cow	910	lb.	at	0.04	36	
2 veal calves	285	lb.	at	0.10	29	
3 yearlings	1,440	lb.	at	0.06	86	
Hogs	189	lb.	at	0.07½	14	
Poultry	692	lb.	at	0.15	104*	
Eggs	2,062	doz.	at	0.25	516*	
Total livestock sales						1,031
Total crop and livestock sales						$5,382
Direct Cash Costs						
Cost of materials and services for crops						
Twine	208	lb.	at	0.13	27	
Threshing	....			...	117	
Picking potatoes	....			...	128	
Corrosive sublimate (potatoes)	6	lb.	at	2.50	15	
Paris green (potatoes)	73	lb.	at	0.35	26	
Superphosphate (5 cwt., potatoes)	2,200	lb.	at	1.75	38	
Sugar beet seed	330	lb.	at	0.15	50	
Sweet clover seed	462	lb.	at	0.10	46	
Alfalfa seed	12	lb.	at	0.35	4	
Corn seed	1½	bu.	at	5.00	8	
Contract labor (sugar beets)	....			...	443	
Total cash crop costs						902
Cost of materials and services for livestock						
Veterinary services and medicine					33	
Protein supplement					38	
Poultry mash					74	
Mineral and grit					10	
Hatching eggs					5	
Brooder coal					3	
Salt					1	
Total cash livestock costs						164
Hired labor						856
Total cash costs of extra labor, power, and materials						1,922
Returns to the organization (above cash costs, which vary with changes in organization)						$3,460

* Includes produce used in home.

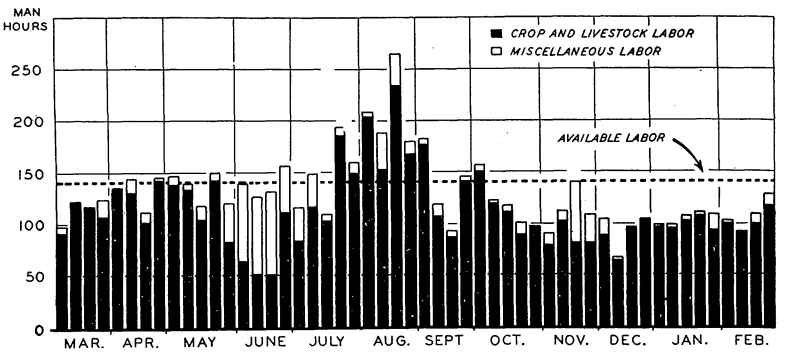

Fig. 16. Utilization of Man Labor on a 224-Acre Farm by Present System

The deficit in the regular labor supply is largely made up by the regular workers through lengthening their normal working day. Moreover, exchange labor received is included in the amount of labor utilized on the farm. No account is taken of exchange labor rendered.

In this organization the problems of weed control and maintenance of soil fertility have been largely solved through the use of sweet clover hay and pasture and of cultivated crops in rotation. In the attempt to obtain a satisfactory volume of business on a small farm, however, the acreage of potatoes and sugar beets, both high gross income-per-acre crops, has been increased out of proportion to the remainder of the cropping system. On the other hand, the opportunity to secure a larger volume of business by increasing the size of the dairy and hog enterprises has been neglected, thus inadequately utilizing the farm-grown feeds, and the labor supply outside the cropping season.

Reorganization Plan

In reorganizing this farm business two things should be accomplished: A better balance between crops and livestock should be arranged, and a more efficient use of the regular supply of labor, during both the cropping season and the winter season, should be provided.

With these objectives in mind an organization is outlined in Tables 39 and 40, using the conclusions and data previously set forth.

To provide a better distribution of labor, it is suggested that 20 acres each of potatoes and sugar beets be grown as compared to 33 acres of potatoes and 17½ of sugar beets in the present organization. To offset partially the proposed decrease in the acreage of these two cash crops, it is suggested that the wheat acreage be increased from 31 to 40. It is further suggested that the oats acreage be reduced from 55 to 40; that the corn-fodder crop be eliminated; and that 36 acres of barley be added to the rotation. The introduction of barley would provide feed for a hog enterprise and make possible a better dairy ration of home-grown feeds. The alfalfa acreage would be increased

Table 39

Suggested Reorganization of Cropping System

Crop	Acreage	Yield per acre	Total production
Wheat	40	17 bu.	680 bu.
Oats	40	40 bu.	1,600 bu.
Barley	36	35 bu.	1,260 bu.
Potatoes	20	125 bu.	2,500 bu.
Sugar beets	20	10¾ tons	215 tons
Sugar beet tops	(20)	1 ton	20 tons
Alfalfa hay (1 cutting)	25	1¼ tons	31 tons
Wild hay	15	1 ton	15 tons
Sweet clover pasture	15		
Farmstead and roads	11½		
Waste	1½		
Total farm area	224		

to 25 acres, thus making it possible to dispense with the use of sweet clover hay in feeding the dairy cows. The alfalfa would be carried as an annual crop in the regular rotation, however, thus making it possible to fallow the alfalfa meadow and the sweet clover pasture in late summer to aid in weed control.

Table 40

Suggested Reorganization of Livestock System

Kind of livestock	Number	Production
Dairy cows	10	2,500 lb. butterfat
Dairy calves	2	....
Dairy heifers	2	....
Dairy bull	1	....
Sows and pigs	5	7,250 lb. gain
Chickens, mature birds	143	2,116 doz. eggs
chicks	132	692 lb. meat
Work horses	8	8,800 hours work

To secure a better balance between crop and livestock production, thus providing better utilization of roughage and farm-grown feed grains as well as labor and equipment, it is proposed that 10 dairy cows and 5 brood sows of good quality be added to the present system. The 6 cows now on the farm are of poor quality and should be disposed of as rapidly as better cows can be obtained to take their places in the herd.

The distribution of man labor in the suggested system is shown in Figure 17. By reducing the acreage of potatoes and increasing that of small grains, three men can handle the crops without additional day help except at threshing time, and without extending the length of their normal working day at frequent intervals. Increasing the number of cows and adding 5 brood sows provide more productive labor during the winter.

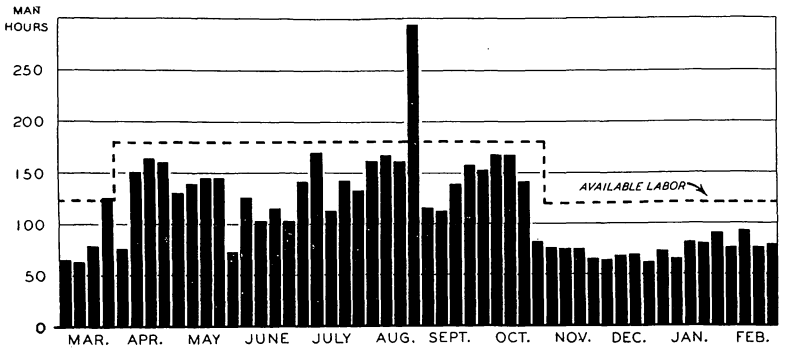

Fig. 17. Utilization of Man Labor on Crops and Livestock on a 224-Acre Farm by Suggested System

The suggested system lightens the labor load during the rush periods in the cropping season. It also provides additional productive employment for the regular labor supply during the slack seasons indicated in Figure 16.

Budgets with Varying Prices

The budgets in the foregoing illustrations have been worked out on the basis of the assumed prices given in Table 10. While these prices were selected after a careful study of the price relationships that have existed during recent years, there can be no assurance that these relationships will be maintained in the future. Any one of these prices may go either up or down in relation to the others and, furthermore, the prices of all farm products may fluctuate widely over a period of years. For this reason it is advisable to compute each budget on the basis of the different price relationships and price levels that are within the range that appears probable (see Table 42). Such additional budgets, worked out with varying prices, are helpful in determining maximum and minimum expectations from the different production programs.

Table 41

Budget for Suggested System (240-Acre Size Group)

Section A. Crops: Acreage, Production, and Disposition

Crop	Acres	Yield per acre	Total production	Home use		Sales	
				Seed	Feed	Quantity	Value
Wheat	40	17 bu.	680 bu.	70 bu.	160 bu.	450 bu.	$ 405
Oats	40	40 bu.	1,600 bu.	110 bu.	1,047 bu.	443 bu.	133
Barley	36	35 bu.	1,260 bu.	63 bu.	862 bu.	335 bu.	151
Potatoes	20	125 bu.	2,500 bu.	398 bu.	....	2,102 bu.*	1,366
Sugar beets	20	10¾ tons	215 tons	....	....	215 tons	1,398
Sugar beet tops	(20)	1 ton	20 tons	....	20 tons	....	....
Alfalfa hay	25	1¼ tons	31 tons	....	31 tons	....	....
Wild hay	15	1 ton	15 tons	....	15 tons	....	....
Sweet clover pasture	15						
Farmstead and roads	11						
Waste	2						
Total	224						$3,453

* Includes 65 bushels used in the home.

Table 41—Continued

Budget for Suggested System (240-Acre Size Group)

Section B. Crops: Man Labor, Horse Work, and Materials for Production

Crop	Farm labor and power		Contract services		Materials		
	Man hours	Horse hours	Kind	Value	Kind	Quantity	Cost
Wheat	316	900	Threshing	$ 41	Seed	70 bu.	Farm†
					Twine	50 lb.	$ 6
Oats	302	964	Threshing	64	Seed	110 bu.	Farm†
					Twine	60 lb.	8
Barley	205	515	Threshing	50	Seed	63 bu.	Farm†
					Twine	90 lb.	12
Potatoes	486*	1,167	Picking	125	Seed	398 bu.	Farm†
					Paris green	40 lb.	14
					Copper sulfate	80 lb.	20
					Lime	80 lb.	1
					Superphos., 16%	500 lb.	9
Sugar beets	456	1,295	Blocking and thinning	160	Seed	280 lb.	57
			Hoeing	120	Superphos., 16%	2,000 lb.	35
			Harvest	200	Paris green	10 lb.	4
			Tonnage bonus	23	Bran	240 lb.	3
Alfalfa hay	119	142			Seed	63 lb.	22
Wild hay	60	98					
Sweet clover pasture	...	...			Seed	165 lb.	16
Fallow after sweet clover	132	792					
Total	2,076	5,873		$783			$207

* Does not include labor of picking.

† Produced on the farm.

Table 41—Continued

Budget for Suggested System (240-Acre Size Group)

Section C. Livestock: Number, and Man Labor, Horse Work, Feeds, and Materials for Production

Kind of livestock	No.	Feeds										Veterinary services, medicine, and miscellaneous	Man hours	Horse hours
		Barley, bu.	Oats, bu.	Wheat, bu.	Alfalfa hay, tons	Wild hay, tons	Beet tops, tons	Mash, lb.	Protein supplement, lb.	Milk, lb.	Skim-milk, lb.			
Dairy cows	10	208	312	..	20	..	20	...	...	...	....	$10.00	1,580	10
Young cattle and bull	11	20	45	..	2	4	..	...	...	4,320	3,600	1.00	165	..
Sows and litters	5	571	...	..	..	..	..	...	...	...	57,985	6.00	180	18
Chickens, mature birds	143	63	65	77	..	..	..	1,599	575	...	1,735	25.00	418	3
chicks	132	...	...	..	..	..	..	...	...	...	....	....	...	..
Work horses	8	...	625	83	9	11	..	...	...	...	....	8.00	1,104	..
Total		862	1,047	160	31	15	20	1,599	575	4,320	63,320	$50.00	3,447	31

Table 41—Continued

Budget for Suggested System (240-Acre Size Group)
Section D. Livestock: Production and Disposition of Products

Kind of livestock	Production	Disposal				
		Fed to livestock	Used in home		Sales	
			Amount	Value	Amount	Value
Dairy cattle						
Butterfat	2,500 lb	151 lb.	203 lb.	$ 81	2,146 lb.	$858
Skimmilk	64,290 lb.	63,320 lb.	970 lb.	2	....	...
Veal	1,280 lb.	.....	...	..	1,280 lb.	128
Cull cows	2 cows	.....	...	..	1,800 lb.	72
Hogs	7,250 lb.	.....	250 lb.	19	7,000 lb.	525
Poultry						
Eggs	2,116 doz.	.....	276 doz.*	56	1,840 doz.	460
Meat	692 lb.	.....	85 lb.	13	607 lb.	91
Total				$171		$2,134

* Includes 54 dozen set, in quantity column but not in the value column.

Table 41—Concluded

Budget for Suggested System (240-Acre Size Group)
Section E. Summary of Returns and Cash Costs of Labor and Materials, with Comparative Data for Present Organization

Crop and livestock returns	Suggested system			Present organization		
Crop returns (Section A)	$3,453			$4,347		
Livestock returns (Section D)	2,305			1,031		
Total crop and livestock returns			$5,758			$5,378
Direct Cash Costs						
Cost of materials and services for crops:						
Contract services (Section B)	783			688		
Materials (Section B)	207			206		
Total cash crop costs		$990			$902	
Cost of materials and services for livestock:						
Vet. med., and misc. (Section C)	50			52		
Poultry mash (Section C)	56			74		
Protein supplement (Section C)	20			38		
Total cash livestock costs		126			164	
Hired labor		882			856	
Interest on additional investment		50			...	
Total cash cost of extra labor, power, and materials			2,048			1,922
Returns to the organization (above cash costs, which vary with changes in organization)			$3,710			$3,460
Probable difference in favor of suggested system						$ 250

Table 42

Returns from Actual and Suggested Organizations with Differing Price Relationships

Item	Probable returns above cash expenses, which vary with changes in organization, when prices are as follows:			
	Assumed relative prices	5-year av. prices 1924-29	Low grain prices	Low prices for all items
Wheat, bu.	$0.90	$1.15	$0.65	$0.65
Flax, bu.	1.90	2.30	1.30	1.30
Barley, bu.	0.45	0.55	0.35	0.35
Potatoes, bu.	0.65	0.70	0.65	0.50
Sugar beets, tons	6.50	6.00	6.50	6.00
Butterfat, lb.	0.40	0.45	0.40	0.30
Lambs, lb.	0.08	0.09	0.08	0.07
Baby beeves, lb.	0.09	0.10	0.09	0.08
Hogs, lb.	0.07½	0.09	0.07½	0.06½
Actual system in Illustration No. 1	2,735	3,460	2,241	1,870
Suggested system in Illustration No. 1	4,495	5,461	4,048	3,108
Actual system in Illustration No. 2	2,997	4,136	2,065	1,617
Suggested system in Illustration No. 2	6,721	8,206	5,783	4,807
Actual system in Illustration No. 3	3,460	3,673	3,372	2,660
Suggested system in Illustration No. 3	3,710	4,079	3,563	2,833

Budgeting Alternative Programs

While on the basis of the relative prices used, the suggested systems presented in the respective budget statements promise a more profitable utilization of the productive resources of these farms than would be obtained by following the actual systems as they existed during the years of the study, it has not been demonstrated that they are the best possible suggestions for the organization of the respective farms. It is advisable to make out budgets for different ways of operating each farm, estimating the probable returns which may result from the different systems, before the final choice of a system of farming is made. The different plans may involve different kinds and acreages of crops and different kinds and numbers of livestock. It will be of value, also, to figure on a basis of different kinds of power and equipment which require different amounts of labor.

The budgets of the alternative programs should be compared; each system should be considered critically to determine the amount of risk involved; the effect upon the fertility of the soil; how well the crops and livestock fit together in the use of labor and equipment; how nearly the feed crops provide a balanced ration for livestock; and the extent to which nonmarketable products, such as pasture, hay, stover, and skim-milk, are utilized. With these comparisons and the returns that may reasonably be expected from each system in mind, one of the systems should be selected. Presumably this will be the system that promises

the largest returns on the basis of normal yields, production standards, and assumed relative prices. Other factors than securing highest returns may, however, affect the choice. The farmer's likes and dislikes or the probable effect of changes in organization upon the farm as a home and other non-economic factors may influence his decisions. In any event, the budgeting of alternative production programs will serve as a check upon what has been accomplished and as a guide to future possibilities. It is for the farmer to decide whether the possible increased returns from changes in his farm organization are a sufficient incentive for putting them into effect.

Applicability of Suggested Systems to Other Farms

It is unlikely that the systems suggested for the three farms used in the illustrations could be applied directly to other farms; yet they have several points of flexibility that give them a wide range of adaptability. For example, the field in the rotation to be planted to cultivated crops may be given over entirely to either potatoes, sugar beets, or corn, or to any other combination of these crops, depending upon the location of the farm with reference to markets and the relative adaptability of the crops, as well as the resources to be utilized on the particular farm. Likewise, the small grains are to a degree interchangeable. Flax might take the place of barley in the rotation to a greater extent when corn displaces cultivated cash crops, as corn would take the place of barley in supplying feed for livestock. Moreover, dairy cattle, beef cattle, and sheep are interchangeable as a means of utilizing pasture, roughage, and bulky feed grains, the choice depending upon the kinds, relative amounts, and quality of feeds available, as well as the amount of labor available for attending livestock.

By application of the principles and the data used in the foregoing illustrations to specific conditions existing on other farms, and by budgeting the changes that promise increased returns, comparisons between the systems being followed and suggestive alternatives are possible. Budgets might be set up here showing the expected returns from suggested systems for various sets of resources, but they would be of little, if any, additional service to an individual working with the organization problems on his farm, as conditions on a selected farm would always only approximate his particular situation.

PLANNING FROM YEAR TO YEAR

After the production program has been adjusted in a thorogoing way to a new and more profitable type, the same general system of farming usually should be followed for several years. On the other hand, it is seldom advisable to plan to grow the same acreage of the

different crops or keep the same number of the different classes of livestock each year. Variations in the number of livestock born and in the size of the crops harvested may make this impossible unless deficits in feed and livestock are made up by purchases. Furthermore, if the farmer closely studies the conditions that influence prices, he usually will be able to form a more accurate judgment as to prices that can be expected during the coming year than would be indicated by the prices of the last year or by average price relationships. Frequently the influence of changes, either actual or prospective, in the relative prices of different products and in the costs of materials and services used in their production suggests a shift in the emphasis to be placed upon the different lines of production. It follows, therefore, that the plans for each year should be different, in at least some respects, from the plans for any other year.

As has been previously pointed out, each of the suggested systems presented in the three illustrations of long-time readjustments has points of flexibility at which minor adjustments in organization in response to changing prices and costs are possible. Let us assume, therefore, the short-time outlook to be changed materially from the relative prices used in budgeting the suggested system in Illustration No. 1. By what means is the operator of this farm to judge what shifts would be warranted from the productive program outlined in the illustration?

If the change in the price outlook should be limited to two competing crops, as, for example, barley and flax, a simple comparison of the changes in returns with the changes in direct cash costs occasioned by a shift from one to the other suffices. The suggested long-time cropping program in Illustration No. 1 provides for 40 acres of barley and 30 acres of flax. Let us suppose that the price of flax promises to be only $1.25 per bushel during the coming year, whereas the crop was sold for $1.90 per bushel the last season. The question arises as to whether or not flax should be dropped from the cropping system for the current year and the barley acreage increased to 70 acres. A method of working out the comparison is as follows:

Probable returns from flax

255 bushels (30 acres at 9 bushels less 15 bushels seed) at $1.25	$318.75
Threshing, 270 bushels at 12 cents	$ 31.00
Twine, at 52 pounds at 13 cents	7.00
Total, threshing and twine	38.00
Probable returns from flax above direct cash costs	$280.75

Probable returns from barley

848 bushels (30 acres at 30 bushels less 52 bushels seed) at 45 cents	$381.60
Threshing, 900 bushels at 4 cents	$ 36.00
Twine, 75 pounds at 13 cents	9.75
Total, threshing and twine	45.75
Probable returns from barley above direct expenses	$335.85
Probable difference in favor of barley	$ 55.10

The problem is seldom so simple, however, as the one just outlined. Usually the changes in prices suggest the advisability of the substitution of a crop that has materially different demands for the use of man labor and horse work, or that requires attention at a different time of the year from that of the crop to be displaced. Such substitutions usually mean less thoro handling of some crops, or the acquiring of extra labor and equipment. If more labor and equipment are provided to make possible the substitution, still other changes are likely to be necessary to avoid underemployment at other times of the year. Furthermore, it may appear advisable to consider changes in the cropping system that will mean less home-grown feed or a different ration for livestock. In cases of involved changes of these kinds, the problem is too complex for such simple comparisons as just illustrated, and it becomes necessary to prepare an annual budget of the entire farm program. As with the choice of a long-time program, it usually will be advisable to work out several trial budgets, thus arriving at an estimate of the returns that can reasonably be expected from the various programs of readjustments. By comparing one with the other, the plan for the coming year can be decided upon.

Annual budgets do not differ from long-time budgets except in time. In preparing annual budgets, it is necessary to adjust the basic data on prices, production, and the amounts of the physical factors used in the production of a unit of product to the current outlook.

Prices and costs can not be forecast with enough accuracy to make it unnecessary to be on the alert for minor changes in the direction of economic adjustments from which substantial gains may be realized. The more carefully the farmer has thought through these problems in advance, the better prepared he will be to meet such conditions when they arise.

Some men are likely to think that there is no advantage in budgeting the farm business because changes in weather and prices will make it impossible to follow a definite plan. Conditions may make it neces-

sary to substitute one crop for another when the planned crop fails, or to supply more labor or power if bad weather should interrupt the work during the rush season. The price outlook, too, may change from what was expected, making it advisable to deviate from the original plan. For example, it may be advisable to market meat animals at lighter or heavier weights, or to feed dairy cows lighter or heavier rations. But the necessity for such changes does not depreciate the value of a definite plan. Few, if any, businesses are unaffected by changing conditions to the extent that a year's operations can be budgeted and carried through without some replanning. Business on the farm as elsewhere will always require the constant supervision of men of good judgment to meet the ever-changing conditions as they occur. The greatest value of a budget as it has been here used lies in the fact that it involves clear and systematic thinking in advance of the time when final decisions must be made. It may at times require more than ordinary persistence to carry through a long-time plan for conducting the farm business; yet it pays in returns, as proved on many successful farms.