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PLANNING FARM ORGANIZATIONS FOR THE NORTHEAST CUT-OVER SECTION OF MINNESOTA

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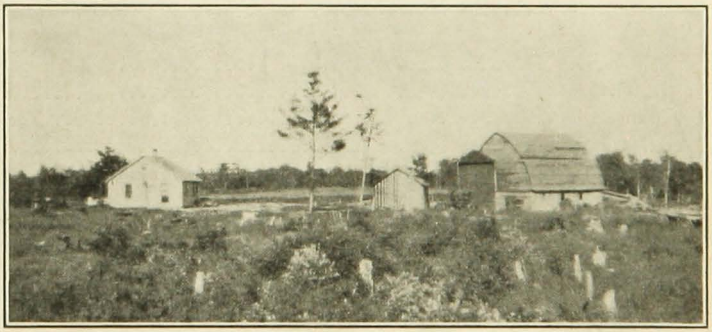

UNIVERSITY FARM, ST. PAUL

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PLANNING FARM ORGANIZATIONS FOR THE NORTHEAST CUT-OVER SECTION OF MINNESOTA

GEORGE A. POND and C. W. CRICKMAN

INTRODUCTION

The agricultural development of the cut-over section of Minnesota has progressed slowly. The removal of stumps and stones, the draining of swamps, and the opening of roads each requires much labor and have prevented more rapid development of the land. Moreover, much of the cut-over area has grown over with second-growth brush and timber, and everywhere there remain fallen trees of the original stand. Sandy jack-pine or scrub-oak land is less difficult to clear than the heavier soils, but it is markedly inferior for agriculture. Land that has been burned over requires little or no brushing; but the stumps and charred logs remain, and the repeated burnings have consumed much of the humus of the soil. Rarely is moderately easy clearing associated with reasonably good land. Such were the conditions that caused the westward tide of land settlement that occupied the southern and western parts of the state to pass by northern Minnesota almost completely as it moved on to the prairies of the Dakotas and beyond. In most of the settled areas of the cut-over section farming was begun within the present century.

Much of the land of this section is unsuited for agriculture. Some of it is better adapted to forestry or recreation. Unfortunately, however, it has been and is now the policy of many lumber companies and other land selling agencies operating in the cut-over region to sell the land they own to settlers regardless of its physical characteristics. This policy, together with the practice of selling for agricultural purposes widely scattered tracts of land to men who often have had little or no farming experience or have no capital, has served to accentuate the natural handicaps of the area in retarding the progress of settlers. At widely separated locations there are communities that have progressed in numbers and wealth sufficiently to provide public improvements—good roads, schools, and other social and economic advantages; but a majority of the settlers still have poor roads and few neighbors. They are waiting, pioneer fashion, for most of the social advantages to come to them. Many are of foreign birth; some do not understand or speak the English language, but in general they are thrifty, industrious, and hard-working.

Notwithstanding the fact that many settlers have come into the cut-over section without sufficient capital and experience for developing and operating a timberland farm, and in many instances have located on land that probably should have remained in forest, a large majority of them will persist in sticking by their homes and their investments. And year by year, in the absence of some systematic classification and settlement of cut-over lands, still others will undertake the task of hewing a farm from the wilderness under conditions no less unfavorable. But all settlers are alike in that they are all planning and laboring to develop a tract of land clear of stumps and stones, and to introduce a profitable system of farming. The difficulties of the misguided will continue to be great, and in some instances will prove to be insurmountable. Neverthless, every settler may obtain more or less help with his problems by inquiring into the experiences of his successful neighbors, and into the results of agricultural investigations made within the area. Farming in the cut-over region is different from that in older sections of the state. The problem has been and still is, to a large extent, to make a living from a small area under cultivation, often twenty acres or less, and at the same time to continue the clearing and development of the farm to the point for operation to best advantage.

NATURE OF THE STUDY

A study of the agriculture in the partially developed counties within the heavy-soils section of the cut-over region was begun in 1925 by the Minnesota Agricultural Experiment Station in co-operation with the Bureau of Agricultural Economics of the United States Department of Agriculture.[1] For the purpose of this study the area described is designated the "Northeast Cut-Over Section" (see Fig. 1). The study was continued during 1926 and 1927. In addition to general observations and an interpretation of statistical information periodically available, a detailed study was made of the organization and operation

[1] The authors wish to acknowledge assistance from the chiefs and members of the staffs of the Divisions of Agricultural Economics, Minn. Agr. Expt. Sta. and of Farm Management and Costs, Bureau of Agr. Econ., in organizing and developing this study, and in reviewing and criticising the manuscript. Special credit is due Andrew T. Hoverstad, former member of the staff of the Division of Agricultural Economics, for his services in collecting and tabulating the data; to Mark J. Thompson, Superintendent of the Northeast Experiment Station, Duluth, for his helpful suggestions during the preparation of the manuscript; and to F. H. Tomlinson, who supervised the collection of the data in the field. The thanks of the authors and of the divisions making this study are due the following farmers in Pine County for their co-operation in furnishing data for this bulletin: D. J. Adolphsen, Jens Arnbal, Hans Clausen, Fred Degerstrom, Knud Feldtmose, Christ Flint, Chris Frederiksen, Gregersen Bros., Jens Gregersen, Jens Hansen, Henrik Henricksen, Jens Henriksen, Wayne Jacobsen, Adolf Jensen, Christ Jensen, Fred Johnsen, A. C. Jorgensen, Johannes Juhl, Christ Larsen, Niels Miller, Christ Morgensen, N. P. Nedegaard, Vilhelm Nielsen, L. C. Pedersen, Petersen Bros., R. P. Rasmussen, Chris Sandahl, Peter Simonsgaard, Arnold Sorensen, Christian Sorensen, Jeppe Sorensen, Lawrence Thompsen, and Holger Voetmann.

of a group of representative farms in the Askov community of Pine County (see Fig. 1). Complete records of the crop and livestock production; the labor, power, equipment, and materials used in production; and the financial transactions of each farmer for each year were obtained to serve as the basis for judging the relative desirability of different combinations of crops and livestock under the conditions of this area and for studying the best methods of handling the crop and livestock enterprises in these combinations.

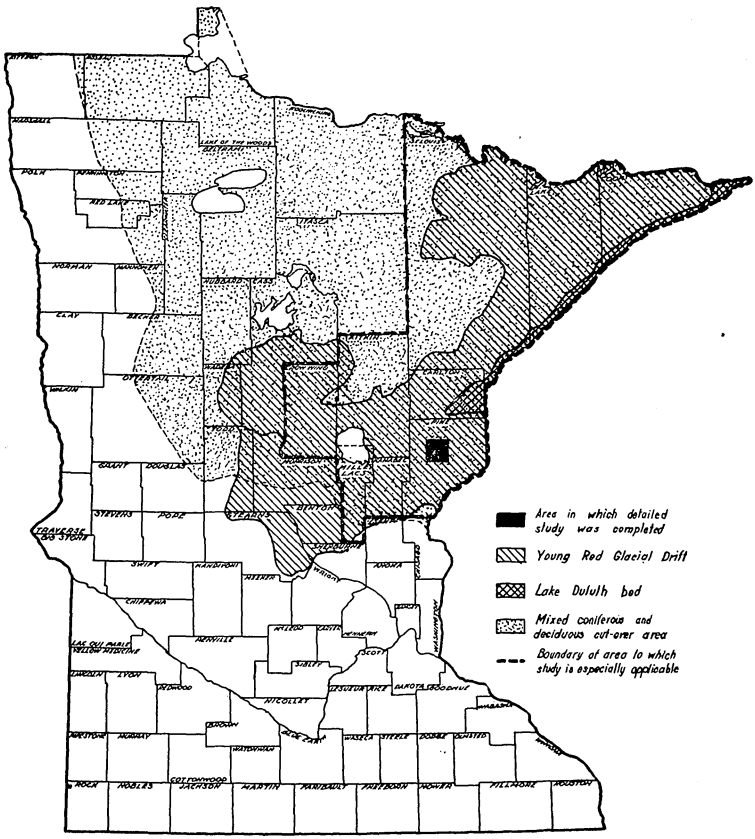

Fig. 1. Location of Area Studied

This study is concerned chiefly with the partially developed cut-over counties within the area covered by the young red glacial drift and the Lake Duluth bed. (Data from Surface Formations and Agricultural Conditions of Northeastern Minnesota. Minnesota Geol. Survey Bulletin 13 by Leverett and Sardanson.)

DESCRIPTION OF THE NORTHEAST CUT-OVER REGION

Topography and Soils

The topography of northeastern Minnesota varies from level to very rough and steep. Soils, likewise, are of uneven quality. Broadly classified, the soils of the cut-over region of the state are of two types, the sandy, loose-textured soils and the heavy loam or clay soils. In general, the heavy soils are confined to a group of counties bordering Lake Superior, while the sandy soils are located farther west. Within small areas throughout this section of the state, soils of both fairly good and extremely poor quality are found. Some parts of the northeastern cut-over section, however, have more of the fairly good soils than others. Basing the classification on the productivity and cultural possibilities, the soils fall into four broad groups.[2]

The area included in Group 1 (Fig. 2) is studded with outcropping rock and strewn with large boulders. Because of the scanty covering of soil, the broken relief, and the presence of many boulders, the rocky hills and stony ridges have little or no agricultural value. They are largely within the national forests, and yield better returns from their forest covering than could be obtained by farming them. A small amount of reclaimable land is adapted to the growing of hay and pasture, but its use is necessarily restricted to supplying residents having an income quite independent of agriculture, such as game wardens, forest rangers, lumber company employees, and summer resort operators.

Group 2 (Fig. 2) includes the lacustral soils adjacent to Lake Superior. They are prevailingly a heavy reddish gray clay with a heavy red subsoil through which water moves slowly. Stone is absent or is found in only small amounts. Much of the area is broken by deep gullies. These soils are moderately productive.

The area included within Group 3 (Fig. 2) is one of extensive peat bogs. The soils of this group are naturally water-logged. After being drained they are unproductive until properly fertilized. They are usually well supplied with lime, but need applications of phosphorus- and potassium-bearing fertilizers. In dry seasons they are subject to the hazards of fire, and crops grown on peat soils are often damaged by frosts in the growing season. Wherever they can be drained sufficiently to keep the water table from three to four feet below the surface, they can be converted into highly productive pastures and meadows, but at considerable expense. Dairy farmers often find it economically

[2] The authors are indebted to F. J. Alway, Chief of the Division of Soils, Minnesota Agricultural Experiment Station, for outlining the soil groups in Figure 2 and for the description of each group.

feasible to reclaim small peat areas included in or adjacent to developed mineral soils. In many places the peat layer is only from one foot to three feet in thickness and is gradually being burned off in dry seasons.

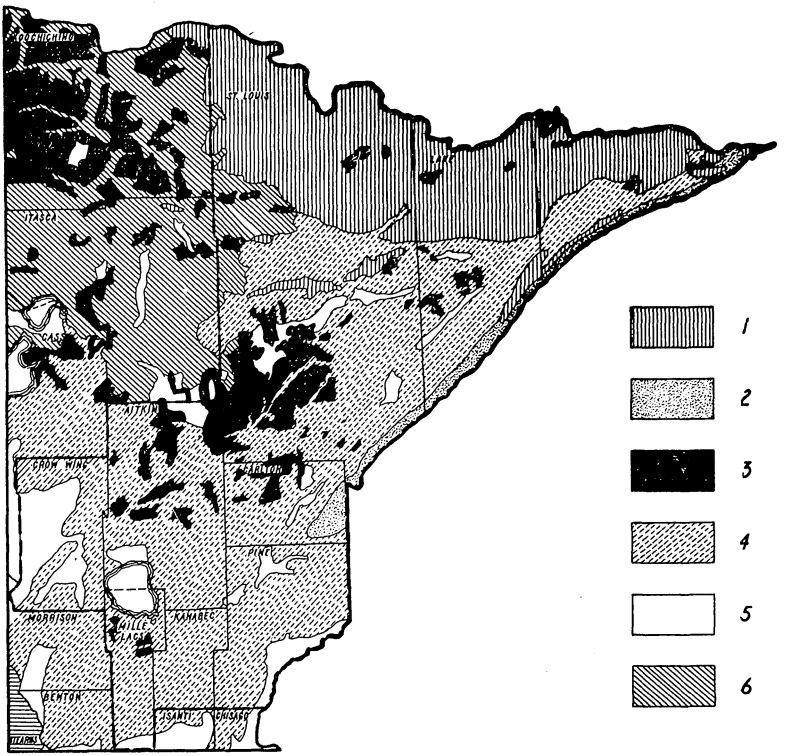

Fig. 2. Map of Broad Soil Groups in the Northeastern Cut-Over Section and Adjoining Counties

The soils are classified with respect to productivity and cultural possibilities. A description of each group is presented in the text, pages 8 to 11. (Map presented through the courtesy of Dr. F. J. Alway, Chief of the Division of Soils, Minnesota Agricultural Experiment Station.)

The soils of that part of Group 4 lying east and north of the Floodwood swamp are a complex of large and small peat bogs with very stony loam on the higher land. The peat bogs occupy one-fourth to one-third of this area. On many of the large tracts of stony loam and on innumerable small ones the boulders are so large and so numerous as to preclude the use of tillage implements (see Fig. 3). Rough and hilly relief is characteristic of the area, and many tracts have a stony or gravelly subsoil that makes them very droughty.

The soils of the southern and western parts of Group 4 are a complex of stony loam, peat bogs, sand plains and ridges, and wet clay

loam in many saucer-like depressions. The areas of light sandy soils are found in the extreme southeastern and north central parts, with extensive sandy plains in the western part. After proper drainage, the almost stone-free, wet, clay loams of the depressions are productive, but the necessary drainage requires much labor, and, in many places, capital outlay. After the removal of the larger stones, the productivity of the stony loam, the main soil of this group, is moderately high, except for alfalfa and sweet clover. Liming is usually unnecessary for alfalfa, but a hard substratum in most soils of this type prevents deep root penetration and in dry seasons causes alfalfa to produce poor yields. Liming is usually necessary for sweet clover.

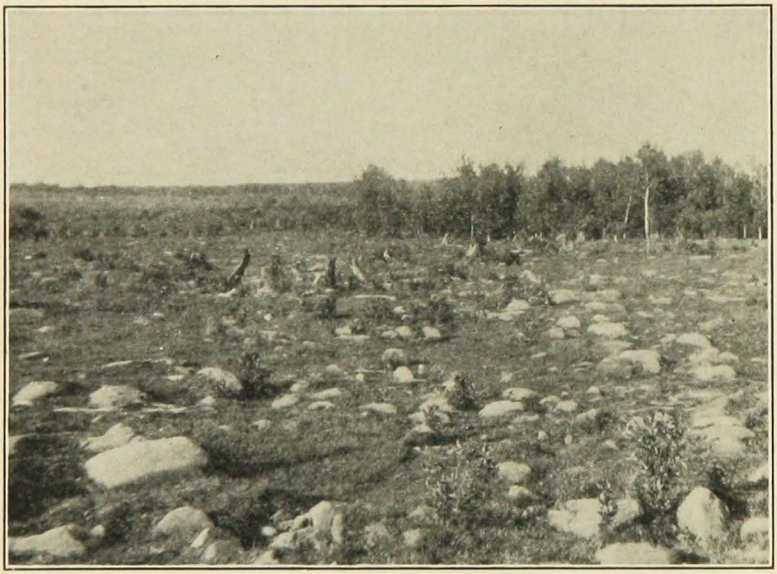

Fig. 3. A View of Cut-Over Land Suited Only to Pasturing

On many of the large tracts of stony loam and on innumerable small ones the boulders are so large and so numerous as to preclude the use of tillage implements.

Groups 5 and 6 protrude into the nine-county area along the western border, but the larger areas covered by these two soil groups are not considered a part of the territory to which this study is specially applicable. Small areas of sandy soils and loams that have sandy or gravelly subsoils close enough to the surface to make them distinctly droughty (Group 5) are scattered throughout Group 4. These soils vary in type from those with a light, drifting sandy surface with a deep sandy subsoil to black sandy loams with gravelly subsoils. The former are second-rate alfalfa land, but only third-rate land for most other crops. The black sandy loams with gravelly subsoils do not pro-

duce alfalfa satisfactorily, tho they may be considered second or third rate for most other crops except grasses. Soils of this group make very poor pasture land.

The soils in the Askov community, in Pine County, are representative of the stony phase of the cut-over loams. It was necessary to remove a great quantity of stone from the surface before tillage machinery could be used. Some tracts are far too stony to justify the expense of clearing.

It can be said of all this section of the state that the soils are essentially timber land soils, having an abundance of potential mineral plant foods, but very low in organic matter and nitrogen. In many parts repeated forest fires have burned off the leaf mold that was previously in the soil. Consequently most crops are benefited by the addition to the soil of nitrogen-carrying materials, either in the form of crop residues and barnyard manure or through the use of leguminous crops in the rotation.

Climate

The climate in northeastern Minnesota is temperate, with rather long, cold winters and short, pleasant summers. The temperature is most changeable during fall and spring. Extremely cold weather with temperatures far below zero last, as a rule, for only short periods; thawing temperatures, also, are of short duration in the winter. Snow usually covers the ground throughout the winter.

The average length of the frost-free season for most of the area ranges from 120 days in the southern part to 90 days farther north (see Fig. 4). Similarly, the average date of the latest frost ranges from May 11 to June 6, and the earliest from September 1 to October 1 (see Figs. 5 and 6). Lake Superior gives to the land along its shore in some places a frost-free season of 130 to 140 days (see Fig. 4). This lengthening of the season near the lake occurs in both spring and fall, particularly in the fall. Altho the normal frost-free season for the area as a whole is shorter than in the agricultural sections of southern Minnesota, a more rapid growth, especially marked in the case of clover and small grain, is noticeable. The longer summer days probably have a slight influence in counteracting the short growing season. Occasional light frosts in July and August, particularly on the peat soils, cause damage to the more tender crops and arrest the growth of other crops. The number of killing frosts between May and September over a period of years is presented, by months, in Table 1 for ten weather stations located in the area.

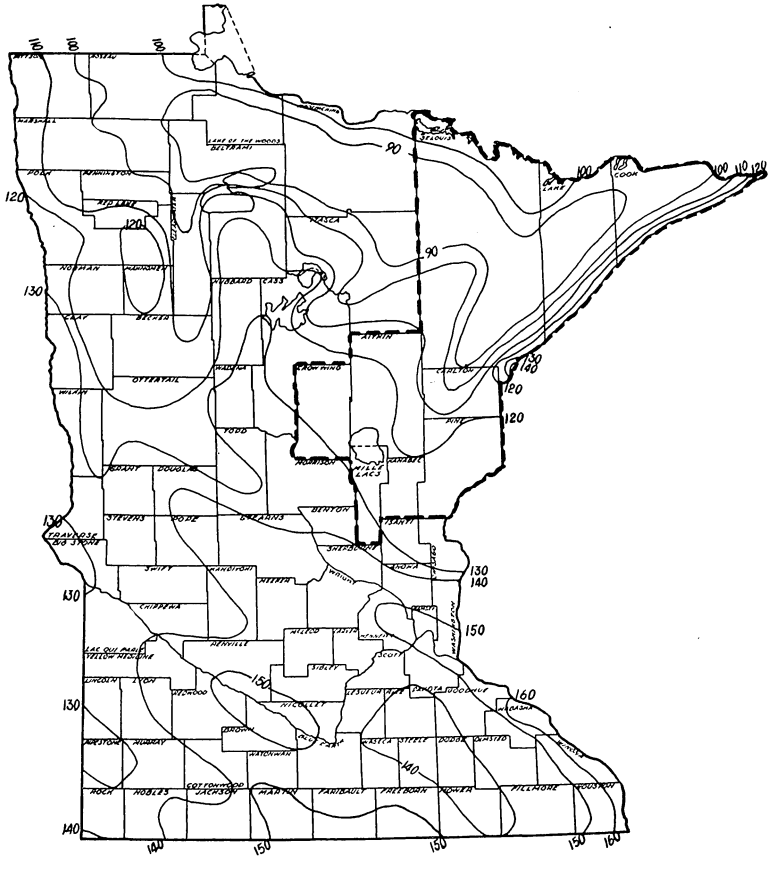

Fig. 4. Average Number of Days Without Killing Frost

The solid black lines are drawn through points at which the average number of days without killing frost is approximately the same. (Data from United States Weather Bureau as reported in U. S. Dept. of Agr. Cir. 160, p. 11.)

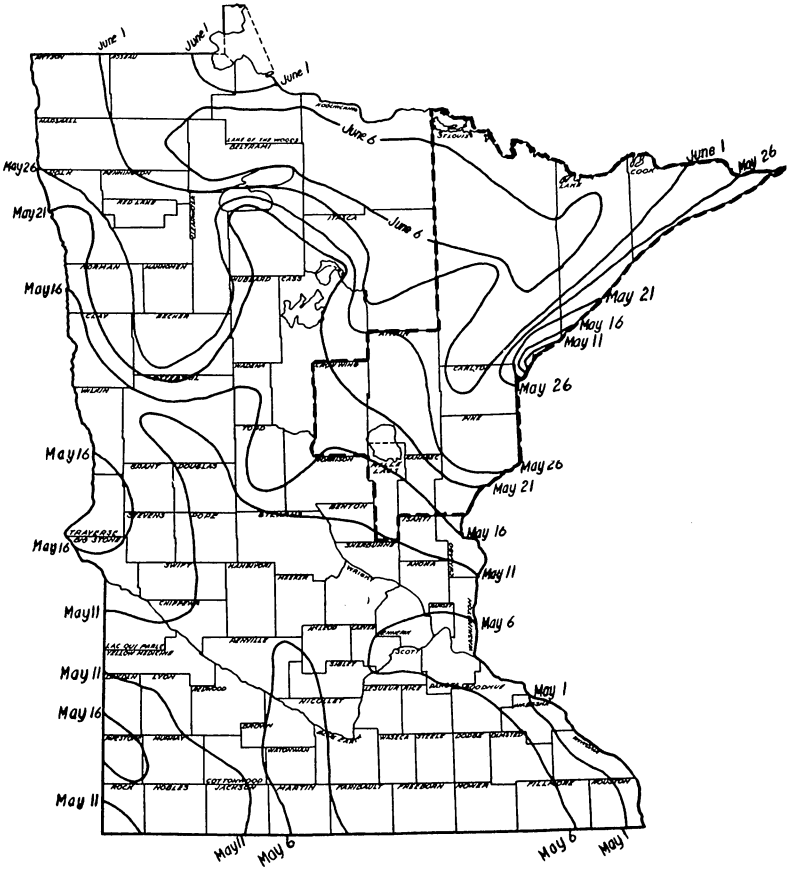

Fig. 5. Average Date of Last Killing Frost in the Spring

The average date of the last killing frost in the spring ranges from May 11 along the shore of Lake Superior above Duluth to June 6 in the Iron Range country. (Data from United States Weather Bureau as reported in U. S. Department of Agr. Cir. 160, p. 12.)

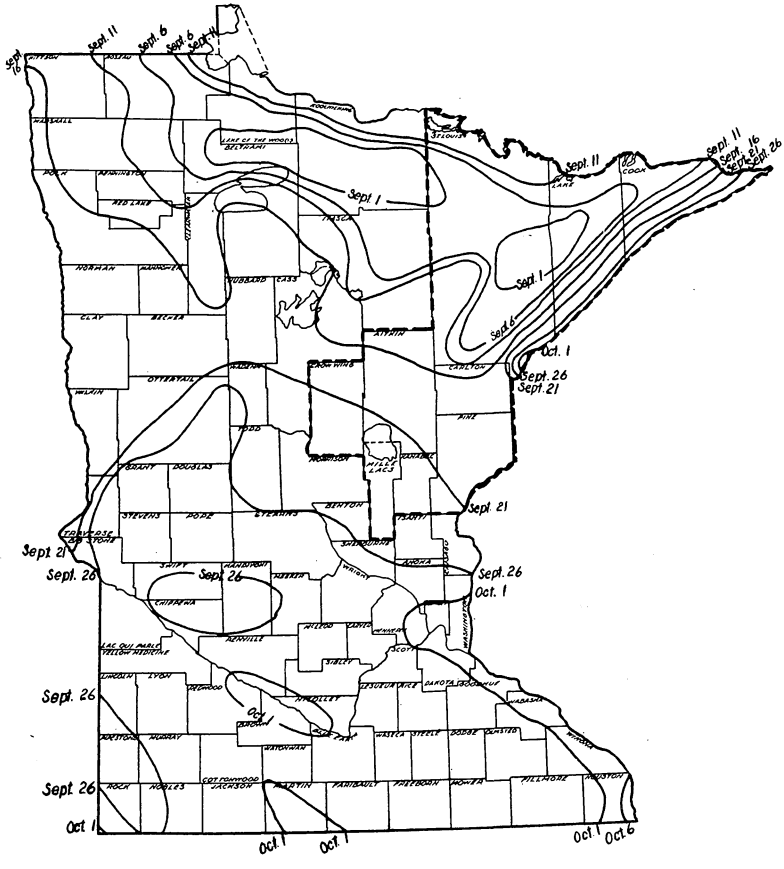

Fig. 6. Average Date of First Killing Frost in Fall

The average date of the first killing frost in the fall ranges from September 1 on the Iron Range to October 1 along the lake shore. (Data from United States Weather Bureau as reported in U. S. Dept. of Agr. Cir. 160, p. 12.)

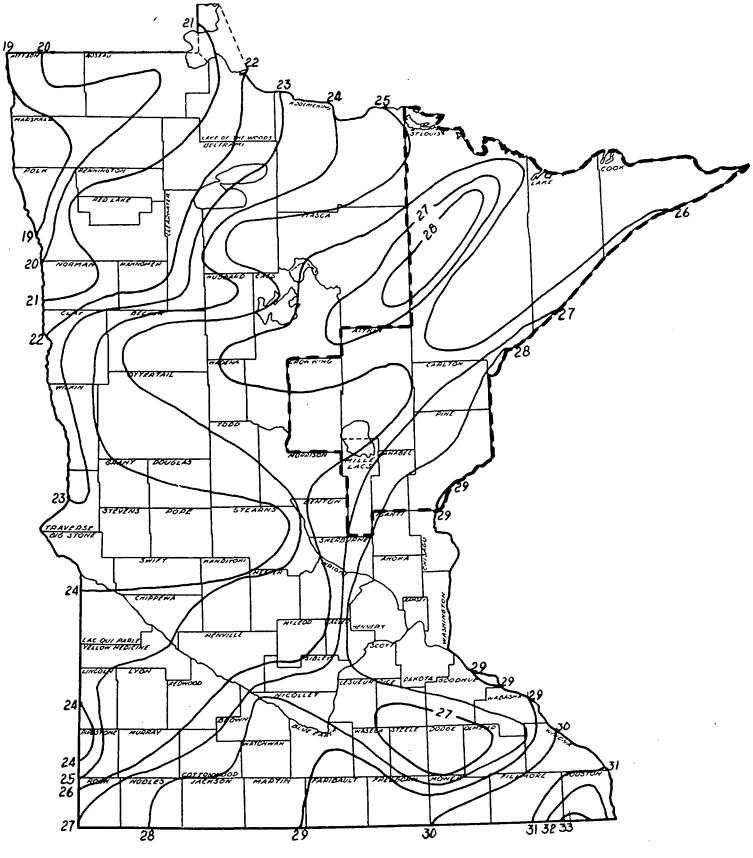

Fig. 7. Average Annual Rainfall

The average annual rainfall in the northeast cut-over section ranges from a maximum of 28 inches in southeastern Pine and Carlton Counties and in Central St. Louis County, to a minimum of 26 inches over much of the area north of Lake Superior. (Data from United States Weather Bureau as reported in U. S. Dept. of Agr. Cir. 160, p. 14.)

Table 1

Number of Years in Which a Temperature of 31 Degrees F. or Lower Was Recorded at Stated Weather Stations During the Growing Season, May to September, 1912-29*

Station	May		June		July		August		September	
	Years of record	Years frost occurred	Years of record	Years frost occurred	Years of record	Years frost occurred	Years of record	Years frost occurred	Years of record	Years frost occurred
Cloquet	18	17	17	12	18	2	18	7	18	17
Duluth	18	14	18	0	18	0	18	0	18	11
Grand Marais.	10	9	10	0	10	0	11	0	12	5
Hinckley	10	10	10	3	10	0	10	2	10	7
Meadowlands .	13	13	13	8	12	2	13	8	13	11
Milaca	14	12	14	1	14	0	13	0	15	11
Mora	17	15	17	0	16	0	17	0	17	12
Two Harbors.	18	15	18	0	18	0	18	0	18	8
Virginia	18	17	18	6	18	0	18	0	17	4
Winton	3	3	3	1	3	0	3	0	3	2

* Compiled from reports of the United States Weather Bureau.

The average annual precipitation in this area ranges from 26 to 28 inches (see Fig. 7). Altho less rain falls here than in the southern part of the state, the cooler climate compensates in a measure for this and, except on the more porous, droughty soils, the supply of moisture is usually sufficient to support good crops. The moisture is well absorbed by the soil, as heavy downpours and high winds seldom occur. In general, the largest proportion of the rainfall comes during the growing season, the time of greatest benefit to crops grown on well drained land (see Fig. 8).

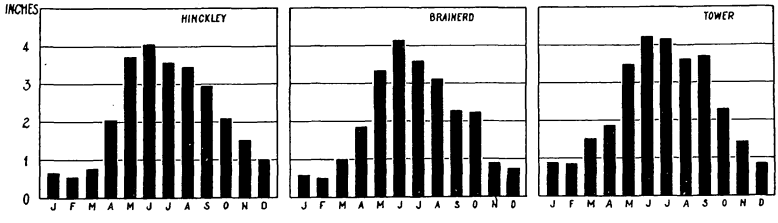

Fig. 8. Average Monthly Precipitation

The monthly distribution of precipitation is fairly uniform in northeastern Minnesota. Approximately 75 per cent falls during the six months from April 1 to September 30. (Data from United States Weather Bureau Reports.)

Adaptation of Crops

Because of the cool summers and the sufficiency of rainfall during the growing season, the grasses and legumes grow abundantly. The soil, as well as the climate, is well adapted to timothy and both are favorable to clover. These plants grow wild in the woods, and fair stands are obtained from seeding on new land with no preparation of the soil. Sown in a wild hay meadow or on stump or light-brush

land, the clovers, especially alsike, compete successfully with the wild grasses. Millet is well adapted to the region and frequently is grown for hay. The most common native grasses are redtop, Italian brome grass, wire grass, and blue joint.

Among the grain crops, oats and barley grow best. Wheat, rye, flax, and buckwheat are all grown successfully, but none of these crops has proved as satisfactory as barley and oats. The growing season is somewhat short for corn. However, if the season is not too unfavorable, early maturing varieties can be ripened for grain in the southern counties, and corn can be grown either for curing as fodder or for ensilage. Sunflowers, also, are well adapted to the production of ensilage.

Both the soil and the climate are favorable to the growing of potatoes. Grown on land newly cleared or land previously in clover, the yields are large and the quality excellent. All the roots commonly grown for livestock—rutabagas, mangels, stock carrots, turnips, and sugar beets—have been grown with success. Rutabagas have proved the most satisfactory of the root crops, as they generally give a greater yield, will produce a crop under poorer conditions of soil and climate, and are commonly in demand for food.

Vegetables of practically all kinds are grown. Garden crops are of excellent quality. Among the small fruits, strawberries, raspberries, gooseberries, and currants do especially well. Red raspberries and blueberries grow wild. The plum is the only tree fruit that is generally adapted to the region. Apples can be grown under favorable conditions.

Crop Yields

Yearly average yields for the last ten years of the crops commonly grown in the northeastern section of the state are shown in Table 2.

Table 2

Yearly Average Yield per Acre of Specified Crops Grown in Northeastern Minnesota, 1921-30, and a 10-Year Average*

Crop	Year										10-year av.
	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1921-30
	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.
Oats	22	38	36	40	41	32	27	39	32	40	35
Barley	21	28	29	33	31	28	28	32	25	29	28
Wheat	11	16	14	24	15	16	12	15	14	16	16
Rye	21	22	17	23	18	16	20	18	16	21	19
Corn	40	30	34	24	29	28	18	27	23	24	28
Potatoes	90	117	115	150	128	115	108	97	89	89	110
	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons
Tame hay	1.2	1.7	1.2	1.7	1.7	1.3	2.1	2.2	1.5	1.5	1.6
Wild hay	1.2	1.2	1.3	1.4	1.3	0.8	1.6	1.3	1.1	1.2	1.2

* Compiled from the annual Crop Reports of the Minn. St. Dept. of Agr. by averaging the reported yields for Cook, Lake, St. Louis, Carlton, Pine, Kanabec, Mille Lacs, Crow Wing, and Aitkin Counties.

The yield of fodder corn has been from 1½ to 2 tons of cured fodder per acre, or from 4 to 6 tons per acre for silage. Under normal conditions the yield of rutabagas has been from 10 to 12 tons per acre. Under especially favorable conditions 20 tons of rutabagas have been grown. The record of ten tests of growing sunflowers for silage at the Northeast Experiment Station, Duluth, averaged approximately 9 tons per acre.

Transportation and Markets

The transportation facilities of the cut-over section are not of the best. The main lines of the present railway systems extend northwest from Chicago and Milwaukee through Minneapolis and St. Paul, with branch lines to Duluth serving this territory, and thus leave the northeast cut-over section off to one side of the main current of traffic. The grain and iron-ore lines centering at Duluth and Superior furnish the chief means of transportation for the northern part of this area. From this northern section, the St. Paul and Minneapolis markets are reached by way of Duluth. Water transportation is available along the north shore of Lake Superior during the seven months of open navigation.

While many short branches have been extended from the main railway lines entering Duluth and Superior, the mileage of these branches is decreasing rather than increasing. These short lines depend mainly on traffic from timber, which has been or is being depleted rapidly. With the increasing shortage of freight tonnage many of the branch lines run trains in the winter only or on irregular schedules. Many miles of such lines have been abandoned, and as a large part of the region is no longer producing timber, there is a great likelihood that additional trackage will be abandoned in the future unless settlement should increase at a much more rapid rate than it has in the past.

A system of good graveled roads, built and maintained with state aid, connects most of the principal trading centers of the area. Motor transports, both passenger and freight, travel most of these roads on regular schedules. But other roads, for the most part, are unimproved and frequently are not passable with an automobile in wet weather. They are narrow, graveled only in spots, and are not maintained regularly.

Practically all the surplus livestock from the area is marketed at South St. Paul. Private or co-operative creameries are located wherever the dairy production within a community is sufficiently heavy to provide enough butterfat for their successful operation. Otherwise, dairy products are marketed as cream to centralizer creameries in Duluth. Potatoes are shipped to the Twin City markets. Rutabagas

find a market principally in the southern states, Texas having taken a large share of the crop.

In most parts of the northeast cut-over area there is a market in local cities for dairy products, eggs, vegetables, and fruits. However, there are comparatively few large cities or towns in the area—Duluth and the iron range towns are the best local markets. In the past, lumber companies have furnished an outlet for hay and vegetables but with the decline in lumbering operations this has largely disappeared. The summer tourist trade affords a market for whole milk, eggs, fruits, and vegetables that as yet has not been supplied locally to its fullest possibilities. Production for these local markets, however, altho they offer a price premium over outside outlets, is capable of only limited expansion without destroying this price advantage.

AGRICULTURAL DEVELOPMENT OF NORTHEASTERN MINNESOTA

History of Settlement

Fur traders and trappers followed the explorers into northeastern Minnesota and established trading posts at various points along the rivers and lakes. After the height of the fur trade was over, when many of the wild animals had been killed or driven away, the lumbermen came. And after the lumberman had arrived there came an occasional settler, who hoped to make a living from the land. The lumber industry increased steadily up to about 1905. As long as logging furnished outside employment, settlers worked in the lumber camps during the winter and farmed small clearings in the summer. Few agricultural communities were established permanently under this system, however. But with the passing of the lumber camps and with the opportunity gone for outside employment in winter, the development of farms was begun more earnestly. Many ex-woodsmen became settlers. The prices prevailing for farm land on the prairies seemed relatively high and caused many farmers in older settled sections to migrate into the cut-over region, where land could be obtained at low prices. The high cost of living was instrumental in inducing city workers to settle in the cut-over country in search of a cheap living from cheap land. Expansion in the number of farms received its first impetus in the six counties in the southern part of the northeast cut-over section in the decade 1890-1900 (see Table 3). The rapid increase in the number of farms in the three counties north of Lake Superior followed 1900. According to the Federal census, 37.6 per cent of the land area of the southern group of counties was in farms in 1930. While only 7.4 per cent of the area of the three northern counties was in farms in 1930, the percentage of farm

land improved in these counties compared favorably with the southern group. These percentages were 34.8 for the northern group and 46.1 for the southern group.

Table 3

Progress of Agriculture in Northeastern Minnesota, 1870 to 1930, According to the Federal Census

Year	No. of farms	Acres of land in farms	Percentage of total area in farms	Percentage of total farm land improved	Value per acre of land and buildings	Percentage of farm land in crops exclusive of wild hay	Population*
			Cook, Lake, and St. Louis Counties				
1870....	†	633	‡	17.5	$25.28	†	1,565
1880....	136	15,428	0.2	23.9	12.05	9.4	1,190
1890....	340	43,611	0.7	12.0	25.56	4.4	13,144
1900....	751	67,908	1.1	16.2	14.70	12.7	35,427
1910....	2,821	319,043	4.9	14.1	20.35	9.0	94,156
1920....	4,620	447,424	6.9	22.3	37.35	16.3	117,566
1925....	7,587	600,927	9.3	29.5	48.16	18.8	†
1930....	5,297	482,047	7.4	34.8	59.22	19.6	112,636
			Aitken, Carlton, Crow Wing, Kanabec, Mille Lacs, and Pine Counties				
1870....	†	15,706	0.4	14.4	6.29	†	2,514
1880....	344	53,440	1.3	23.7	7.06	15.0	7,286
1890....	1,530	210,543	5.2	17.8	8.67	12.3	25,062
1900....	5,801	721,907	17.9	20.2	10.93	18.3	55,236
1910....	8,052	935,778	23.3	28.3	26.83	24.6	77,835
1920....	11,697	1,300,790	32.3	34.9	63.04	23.9	103,383
1925....	12,973	1,385,683	34.5	46.1	54.28	26.6	†
1930....	13,081	1,458,452	37.6	47.4	49.50	21.8	104,766

* Exclusive of Duluth.
† Not recorded by the census.
‡ Less than one-tenth of one per cent.

Changes in Crop and Livestock Production

With the exception of the practical disappearance of wheat from among the crops commonly grown in northeastern Minnesota, there has been little change in the percentage of the crop land devoted to the various crops (see Fig. 9). During the period of rapid expansion in settlement about 1910, tame hay occupied a relatively larger acreage than it has in more recent years. Oats have occupied annually approximately 20 per cent of the cropped area since 1919. The acreage of barley has increased rather steadily since 1924, but the crop land devoted to this crop has not yet exceeded 8 per cent. The relative importance of rye has gradually declined. Next to oats, corn is the most important grain crop, within the limits of its adaptation. Very little corn is grown in Carlton and the lake-shore counties. Potatoes are the principal cash crop. The acreage of potatoes, however, has not increased so rapidly as has that in feed crops. The heavy labor demands of potatoes makes it impractical to continue increasing the potato acreage as the size of the cleared area increases. Tame hay has rapidly

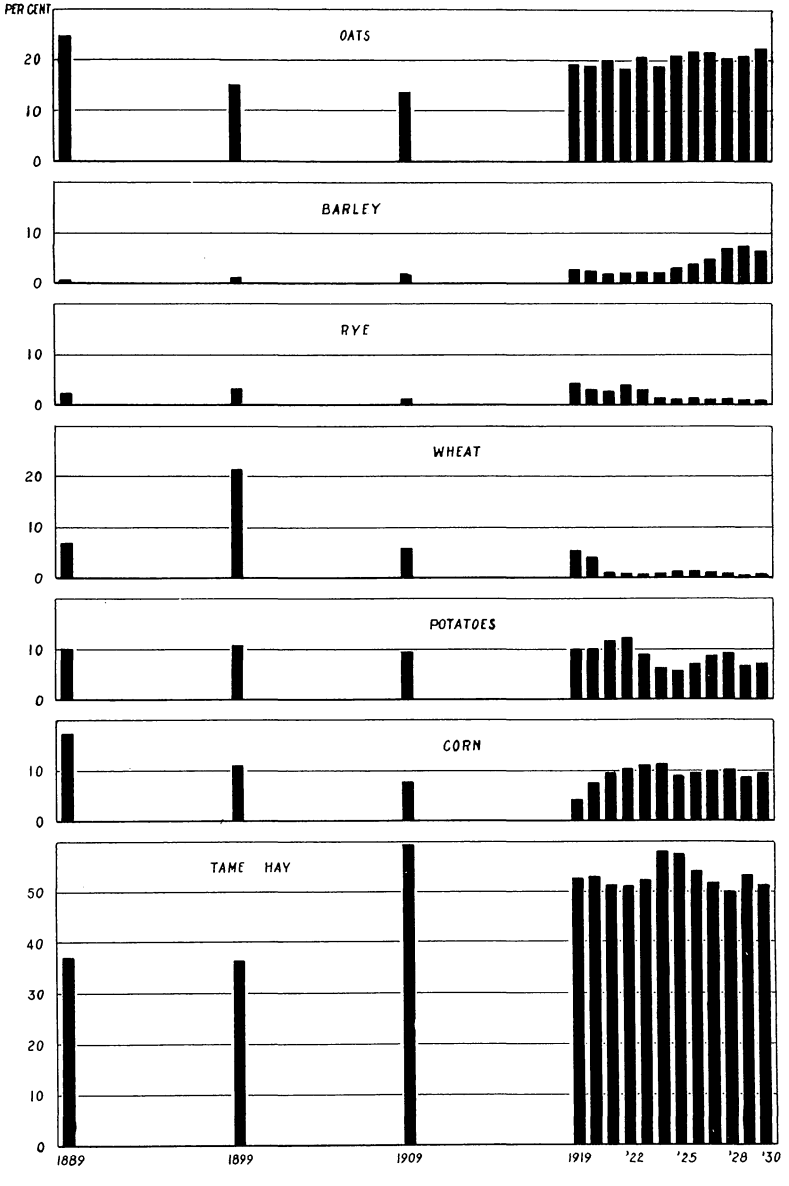

Fig. 9. Changes in the Choice of Crops in the Northeast Cut-Over Section, 1889-1930, as Shown by the Percentage Distribution of Seeded Crops

The trend in the percentage of crop land devoted to wheat has been downward; that in the percentage devoted to feed crops has been generally upward.

supplanted wild hay in this area, where clover stands are so easily obtained on the virgin soil. Since 1910, approximately half of the area in crops has grown tame hay.

The changes in the numbers of the different kinds of livestock per farm have been relatively greater than have those in the crops. On the whole, the numbers of livestock per farm have increased steadily since 1880 (see Table 4). The number of cows had increased to an average of seven per farm in 1924. The decrease in the numbers of cows following 1924 reflects a less favorable relation between butterfat prices and feed costs than that which prevailed in 1924. This area normally imports a considerable part of its concentrated dairy feed. The numbers of sheep averaged less than 3 per farm in 1929, but the trend in numbers during the last few years has been upward, particularly in Aitken, Kanabec, and Mille Lac Counties. The average numbers of hogs per farm increased between 1910 and 1920, perhaps more than the figures in Table 4 indicate in view of the change in census date from April 15 in 1910 to January 1 in 1920. Over the longer period, from 1910 to 1930, however, the numbers decreased. The census dates were April 15 in 1910 and April 1 in 1930. The size of the hog enterprise in the cut-over section bears a close relationship to the amount of skimmilk and other by-product feeds available.

Table 4

Total Numbers of Different Classes of Livestock on Farms in the Northeast Cut-Over Section of Minnesota and Average Number per Farm*

Year	Cows		Other cattle		Sheep		Hogs	
	Total	Av. per farm	Total	Av. per farm	Total	Av. per farm	Total	Av. per farm
1880	1,299	2.7	1,943	4.0	465	1.0	575	1.2
1890	5,154	2.8	6,153	3.3	1,964	1.0	3,197	1.7
1900	17,722	2.7	30,899	4.7	10,415	1.6	11,725	1.8
1910	52,308	4.8	36,678	3.4	16,624	1.5	15,727	1.4
1920	89,912	5.5	68,397	4.2	43,682	2.7	35,437	2.2
1923	113,800	7.0	45,500	2.8	33,500	2.0	61,500	3.8
1924	117,900	7.2	43,400	2.6	35,200	2.1	61,300	3.7
1925	103,700	5.0	64,800	3.2	40,800	2.0	52,400	2.6
1927	98,400	5.7	63,000	3.6	38,500	2.2	52,900	3.1
1929	100,500	5.9	77,700	4.5	50,500	3.0	47,200	2.8
1930	104,091	5.7	74,600	4.1	65,737	3.6	20,999	1.1

* Compiled from records of the Federal Census and Minnesota State Farm Census. Census dates were June 1 from 1880 to 1900; April 15, 1910; January 1 from 1920 to 1929; and April 1 in 1930.

Present Organization of Farms

Northeast cut-over section.—Approximately 80 acres is the most common size of farm in each county, except Crow Wing, of the northeast cut-over section south of Lake Superior (see Table 5). Slightly

more than half of the farms in Crow Wing County contain 100 or more acres. In St. Louis and Lake Counties, 40-acre farms are most common. Farms ranging from 120 to 160 acres in size rank second in number in counties where 80-acre farms predominate, except in Carlton County. The many small farms in Carlton County are partly explained by the nearness of Duluth and the opportunity thus afforded for truck farming and poultry raising.

Table 5

Percentage Size Distribution of the Farms Studied in Pine County and of All Farms in Northeastern Minnesota, by Counties, According to the 1930 Federal Census

Size group, acres	Farms studied in Pine County	County								
		Lake	St. Louis	Carlton	Mille Lacs	Pine	Aitkin	Cook	Kanabec	Crow Wing
	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
Under 20	...	6.4	5.0	2.9	3.1	2.6	2.2	2.4	2.0	9.1
20– 49	2.5	39.0	31.3	26.8	17.0	14.0	20.6	19.7	11.9	15.3
50– 99	51.2	30.5	30.2	41.2	43.3	38.9	33.3	24.4	35.9	23.2
100–174	35.0	19.8	27.0	22.8	28.6	33.4	30.2	37.8	33.5	30.6
175–259	10.0	3.0	4.5	3.4	5.7	7.6	8.5	11.8	9.5	12.0
260–499	1.3	1.3	1.6	2.3	1.9	3.0	4.7	3.9	6.6	8.0
500–999	...	...	0.3	0.6	0.3	0.5	0.4	...	0.6	1.5
1,000 and over	...	...	0.1	...	0.1	...	0.1	...	*	0.3
Average ...	113.8	77.5	91.2	91.4	100.2	110.0	116.2	117.0	125.2	139.9

* Less than one-tenth of one per cent.

Farm values in this area, according to the 1930 census, averaged from $32 per acre in Cook County to $68 in Mille Lacs County (see Table 6). The farms are improved with buildings ranging in number, size, and construction from those illustrated on the cover page to those pictured in Figure 10. The investment in improvements generally is dependent on the stage of development of the land.

Table 6

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 Federal Census

County	Value of land and buildings per acre 1930	Ratio of debt to value, 1930	Percentage of tenancy			
			1910	1920	1925	1930
		per cent				
Cook	$32.25	12.4	1.4	2.8	2.6	2.4
Lake	51.82	25.3	1.0	1.9	2.3	1.7
St. Louis	47.81	27.1	3.2	3.4	2.8	3.6
Aitkin	33.60	35.7	6.2	6.6	8.6	12.0
Carlton	54.16	32.4	3.7	3.6	4.3	6.6
Crow Wing ..	37.89	34.5	10.4	17.4	16.6	19.4
Kanabec	55.33	44.6	5.9	9.6	14.2	19.3
Mille Lacs	67.82	40.6	9.3	9.9	15.3	20.9
Pine	52.50	40.4	5.4	7.5	10.0	15.3

A great majority of the farmers are owner-operators. Most owner-operated farms were heavily mortgaged in 1930, however. The ratio of debt to value of owned farms in the counties south of Lake Superior ranged from about 35 to 40 per cent, and was slightly above 44 per cent in Kanabec County (see Table 6). In general, the percentage of tenancy has been increasing since 1910 (See Table 6).

Fig. 10. Well Developed Farmstead in Pine County

In many of the older and more fully developed sections of the northeast cut-over region improvements like these are being constructed to replace less expensive building equipment such as is illustrated on the cover page. The latter are fairly typical of the newly cleared areas.

Table 7

Distribution of Acreage of Farms Included in Study in Pine County*

Crop	Total acreage†	No. of farms growing the crop	Acreage on farms growing the crop			Per cent of total crop acreage
			Average	Maximum	Minimum	
Pasture	3,172	80	39.7	112.1	2.5	41.8
Tame hay	1,157	78	14.8	40.4	0.1	15.2
Oats	862	71	12.1	34.4	1.8	11.4
Wild hay	751	68	11.0	45.0	0.3	9.9
Corn	630	78	8.1	19.1	1.1	8.3
Potatoes	368	80	4.6	17.6	0.5	4.8
Rutabagas	296	76	3.9	12.2	0.5	3.9
Oats and barley	119	13	9.2	26.8	2.1	1.6
Millet	99	36	2.8	9.8	0.2	1.3
Alfalfa	48	22	2.2	8.2	0.3	0.6
Rye	31	4	7.8	24.3	1.6	0.4
Barley	27	9	3.0	4.9	0.8	0.4
Wheat and oats	7	3	2.3	3.2	2.1	0.1
Wheat	2	2	1.0	1.0	1.0	‡
Miscellaneous crops	20	37	0.5	3.0	0.1	0.3

* Records were obtained from 22 farms for the entire three-year period, 1925-27; from 3 farms for two years; and from 8 for one year—a total of 80 farm-year records.

† Acreage for 80 farm-record years, 1925-27 inclusive.

‡ Less than one-tenth of one per cent.

Pine County farms.—The average size of the farms studied in Pine County was 114 acres. Of this, 55 acres were in crops as follows: hay, 26 acres; small grain, 13 acres; corn, 8 acres; and potatoes and rutabagas, 8 acres (see Table 7). The crop acreage was not all tillable, however, as considerable of the hay land is still encumbered with rocks and stumps. About 40 acres of land on each farm was used for pasture, and much of this land was still covered with stumps, rocks, and brush. The size of these farms varied from 46 to 282 acres; the crop acreage from 12 to 125 acres. Eighty-acre farms were most common. The proportion of the farm that was crop land was much lower on the larger farms.

Dairy cattle were the principal kind of livestock on the farms studied. The average number per farm was a little more than 11. The range was from 4 to 24. Sixty-eight of the 80 herd-year records were on herds of dairy breeding—either Holstein or Guernsey—and eight on herds of such dual purpose breeds as Red Polled and Milking Shorthorns, or mixtures of the two. Most of the herds were grades, altho purebred sires were used almost exclusively. The herds were maintained primarily for butterfat production. The principal product sold was cream for manufacture into butter. Only enough young cattle were raised, in most cases, to maintain the herds.[3]

The utilization of the farm land and the numbers of different kinds of livestock on each of the farms studied in Pine County in 1927 are shown in Figure 11. This chart indicates the wide variation in the organization of different farms. The reasons for this variation are to be found largely in the size of the farm, the number of cleared acres, the amount of family help, the amount of capital available, and the personal preferences of the farmers.

The sources of gross income on twenty farms that were included in the study throughout the three-year period are shown in Table 8. The percentages shown are three-year averages. Here, again, the variations between individual farms are quite noticeable.

[3] Pond, George A. and Ezekiel, Mordecai. Factors Affecting the Physical and Economic Cost of Butterfat Production in Pine County, Minnesota. Minn. Agr. Expt. Sta. Bull. 270. 1930.

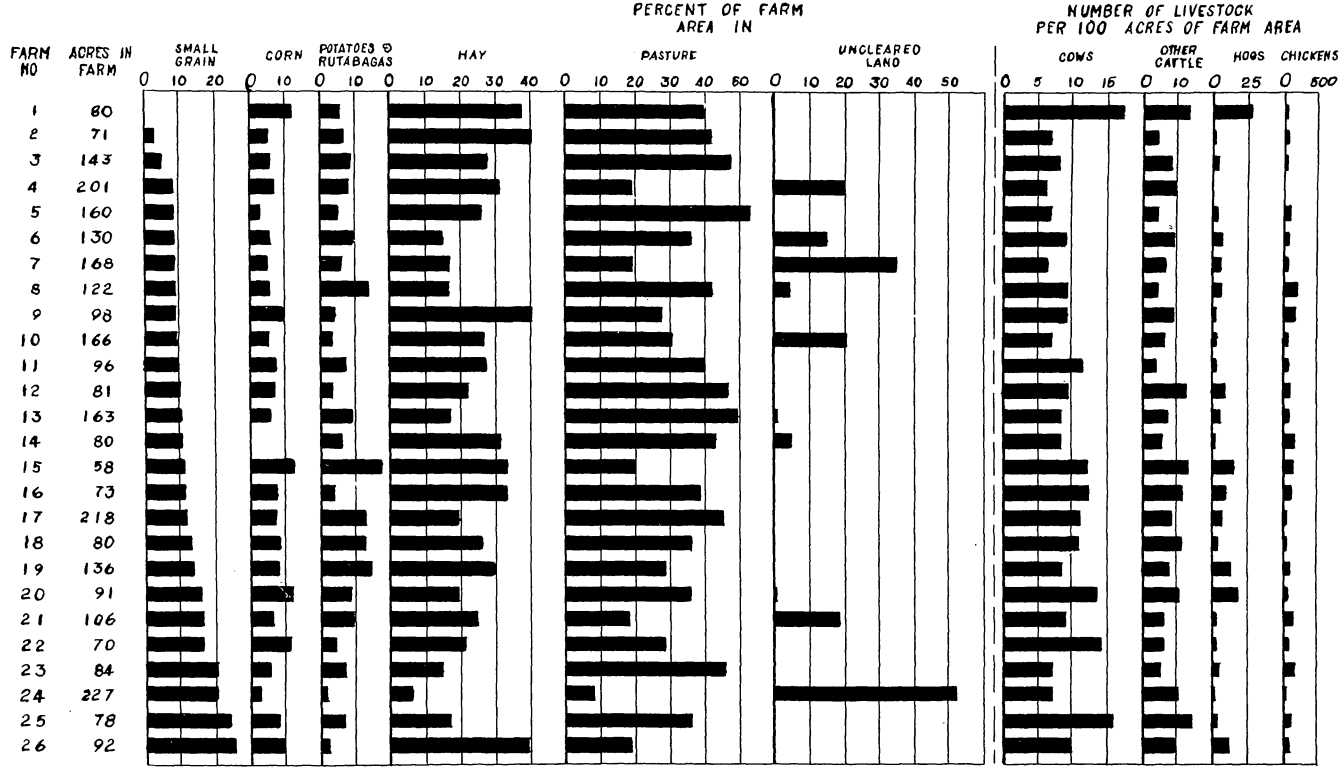

Fig. 11. Distribution of Crops and Livestock on the Farms Studied in 1927

Each line indicates the organization of one farm. The reasons for the variation among farms are to be found largely in the size of the farm, the number of cleared acres, the amount of family help, the amount of capital available, and the personal preferences of the farmer.

Table 8

Sources of Gross Cash Income on Each of Twenty Farms, Pine County, Yearly Average, 1925-27

Farm No.	Average gross income	Percentage of gross income from: Dairy products	Cattle	Poultry products	Hogs	Other livestock	Potatoes	Rutabagas	Other crops	Outside labor	Miscellaneous
		per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent	per cent
1	$3,415	49.2	6.1	8.8	6.5	..	13.2	14.6	0.5	0.1	1.0
2	4,030	47.5	6.5	16.3	5.1	1.9	16.1	3.4	0.1	..	3.1
3	3,489	54.7	7.9	2.2	15.2	..	12.2	4.6	..	0.9	2.3
4	2,671	54.0	9.3	10.0	4.8	..	12.5	7.8	..	0.1	1.5
5	3,664	32.4	7.6	7.1	11.8	..	21.5	13.7	0.4	3.9	1.6
6	2,665	47.7	5.4	11.9	3.0	..	22.4	6.4	0.2	0.3	2.7
7	3,022	51.9	12.0	5.4	12.1	0.6	6.4	4.8	0.9	3.5	2.4
8	4,630	42.7	6.8	3.5	6.3	..	22.5	14.4	0.6	0.9	2.3
9	1,332	39.2	8.9	6.4	3.0	..	24.2	13.7	0.3	0.8	3.5
10	2,260	49.7	10.9	1.2	3.9	..	20.4	13.4	0.2	..	0.3
11	1,706	46.7	6.0	18.0	..	..	7.7	20.9	..	..	0.7
12	2,885	45.5	13.3	9.2	6.3	..	13.1	3.3	1.3	3.1	4.9
13	2.606	61.0	9.5	15.3	2.8	..	1.5	4.7	..	4.1	1.1
14	2,862	43.3	10.8	4.3	1.4	2.0	7.8	23.4	..	3.8	3.2
15	3,804	36.3	11.7	4.0	11.3	0.1	12.5	7.8	0.3	14.1	1.9
16	1,718	59.8	8.5	11.8	4.9	0.4	5.7	6.4	..	0.7	1.8
17	3,215	45.7	11.8	1.9	15.6	3.7	5.5	5.5	1.7	4.8	3.8
18	2,954	46.7	7.7	6.2	2.8	..	18.7	10.2	1.3	2.3	4.1
19	1,723	38.0	16.2	17.4	5.2	..	3.9	15.6	0.9	1.1	1.7
20	2,347	56.4	12.5	2.0	2.3	3.8	7.8	0.8	..	6.9	7.5
Av.	$2,850	47.4	9.5	8.1	6.2	0.6	12.8	9.8	0.4	2.6	2.6

The average operator's labor earnings for the three-year period, 1925-27, of each of the same twenty farmers are shown in Table 9. The average earnings obtained by the operators for their labor and managment ranged from a minus quantity of $374 to earnings of $1,356. Two of the twenty farmers not only failed in making their farm business reimburse them for their labor and management but failed, also, in varying degrees, in making it earn a market rate on the capital invested. The other eighteen farms returned 5 per cent on the investment and in addition paid the operator something for his labor and management. The amount, however, was not equal to a hired-man wage on at least seven of the eighteen farms.

Table 9

Yearly Average Operator's Labor Earnings on Each of 20 Farms, Pine County, Minnesota, 1925-27

Farm No.	Size of farm	Capital investment	Cash receipts	Non-cash receipts	Inventory change	Cash expenses	Non-cash expenses	Operator's labor earnings*
	Acres							
1	78	$12,984	$3,415	$365	$ 144	$2,145	$ 423	$1,356
2	128	18,549	4,030	540	342	3,448	386	1,078
3	85	16,692	3,489	753	—31	2,279	904	1,028
4	168	11,500	2,671	348	1,913	3,592	428	912
5	131	14,936	3,664	476	135	1,995	1,482	798
6	102	10,875	2,665	326	127	2,108	234	776
7	89	14,658	3,022	579	132	2,157	889	687
8	204	21,169	4,630	514	1,026	3,101	2,401	668
9	54	4,839	1,332	204	135	867	177	627
10	80	12,624	2,260	416	—408	1,134	616	518
11	80	9,702	1,706	335	436	1,457	508	512
12	79	15,350	2,885	558	—88	1,680	1,276	339
13	87	13,059	2,606	323	—102	1,493	963	371
14	124	12,979	2,862	336	296	1,774	1,401	319
15	132	14,343	3,804	374	467	2,662	1,759	224
16	84	12,859	1,718	585	244	1,791	558	198
17	80	19,128	3,215	696	—85	2,053	1,638	135
18	161	18,119	2,954	541	—403	1,376	1,596	120
19	84	12,066	1,723	312	160	1,389	964	—158
20	160	14,510	2,347	438	—336	1,331	1,492	—374

* Operator's labor 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 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 decreases in inventory value.

AGRICULTURAL PROBLEMS OF THE NORTHEAST CUT-OVER SECTION

Every farming section has its problems. The principal problem of northeastern Minnesota may be summarized under five heads, as follows: Land development, maintenance of soil fertility, lack of capital and credit, sparsity of settlement, and tax burden.

Land Development

The northeast cut-over section lies within the area of coniferous and deciduous forests and was heavily wooded, except in some of the muskeg swamps and in narrow marshy strips bordering the lakes and streams. The sandy and loose-textured soils were occupied largely by pine forests; the clay or heavier soils carried usually a mixed growth, embracing deciduous as well as coniferous trees.

Practically all of the land must be cleared before it can be used for agriculture. The clearing process is both slow and costly. The pine stumps are not very close together but most of them are large and the job of clearing is immensely more difficult than it was in the hard-

wood regions farther south (see Fig. 12). Hardwood stumps can be left to decay, but pine stumps have to be pulled or blasted. Moreover, on most of the land a covering of stones and second-growth brush adds to the difficulties.

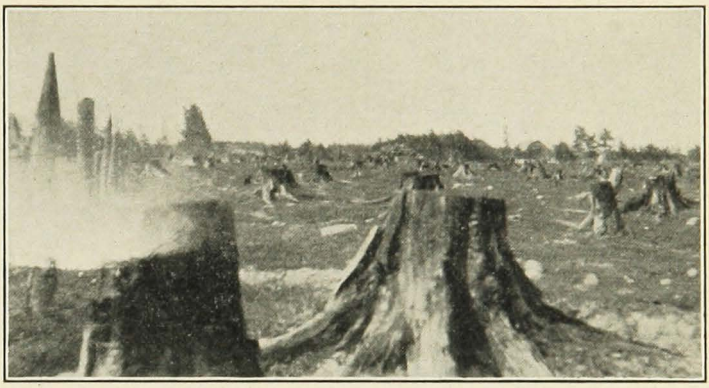

Fig. 12. White Pine Stumps in Northern Pine County

This land was brushed and then pastured for several years. The hardwood stumps have decayed and only the pine stumps remain. The next step in the clearing process is blasting these stumps.

To prepare the land for crop production, the brush must be cut and removed, along with down logs, stones, and stumps after they have been pulled or blasted. Next, the land must be leveled. Most cut-over land is uneven before the stumps are pulled and removing the stumps leaves deep holes that must be filled. After leveling comes the breaking, which is a slow and difficult process. Investigations by Worsham and Boss indicate that the average amount of land cleared annually per farm is between three and four acres.[4]

The labor and cash outlay for clearing land vary widely. Factors that affect the expense include: Type of timber as determined by species of trees, density of stand, and diameter of trees; condition of timber covering as influenced by previous cutting and burning; method of clearing; conditions under which clearing is done; and type of soil. Type of soil is an important consideration. Sandy soil usually carries a light growth of brush, but stumps are more difficult to blast from sand than from heavier soils.

The results of investigations into the cost of clearing an acre of cut-over land in northern Minnesota on various soil types are summarized in Table 10.[5] These data were obtained from farm operators

[4] Worsham, C. G. and Boss, Andrew, Farm Development Studies in Northern Minnesota, Minn. Agr. Expt. Sta. Bull. 196, p. 22. 1921.

[5] Unpublished data by the Division of Agricultural Engineering, Minn. Agr. Expt. Sta. during 1925-30 under the direction of M. J. Thompson. The authors wish to acknowledge their indebtedness to him and to L. H. Schoenleber and N. A. Kessler, who prepared this table.

who kept records of the amounts of labor, horse work, and materials used in land clearing on their farms. The clearing was done under prevailing farm conditions. There was no standing timber of any consequence on this land at the time of clearing. Much of it had been burned over, and later pastured for varying periods of time. No salable timber was obtained to offset a part of the cost of clearing.

Table 10

Labor, Horse Work, and Materials Used per Acre for Clearing on Various Soil Types*

	Soil types							
	Sandy		Sandy loam		Clay loam		Clay	
	Man hours	Horse hours	Man hours	Horse hours	Man hours	Horse hours	Man hours	Horse hours
Labor and horse work:								
Brushing	15.1	5.8	49.7	...	30.2	...	9.3	...
Stump removal	28.4	16.1	38.1	23.0	49.4	39.2	58.4	54.9
Breaking	14.0	29.0	21.2	39.9	25.6	42.7	19.2	39.3
Stone and root picking	18.2	19.8	9.5	11.4	23.4	25.2	4.9	8.5
Total	75.7	70.7	118.5	74.3	128.6	107.1	91.8	102.7
Materials:								
Dynamite, lb.		90		104		159		165
Fuse, ft.		57		66		110		99
Caps		52		43		70		77
Value of labor, horse work, and materials at 1932 prices†	$35.23		$44.50		$59.78		$55.05	
Stumps per acre		102		49		78		80
Average diameter, in.		9.2		11.1		13.2		14.6
No. blasted		40		30		52		63

* Unpublished data by Div. of Agr. Eng., Minn. Agr. Expt. Sta.

† Man labor, 15 cents per hour; horse work, 8 cents per hour; dynamite, $18.75 per 100 pounds; fuse, 90 cents per 100 feet; caps, $1.60 per hundred.

The acreage of land cleared on each type of soil was hardly large enough to give an accurate picture of differences in expenditures among the different types. However, some characteristic differences may be noted. There were more stumps on the sandy soil but because of their smaller size more of them could be pulled and fewer had to be blasted. In general, the heavier the soil the larger the stumps and the larger the amounts of labor and material needed to remove them. Less labor and power are required to break light, sandy soils. The less time spent picking roots and stones on the sandy loam and clay soils was due to the smaller number of stones on these types. Most of the other differences are due to variations in the amount of brush to be cleared off and in the organization and efficiency of the clearing crews. At present prices (December, 1932), the average cost of clearing an acre in the area of each of the four soil types is as follows:

sand, $35.23; sandy loam, $44.50; clay, $55.05; clay loam, $59.78. Man labor has been charged at 15 cents per hour. Much of the labor was done by the farmer and his family during slack periods when there may have been no other productive use of their time. During the period covered by this study, however, it would have been difficult to hire labor at this price.

The rate at which the settler can clear his land is a matter of considerable importance to him. During the developing process he is confronted with the problem of making a living from the tillable area, which remains small for several years even with a relatively rapid rate of clearing. Removing the green stumps with a liberal use of explosive is the quickest way. But with dynamite, fuse, and caps selling at high prices, the settler usually can afford to buy only small quantities annually. Unless he can find profitable outside work close to his farm, the returns from which may be turned into explosives, he most likely will have to follow the slower method, but less expensive in cash outlay, of putting in more labor at pulling and grubbing the stumps.

Most successful settlers are of the opinion that the cheapest and most satisfactory method of clearing, after a garden patch has been opened by the new settler, is to cut out the underbrush from a fenced area, seed it with clover and timothy, and turn in cattle or sheep. The land should be kept in pasture for five or six years and enough stock pastured to keep down the new growth of brush. At the end of this period the small stumps can be jerked out with a team; also the larger ones will require much less dynamite than when green. Furthermore, during the pasturing period, the clover sod supplements the thin layer of leaf mold on the virgin soil in storing humus-forming material; roots and refuse decay; and the land settles—all of which contribute to simplify the job of breaking and preparing a seedbed, and to insure a good crop on the new breaking.

The areas, including the farms from which the records were obtained, that are summarized in Table 10 did not present a particularly difficult stone problem. Frequently the removal of stones involves a greater expenditure of labor than does the clearing of brush and stumps. Moreover, stone removal differs from stump removal. The latter is accomplished by going over the land once, but the process of clearing a field of stones usually extends over many years. All the stones can be removed from the surface at the time the land is broken and yet it will be necessary annually to pick the stones which are brought to the surface by cultivation. The amounts of labor, horse work, and materials used for stoning an acre of land at locations near Askov and Cass Lake are presented in Table 11. The stone covering pictured in Figure 13 is typical of the problem encountered in the Askov com-

munity. At present (1932) prices, the cost of this phase of land clearing in areas presenting an equally difficult problem, would range from $7.00 to $19 per acre. Records on stone picking obtained in the three-year study in Pine County indicate that approximately 2 hours of man labor and 2.3 hours of horse work were expended per acre each year for picking stones from cultivated fields.

Table 11

Labor and Materials Used per Acre for Removal of Stones*

Plot No.	Labor						Materials			Value of labor and materials at 1932 prices†
	Prying, man hours	Hauling		Blasting, man hours	Total		Dynamite sticks	Caps	Fuse, feet	
		Man hours	Horse hours		Man hours	Horse hours				
1	12.0	53.5	47.2	2.0	67.5	47.2	36	20	30	$18.97
2	16.5	49.5	48.2	1.0	67.0	48.2	16	4	4	15.33
3	12.0	49.2	41.6	1.5	62.7	41.6	24	20	30	17.02
4	6.5	49.2	43.2	4.0	59.7	43.2	72	20	20	19.02
5	14.5	43.6	43.6	1.5	59.6	43.6	18	16	30	16.26
6	2.8	42.0	32.2	2.0	46.8	32.2	46	16	20	14.45
7	3.8	39.8	33.2	0.8	44.4	33.2	14	4	4	10.61
8	5.2	24.0	24.0	2.0	31.2	24.0	41	18	30	11.95
9	3.8	26.4	22.2	0.8	31.0	22.2	14	4	4	7.72
10	3.8	25.4	13.0	0.8	30.0	13.0	14	4	4	6.83
Average	8.1	40.2	34.8	1.7	50.0	34.8	30	13	18	$13.82

* Based on data reported by Thompson, M. J. and Schwantes, A. J., Stoning Farm Lands. Minn. Agr. Expt. Sta. Bull. 250. 1929.

† The prices were the same as those used in compiling Table 10.

Fig. 13. Stony Loam Land Near Askov

The land pictured is fairly typical of much of the stony loam now under cultivation, before the stones were removed.

Maintenance of Soil Fertility

Once the land is cleared and put under cultivation, the settler is faced with the problem of maintaining the productivity of the timber land soil, particularly after the first few crops have derived the full

benefit of the leaf mold turned under by the first breaking. Experiments conducted at the Northeast Experiment Station, at Duluth, to test the capacity of the heavy soils in cut-over areas to withstand cropping with standard crop rotations, with an average yearly application of two tons of barnyard manure, indicated that this quantity does not maintain yields of the small grains and cultivated crops. The first clearing on the Northeast Experiment Station farm was done in 1913. In 1918, records were started on the behavior of yields under the conditions described above. The results show a progressive decline in yields. The total decline up to and including the 1929 crop was 13.5 bushels, or 8.3 per cent with potatoes; 5.5 bushels, or 17.2 per cent, with barley; 9.7 bushels or 19.0 per cent, with oats; and 3.1 tons, or 33 per cent, with sunflowers.[6] The yields of the hay crop have shown no appreciable decrease. The rotations were three- four- or five-year rotations of small grain, hay or pasture, and potatoes or sunflowers. The number of years required to complete the rotation depended upon whether the grass seeding was left for one, two, or three years. The conclusions from this experiment thus far are that the heavy timber soils of northeastern Minnesota require an average yearly addition of more plant food than is contained in the usual crop residues and the two tons of manure if the yields of cultivated crops are to be maintained. Farmers throughout the area are arriving at similar conclusions from their own experiences. Failures of clover seedings to catch and winter-killing of the stands have become more frequent as the number of years the land has been farmed increases. Both of these conditions are evidence of declining fertility.

Additional experiments at the Duluth station have shown that an application of 10 tons of manure once in a three-year rotation maintains grain and potato yields reasonably well; also that these crops are benefited by commercial fertilizer treatments. The application at the Northeast Experiment Station farm of one ton of 4-8-6 fertilizer, or its equivalent, once in a three-year rotation resulted in average increases from all fertilizers of 43 bushels with potatoes; 10 bushels with oats; and 819 pounds with hay, over the yield from untreated check plots. These results are based on 9 crops of potatoes, 4 crops of oats, and 4 crops of hay.[7]

The treating of soils in the cut-over country is not uniform. Well drained upland timber soils are very much spotted in their productive power. The causes of this condition are as yet not well known.

[6] Thompson, M. J. Field Crops at Duluth. Minn. Agr. Expt. Sta. Misc. Bull. 1930.
[7] Ibid.

Credit Conditions

Credit is one of the most important of the settler's needs. And it is difficult to obtain on reasonable terms. Few settlers in the cut-over region have sufficient resources—after they have made the initial payment on their land, built a house and barn, and bought a cow and a team—to carry them until they have developed the farm to the point where it will provide a living. Most of them, therefore, must earn money away from the farm or be dependent upon irregular and short-time sources of credit. If the settler works for wages, he delays development of his farm. On the other hand, if he depends upon available sources of credit, he frequently has to accept difficult terms.

Many applications to the Federal Land Bank for loans are refused under the ruling that no loans shall be made on farms that can not be expected to support the operator's family without considerable income from sources other than the farm. The policy of the Federal Farm Loan Board also requires that the community have good roads, schools, and market facilities, before a farm loan association can be chartered there. The Minnesota Rural Credits Department is guided by essentially the same considerations. Few, if any, commercial banks or mortgage companies will advance credit before the farm has been sufficiently developed to become self-supporting. In fact, most of these agencies that formerly made a practice of loaning money on cut-over farms are no longer doing business in that region. The majority of settlers, therefore, are dependent largely upon credit from the land-selling agency, usually a lumber company, or from other agencies financially interested in the settler's welfare because of their investment in land or community enterprises. These agencies seldom offer the settler long-term credit at low interest rates.

Sparsity of Settlement

The diversity of topography, drainage, and soil in the cut-over region, with so large a proportion of the land unsuited to agriculture, causes settlement to be scattered. Too few settlers are on the land to support community centers within short distances from all settled territory. Consequently many settlers have to travel several miles to market, and frequently over poor roads. The expense of maintaining roads in good condition would be too heavy a tax burden under the sparsely settled conditions, except roads selected for state or county aid. Where the roads are poor, the mail service, also, is poor. Likewise, going to and from schools is difficult over poor roads. Settlers are often so scattered that children must be carried long distances by bus to consolidated schools.

The absence of good local markets is perhaps the greatest handicap to farming in a sparsely settled region. Not only are markets difficult to reach because of poor roads, but the existing local marketing agencies demand high prices for merchandise sold and pay relatively low prices for farm produce purchased. In the first place, margins must be high because the volume of business is small. In the second place, local stores are handicapped by the frequent financial straits of the settlers. This means that the storekeeper serving the community must sell to many who may not be able to pay in full for a long time, or who may leave the country and never pay. The cost of carrying such risks must be covered by the local margins in prices if the merchant continues in business without serious loss.

In 1927, there were 64 local creameries in the nine counties included in the area studied. Of these, 10 received less than 50,000 pounds of butterfat, and 32 received less than 150,000 pounds during the year. Operating expenses are high for small creameries because the volume of business is insufficient to provide a unit rate of overhead expense comparable with that of larger plants. Moreover, many communities produce too little cream to support a creamery and find it necessary to ship to centralizers, which ordinarily means that they receive a somewhat lower price than a successful local creamery could pay.

Tax Burden

High taxes are a serious handicap to the farmer in northeastern Minnesota. Sparsity of settlement is an important cause of this heavy tax burden. Schools, roads, and other public services are provided, to a considerable extent, on an area basis. With a small number of settlers and a small amount of taxable property in a given area, the tax per settler or per value unit of property is high even tho the public services may be much less adequate than are furnished in more thickly settled areas. This heavy tax burden is particularly oppressive in an area of small farms with limited acreages of tillable land. The net incomes of such farms are low and their tax-paying ability is correspondingly limited.

The average net income of real estate per acre was $1.07 in 1930 on the Pine County farms included in this study. The real estate tax payable that year was $1.57 per acre. The net income of real estate the same year on 180 farms in southeastern Minnesota was $8.45 per acre and on 22 farms in southwestern Minnesota $7.12 per acre. In these two cases, the real estate taxes were 15 per cent and 14 per cent, respectively, of the net income per acre of real estate as compared with 147 per cent in Pine County.[8]

[8] Blakey, R. G. Taxation in Minnesota, Table 41, page 101. University of Minnesota Press, 1932.

Some data regarding the tax situation in this area as compared with that in southern Minnesota are presented in Table 12. Only six of the nine counties included in this study have been included in this tabulation. In Carlton, Crow Wing, and St. Louis Counties more than half of the total assessed value of property is in cities and villages. As data covering delinquent taxes are not available for townships separate from that for cities and villages, only the counties are included in which two-thirds or more of the total value of assessed property is outside of cities and villages. For the same reason, Winona and Olmsted Counties have been omitted in southeastern Minnesota.

Table 12

Comparison of Tax Rates and Tax Delinquency in Different Sections of Minnesota*

	South-east†	South-west‡	North-east§
Taxes per $1,000 taxable value in townships, 1930	$38.30	$34.26	$94.75
Percentage of 1930 tax and special assessments uncollected, Jan. 1, 1932	3.5	8.2	35.0
Total uncollected taxes Jan. 1, 1932 as a percentage of 1930 levy	6.2	15.2	177.0

* From reports of State Tax Commission.
† Dodge, Fillmore, Goodhue, Houston, Mower, and Wabasha Counties.
‡ Cottonwood, Jackson, Murray, Nobles, Pipestone, and Rock Counties.
§ Aitkin, Cook, Kanabec, Lake, Mille Lacs, and Pine Counties.

The levy per $1,000 of taxable value in northeastern Minnesota is two and one-half times as high as in the more thickly settled counties in the southern part of the state. The large amount of uncollected taxes indicates that the tax burden is proving excessive in many cases. The effect of delinquent taxes is cumulative in increasing the tax borne by those who continue to pay their taxes, as a fairly fixed amount of public revenue must be obtained and the smaller the tax base the higher the rate per unit. This situation is further complicated by the fact that large areas of land in northeastern Minnesota are owned by lumber companies and others not engaged in farming. The lumber companies pay the taxes as long as there is merchantable timber on the land but once the timber is cut, they often have no further interest in the land and allow the taxes to become delinquent. As the delinquency increases, the tax rate must be raised to provide the needed current revenue. Owners of idle unimproved land refuse to pay the higher tax. The net result is increased delinquency and a still greater burden on those who continue to pay taxes. Ten times as large a proportion of the tax levied in 1930 was delinquent in the six counties selected in northeastern Minnesota as was the case in the southeastern counties.

The accumulation of uncollected taxes on January 1, 1932, was one and three-fourths times as great as the total tax due and payable the previous year. Unless a drastic change is made in the present system of collecting and expending public revenue, the tax burden is likely to continue as a serious handicap to farmers in northeastern Minnesota.

AMOUNTS OF LABOR, POWER, AND MATERIALS USED IN CROP AND LIVESTOCK PRODUCTION

A knowledge of the labor, power, and materials used in crop and livestock production in an area is necessary in planning systems of farming for that locality. It is also necessary to know the seasonal distribution of the labor, the succession of crops, the usual crop and livestock practices, and the possible production that may be expected. The data presented in this section were obtained in the accounting study in Pine County described on page 6. The labor on crops is shown by operations in order that adjustments may be made for changes in cropping practices. In addition to the average expenditures of labor and materials for the farms studied, standards are presented. These standards represent approximately the accomplishment of the farmers in the upper 25 per cent in the scale of labor efficiency.[9] They indicate the achievement possible under good management with a well balanced system of farming.

Crop Production

Labor and power expenditures per acre for crop operations are shown in Table 13. Both the average obtained in the accounting study and a suggested standard are shown for each operation. These expenditures have been computed for the various sizes of horse power units commonly used in this region. No data for tractor power are given. Because of the small area of cultivated land per farm in this area, it is difficult to use a tractor profitably on most farms. The farmer having a tractor may, however, compute the labor expenditure for tractor operation on the basis of comparisons between the rate of performance of horse and tractor power given in Minnesota Agricultural Experiment Station Bulletin 280.[10]

[9] For a fuller discussion of standard expenditures, see page 47, Minn. Agr. Expt. Sta. Bull. 282, An Economic Study of Crop Production in the Red River Valley of Minnesota. by G. A. Pond, G. A. Sallee, and C. W. Crickman. 1932.

[10] Schwantes, A. J. and Pond, G. A., The Farm Tractor in Minnesota. p. 44, Table 28. Minn. Agr. Expt. Sta. Bull. 280, 1931.

Table 13

Average and Standard Amounts of Labor and Power Used per Acre for Crop Operations

Operation	Power	Average		Standard	
		Man hours	Horse hours	Man hours	Horse hours
General					
Plowing	2-horse	7.0	14.0	6.0	12.0
Plowing	3-horse	4.8	14.4	4.0	12.0
Disking	2-horse	1.2	2.4	1.0	2.0
Disking	3-horse	0.9	2.7	0.8	2.4
Disking	4-horse	0.7	2.8	0.6	2.4
Spring-tooth harrowing	2-horse	1.5	3.0	1.3	2.6
Spring-tooth harrowing	3-horse	1.0	3.0	0.9	2.7
Spring-tooth harrowing	4-horse	0.8	3.2	0.7	2.8
Harrowing	2-horse	0.8	1.6	0.6	1.2
Harrowing	3-horse	0.6	1.8	0.4	1.2
Rolling	2-horse	0.6	1.2	0.5	1.0
Small grain					
Picking rock		1.3	1.6	1.1	1.4
Seeding	Hand	1.0	..	1.0	..
Seeding	2-horse	1.0	2.0	0.9	1.8
Seeding	3-horse	0.8	2.4	0.6	1.8
Cutting	3-horse	1.3	3.9	1.1	3.3
Cutting	4-horse	1.0	4.0	0.9	3.6
Shocking	Hand	1.7	..	1.2	..
Stacking		2.7	3.1	2.1	2.3
Threshing		2.4	1.0	1.9	1.0
Corn					
Picking rock		2.8	3.1	2.4	2.6
Planting	2-horse	1.1	2.2	0.9	1.8
Cultivating	1-horse	2.3	2.3	1.9	1.9
Cultivating	2-horse	1.8	3.6	1.5	3.0
Cutting	Hand	13.0	..	9.0	..
Cutting	3-horse	1.9	5.7	1.5	4.5
Shocking	Hand	5.0	..	3.0	..
Filling silo		13.5	13.5	10.0	10.0
Tame hay					
Picking rock		0.5	0.4	0.4	0.3
Mowing, 1st cutting	2-horse	1.7	3.4	1.2	2.4
Raking, 1st cutting	2-horse	0.8	1.6	0.6	1.2
Cocking, 1st cutting	Hand	1.1	..	1.0	..
Hauling, 1st cutting		4.7	5.7	3.2	4.1
Stacking, 1st cutting		5.0	5.7	3.5	4.4
Mowing, 2nd cutting	2-horse	1.5	3.0	1.2	2.4
Raking, 2nd cutting	2-horse	0.7	1.4	0.6	1.2
Hauling, 2nd cutting		1.7	2.9	1.3	1.9
Wild hay					
Mowing	2-horse	1.7	3.4	1.3	2.6
Raking	2-horse	0.8	1.6	0.6	1.2
Hauling		3.1	4.2	2.4	3.4
Stacking		3.8	4.2	2.8	3.2
Potatoes					
Picking rock		2.8	3.1	2.4	2.6
Cutting seed	Hand	4.2	..	3.0	..
Planting	2-horse	2.3	4.6	1.8	3.6
Cultivating	1-horse	2.3	2.3	1.9	1.9
Cultivating	2-horse	1.8	3.6	1.5	3.0
Spraying	Hand	2.0	..	2.0	..
Digging	Hand	40.0	..	22.0	..
Digging	4-horse	4.4	17.6	3.2	12.8
Picking	Hand	20.0	..	15.0	..
Hauling	2-horse	9.0	15.0	7.5	12.0

Table 13—(Continued)
Average and Standard Amounts of Labor and Power Used per Acre for Crop Operations

Operation	Power	Average		Standard	
		Man hours	Horse hours	Man hours	Horse hours
Rutabagas					
Picking rock		2.8	3.1	2.4	2.6
Planting	Hand	2.5	..	2.0	..
Thinning and weeding	Hand	24.0	..	18.0	..
Cultivating	1-horse	2.8	2.8	2.4	2.4
Cultivating	2-horse	2.0	4.0	1.7	3.4
Pulling and topping	Hand	32.0	..	25.0	..
Hauling	2-horse	15.0	24.0	12.0	20.0

Small Grains

Oats are the principal small grain crop in northeastern Minnesota with barley second in importance. Rye is grown to some extent on the lighter soils. Oats and barley commonly are grown on land that was in a cultivated crop the previous year. Usually the land is not plowed. The seedbed is prepared with a disk or a spring-tooth harrow. Most of the small grain is drilled, altho 20 per cent of the acreage on the farms studied was broadcast by hand. In case of broadcast seeding, the seed is covered with a disk or a spring-tooth harrow. When sown with a drill, the land generally is harrowed after seeding. On recently cleared land, rolling may be necessary to secure a firm seedbed. Seventy-five per cent of the small grain on the farms studied was harvested with a binder, stacked, and threshed from the stack. The rest was cut for hay with a mower. Anthony and Minrus oats are the varieties recommended for this section of the state and Gopher for the soils on which the crop is particularly subject to lodging.[11] Glabron and Velvet barley are recommended for general planting and Peatland for peat soils. These are six-rowed varieties. The two-rowed variety, Svansota, is especially recommended for this part of the state. Dakold is the recommended variety of rye.

The usual operations performed on small grains and the number of times each operation is repeated is indicated in Table 14. The average and standard amounts of labor and power used for each operation, obtained by applying the data presented in Table 13, as well as the totals for all operations combined are also shown. Average and standard amounts of materials used are shown. Most of these data cover only oats and barley, but adjustments can be made for obtaining the total amounts of labor and power used for rye and other small grains by using the data in Table 13. Table 14 indicates, also, both average and standard yields for each of the small grains.

[11] Minnesota Agricultural Experiment Station. Improved Varieties of Farm Crops for Minnesota. Extension Folder No. 2, revised March, 1933.

Table 14

Amounts of Labor, Power, and Materials Used and Yield per Acre of Small Grain

Operation	Average			Standard		
	Times over	Man hours	Horse hours	Times over	Man hours	Horse hours
Plowing	0.36	1.7	5.1	...	...	...
Disking	2.00	1.8	5.4	2.0	1.6	4.8
Spring-tooth harrowing	1.00	1.0	3.0	1.0	0.9	2.7
Harrowing	1.25	1.0	2.0	1.0	0.6	1.2
Rolling	0.20	0.1	0.2	...	...	...
Seeding	1.00	1.0	2.0	1.0	0.9	1.8
Cutting	1.00	1.3	3.9	1.0	1.1	3.3
Shocking	1.00	1.7	...	1.0	1.2	...
Stacking	1.00	2.7	3.1	1.0	2.1	2.3
Stack threshing	1.00	2.4	1.0	1.0	1.9	1.0
Total	...	14.7	25.7	...	10.3	17.1
Plowed (but not spring-tooth harrowed; disked once)	...	15.9	29.3	...	12.6	24.0
Cut for hay (hauled to barn)	...	13.8	28.4	...	9.0	18.2

Materials	Average	Standard
Seed:*		
Oats, bu.	3.0	2.50
Barley, bu.	2.0	2.00
Oats and barley { oats, bu.	1.5	1.25
Oats and barley { barley, bu.	1.0	1.00
Rye, bu.	1.5	1.50
Twine, lb.	2.8	3.00
Threshing, per bu.	$0.03	$0.03
Yield:		
Oats, bu.	44	50
Barley, bu.	30	35
Oats and barley, bu.	39	44
Rye, bu.	19	22

* Standard rates of seeding are for grain sown with a drill. For broacast seeding, increase at least one-third.

All of the farms studied were on heavy soil with considerable stone. For such land, the time spent annually in picking stones, as given in Table 13, should be added to the total amounts of labor and power shown in Table 14. On lighter soils or with larger fields, most of these operations could be performed in a somewhat shorter time than shown in the tables. Each farmer must make allowance for these factors in applying the data to his farm.

Corn

Corn is grown largely as a silage crop in this part of the state. On farms not equipped with silos, it may be cut and fed as fodder. It is seldom grown for grain. Even the early varieties can not be depended upon to mature regularly because of the cool summers and the short growing season. In only the southern part of this area is corn sufficiently well adapted to justify its use as a forage crop. In other

areas, particularly in those in close proximity to Lake Superior, sunflowers are used to some extent as a silage crop instead of corn and take the place of the corn in the cropping system. Sunflowers have outyielded corn consistently as a silage crop at the Northeast Experiment Station at Duluth.[12]

Corn commonly follows a hay or pasture crop in the rotation. On the farms studied, about 25 per cent of the corn crop followed potatoes and rutabagas and 12 per cent followed small grain. About a third of the corn land was plowed in the fall; the rest in the spring. The seedbed is prepared with a disk or a spring-tooth harrow. Practically all the corn is drilled rather than checked. The land usually is harrowed after planting and cultivated four or five times. Eighty-five per cent of the corn on the farms studied was put into the silo. On a few farms there were no silos. In years of good yields the production of forage exceeded the capacity of the silos. The rest of the crop was cut and fed as fodder.

The amounts of labor, power, and materials used for corn are shown in Table 15. Northwestern Dent and the early strains of Minnesota No. 13 are recommended for silage production. The yields given for both fodder and silage can be obtained only in the southern part of this area.

Table 15

Amounts of Labor, Power, and Materials Used and Yield per Acre for Corn Silage and Corn Fodder

Operation	Average			Standard		
	Times over	Man hours	Horse hours	Times over	Man hours	Horse hours
Plowing	1.0	4.8	14.4	1.0	4.0	12.0
Disking	1.4	1.3	3.9	2.0	1.6	4.8
Spring-tooth harrowing	1.0	1.0	3.0	1.0	0.9	2.7
Harrowing	2.4	1.9	3.8	2.0	1.2	2.4
Planting	1.0	1.1	2.2	1.0	0.9	1.8
Cultivating	4.2	7.6	15.2	4.0	6.0	12.0
Total to harvest	...	17.7	42.5	...	14.6	35.7
Cutting	...	1.9	5.7	...	1.5	4.5
Filling silo	...	13.5	13.5	...	10.0	10.0
Total for silage corn	...	33.1	61.7	...	26.1	50.2
Cutting	...	1.9	5.7	...	1.5	4.5
Shocking	...	5.0	...	...	3.0	...
Total for fodder corn	...	24.6	48.2	...	19.1	40.2

Materials	Average	Standard
Seed, lb.	17.0	17.0
Twine, lb.	4.5	4.5
Yield:		
Silage, tons	6	6
Fodder, tons	2	2

[12] Thompson, M. J. Report of Northeast Experiment Station, Duluth, 1926 and 1927.

Sunflowers

The amounts of labor and power for raising sunflower silage differ very little from those for corn silage except as yields differ. Sunflowers were not raised on the farms studied in Pine County but the expenditures for the crop were computed on the basis of the labor and power used for corn silage and are presented in Table 16.[13] Varieties grown at the Northeast Experiment Station include Mammoth Russian, Zenith Special, and Dwarf Northern.

Table 16

Unit Expenditures of Labor, Power, and Materials Used and Yield per Acre of Sunflower Silage

Operation	Average			Standard		
	Times over	Man hours	Horse hours	Times over	Man hours	Horse hours
Plowing	1.0	4.8	14.4	1.0	4.0	12.0
Disking	1.4	1.3	3.9	2.0	1.6	4.8
Spring-tooth harrowing	1.0	1.0	3.0	1.0	0.9	2.7
Harrowing	2.4	1.9	3.8	2.0	1.2	2.4
Planting	1.0	1.1	2.2	1.0	0.9	1.8
Cultivating	4.2	7.6	15.2	4.0	6.0	12.0
Cutting	1.0	2.5	7.5	1.0	2.0	6.0
Filling silo	1.0	18.0	18.0	1.0	13.5	13.5
Total	...	38.2	68.0	...	30.1	55.2

Materials	Standard
Seed, lb.	10
Twine, lb.	6
Yield:	
Silage, tons	8

Tame Hay

The common seeded hay crop in this part of the state is a mixture of red clover, alsike, and timothy. Redtop and Mammoth clover may be included in the mixture. Alfalfa and sweet clover are grown to a limited extent. They are fairly well adapted to some localities but require the application of lime, and in general it is more difficult to secure and maintain a stand than in case of the mixture mentioned. Hay is usually seeded with small grain as a companion crop. In a few cases it is seeded on raw land that has been cleared of brush and stumps but not broken. A crop of hay is cut the first year after seeding and the land is pastured the second year. On farms with non-tillable pasture the hay land may be plowed after the first year, altho on the farms studied most of the seedings were not plowed until after the second year. A better quality of hay is obtained the first year after seeding. As the hay is largely alsike and timothy, it is cut but once.

[13] The authors wish to acknowledge the assistance of M. J. Thompson, superintendent, Northeast Experiment Station, Duluth, in making these computations.

Only in case of alfalfa or red clover is it cut twice. Eight per cent of all tame hay on the farms studied was cut a second time.

Table 17

Amounts of Labor, Power, and Materials Used and Yields per Acre of Tame Hay

Operation	Average			Standard		
	Times over	Man hours	Horse hours	Times over	Man hours	Horse hours
First Cutting:						
Mowing	1.0	1.7	3.4	1.0	1.2	2.4
Raking	1.0	0.8	1.6	1.0	0.6	1.2
Cocking	0.7	0.8	...	1.0	1.0	...
Hauling into barn	1.0	4.7	5.7	1.0	5.0	6.0
Stacking	1.0	5.0	5.7	1.0	5.5	6.5
Total (hauled into barn)	...	8.0	10.7	...	7.3	9.6
Total (stacked)	...	8.3	10.7	...	8.3	10.1
Second Cutting:						
Mowing	1.0	1.5	3.0	1.0	1.2	2.4
Raking	1.0	0.7	1.4	1.0	0.6	1.2
Hauling into barn	1.0	3.1	4.2	1.0	3.1	4.2
Stacking	1.0	3.8	4.2	1.0	3.8	4.2
Total (hauled into barn)	...	5.3	8.6	...	4.9	7.8
Total (stacked)	...	6.0	8.6	...	5.6	7.8

Materials	Average	Standard
Seed:		
Red clover, alsike, and timothy — red clover, lb.	3	6
Red clover, alsike, and timothy — alsike, lb.	3	4
Red clover, alsike, and timothy — timothy, lb.	2	4
Red clover or alsike and timothy — red clover or alsike, lb.	6	6
Red clover or alsike and timothy — timothy, lb.	3	4
Red clover, lb.	8	8-10
Alsike, lb.	6	6- 8
Alfalfa, lb.	10	15
Yield:		
Red clover and alsike—alone or in mixture with timothy, tons	1.10	1.75
Alfalfa, tons	...	2.50

The amounts of labor, power, and seed for tame hay are shown in Table 17. The amount of labor per acre is somewhat higher than in southern and western Minnesota because of the smaller fields and because less labor-saving machinery can be used profitably on these small farms with limited capital and usually a relatively greater available supply of family labor. The data given for the first cutting apply in case only one cutting is made. The average yield of hay on the farms studied in 1925, 1926, and 1927 is lower than usual because production was greatly reduced by drouth in 1926. The yield was only one-half ton per acre that year. The drouth also resulted in poor stands in case of hay seeded in 1926 that were reflected in low yields in 1927. The yields suggested as standards are possible only in case of a good

stand. It is assumed that the red clover, alsike, and timothy mixture is cut once and the alfalfa twice.

Wild Hay

Wild hay in this part of the state is grown on land unfit for cultivation, usually because of lack of drainage. It consists largely of Kentucky bluegrass, redtop, and native marsh grasses. The area of wild hay cut varies from year to year. In a dry season, it is possible to gather hay on land that would be flooded or at least too soft to bear up a team in years of normal precipitation. In some cases, farmers cut these wet meadows with a scythe and put up the hay by hand. Both the yield and the quality of wild hay vary widely with the time of cutting and the varieties of grass included. The amounts of labor and power for putting up wild hay are given in Table 18.

Table 18

Unit Expenditures of Labor and Power and Yield per Acre for Wild Hay

Operation	Average			Standard		
	Times over	Man hours	Horse hours	Times over	Man hours	Horse hours
Mowing	1.0	1.7	3.4	1.0	1.3	2.6
Raking	1.0	0.8	1.6	1.0	0.6	1.2
Hauling into barn	1.0	3.1	4.2	1.0	2.5	3.4
Stacking	1.0	3.8	4.2	1.0	2.8	3.2
Total (hauled into barn)	..	5.6	9.2	..	4.4	7.2
Total (stacked)	..	6.3	9.2	..	4.7	7.0

	Average	Standard
Yield:		
Hay, tons	0.8	1.0

Potatoes

The better practice in this section of the state is to raise potatoes on clover sod. A little more than half of the potato acreage on the farms studied was grown on land that had been in tame hay the previous year. About a third followed corn or rutabagas. The rest either followed small grain or was on raw land that had just been broken. Twenty per cent of the land was plowed in the fall, the rest in the spring. The seedbed was prepared with a disk or a springtooth harrow. The insecticide commonly used was paris green applied with a hand duster. Only a third of the fields was dusted more than once during the season. No fungicide was used for the control of blight. Eighty-five per cent of the crop graded No. 1, 6 per cent No. 2, and 9 per cent culls. Green Mountain was the principal variety grown on the farms studied, altho a limited acreage of Irish Cobbler also was grown. Green Mountain is recommended as a standard late variety for northeastern Minnesota and Irish Cobbler as the standard

early variety. Irish Cobbler and Triumph are especially adapted to peat soils and King to light sandy soils. Russett Burbank yields well on mineral soils. The soil and climate of this area are favorable for the production of certified seed stock, but because of the limited acreage of potatoes on most farms, only a comparatively few growers are producing certified stock.

The amounts of labor, power, and materials for potato production are given in Table 19. Labor and power units are on the basis of machine digging. On farms with three acres or less, potatoes are sometimes dug by hand. The hours of labor for hand digging given in Table 13 may be substituted in Table 19. No data for hauling to market are given because the time is so largely dependent on the distance from the farm to the shipping point. Half the potatoes on the farms studied were hauled directly to market, the rest were stored on the farm. The standard yields are for potatoes grown on clover sod and fertilized with farm manure or commercial fertilizer or both. Because of the wide variation in the response of soils in this section to commercial fertilizer, no general recommendations can be made. The Division of Soils, of the Minnesota Agricultural Experiment Station, recommends that each grower try out various rates of application of the commercial fertilizers suggested and by means of unfertilized check rows determine the response of his soil before attempting their general use.

Table 19

Unit Expenditures of Labor, Power, and Materials Used and Yield per Acre of Potatoes

Operation	Average			Standard		
	Times over	Man hours	Horse hours	Times over	Man hours	Horse hours
Plowing	1.0	4.8	14.4	1.0	4.0	12.0
Disking	1.7	1.5	4.5	2.0	1.6	4.8
Spring-tooth harrowing	0.8	0.8	2.4	1.0	0.9	2.7
Harrowing	2.5	2.0	4.0	2.0	1.2	2.4
Cutting seed	1.0	4.2	...	1.0	4.0	...
Planting	1.0	2.3	4.6	1.0	1.8	3.6
Cultivating	4.0	7.2	14.4	4.0	6.0	12.0
Dusting	1.3	2.0	...	2.0	3.0	...
Digging	1.0	4.4	17.6	1.0	3.2	12.8
Picking	1.0	20.0	...	1.0	15.0	...
Hauling (to storage)	1.0	9.0	15.0	1.0	8.0	13.0
Total	...	58.2	76.9	...	48.7	63.3

Materials	Average	Standard
Seed, bu.	10.7	12- 15
Fertilizer (for trial) 4-8-6 or 2-8-12, lb.	...	125-250
Spray { Paris green, lb.	2.5	4
Spray { or calcium arsenate, lb.	...	2- 3
Yield:		
Potatoes, bu.	135	150

Rutabagas

Rutabagas are an important cash crop in some parts of northeastern Minnesota. The usual practice is to grow them on clover sod or raw land that has just been broken. They were the principal crop on new land on the farms studied. Eighty per cent of the acreage was grown either on tame hay sod or on new land. As in case of other cultivated crops, the land usually is plowed in the spring and worked up with a disk or spring-tooth harrow. The seed is planted with a small garden seeder. Considerable rather tedious hand work is involved in thinning, weeding, pulling, and topping. There is a wide range in the date of seeding. It takes approximately 100 days for the crop to reach marketable size. Since the price of rutabagas is often considerably higher in August than in the late fall and winter months, some growers seed a part of the crop early in May so it will be ready for the August market. This early marketing usually is done at some sacrifice of yield. Rutabagas make their most rapid growth during cool weather. They grow rapidly in late September and October and even up to the time the ground freezes. For this reason, the bulk of the crop is not seeded till June or even later and is harvested in October.

Table 20

Unit Expenditures of Labor, Power, and Materials Used and Yield per Acre of Rutabagas

Operation	Average			Standard		
	Times over	Man hours	Horse hours	Times over	Man hours	Horse hours
Plowing	1.0	4.8	14.4	1.0	4.0	12.0
Disking	2.7	2.4	7.2	2.0	1.6	4.8
Spring-tooth harrowing	1.2	1.2	3.6	2.0	1.8	5.4
Harrowing	2.0	1.6	3.2	2.0	1.2	2.4
Seeding	1.0	2.5	...	1.0	2.0	...
Thinning and weeding	...	24.0	...	...	18.0	...
Cultivating	3.7	7.4	14.8	4.0	6.8	23.6
Pulling and topping	1.0	32.0	...	1.0	25.0	...
Hauling (to storage)	1.0	15.0	24.0	1.0	15.0	24.0
Total	...	90.9	67.2	...	75.4	62.2

Materials	Average	Standard
Seed, lb.	1.6	1.5
Fertilizer (for trial) 4-16-4 or 2-8-8, lb.	...	125-250
Yield:		
Rutabagas, tons	10	12

The amounts of labor, power and materials for rutabaga production are shown in Table 20. No data are given for marketing because this depends so largely on the distance to market. Sixty per cent of the rutabagas on the farms studied were marketed direct from the field,

the rest were stored on the farms to be marketed later or fed to livestock. Ninety-three per cent of the crop was marketable roots and the rest culls. The standard yields are for roots grown either on new breaking or on clover sod fertilized with barnyard manure or commercial fertilizer. The suggestion on page 45 regarding the use of commercial fertilizer for potatoes applies also to rutabagas.

Manure Hauling

In addition to the direct operations involved in crop production, considerable time is spent on a livestock farm in hauling manure to the crop land. Since this can not all be charged directly to the crop immediately following its application, it was not included in the crop tables previously presented. Thirty per cent of all crop land on the farms studied was manured each year at an average rate of ten loads per acre. Sixty-eight per cent of the land to be planted to cultivated crops was manured each year, 12 per cent of the small grain land, and 9 per cent of the hay land. Approximately 80 per cent of all manure hauled out was applied to land to be planted to cultivated crops and 10 per cent each to small grain land and hay land. The average amount of manure produced annually by the different classes of livestock and hauled out to the fields was as follows:

	Loads
Work horses, per head	7.0
Milk cows, per head	7.0
Young dairy cattle, per head	3.5
Hogs, per 100 lb. produced	0.2
Poultry, per 100 hens	4.0

Additional amounts, of which no records are available, were produced when the stock was on pasture. These figures showing the probable production of manure by different classes of livestock should serve as a basis for estimating the amount to be hauled out. The average amount of time spent hauling manure was one man hour and 1.75 horse hours per load, or 10 man hours and 18 horse hours per acre. Most of the hauling was done with two-horse teams.

Miscellaneous Crop Work

In addition to field work on crops, some time is spent purchasing, cleaning, and treating seed, in obtaining materials for crop production, and in grading and marketing crops in storage, as potatoes and rutabagas. The average amount of time so spent on the farms studied was 48 man hours and 26 horse hours per farm. Most of this time was spent in grading and marketing potatoes and rutabagas. It amounted to only 14 minutes of man labor and 7 minutes of horse

work per acre for all other crops. The average expenditure per acre for non-field work on potatoes was 4 man hours and 1.5 horse hours. For rutabagas, the corresponding figures were 5 man hours and 4 horse hours. These items vary widely from farm to farm because of the varying proportions of these crops that are marketed from storage and the varying distances from farm to market. They must be considered in planning the labor program, but most of this work is performed during the winter and early spring when it can easily be handled by the regular labor supply and hence involves no labor conflict with other enterprises or operations.

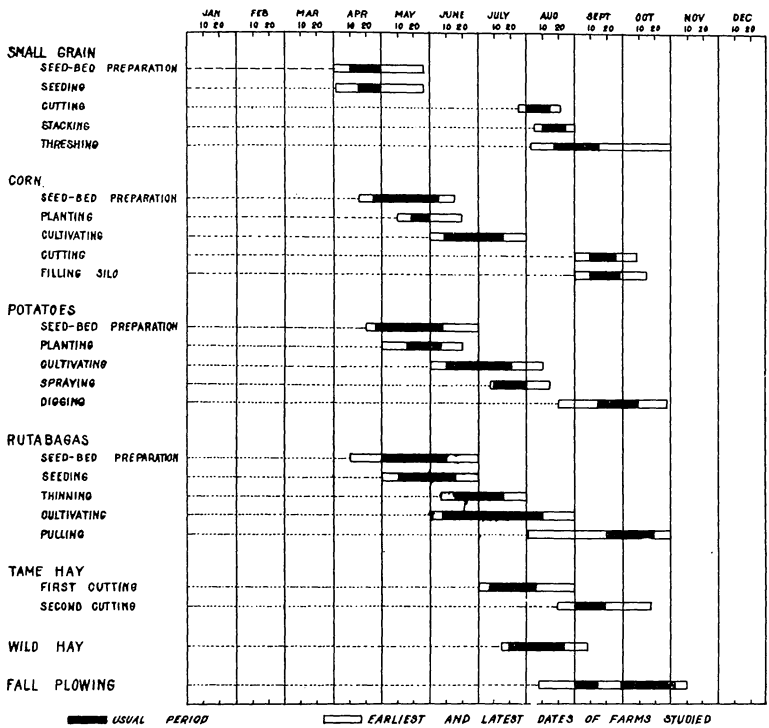

Fig. 14. Usual Periods for the Performance of Field Crop Operations in Pine County

The same succession of operations occurs throughout northeastern Minnesota. In applying this to other counties, allowance must be made for differences in the length of the growing season and the time when field work may be started in the spring and the time the ground freezes in the fall.

Seasonal Distribution of Crop Labor

A knowledge of the seasonal distribution of crop labor is as important as a knowledge of the quantities to be used. Because of the variation in climate between different parts of this area, the time at which the different crop operations should be performed varies also.

The sequence of operations, however, is approximately the same throughout. In Figure 14 are shown the approximate dates within which the important crop operations were performed on the farms studied in Pine County. The extreme range in the dates of these operations also is given. With these as a guide, similar seasonal distributions may be computed for other sections of northeastern Minnesota in line with dates and length of the period in which crop operations may be performed in those regions.

The seasonal distribution of manure-hauling labor by four-week periods is shown in Figure 15. During most of the year, much of the manure produced is hauled currently to the fields if weather conditions permit. The heavier labor expenditure in April, May, and June represents the application of manure that has accumulated during the winter and is spread in advance of planting. In November, after field work is complete, manure is hauled that has accumulated during the summer.

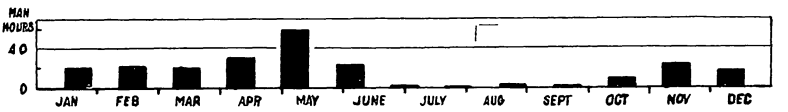

Fig. 15. Distribution of Labor Used for Hauling Manure by Four-Week Periods

Most of the manure is hauled out currently as produced on the farms studied. Some manure accumulates during the winter. This is hauled in the spring before planting. The accumulation during the summer is hauled in November, after field work on crops is finished.

Livestock Production

The data in this section were obtained largely from the study of the farms in Pine County mentioned on page 6. Physical conditions affecting livestock production in this area are fairly representative of most of northeastern Minnesota. The pasture season is a little longer than in some of the counties farther north and, as was mentioned in the discussion of crops, it is possible to grow silage corn fairly satisfactorily in Pine County. Allowances must be made for these differences in applying the data to counties such as St. Louis, Lake, and Cook. The standards for each class of livestock have been prepared in consultation with members of the staff of the divisions of the Minnesota Agricultural Experiment Station specializing in the study of the feed requirements of that class of stock. They have been designed to utilize to best advantage the type of feeds available in this area. These standards should serve farmers as a basis for checking efficiency in the use of feed and labor as well as in planning desirable changes in their livestock organization.

Dairy Cows

All of the cattle on the farms studied were of dairy breeding. Ninety per cent were high grade Holsteins or Guernseys. The rest were of dual-purpose breeds, such as Red Poiled and milking Shorthorn. Purebred sires were used exclusively and had been in most cases for several years. Most of the herds had been included in dairy herd improvement associations and had been culled on the basis of production records. These herds were maintained primarily for butterfat production. The principal sale product was cream for manufacture into butter. The milk was separated on the farm and the skimmilk retained for livestock feed. An average of one cow in five was replaced each year. Ninety per cent of the replacements were heifers raised on the farm and 10 per cent were purchased cows. Eighty-eight per cent of the cows displaced were sold for slaughter, 7 per cent were sold as milk cows to other farmers, and 5 per cent died.

It was common practice to have from 60 to 80 per cent of the cows freshen in the fall months, September to December inclusive, altho there was considerable variation from this practice. On some farms, all the cows freshened during the fall, on others none. The average percentage of fall-freshening cows was 59. On the farms studied, greater efficiency in the use of feed was obtained with fall-freshening cows.[14] It seems probable, however, that in much of northeastern Minnesota, especially on farms with considerable pasture and legume roughage, it may be possible to produce dairy products at lower cost with spring-freshening cows. At least, this system would make possible the maximum use of home-grown roughage and pasture and decrease expenditures for purchased concentrates, which are usually high in price relative to those in other parts of the state. This system would also provide the maximum supply of skimmilk when it is needed for spring pigs, chicks, broilers, and growing pullets. The economy of this system would depend on the relative cost of pasture and roughage as compared with that of concentrates as well as upon the possible reduction in total production. Spring-freshening may have a disadvantage in that relatively more labor on cows would be required during the crop growing season and less during the winter when there is usually less productive work to provide employment for labor. Whether this would be a serious disadvantage would depend on the labor supply of the individual farm.

There is also a slight disadvantage in the price received for the product of the spring-freshening herds. This was computed on the

[14] Pond, G. A. and Ezekiel, M. Factors Affecting the Physical and Economic Cost of Butterfat Production in Pine County, Minnesota. Agr. Expt. Sta. Bull. 270. 1930.

basis of the monthly distribution of butterfat sales for the two groups of herds for which data are shown in Figure 17. The monthly percentage variations in butterfat prices were computed on the basis of the monthly prices of 92-score butter on the New York market for the ten-year period 1922 to 1931, inclusive. A production of 260 pounds of butterfat per cow, the average of the Pine County herds studied, was assumed. On this basis, the value of butterfat produced per cow was 1.66 per cent less for herds freshening in the spring than for those freshening in the fall. This factor is apparently less important than differences in labor distribution between the two systems of production.

The average amounts of feed, labor, horse work, and materials used per year for a dairy cow are shown in Table 21. The concentrates include both home-grown grains and purchased feed. A large proportion of the concentrates fed to cows on the farms studied in Pine County was purchased. The labor includes both daily chores and the special labor, such as delivering cream, caring for sick cows, and testing for tuberculosis. Since it is impossible to list in terms of physical quantities such services and material as veterinary services and medicine, the cash cost of these items is given. The average production is based on the actual utilization and includes the butterfat in cream and milk sold, that in dairy products used in the house, and that in whole milk fed to the calves.

Table 21
Feed, Labor, Horse Work, and Materials Used per Year for a Dairy Cow

Item	Average	Standard
No. of cows per herd	11	10 or more
Butterfat per cow, lb.	260	300
Concentrates, lb.	1,520	1.700
Hay and other dry roughage, lb.	3.450	4,000
Succulent roughage (silage, roots and potatoes), lb.	6,693	4,500
Pasture, days	161	150
Man labor, hr.	205	175
Horse work, hr.	9	9
Miscellaneous expenses (veterinary services, medicine, etc.), cents	73	75

The standards indicated are well within the range of accomplishment. On the farms studied, where good pasture was available legume hay was used, and the concentrates were such as to provide a balanced ration. This ration will provide one pound of grain to 3.5 or 4 pounds of 3.5 per cent milk or 3 pounds of 4 per cent milk during the winter feeding season. Allowance is also made for some grain to be fed to

high producing cows during the pasture season. If no silage or roots are available, hay may be substituted at the rate of one pound of hay to 3 pounds of succulent roughage. If an abundant supply of succulent feed is available, the proportion may be increased relative to hay at the same rate. The standard for man labor is computed for a herd of at least 10 cows.

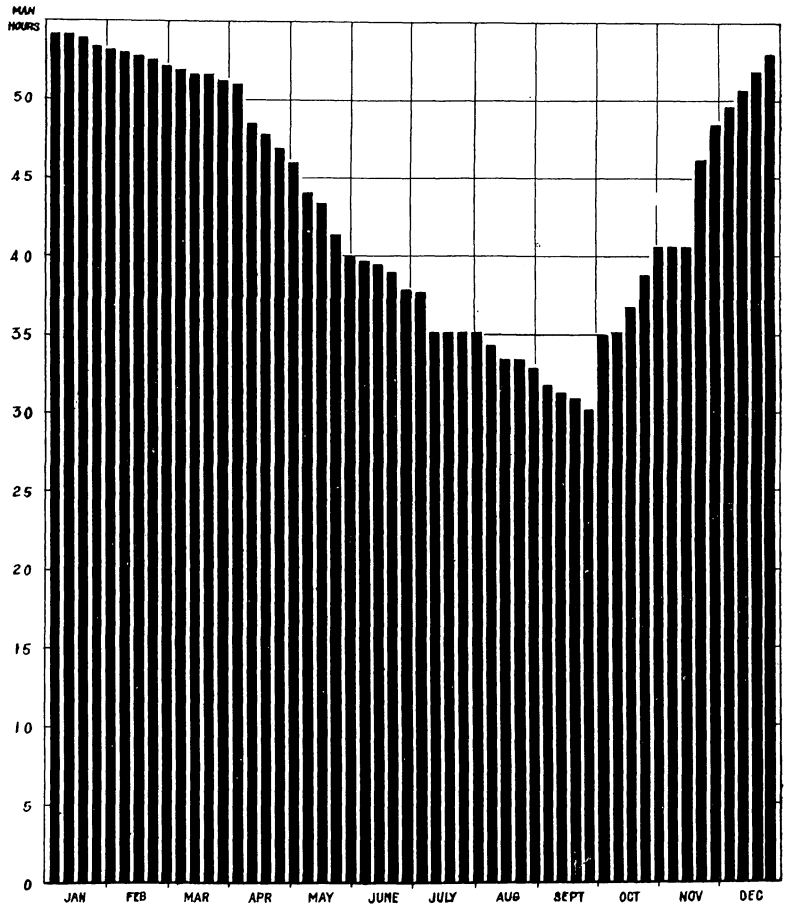

Fig. 16. Weekly Distribution of Labor on a Herd of 11 Cows

Dairy Cows require large amounts of labor throughout the year but the labor demand is somewhat lighter during the crop season, especially during late summer and early fall when haying, harvesting, silo filling, and potato digging are competing most heavily for the farmer's time.

The weekly distribution of labor on a herd of 11 cows, the average size of the herds studied, is shown in Figure 16. The amount of labor varies little during the first three months of the year, when cows are kept in the barn continuously. There is some decrease in

April, when they are turned out in the yard during the day; and a further decrease in May, when they are turned onto pasture. This decrease continues through the summer as the fall-freshening cows become dry. There is a sharp increase in September when these dry cows begin to freshen and supplementary feeding is increased. There is another sharp increase the last of October, at the close of the pasture season, and a less rapid increase throughout the rest of the year.

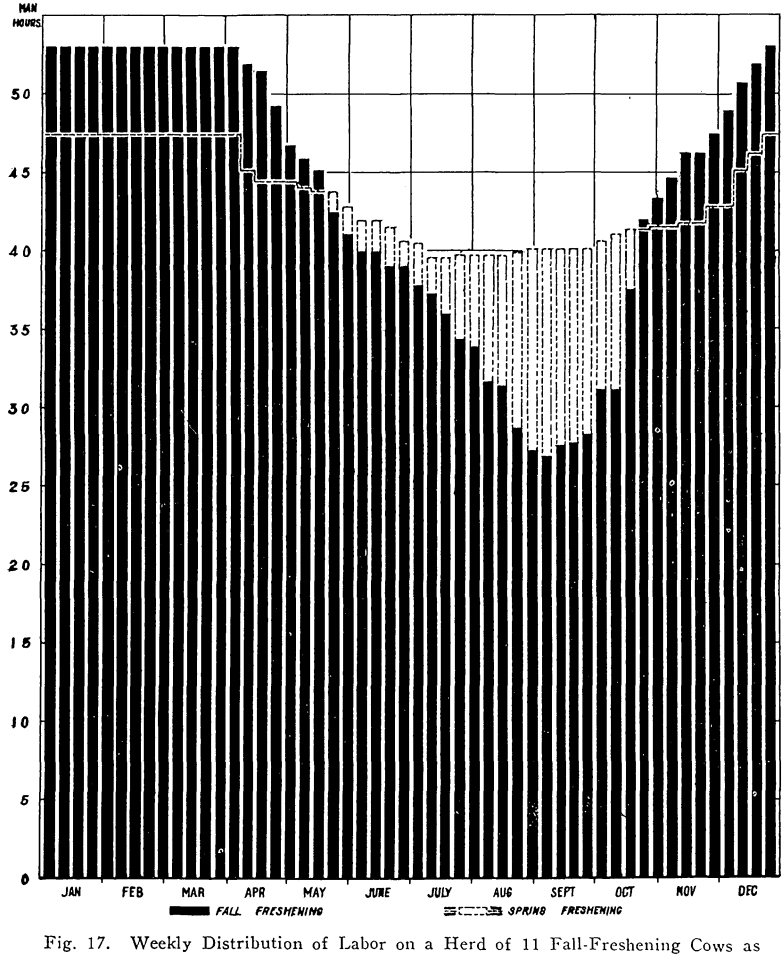

Fig. 17. Weekly Distribution of Labor on a Herd of 11 Fall-Freshening Cows as Compared with a Herd of 11 Spring-Freshening Cows

A fall-freshening herd competes much less seriously with crops for the farmer's time than does a spring-freshing herd. Altho the fall-freshening herd requires more labor in winter, it does not interfere nearly so seriously with crop work in the rush season in late summer and early fall as does the spring-freshening herd.

The data presented in Figure 16 show the average distribution of labor for all herds included in this study. A comparison between the labor distribution of fall- and spring-freshening herds is shown in Figure 17. This is based on a herd of eleven cows and is, therefore, directly comparable with Figure 16. The labor distribution for the fall-freshening cows is based on the data from twenty herds in which more than 85 per cent of the cows freshened during the fall months. Data from ten herds in which less than 20 per cent of the cows freshened in the fall furnished the basis for the distribution for spring-freshening cows. The fall-freshening herds require much more time, relatively, during the late fall, winter, and spring. On the other hand, since a large proportion of the herd is dry in late summer and early fall the labor load is lightest at the time when crop work, such as haying, harvesting, silo filling, and potato digging, is heaviest. Undoubtedly, this is an important factor accounting for the large proportion of fall freshening in the area. The distribution of labor on the spring-freshening herds varies comparatively little throughout the year. On farms having family labor available to handle the dairy herd through the summer without interfering with crop work, spring-freshening may be satisfactory from a labor standpoint. The farmer who is attempting to operate his farm with his own labor finds that a spring-freshening herd competes seriously with crops during the summer and early fall as compared with a fall-freshening herd.

Young Dairy Cattle

The term "young dairy cattle" as used here includes all cattle other than milk cows. The group is made up largely of heifers raised for replacements but includes also bulls, veal calves, and occasionally a heifer or steer being fattened for home slaughter. Forty-eight per cent of all calves born were sold as veals and 10 per cent as breeding stock. Nineteen per cent were heifers that were raised and added to the milking herd when they freshened. Fourteen per cent were slaughtered and 9 per cent died. Practically all herd bulls were purchased from other herds. Some co-operation was practiced in the ownership and use of bulls. On 59 per cent of the farms, a herd sire was owned in full, on 17 per cent a half interest was owned, and on 24 per cent bull service was hired. This was, on the average, a bull to each one and one-half farms or to each 17 cows.

The average amounts of feed, labor, horse work, and materials used per head of young dairy cattle are shown in Table 22. Standards are also given. These standards are computed on the basis of the average distribution of calves, heifers, and bulls on the farms studied.

In order to use them with different combinations of these different classes of stock, separate feed standards for each class are presented as follows:

	First year	Second year
Heifer—		
Whole milk	200 lb.	....
Skimmilk	3,000 lb.	(3,000 lb.*)
Concentrates	300 lb.	300 lb.
Hay	700 lb.	3,000 lb.
Pasture		150 days

* May be substituted for concentrates.

Veal calf—up to marketable age	
Whole milk	600 lb.
Bull—one year	
Concentrates	1,000 lb.
Hay	8,000 lb.

Table 22

Amounts of Feed, Labor, Horse Work, and Materials Used per Head per Year for Young Dairy Cattle

Item	Average	Standard
No. of head	9	9 or more
Concentrates, lb.	282	200
Hay and other dry droughage, lb.	1,477	2,500
Succulent roughage (silage, roots, and potatoes), lb.	1,869	....
Whole milk, lb.	158	280
Skimmilk, lb.	2,598	2,500
Pasture, days	120	125
Man labor, hr.	33	35
Horse work, hr.	1	1
Miscellaneous expense (veterinary services, medicine, etc.), cents	75	75

In case of a heifer calf, a limited amount of hay can be replaced with succulent roughage at the rate of three pounds of succulent roughage to each pound of hay displaced. For the yearling, succulent roughage may displace up to half the hay at this same rate. It also may be substituted for part of the hay allowance for the bull at this rate. Skimmilk may be substituted for concentrates for the yearling heifers at the rate of 10 pounds of skimmilk to one pound of concentrates displaced. It may also be substituted at this rate for a portion of the concentrate ration for the bull. The roughage allowance for the bull may be reduced if pasture is available. On many of the farms studied, the bull was either pastured in a small lot or tethered out in the farmstead or on adjoining grass land.

The weekly labor distribution for a herd of nine head of young dairy cattle is shown in Figure 18. A herd of this size requires slightly more than an hour a day from November to April, inclusive, and an average of about half an hour a day during the crop season.

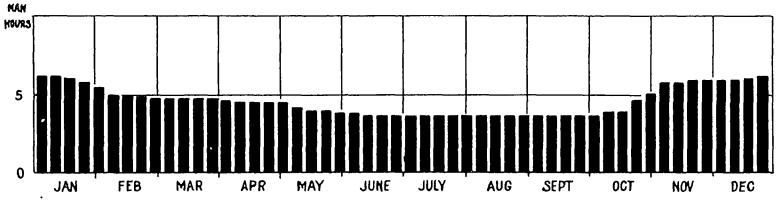

Fig. 18. Weekly Distribution of Labor on a Herd of 9 Young Cattle

The amount of labor used on young dairy cattle is not large at any season of the year and is especially small during the crop season.

Beef Cattle

Very few beef cattle are raised in northeastern Minnesota because of the small size of the farms and the relatively high prices of concentrate feeds. An important function of livestock on a small farm is to provide a market for labor, especially during the winter. Since beef cattle require comparatively little labor, they do not perform this function as satisfactorily as do dairy cattle.

Sheep

There were too few sheep on the farms studied to give a representative picture of the quantities of feed and labor used in sheep production or to serve as a basis for computing standards. Altho sheep are a relatively minor enterprise in this region, the numbers have almost doubled during the last eight years. The type of sheep enterprise that seems adapted to this part of the state is a breeding flock of ewes that is raised almost exclusively on pasture and roughage. The lambs are marketed directly from pasture without supplemental grain feed. The price of concentrates is usually so high as to make unprofitable the finishing of lambs on grain. The following standards for a ewe in a small farm flock are adapted from studies in other parts of the state from which more adequate data are available:[15]

Grain, lb.	125
Hay, lb.	750
Man labor, hours	4
Horse work, hours	1
Veterinary services and shearing, cents	24

[15] Sallee, G. A., Pond, G. A., and Crickman, C. W. An Economic Study of Livestock Possibilities in the Red River Valley of Minnesota. Minn. Agr. Expt. Sta. Bull. 283. 1931.

The weekly distribution of labor used on sheep is practically constant from November to April, inclusive. About half as much is required in May. During the rest of the year, they are on pasture and require little attention.

Swine

Swine were maintained on 95 per cent of the farms studied. They were kept largely to utilize skimmilk, cull potatoes, and other nonmarketable products. The annual production of hogs per farm varied from less than 250 pounds to more than 5,000 pounds. Brood sows were maintained on about two-thirds of the farms. On the rest, pigs were bought, and fed either for home use or for sale. Those keeping breeding stock sold as feeder pigs 40 per cent of the pigs farrowed. Twenty per cent of the hogs raised to market weight were slaughtered for home consumption and the rest were sold.

The average amounts of feed, labor, horse work, and materials used for the production of 100 pounds of hogs are shown in Table 23. The production of hogs per farm is computed by adding the weight of all hogs sold or slaughtered for home consumption and that of hogs on hand at the close of the year and deducting from this total the sum of the weights of all hogs purchased or on hand at the beginning of the year. Standards for hog production that will utilize the feeds available on these farms are shown in Table 23.

Table 23

Amounts of Feed, Labor, Horse Work, and Materials for the Production of 100 Pounds of Hogs

Item	Average	Standard
Production per farm, lb.	1,959	1,500 or more
Concentrates, lb.	231	250
Potatoes and rutabagas, lb.	179	200
Skimmilk, lb.	1,703	1,300
Pasture, days	21	30
Man labor, hr.	12.0	8.0
Horse work, hr.	0.7	0.5
Minerals, medicine, and disinfectants, cents	5	5

The weekly distribution of labor used in producing 2,000 pounds of hogs is shown in Figure 19. Because of the small size of the enterprise, little labor is spent at any time during the year. Altho the largest number of hogs is on hand during the spring, summer, and early fall months, less labor is required during this period because they are on pasture much of the time.

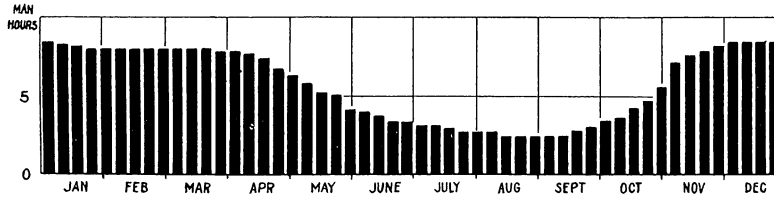

Fig. 19. Weekly Distribution of Labor Used in Producing 2,000 Pounds of Hogs
There is little seasonal variation in the use of labor on hogs in this area.

Poultry

On the farms studied, poultry was raised primarily for egg production. Sales of poultry were largely of old hens, cull pullets, and cockerels, which were usually sold as broilers. Eighty-six per cent of the flocks were of the Mediterranean breeds, chiefly White Leghorns, 9 per cent were of the American breeds, and 5 per cent were mixtures of the two. The number of hens per flock ranged from 25 to 220.

Table 24

Amounts of Feed, Labor, Horse Work, and Materials Used and Production per 100 Hens

Item	Average	Standard
No. of hens per flock	78	75 or more
Percentage hens of total flock	78	....
Grain and millfeeds, lb.	6,795	7,000
Meat scraps, lb.	43	....
Rutabagas, cabbage, potatoes, etc., lb.	1,068	1,000
Skimmilk, lb.	7,872	14,000
Medicine, disinfectants, shells, etc., dollars	7.14	7.15
Man labor, hr.	417	400
Horse work, hr.	5	5
Production { eggs	12,381	14,400
Production { meat, lb.	258	360

The average amounts of feed, labor, horse work, and materials used per 100 hens is shown in Table 24. These amounts cover not only the laying hens but also the baby chicks from the time they are hatched or purchased till they are either sold or added to the laying flock as pullets, and also the cockerels up to the time they are sold. Seventy-eight per cent of the average flock for the year was laying hens, the rest was growing stock. Two chickens under 6 months of age were considered equal to one hen in computing the total number of birds in the flock. Standards for poultry production are also shown in Table 24. As the poultry on the farms studied was handled with such a high degree of efficiency, this standard varies little from the average. It is assumed that 200 baby chicks are hatched or bought each year and that

from these 150 are raised. The pullets are added to the laying flock and the cockerels are sold as broilers at a weight of one and three-fourths to two pounds each. A 15 per cent death loss of hens is also assumed. These standards are for light breeds, such as Leghorns. American breeds would require more feed but more meat would be produced.

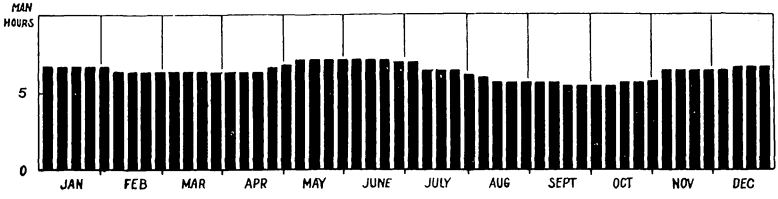

Fig. 20. Weekly Distribution of Labor Used on a Flock of 80 Laying Hens

Poultry receive fairly constant attention throughout the year. A little extra time is used during late fall and early winter and again during the brooding and rearing season, in May and June.

The weekly distribution of labor on a flock of 80 hens is shown in Figure 20. There is little variation throughout the year as compared with other classes of livestock. Slightly more attention is given during November, December, and January, and again in the spring and early summer during the hatching and rearing season.

Work Horses

Work horses are the principal source of power on farms in northeastern Minnesota. Horses are maintained primarily as a source of power and colts are raised only to supply replacements. The average amounts of feed, labor, and materials used, and the number of hours of work per year for a work horse are shown in Table 25. Standard amounts are also given. The weekly distribution of labor used in the care of three work horses is shown in Figure 21. Some extra labor

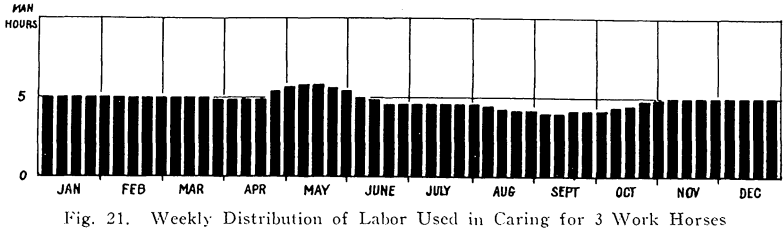

Fig. 21. Weekly Distribution of Labor Used in Caring for 3 Work Horses

Work horses received practically the same amount of care throughout the year. The labor saved by having the horses on pasture in summer is largely offset by the extra time spent in grooming and harnessing them.

is used when spring work starts but as soon as the rush of the planting season is over considerable use is made of pasture and less labor is used. There is practically no variation from the time field work ceases in the fall till it starts again in the spring.

Table 25

Feed, Labor, and Materials Used and Hours of Work per Year for a Work Horse

Item	Average	Standard
No. per farm	3.4	3 or more
Grain, lb.	1,160	1,200
Hay, lb.	3,900	4,000
Straw and fodder, lb.	860	1,000
Pasture, days	127	125
Veterinary services, medicine, and shoeing, dollars	1.95	2.00
Man labor, hr.	87	80
Work performed, hr.	766	850

Indirect Livestock Work

In addition to the regular daily care that can be charged directly to the class of stock served, there are certain items of indirect labor on livestock. These include such items as purchasing feed, grinding and mixing feed, and hauling hay and bedding. Frequently these operations serve several classes of stock jointly. The amount of time spent at this work varies much more widely from farm to farm than does the time spent in regular daily care. The proportion of feed that must be bought, ground, or hauled varies widely with the feeding system practiced, the source of feed supply, and other conditions peculiar to the individual farm. Three and one-half per cent of all man labor and 54 per cent of all horse work used on livestock on the farms studied was of this indirect type. The amount of indirect man labor and horse work per unit of each class of livestock is shown in Table 26. The average weekly distribution of this labor is shown in Figure 22. Most of this labor is performed during the late fall, winter, and early spring, hence does not compete with crop operations for the farmer's time. The percentage distribution of this labor by week is shown in Table 27.

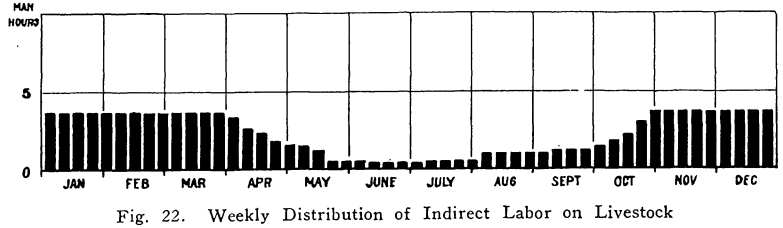

Fig. 22. Weekly Distribution of Indirect Labor on Livestock

Most of this work is done during the months in which there is little crop work and hence does not compete seriously with crops for the farmer's time.

Table 26

Average Amount of Indirect Labor and Horse Work Used per Unit of Livestock

Class of livestock	Unit of livestock	Man labor, hours	Horse work, hours
Dairy cows	1 head	6.0	6.9
Young dairy cattle	1 head	1.9	2.0
Hogs	100 lb. hogs produced	0.5	0.4
Poultry	100 hens	9.7	10.7
Work horses	1 head	5.1	5.9

Weekly Percentage Distribution of Livestock Labor

The amounts of man labor and horse work used in livestock production have been presented in Tables 21 to 26. The weekly distribution of labor for the average size of each livestock enterprise on the farms studied is shown in Figures 16 to 22. In order that these distributions may be used for enterprises varying from the sizes shown, the percentage distribution of the labor on each class of livestock is shown in Table 27.

Table 27

Weekly Percentage Distribution of Man Labor on Livestock Beginning January 1

Week	Direct labor					Indirect labor
	Dairy cows	Young dairy cattle	Hogs	Poultry	Work horses	
	per cent	per cent	per cent	per cent	per cent	per cent
1	2.40	2.84	2.60	2.00	1.98	3.14
2	2.40	2.80	2.60	2.00	1.98	3.14
3	2.39	2.75	2.50	2.00	1.98	3.14
4	2.37	2.70	2.40	2.00	1.98	3.14
5	2.36	2.70	2.30	2.00	1.98	3.14
6	2.35	2.70	2.10	1.95	1.98	3.14
7	2.34	2.70	2.06	1.95	1.98	3.14
8	2.33	2.70	2.05	1.95	1.98	3.14
9	2.31	2.70	2.00	1.95	1.98	3.14
10	2.30	2.70	2.00	1.95	1.98	3.14
11	2.29	2.70	2.00	1.95	1.98	3.14
12	2.29	2.70	2.00	1.95	1.98	3.14
13	2.27	2.63	2.00	1.90	1.96	3.14
14	2.26	2.63	1.90	1.90	1.94	2.80
15	2.14	2.61	1.89	1.90	1.94	2.21
16	2.12	2.50	1.89	1.90	1.94	1.95
17	2.08	2.24	1.88	2.00	2.15	1.54
18	2.04	2.13	1.88	2.05	2.26	1.36
19	1.95	1.96	1.76	2.15	2.30	1.27
20	1.92	1.74	1.67	2.15	2.30	1.02
21	1.83	1.72	1.67	2.15	2.24	0.42
22	1.77	1.39	1.60	2.15	2.15	0.42
23	1.76	1.33	1.60	2.15	1.98	0.42

Table 27

Weekly Percentage Distribution of Man Labor on Livestock Beginning January 1

Week	Direct Labor					Indirect labor
	Dairy cows	Young dairy cattle	Hogs	Poultry	Work horses	
24	1.75	1.26	1.55	2.15	1.95	0.34
25	1.73	1.19	1.55	2.15	1.85	0.34
26	1.68	1.10	1.55	2.10	1.83	0.34
27	1.67	1.06	1.55	2.10	1.83	0.34
28	1.56	1.06	1.55	1.95	1.83	0.42
29	1.56	0.96	1.55	1.95	1.83	0.42
30	1.56	0.90	1.55	1.95	1.83	0.42
31	1.56	0.90	1.55	1.85	1.83	0.42
32	1.52	0.90	1.55	1.80	1.80	0.85
33	1.48	0.85	1.55	1.70	1.70	0.85
34	1.48	0.85	1.55	1.70	1.67	0.85
35	1.46	0.85	1.55	1.70	1.66	0.85
36	1.41	0.85	1.55	1.70	1.60	0.85
37	1.39	0.85	1.55	1.70	1.60	1.02
38	1.37	0.90	1.55	1.64	1.66	1.02
39	1.34	1.00	1.55	1.64	1.66	1.02
40	1.55	1.14	1.55	1.64	1.66	1.20
41	1.56	1.20	1.64	1.64	1.77	1.54
42	1.63	1.41	1.64	1.70	1.81	1.87
43	1.72	1.59	1.96	1.70	1.91	2.55
44	1.80	1.87	2.11	1.75	1.96	3.14
45	1.80	2.43	2.40	1.95	1.98	3.14
46	1.80	2.55	2.40	1.95	1.98	3.14
47	2.05	2.65	2.50	1.95	1.98	3.14
48	2.15	2.75	2.50	1.95	1.98	3.14
49	2.20	2.84	2.50	1.96	1.98	3.14
50	2.25	2.84	2.50	2.00	1.98	3.14
51	2.30	2.84	2.55	2.00	1.98	3.14
52	2.35	2.84	2.60	2.00	1.98	3.14

SUMMARY OF UTILIZATION OF MAN LABOR AND HORSE WORK

The amounts of man labor and horse work used in crop and livestock production have been discussed in the preceding pages. There is, in addition, a certain amount of miscellaneous or maintenance work on every farm that can not be allocated to either crop or livestock enterprises and yet is essential to the operation of the farm. Fifteen per cent of all man labor and 13 per cent of all horse work on the farms studied in Pine County was of this type. The average amounts of man labor and horse work expended annually per farm on crops and livestock and also the amount spent at this miscellaneous work is shown in Table 28.

Table 28

Average Distribution of Man Labor and Horse Work Used Annually per Farm

	Man hours		Horse hours	
Crops:				
Field	1,513		2,039	
Other	48		26	
Total		1,561		2,065
Livestock:				
Direct	3,232		109	
Other	116		126	
Total		3,348		235
Miscellaneous:				
Buildings, fences, drains	281		59	
Machinery and equipment	95		13	
Land development	236		168	
General farm	74		40	
Household	164		77	
Total		851		357
Grand total		5,760		2,657

The miscellaneous or maintenance work is classified into five groups. The labor on buildings, fences, and other improvements includes repairs and new construction. Forty-two per cent of the man labor and 54 per cent of the horse work were used in new construction. Labor on machinery includes the repair of all machinery and equipment and the time spent in purchasing new machinery, repair parts, motor fuel, and lubricants. Land development includes time spent in brushing, stumping, stoning, breaking, and similar operations involved in land clearing and development. Such items as attending farm organization or extension meetings, and attending to general farm business is classified as "general farm." "Household" includes only work that contributes to maintaining the farm family that is regularly done by the farmer or his hired help. Most of it consists of cutting and hauling firewood and purchasing groceries and household supplies. It does not include such items as preparing meals, caring for children, or doing the family washing even tho this work may be performed by the farmer.

The distribution by four-week periods of each class of miscellaneous labor is shown in Figure 23. Only two classes, building, fence, and drainage work and land development are of sufficient size and of such seasonal distribution that they conflict materially with crop work. Because of the severe winters, much of this work must be done during the rest of the year, but it can be fitted in at times when crops do not need attention or when weather interferes with field work.

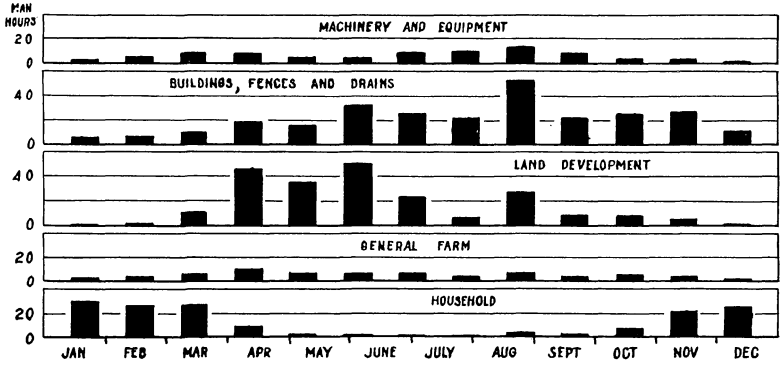

Fig. 23. Distribution of Miscellaneous Labor by Four-Week Periods

Most of this type of work is of such a nature that it can be shifted so as to fit in between the more or less fixed and regular work on crops and livestock.

The average distribution by four-week periods of all man labor used on the farms studied is shown in Figure 24. Both direct and indirect labor on crops and on livestock have been combined. In general, crops and livestock supplement each other in the use of labor. Miscellaneous labor, in so far as it permits of shifting, is fitted in when crops and livestock need less attention. There is little variation in the amount of labor used from November to March, inclusive. The high peak in May is due to a combination of seedbed preparation and seeding at a time when livestock still require considerable attention. The labor peak in September is largely due to a combination of silo filling, potato digging, and fall plowing. The crops grown in this area require comparatively little labor during August, and livestock labor is also close to the low point at this time. Miscellaneous work takes up some of the slack during this period.

The average distribution by four-week periods of all horse work is shown in Figure 25. Most of the horse work is used in crop production. The peak load of horse work comes in May during seedbed preparation and seeding. Even during this period the average number of hours per horse is less than five per work day. During most of the year, the horses are worked at much less than their full capacity.

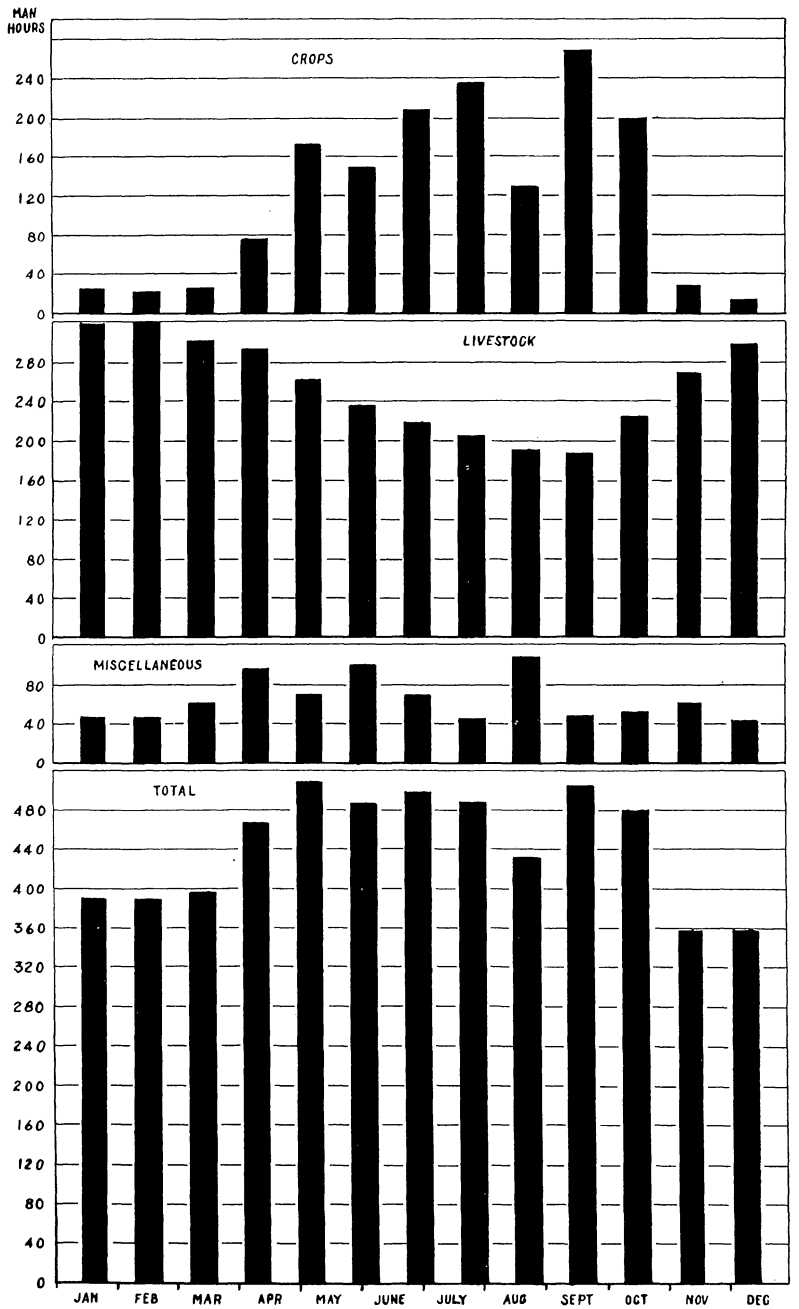

Fig. 24. Distribution of All Man Labor per Farm by Four-Week Periods

Crops and livestock supplement each other to such an extent that there is a fairly uniform distribution throughout the year.

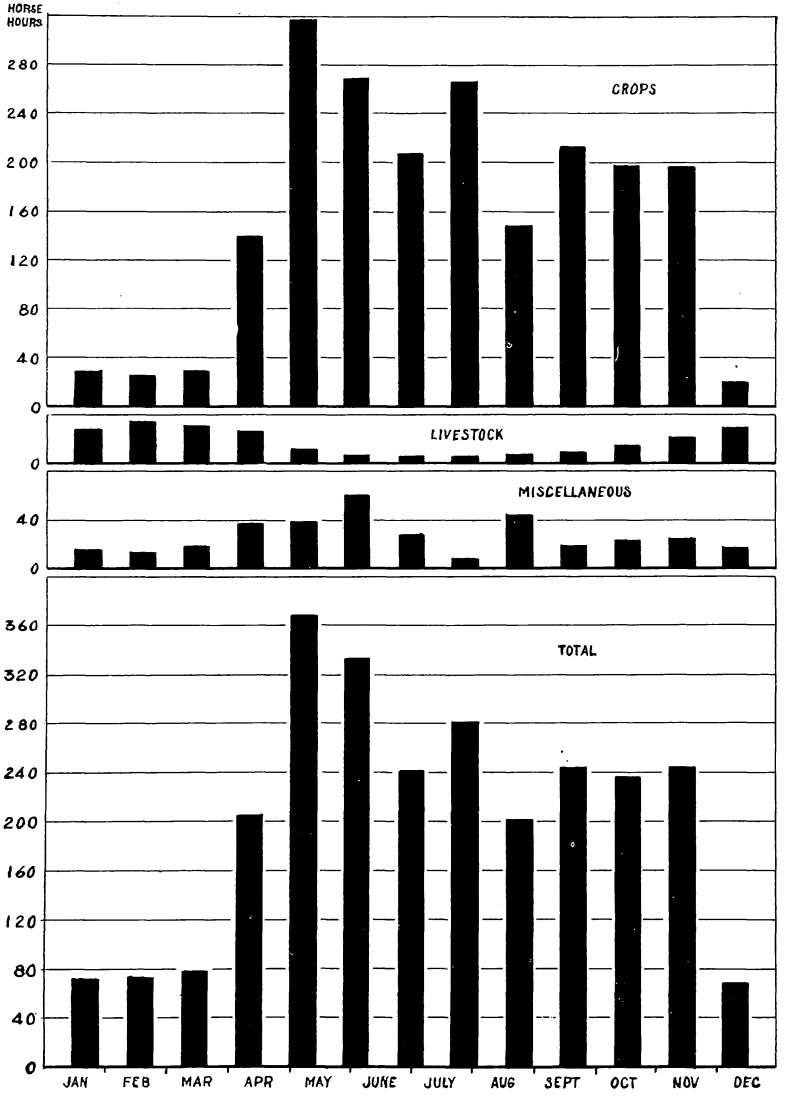

Fig. 25. Distribution of All Horse Work per Farm by Four-Week Periods

The distribution of horse work is much less uniform than that of man labor. During most of the year, horses are worked at much less than their full capacity.

FACTORS AFFECTING THE SELECTION OF CROPS AND LIVESTOCK

Climate and Soil

Climate and soil are two of the most important factors affecting the farm organization in any area because they determine very largely the crops that may be grown, and the choice of livestock is to a considerable extent dependent on the feed crops available. The climate of northeastern Minnesota, as has already been noted, is favorable to the production of small grains, forage crops (especially alsike and timothy), root crops, and potatoes. The growing season is too short and too cool to grown corn for grain except on the southern edge of the area covered by the study. It may be grown as a forage crop in the southern half, but in Cook, Lake, St. Louis, and Carlton Counties sunflowers take its place largely as a silage crop. Late spring and early fall frosts limit the production of tender crops on peat soils. Both root and leaf vegetable crops are well adapted climatically and do well on most of the peat land, altho commercial fertilizer may be needed if it is deficient in certain essential elements.

Soils are highly variable in this section of the state but on most of the mineral soils the crops mentioned in the previous paragraph can be successfully grown. Potatoes are grown on both the heavy clay soils and on the light sandy soils. Root crops are better adapted to the heavier soils. Most of this area is deficient in lime, and alsike is the only legume roughage that is generally adapted. Alfalfa can be grown in some sections, but a heavy application of lime must be put on most soils, and on the heavier soils the crop winter kills frequently. In general, it has a limited place in the agriculture of this area. Much of the soil lacks sufficient lime for red clover and, in general, alsike is the most dependable legume.

Because of the nature of these soils as mentioned on page 33, it is necessary to keep a fairly large proportion of the crop land seeded to legume hay in order to maintain the nitrogen and humus supply, especially if such intensive, cultivated crops as potatoes and rutabagas are to be grown. This, in turn, necessitates a sufficient acreage of small grain to serve as a companion crop for the seedings. Alsike and timothy can be grown for hay or pasture on land too stony to be plowed (see Fig. 26). They are often seeded in newly brushed land under a system of delayed clearing. Usually good stands are secured by scattering the seed with little or no previous preparation of a seedbed. Both soil and climate are such as give hay and pasture crops a major place in the farming systems of the area.

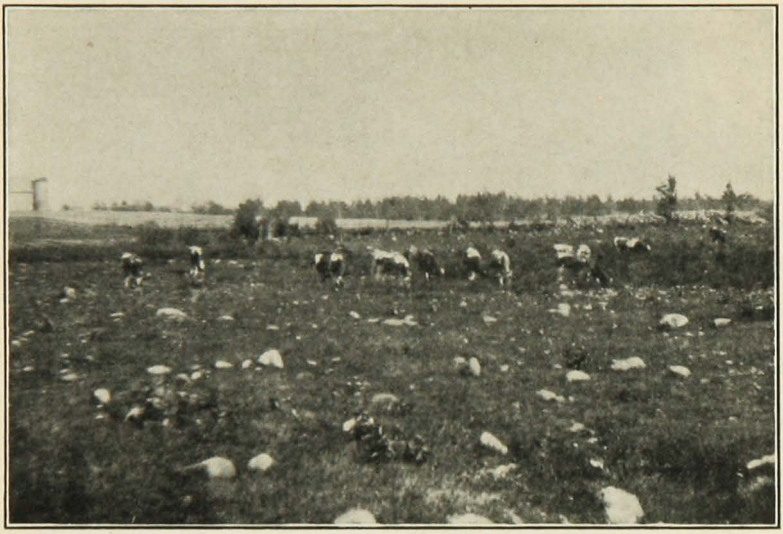

Fig. 26. Stony Land Used for Pasture

This field has been cleared of brush and seeded to alsike clover and timothy. It makes a very satisfactory pasture but there are too many surface stones to permit of its being mowed for hay.

Labor Supply

Most of the labor used on farms in northeastern Minnesota is supplied by the farmer and his family. On the farms studied in Pine County, only 3 per cent of all labor was hired. Most of this was employed in land clearing or during haying and harvest. The receipts from outside labor exceeded the cost of hired labor. This is fairly representative of this part of the state. As the farms are small and have a relatively small percentage of tillable land as compared with the rest of the state, there is, on many farms, more labor than can be used advantageously in crop and livestock production. On farms in the process of development, this labor can be used in clearing land and in the cutting and marketing of timber products. Because of the limited income, the farmer and his family often obtain outside work, such as lumbering, mining, and road construction. This is especially likely to be the case during the earlier stages of the development of a farm and is often necessary in order to get sufficient income to maintain the family until more of the farm is brought into production. This type of labor is commonly available for hire by neighboring farmers who have more fully developed farms.

An important problem of the cut-over farm is to find productive employment throughout the year for the available family labor. Because of the large supply of labor relative to the area of tillable land,

crops such as potatoes, rutabagas, and the more intensive vegetable crops have an important part in the cropping system. Four times as much man labor is used in raising an acre of potatoes as in raising an acre of small grain. Six times as much is used on an acre of rutabagas. The difference is even greater between these crops and the hay crops. These intensive crops make possible a fuller utilization of the available family labor. Likewise such livestock enterprises as dairy cows and poultry use more labor in proportion to feed consumption than beef cattle, sheep, or swine. Dairy cattle have a special advantage in that they furnish much employment in winter when there is no crop work to be done (see Fig. 16).

Feed Supply

Hay and pasture are the principal feed crops produced in northeastern Minnesota. Good legume hay and good pastures can be depended on except in periods of extreme drouth. The pasture season is shorter than in southern or western Minnesota and the pasture has a lower carrying capacity than the good sweet clover pastures on high-lime soils. The low price of land, however, makes pasture available at a comparatively low cost. Legume hay can be produced at a cost comparable with other parts of the state. In the production of corn for either grain or silage, northeastern Minnesota is at a distinct disadvantage because of the climate. Small grain yields are comparable with those of other sections of the state but costs are relatively high because of the small fields and the small acreage per farm. Root crops can be produced at as low a cost as in any part of the state but they have an unimportant place in livestock feeding because the cost of nutrients in root crops is high relative to those in grain or hay or in such succulent roughages as corn or sunflower silage.[16]

Northeastern Minnesota is a distinctly deficit area in corn and small grains. Even in years of high yields, large quantites of cereals and cereal by-products are shipped in from outside the area for livestock feeding. According to the 1930 Federal Census, the average purchase of feed per 100 acres of land in farms was $127 in 1929 in the nine counties included in this study as compared with $64 for the state as a whole. Hay, except in occasional dry years, is produced in sufficient quantities to supply farm feeding needs with some surplus for use in local cities and lumber camps. As a result, the prices of grains and grain feeds are higher than in any other part of the state. A comparison of the average December 1 prices of oats, barley, corn, and tame hay in several of the crop-reporting districts of the state, with the

[16] Cleland, S. B. and Pond, G. A. Selecting Crops for Economical Feed Production. Minnesota Farm Business Notes No. 113. April, 1932.

state price, is shown in Table 29. Prices are highest for each of these crops in the northeastern district, which includes St. Louis, Lake, and Cook Counties. The other six counties to which this study applies are located in the east central district but as they are all in the northern part of the area, the district prices are probably materially lower than those of the six counties. The prices in these counties would probably approach more nearly those of the north central district.

Table 29

Average December 1 Farm Prices of Oats, Barley, Corn, and Tame Hay in Minnesota, 1923 to 1931*

District†	Oats, per bu.	Barley, per bu.	Corn, per bu.‡	Tame hay, per ton
	cents	cents	cents	
Northeastern	44	59	65	$12.48
North Central	40	55	62	11.36
East Central	36	53	64	11.52
Northwestern	31	46	61	9.22
Southwestern	32	51	54	10.56
State	33	50	57	10.79

* Compiled from annual crop reports of Minnesota State Dept. of Agr.

† A list of the counties included in each district may be found in Bull. 9 of the Minn. State Dept. of Agr., Minnesota Crop and Livestock Statistics, 1930-31.

‡ Data for 1924 are omitted because of a short corn crop and abnormal prices that year.

The farm prices are those paid to the producer by the usual marketing agencies. As practically no corn and very little small grain is sold, there is an inadequate basis for these estimates and it seems probable that the price differences between various parts of the state are under- rather than over-estimated. This is indicated by the data presented in Table 30.

Table 30

Comparison of Average Monthly Market Prices of Oats, Barley, Corn, and Tame Hay at Askov, Pine County, with Average Monthly Farm Prices in Minnesota,* 1924-27

Year	Oats		Barley		Corn		Tame Hay	
	Askov	State	Askov	State	Askov	State	Askov	State
1925	$0.54	$0.36	$0.98	$0.65	$1.11	$0.82	$11.75	$13.86
1926	0.53	0.33	0.79	0.51	0.90	0.59	14.67	13.37
1927	0.54	0.40	0.96	0.63	1.04	0.70	14.50	14.12
Average, 1925-27	0.54	0.36	0.91	0.60	1.02	0.70	13.64	13.78
Ratio of Askov price to state price, per cent	150		152		146		99	

* From annual crop reports of Minn. State Dept. of Agr.

The average annual price reported at Askov is a simple average of the prices of these feeds on the 15th of each month at local feed stores. The state price is the average of monthly prices paid producers in Minnesota on the corresponding dates, as reported by the United States Department of Agriculture in Crops and Markets. This is undoubtedly a more representative picture of the feed price situation in northeastern Minnesota than was shown in Table 29. The grains are approximately 50 per cent higher than in the state as a whole. The difference would be even greater if comparisons were made with such surplus feed areas as the northwestern or southwestern districts. Hay prices, on the other hand, correspond quite closely to the state prices. The high price of hay in the northeastern district relative to the state price is no doubt due to the local demand for hay in cities and lumber camps. The hay price situation in Askov is more representative of the better developed agricultural areas of this region.

The relatively high prices of feed grains in northeastern Minnesota is due both to the cost of transportation from surplus areas and to the high cost of handling small quantities. Farms are small and scattered and the individual sales are not only small but the volume of business per dealer is so small as to make the expense per unit high. This applies not only to farm grains but to by-products such as millfeeds and oilmeal. Because of the high prices of grain feeds relative to roughage, livestock that can utilize considerable roughage in proportion to concentrates have an advantage. Dairy cattle are well adapted to the area for this reason and also because they provide productive employment for labor, especially in winter. Sheep can be maintained largely on roughage, but they have a disadvantage on the small farm in that they do not provide productive employment for any considerable amount of labor. The lack of sheep-tight fences or the capital with which to build them also limits sheep production. Further, dogs and wolves are a menace to sheep in many sections. The high price of concentrate feeds makes unprofitable the feeding of beef cattle and, too, they offer a small market for family labor. Both hog and poultry production are handicapped as compared with dairying by the high price of concentrates, as neither can use roughage in any quantity. Poultry have an advantage over hogs in that they provide productive employment for relatively more labor.

Another element in the feed-supply situation that affects the selection of livestock in this area is the availability of certain by-products for livestock feeding. Most important of these are skimmilk and cull potatoes and roots. The principal dairy product sold is cream for butter manufacture. The skimmilk is retained on the farm. Some of this is fed to young dairy cattle and even to the cows, but most of it is fed

to hogs and poultry and on many farms considerable quantities are thrown away during part of the year. The availability of skimmilk often makes profitable the raising of either hogs or poultry, altho they would involve a loss if all feed consumed by them were purchased on the market. Cull potatoes may also be utilized by swine. Many farmers in this section reduced the grain feed for hogs very materially through the use of cull potatoes and skimmilk. Cull rutabagas can be used to good advantage by dairy cows and in years of low prices feeding the marketable roots may be more profitable than selling them for cash. In some years there is no sale for root crops, and livestock afford an assurance of a market for them in such cases.

Available Capital

The importance of credit to a settler on cut-over land has already been discussed. As in many other parts of the state, the credit advanced in the past is often greatly in excess of what is justified by prices of the last three years. As a result, loaning agencies that have previously loaned money on farms are making no new loans. Many of the old loans are renewed only at a higher interest rate. The cost of making and supervising loans is greater in an area of small farms and low acre values because of the small size of the loans, and is further increased by the sparsity of settlement. The risk is also greater in a newly developed region and there is usually little accumulation of locally owned or controlled capital available for loaning. It seems probable that, at least for some time in the future, the farmer in northeastern Minnesota will have to depend to an increasing extent on his own resources to finance his farming operations. This will limit very definitely any expansion of the livestock enterprises that involve purchases of breeding stock or the construction of expensive shelter. It will also limit the use of labor-saving machinery and power equipment.

Co-operative ownership of the more expensive machines, as grain and corn binders, potato planters and diggers, and silage cutters, makes possible considerable economy in machine investment. This type of machinery is seldom used to capacity on the small farm and two or more farmers may use the same machine with little or no inconvenience. Exchanging horse work between farms makes possible a more effective use of work stock. Often a farmer may be able to do all his work with two horses except on such operations as harvesting grain, filling the silo, and digging potatoes. By exchanging both man labor and horse work with his neighbors, and by co-operative ownership of machinery, his capital investment may be kept down. Where co-operative ownership is not practicable, machines may often be hired from other farmers who are not using them to capacity. Co-operative

ownership of sires or the hiring of the service of sires owned by other farmers helps to keep down the livestock investment.

Market Outlets

Market outlets are also important in determining the selection of both crops and livestock in northeastern Minnesota. In most of this area there are regular markets for cream at prices comparable with the rest of the state. On the other hand, there is a very limited outlet for fluid milk except in the vicinity of Duluth and the iron range. Eggs are salable anywhere but the quality of the markets varies widely. In some regions, co-operative marketing of graded eggs has resulted in a sufficient price advantage to offset the handicap of high-cost feeds.

The cash crops that may be grown depend largely on the local market. Potatoes are the only cash crop for which a market is available practically anywhere in the area. In a few localities, such as that at Askov, a regular market for rutabagas has been developed. The same is true of other vegetables. There has been a good outlet for hay in the vicinity of lumber camps, but at present little timber is being cut and the remaining stands are mostly rather distant from developed farming communities. The selection of cash crops for the individual farm is largely dependent on the special market outlets available.

PLANNING THE FARM ORGANIZATION

The data presented thus far in this study may be used as a basis for planning farm organizations for cut-over farms in northeastern Minnesota. Both farms and farmers differ so widely, especially in this part of the state, that it is impossible to set up any one plan that will apply to all farms or even to a considerable portion of them. In general, the objective in farm planning is to determine the utilization of the factors of production within the control of the individual farmer that will result in the largest net return to himself and his family. Obviously, this involves a combination that will change from time to time. This is especially true on a farm in the process of development. This part of the bulletin is devoted to a discussion of the principles of farm organization and to the illustration of a method of developing a farm plan and adjusting it to the conditions encountered on a single farm.

Basis of Planning

Selecting crop rotations.—The first step in balancing a farm organization is the development of a cropping system. This system should provide the optimum quantity and quality of sale crops adapted to the market outlets and feed crops adapted to the livestock planned for

the farm. The balance between these two groups of crops and a balance among the individual crops in each group is a matter for further consideration. In order to aid in maintaining soil fertility, controlling weeds, and utilizing most fully the various factors of production available on the farm, a fairly definite succession or rotation of crops is necessary. A good rotation for this part of the state includes a grain crop, a legume hay or pasture crop, and an intertilled crop grown in regular succession. The comparative advantage of hay crops, especially the legumes, in this part of the state has already been mentioned. Small grain is advisable as a companion crop in seeding the hay crop. The intertilled crops are useful in controlling weeds and the more intensive ones increase the size of the business (see Fig. 27). The latter is an important factor on a farm with a limited crop acreage.

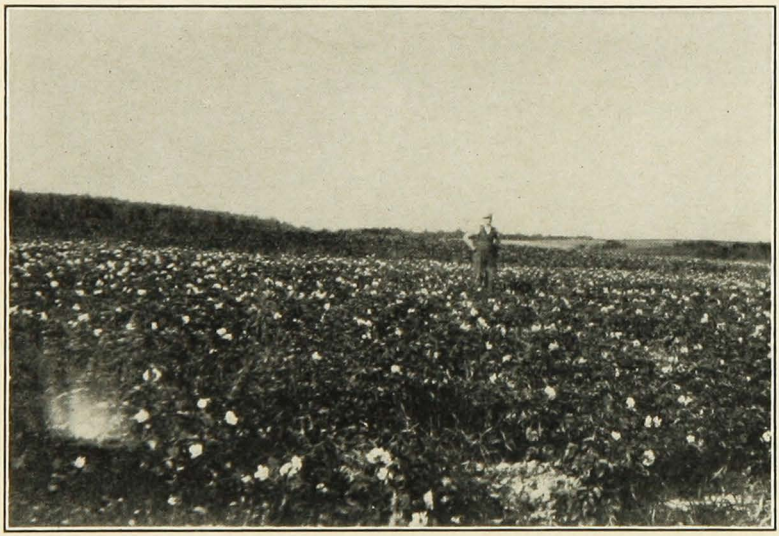

Fig. 27. A Potato Field in Pine County

Potatoes are the leading cash crop in the northeast cut-over section. They are well adapted to the soils and climate of this area. As an inter-tilled crop, they have an important place in the rotation in controlling weeds. They have an advantage on the smaller farm in that they provide profitable employment for a much larger amount of labor than do the hay and grain crops.

The common rotation in the past has been a three-year succession of these three classes of crops. As there is usually non-tillable land to provide pasture, the legume crop is cut for hay. Experimental work at the Northeast Experiment Station indicates that, at least for the live-stock farm, the four-year rotation with one year of small grain, two years of hay, and one year of intertilled crops has certain definite ad-

vantages over the three-year system as indicated by the following statement:

> "In the light of these findings, what rotation should be adopted on the reasonably developed northern livestock farm? There was a time when the three-year rotation was universally recommended, and with reason. The hay would contain more clover, and clover was easy to raise. Times have changed. Failures to "catch" and winter-killing have become more frequent with the passing years and the opening of the country. On the assumption that an abundant supply of roughage must at all times be assured, this station is disposed to favor the lengthened rotation of four years, and sometimes at certain places, five years, once the farm is cleared and stocked. These reasons advanced in favor of the four-year as compared with the three-year rotation are:
>
> 1. One-half the land instead of one-third is engaged in growing a crop that is relatively sure, cheap to grow, and native to the country—hay.
> 2. It is a more normal division of the plow land. One-third of the land in cultivated crops is usually too heavy a proportion; a fourth is ample.
> 3. With 50 to 60 per cent of the land in hay, the market problem is lessened, for this crop is marketed through the farm livestock.
> 4. The slightly reduced hay yield and clover content is more than compensated for by the reduced annual plowing or breaking cost; the better, thicker sod developed; the lower growing cost as compared to cultivated crops; the greater net return as compared to grain." [17]

Obviously the length of the rotation for any particular farm will depend on factors such as the quality of the soil, the market outlets, the size of the farm, the available labor, and capital and similar factors so that only general suggestions can be made.

The selection of crops within each of the three rotation groups, like the selection of the rotation itself, is also an individual problem for each farm and farmer. The data in Table 31 indicate some of the factors involved in the selection of cash crops. The crops to be selected for such a comparison as well as the prices to be used depend on local markets. In this case, rutabagas yield a larger cash value per acre. The direct cash costs of production, which are spray materials in case of potatoes and seed in case of rutabagas, are about equal. Fertilizer expense for the two crops is the same. Potatoes require less man labor than do rutabagas but involve the use of more specialized equipment, as planters and diggers, if considerable acreages are to be produced. The cost of this special equipment required for the potato crop may not be a factor of immediate importance in determining the relative profitability of these two crops for the farmer who already has

[17] Thompson, M. J. Field Crops at Duluth. Minn. Agr. Expt. Sta. Misc. Bull. 1930.

the potato machinery. It must, however, be considered by him when making replacements and also by other farmers who are considering the introduction of potatoes into their cropping systems. The seasonal distribution of labor for the two crops, as shown in Figure 14, must also be considered in determining how each crop will fit into the labor program. This same method may be used in comparing other crops.

Table 31

Cash Value per Acre of Potatoes and Rutabagas in Northeastern Minnesota

	Potatoes	Rutabagas
Standard yield, bu. or ton*	150	12
Amount seeded, bu.	15	...
Net yield, bu. or ton	150	12
Relative sale price†	$ 0.40	$ 6.00
Gross cash value	$60.00	$72.00
Hours of man labor	48.7	75.4
Hours of horse work	63.3	62.2

* From Tables 19 and 20.
† See Table 33, page 81.

The selection of feeding crops may be based in part upon the method of comparison shown in Table 32. The feed production is based on the standard yields shown in Tables 14 to 20. The individual farmer making this comparison should use yields that may reasonably be expected on his farm. Other crops may be included in this comparison. Wherever barley yields as well relative to oats as in this comparison, it will produce more digestible feed per acre at practically the same cost. The percentage of protein is, however, somewhat smaller but the total quantity is approximately the same. A mixture of oats and barley yields slightly more digestible feed per acre than barley alone and has a higher protein content.

Among the roughages, alfalfa produces the most digestible feed per acre and contains the highest percentage of protein. Wherever it can be grown successfully, this increased production much more than offsets the additional labor and cash costs. However, alfalfa does not fit into a rotation as well as clover and timothy do and in most of this area it is so difficult to secure and maintain a stand that the crop is not generally adaptable. Rutabagas are second in the production of digestible feed per acre but require large amounts of rather tedious hand labor. Sunflowers produce more digestible feed per acre than does corn silage, but the labor, power, and cash costs are somewhat higher. The two crops require practically the same tillage and harvesting machinery. As compared with rutabagas, they require relatively less hand labor but more machinery. On the small farm, therefore, succulent feed can be produced to better advantage in a root crop such as rutabagas, but on

the larger farms either corn or sunflower silage has an advantage from the labor standpoint.

Table 32

Feeding Value Yielded per Acre by Various Crops in Northeastern Minnesota

Crop	Yield per acre less seed*	Pounds of feed	Pounds digestible matter available†		Production costs		
			Total digestible nutrients	Digestible protein	Man labor hr.*	Horse work hr.*	Direct cash costs
Oats, bu.	47.5	1,520	1,070	147	12.6	24.0	$1.75
Barley, bu.	33.0	1,584	1,258	143	12.6	24.0	1.30
Oats and barley, bu.	41.75	1,670	1,266	155	12.6	24.0	1.65
Corn fodder, tons‡	2	4,000	1,443	111	19.1	40.2	1.05
Corn silage, tons	6	12,000	1,596	120	26.1	50.2	2.85
Sunflower silage, tons	8	16,000	2,016	160	30.1	55.2	3.85
Rutabagas, tons	12	24,000	2,280	240	75.4	62.2	0.06
Alfalfa hay, tons§	2.50	5,000	2,550	530	12.2	17.4	1.20
Alsike hay, tons‖	1.75	3,500	1,656	277	7.3	9.6	0.65
Alsike, clover and timothy hay, tons	1.75	3,500	1,726	179	7.3	9.6	0.70
Wild hay, tons	1.00	2,000	964	60	4.7	7.0	...

* Data from Tables 13-19.

† Based on average analyses given in Feeds and Feeding, by Henry and Morrison, and in Feeding the Dairy Herd, Minn. Agr. Expt. Sta. Bull. 218, by Eckles and Schaefer.

‡ Original feeding value has been reduced one-fourth to compensate for losses by weathering and by failure of animals to consume the whole plant.

§ Seed cost based on the assumption of a two-year stand.

‖ Seed cost based on the assumption of a three-year stand.

Alsike produces slightly less total digestible feed per acre than does mixed alsike, red clover, and timothy hay but produces considerably more protein. The costs are similar but the mixed hay is somewhat easier to cut and cure and it is easier to secure a good stand with the mixed seeding. Both these hay crops produce more digestible feed of a much higher protein content than does either corn fodder or corn silage and the costs are lower. The latter crops, however, may be desirable in a rotation in order to provide a sufficient area of intertilled crops to control weeds. This is likely to be the case on the larger farms, where the labor supply is insufficient to care for the desired acreage of intertilled crops if only such intensive crops as potatoes and rutabagas are grown. The digestible feed obtained from an acre of wild hay is so small and of such poor quality that this crop is grown only on land that is too wet or too stony or otherwise unfit to be included in the rotation.

In selecting from each group the feed crops to be included in the rotation, the farmer must consider the labor distribution, as shown in Figure 14, the labor supply of the farm, the machine equipment, and especially the kind and amount of livestock to be kept. The crop by-products also affect the selection. The small grain crops produce straw

that may be used for either feed or bedding. Oats usually produce more straw per acre than barley and oat straw is more valuable as feed. Rutabaga tops provide considerable succulent feed for dairy cattle. The aftermath of the meadows may be used as pasture. All these factors must be weighed in determining the crops best adapted to the rotation for a particular farm.

Balancing crops and livestock.—After developing the cropping system of the farm organization, the next step is to combine with it such livestock enterprises as will utilize effectively the feeds available. The data contained in Tables 21 to 25 are a useful guide in determining the amount of each class of livestock that can be maintained with the feeds that can be produced and with the other resources of a given farm. The main problem is to secure such a combination of the different classes of livestock that the net return to the farmer for the resources available will be a maximum.

Some of the functions performed by livestock are:

1. To increase the volume of business, thus making for less overhead expense per unit of product.
2. To convert both salable and unsalable farm products into salable products with a higher market value.
3. To aid in maintaining the productivity of the soil and in this way the returns to the farm operator.
4. To concentrate salable feed products into less bulky products, thus reducing shipping costs.
5. To distribute the demand for labor, power, and equipment over a greater part of the year than could be done with crops alone, thus aiding in the reduction of these direct costs.

For the small farms of northeastern Minnesota, which have ample labor supply but a limited crop area and fertility, and higher cash outlays for materials, it is especially important that (1) the volume of business be increased in so far as possible with a given overhead, (2) everything that can be produced on the farm be used to advantage, (3) the fertility of the soil be maintained, (4) the bulk of shipped products be reduced to offset shipping charges, (5) the available family labor supply be utilized effectively.

As already noted, dairy cattle are admirably fitted to serve as the major livestock enterprise on farms in this area. They use to advantage both absolutely and relatively large quantities of rough feeds necessary in the cropping system that otherwise could be marketed only with difficulty, if at all. Further, they permit the return to the soil of much of the crop fertility removed. The concentration of bulky feeds into marketable products of higher unit value, the addition of volume to the business, and the more effective utilization and distribution of labor

are further favorable characteristics of this type of livestock. The opportunity to market productively the otherwise unused family labor and the unsalable rough feeds is an important advantage to the small farmer in this region.

In contrast, the high price of grain for feeding beef cattle, the limited opportunities for this enterprise on a small farm, and the all too modest opportunity to market productively the labor of the family, rule beef cattle out of consideration for this area. Sheep, similarly, can not be considered, altho on larger farms with surplus roughage, ample finances, and freedom from dogs and wolves, some sheep may find a place. Hogs in small numbers are useful primarily to consume the otherwise waste skimmilk and some of the cull potatoes. In utilizing such by-products it is necessary to reduce the use of concentrates to the minimum consistent with satisfactory gains. Feed constitutes such a large proportion of the total cost of hog production (at times calculated as from 75 to 80 per cent), and as this feed must be very largely concentrates, northeastern Minnesota can not produce hogs exclusively on purchased or marketable feeds in competition with the opportunity to market these feeds through dairy cattle, which can at the same time utilize productively the available family labor. Poultry, like hogs, can use little other than concentrated feeds. Poultry offer an effective opportunity to market much of the skimmilk, which, with some cull potatoes, cull roots, and some added grain represents a large proportion of the cost of poultry production. The labor used on poultry is largely family labor for which there is less productive opportunity on the other and larger farm enterprises.

Ninety-four per cent of all livestock farms in the nine counties to which this study applies are dairy farms and 4.1 per cent are poultry farms.[18] Corresponding figures for the state are 73.2 per cent and 2.6 per cent, respectively. Of all farms in these counties except those classified as "self-sufficing," "abnormal," or "unclassified," 67.4 per cent are listed as dairy farms as compared with 39.3 per cent for the state as a whole. Corresponding percentages for poultry farms are 3.0 and 1.4, respectively. This indicates that farmers realize the comparative advantage of these two classes of stock.

Budgeting production programs.—The final step in planning a farm organization is a comparison of the returns that might be expected from the various possible combinations of crops, and livestock that might be selected on the basis of the considerations just discussed. With the data previously presented, it is possible to determine whether these plans can be handled with the feed, labor, power, and equipment

[18] Fifteenth Census of the United States: 1930. Minnesota Agriculture, Statistics by Counties, Third Series. "Type of Farm."

available. The probable production under each plan can be estimated and the approximate return over cash expense that may be expected can be computed.

In using the data presented in this study, the farmer should adjust them to conditions on his farm. While the standards presented may be taken as representative of what may be attained by using good practices in the area studied, they can not be applied directly to any farm anywhere in this part of the state. They do, however, indicate general relationships, and have been described in sufficient detail so that any individual may make such adjustments as are necessary in applying them to his situation. Wherever possible, these data should be supplemented with such records as the farmer may have of his own crop yields and his own livestock production. The prices to be used in computing costs and returns should be based on the best information available regarding the probable trend in prices over the period for which he is planning the program. A comparison of the probable returns from the different plans will enable him to choose that which appears most promising.

APPLICATION OF BUDGETING METHOD TO SPECIFIC FARMS

The following examples will serve to illustrate the application of basic farm organization data, such as have been presented in the previous sections, to individual farms for planning future operations. The two farms to which the data are applied have been selected as being typical in size and general organization of a large number of farms in northeastern Minnesota. They are representative, however, of the group of farms on which a fairly large proportion of the land has been cleared and put under cultivation. The purpose of this section is primarily to illustrate a method of systematic farm planning through the use of the budget method rather than to set up an ideal organization that can be recommended generally for all farms of the sizes selected, in this section of the state. The application of the method to other farms than these selected will be discussed in a following section.

It is necessary to select prices to apply to the sale products and also to the factors of production in order to compute the probable returns from the various combinations of enterprises that will be presented. The prices given in Table 33 will be used in these computations. These prices are selected on the basis of both the present price level (September, 1932), and the relations between the prices of these commodities during the last ten years. They are not intended as a forecast of future prices. A farmer, in applying prices to his own farm budget,

must select them in line with the best information available as to probable future prices in his markets. As will be pointed out later, the returns from the organizations considered can be compared on the basis of several different price schedules.

Table 33

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:	
Potatoes, bu.	$0.40	Corn, bu.	$0.40
Rutabagas, ton	6.00	Middlings, cwt.	0.85
Livestock and livestock products:		Oilmeal, cwt.	1.60
Butterfat, lb.	0.30	Dairy ration, cwt.	0.90
Cows, cwt.	2.00	Poultry feed	1.25
Heifers, cwt.	4.00	Seeds:	
Veal calves, cwt.	6.00	Alsike, lb.	0.20
Hogs, cwt.	5.00	Red clover, lb.	0.20
Chickens, lb.	0.10	Timothy, lb.	0.06
Eggs, doz.	0.15	Corn, lb.	0.04
		Rutabagas, lb.	0.40
		Fertilizer:	
		Mixed, 4-8-6, cwt.	1.75
		Mixed, 4-16-4, cwt.	2.10
		Miscellaneous:	
		Bull service, per cow	2.00
		Baby chicks, per 100	7.00
		Threshing oats or barley, bu.	0.03
		Silo filling, ton	0.30
		Twine, lb.	0.08
		Paris green, lb.	0.40

Illustration No. 1

Since 80-acre farms predominate in northeastern Minnesota, a farm of that size has been selected for the first illustration. This farm is located in Pine County, and complete accounting records for three years are available as a basis for the budget. The present resources of this farm are as follows:

Inventory of Resources

Real Estate:	Acres
Total crop area	43
Permanent pasture	29
Farmstead, road, and waste	8
Total	80

Labor Supply:

The operator's labor for the entire year

Labor of one grown son for the entire year

The assistance of the operator's wife in chores and the care of chickens

Power and Equipment:
2 work horses
All machinery needed for the crops grown or suggested

Buildings:
Present buildings are sufficient to house 2 work horses, 12 cows, 10 head of young cattle, 3 brood sows, and 70 hens.

The present cropping system and the disposal of these crops are shown in Table 34. The normal amounts of man labor and horse work used in producing crops on this farm are presented in Table 35. These represent the usual cropping practice and the usual yields and labor accomplishment on this farm as indicated by the accounting records and the operator's statement as to his usual practices. Normal amounts of materials used in crop production determined in the same way are given in Table 36.

Table 34

Distribution of Acreage and Production and Disposal of Crops

Crop	Acreage	Yield per acre, bu. or ton	Total production, bu. or ton	Disposal		
				Seed bu.	Feed, bu. or ton	Sales, bu. or ton
Oats	10½	50	525	32	493	..
Barley	3	35	105	8	97	..
Corn silage	6¾	6	40½	..	40½	..
Corn fodder	1¼	2	2½	..	2½	..
Alsike, red clover, and timothy hay	17	1¾	..	..	29¾	..
Wild hay	3	9	2¾	..	2¾	..
Potatoes	1	160*	160	11	87†	62
Rutabagas	½	12‡	6	..	2	4
Total crop area	43	..	..	..	..	..

* Includes 20 bu. of No. 2 and cull potatoes.
† Includes 10 bu. used in house.
‡ Includes 1 ton of culls.

The present livestock organization of this farm and the disposal of livestock and livestock products are shown in Table 37. The normal amounts of labor, horse work, feed, materials and services for livestock are shown in Table 38. The distribution of man labor on this farm is shown in Figure 28. The available labor is estimated on the basis of 65 hours of labor per week for the operator and for his son and 10 hours per week for the operator's wife. During only 8 weeks of the year does the labor load of the farm exceed this available supply and then by only slight amounts in most cases. Such peak labor periods as threshing and silo filling are handled by the use of exchange labor. As a matter of fact, the labor supply is really quite elastic and may be expanded very materially in rush periods by lengthening the work day. On this farm there is a large amount of miscellaneous labor, most of which permits of considerable seasonal shifting to avoid

the labor peaks of the productive enterprises. Because of the large supply of labor available, the operator did not find it necessary to make a careful seasonal adjustment of the miscellaneous labor to avoid conflicting demands.

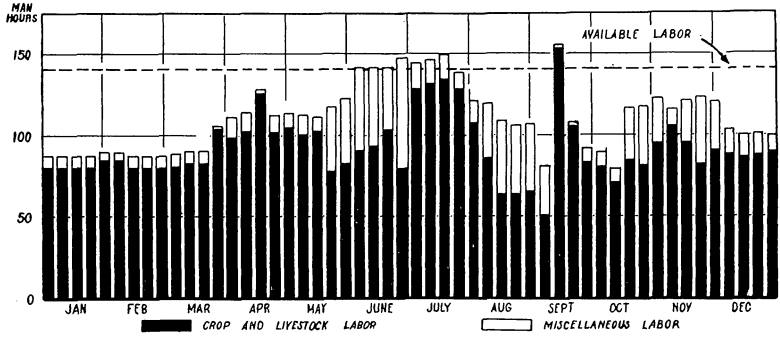

Fig. 28. Distribution of Man Labor by Weeks on an 80-Acre Farm Under the Present System

The available supply of labor on this farm was large relative to the amount needed to operate the farm under the present system. No serious labor conflicts occur.

Table 35
Normal Amounts of Man Labor and Horse Work per Acre for Crops

Field operation	Man hours	Horse hours	Times over
Small grain operations:			
Disking	1.0	2.0	1.0
Spring-tooth harrowing	2.0	4.0	2.0
Rolling	0.7	1.4	1.0
Seeding	1.2	2.4	...
Cutting	1.2	4.0	...
Shocking	1.8	...	...
Stacking	2.6	2.6	...
Threshing	1.8	1.7	...
Corn operations:			
Plowing	6.4	12.8	1.0
Disking	2.0	4.0	2.0
Spring-tooth harrowing	1.2	2.4	1.0
Harrowing	1.2	2.4	2.0
Planting	1.0	2.0	...
Cultivating	7.2	14.4	4.0
Cutting	2.2	4.4	...
Silo filling	13.0	11.0	...
Shocking	8.0	...	...
Tame hay operations:			
Cutting	1.8	3.6	...
Raking	0.7	1.4	...
Cocking	2.0	...	...
Hauling	6.0	7.2	...
Wild hay operations:			
Mowing	1.4	2.8	...
Raking	0.8	1.6	...
Hauling	3.6	3.9	...
Potato operations:			
Plowing	6.4	12.8	1.0
Disking	2.0	4.0	2.0
Harrowing	1.2	2.4	2.0
Cutting seed	5.0	...	...
Planting	3.0	6.0	...
Cultivating	7.2	14.4	4.0
Dusting	1.5	...	1.0
Digging	4.5	18.0	...
Picking	16.0	...	...
Hauling	10.0	20.0	...
Rutabaga operations:			
Plowing	6.4	12.8	1.0
Disking	2.0	4.0	2.0
Harrowing	0.6	1.2	1.0
Planting	3.0	...	...
Thinning	26.0	...	...
Cultivating	7.2	14.4	4.0
Pulling and topping	45.0	...	...
Hauling	15.0	28.0	...

Table 36

Normal Amounts of Materials Used per Acre for Crops

Crop	Kind	Quantity	Crop	Kind	Quantity
Oats	Seed	3 bu.	Tame Hay	Seed—Red clover	4 lb.
	Twine	3 lb.		Alsike	4 lb.
				Timothy	2 lb.
Barley	Seed	2½ bu.			
	Twine	2½ lb.	Potatoes	Seed	11 bu.
				Paris green	2 lb.
Wheat	Seed	1½ bu.		Fertilizer, 4-8-6	125 lb.
	Twine	2½ lb.			
			Rutabagas	Seed	1½ lb.
Corn	Seed	17 lb.		Fertilizer, 4-16-4	125 lb.
	Twine	4½ lb.			

Table 37

Number, Production, and Disposal of Livestock and Livestock Products

Kind of livestock	Number	Production		Disposal		
		Kind	Amount	Fed to livestock	Used in home	Sold
Dairy cows	9	Butterfat	2,790 lb.	60 lb.	135 lb.	2,595 lb.
		Skimmilk	84,400 lb.	84,400 lb.	...	....
		2 cull cows	2,200 lb.	.....	...	2,200 lb.
Young dairy cattle	9	5 veal calves	625 lb.	.....	...	625 lb.
		2 heifers	1,850 lb.	.....	...	1,850 lb.
Brood sows	3	Marketable hogs	3,600 lb.	.....	165 lb.	3,435 lb.
Hens	70	Eggs	595 doz.	.....	85 doz.	510 doz.
		Meat	160 lb.	.....	105 lb.	55 lb.

Table 38

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

	Dairy cows	Young dairy cattle	Hogs	Poultry	Work horses
Unit	1 head	1 head	100 lbs.	100 hens	1 head
Concentrates, lb.	1,765	290	225	6,570	1,625
Legume hay, lb.	3,560	1,500	....	....	7,500
Wild hay and corn fodder, lb.	365	195	....	....	2,000
Corn silage, lb.	7,000	2,000	....	....	....
Rutabagas, lb.	....	....	55	1,430	....
Potatoes, lb.	....	....	95	....	....
Whole milk, lb.	....	200	....	....	....
Skimmilk, lb.	....	2,100	1,350	10,000	....
Pasture, days	160	110	15	....	42
Vet, services, medicine, etc., dollars	2.00	....	0.06	7.00	5.00
Man labor, hr.	260	40	10	420	110
Horse work, hr.	8.0	....	½	4.0	....

Table 39

Normal Returns From Present Organization

Crop and Livestock Sales						
Crop sales:						
Potatoes	62	bu.	@ $0.40	$ 24.80		
Rutabagas	4	tons	@ 6.00	24.00		
Total crop sales					$ 48.80	
Livestock and livestock product sales:						
Butterfat	2,595	lb.	@ $0.30	$778.50		
2 cows	2,200	lb.	@ 0.02	44.00		
2 heifers	1,850	lb.	@ 0.04	74.00		
4 veal calves	500	lb.	@ 0.06	30.00		
Hogs	3,435	lb.	@ 0.05	171.75		
Poultry	55	lb.	@ 0.10	5.50		
Eggs	510	doz.	@ 0.15	76.50		
Total livestock sales					1,180.25	
Total crop and livestock sales						$1,229.05
Direct Cash Costs						
Cost of materials and services for crops:						
Twine	39	lb.	@ $0.08	$ 3.12		
Threshing	630	bu.	@ 0.03	18.90		
Silo filling	40½	tons	@ 0.30	12.15		
Fertilizer, 4-8-6	1.25	cwt.	@ 1.75	2.19		
Fertilizer, 4-16-4	0.63	cwt.	@ 2.10	1.32		
Paris green	2	lb.	@ 0.40	0.80		
Alsike seed	54	lb.	@ 0.20	10.80		
Red clover seed	54	lb.	@ 0.20	10.80		
Timothy seed	27	lb.	@ 0.06	1.62		
Rutabaga seed	0.75	lb.	@ 0.40	0.30		
Seed corn	136	lb.	@ 0.04	5.44		
Total cash crop costs					$ 67.44	
Cost of materials and services for livestock:						
Veterinary services and medicince				$ 31.06		
Bull service	9	cows	@ $2.00	18.00		
Baby chicks	125		@ 0.07	8.75		
Dairy feeds	79.20	cwt.	@ 0.90	71.28		
Hog feed	29.23	cwt.	@ 0.73	21.34		
Poultry feeds	29.42	cwt.	@ 1.25	36.78		
Total cash livestock costs					187.21	
Total cash costs of materials and services						254.65
Cash returns to organization (above cash costs that vary directly with changes in the organization						$974.40

A statement of the returns from the present organization, based on the prices given in Table 33 and on the quantity of sales and of cost factors used as given in Tables 34 to 38, is presented in Table 39. The returns to the organization, $974.40, represent the excess of cash receipts over cash expenses that vary directly with changes in the kind and amount of livestock and of crops. For purposes of budgeting different organizations for a given farm, it is not necessary to include such items as taxes, insurance, interest, repairs, and replacement of equipment and buildings, general overhead, and similar items as long as they are constant elements with each organization. When changes in the organization involve changes in these items, they must be considered.

The present organization of this farm may be criticized because it does not include a definite crop rotation that will maintain a fairly uniform feed supply from year to year and a definite succession of crops. Some crops, as corn fodder, do not produce as much feed as some of the possible substitutes (see Table 32). More small grain is being raised than is necessary for seeding the hay crop. The available labor supply is not utilized as fully as it would be if the acreage of the more intensive crops, such as potatoes and rutabagas, or the number of dairy cows was increased.

Table 40

Distribution of Acreage and Production and Disposal of Crops
Reorganization Plan A

Crop	Acreage	Yield per acre, bu. or ton	Total production, bu. or ton	Disposal		
				Seed, bu.	Feed, bu. or ton	Sales, bu. or ton
Oats and barley	10	44	440	30	410	...
Corn silage	6	6	36	..	36	...
Red clover, alsike, and timothy hay	18	1¾	31½	..	31½	...
Wild hay	3	9	2¾	..	2¾	...
Potatoes	3	160*	480	33	70†	377
Rutabagas	3	12‡	36	..	4	32
Total crop area	43	...	...	..	...	...

* Includes 20 bu. of No. 2 and cull potatoes.
† Includes 20 bu. used in house.
‡ Includes 1 ton of culls.

Reorganization Plan A.—A suggested reorganization of the cropping plan for this farm is presented in Table 40. This provides for four 10-acre fields and a definite four-year rotation. The 10 acres of alsike, red clover, and timothy hay will be seeded in the small grain. The entire field will be cut for hay the first year after seeding and all but eight acres the second year. Two acres will be broken the second year and planted to rutabagas. In the fourth year this field will be devoted to inter-tilled crops—corn, potatoes, and rutabagas. Oats and

barley will be seeded together in order to produce a larger amount of digestible feed than can be produced with either alone. Less corn will be raised and the entire crop will be put into the silo. As the wild hay is on non-tillable land, it can not be included in the rotation and will be left as it is. The livestock organization will be the same as at present.

The probable returns from this reorganized plan of operation are shown in Table 41. These are computed on the basis of the factors of cost shown in Tables 25, 26, and 38, and of the prices shown in Table 33 and are therefore directly comparable with those in Table 39. The cash income over cash costs that vary directly with the organization would be increased 27 per cent on the basis of the prices used. The principal difference is an increase in the acreage devoted to cash crops and an adjustment of the feed crop acreage so as to secure the maximum feed production. It would be necessary to purchase some additional feed to compensate for the slight reduction in home-grown feeds used. The labor distribution under the new plan is shown in Figure 29. Under this plan, 208 additional hours of labor would be required.

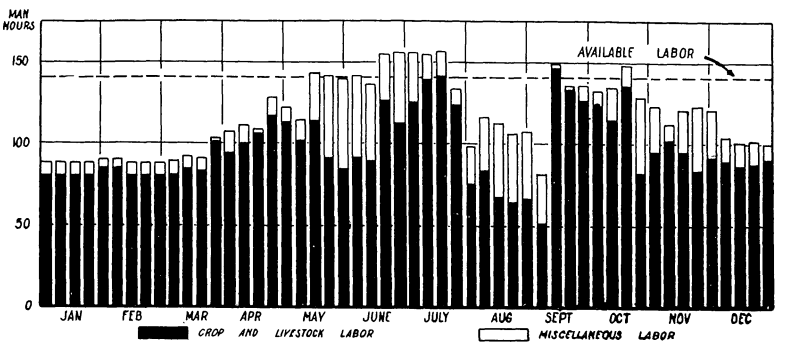

Fig. 29. Distribution of Man Labor by Weeks on an 80-Acre Farm Under Reorganization Plan A

Slightly more total labor is required under this plan than is required at present but the extra load could easily be handled by the present labor force.

This increase occurs largely in late May, July, September, and October. It could be handled easily without hiring additional labor either by increasing the length of the work day of the present workers or by shifting some of the miscellaneous work to slack periods. More horse work, also, would be required under the suggested plan but two horses could still handle it easily except during silo filling and when more than two horses are required for such operations as cutting grain or digging potatoes. These could still be handled as at present by exchanging horse work with neighboring farmers.

Table 41

Probable Returns From Reorganization Plan A

Crop and Livestock Sales				
Crop sales:				
Potatoes	377 bu. @ $0.40	$150.80		
Rutabagas	32 tons @ 6.00	192.00		
Total crop sales			$ 342.80	
Livestock and livestock product sales:				
Same as present organization (Table 39)			1,180.25	
Total crop and livestock sales				$1,523.05
Direct Cash Costs				
Cost of materials and services for crops:				
Twine	30 lb. @ $0.08	$ 2.40		
Threshing	440 bu. @ 0.03	13.20		
Silo filling	36 tons @ 0.30	10.80		
Fertilizer, 4-8-6	3.75 cwt. @ 1.75	6.56		
Fertilizer, 4-16-4	3.75 cwt. @ 2.10	7.88		
Paris green	6 lb. @ 0.40	2.40		
Alsike seed	40 lb. @ 0.20	8.00		
Red clover seed	40 lb. @ 0.20	8.00		
Timothy seed	20 lb. @ 0.06	1.20		
Rutabaga seed	4.5 lb. @ 0.40	1.80		
Seed corn	102 lb. @ 0.04	4.08		
Total cash crop costs			$ 66.32	
Cost of materials and services for livestock:				
Same as present organization (Table 39)		$187.21		
Additional feed purchased, corn	50 bu. @ $0.40	20.00		
Additional feed purchased, middlings	15 cwt. @ 0.85	12.75		
Total cash livestock costs			219.96	
Total cash costs of materials and services				286.28
Cash returns to organization (above cash costs that vary with changes in organization)				$1,236.77
Probable difference in favor of reorganization plan A				262.77

Reorganization Plan B.—Another reorganization of the cropping system for this farm is shown in Table 41. This provides for a four-year rotation consisting of one year of small grain, 2 years of hay, and one year of potatoes and rutabagas. The livestock organization is left as at present. The probable cash returns from this organization above the cash costs that vary directly with the organization are

shown in Table 43. On the basis of the prices used, the returns are increased 41 per cent over the present plan. The increased sale of cash crops more than offsets the increase in purchased feeds necessitated by the reduced production and use of home-grown feeds. Under both this and the previous reorganization plan, a considerable quantity of rutabaga tops would be available for feeding to dairy cattle. No allowance has been made for these in computing the feeds required, so there is some margin of safety in both of these plans as compared with the present one. Reorganization Plan B would require 420 hours of additional man labor but this could still be easily handled by the present labor force. The increased acreage of rutabagas involves more of the tedious type of hand labor but this extra labor is well remunerated by the additional returns.

Table 42

Distribution of Acreage and Production and Disposal of Crops
Reorganization Plan B

Crop	Acreage	Yield per acre, bu. or ton	Total production, bu. or ton	Disposal		
				Seed, bu.	Feed, bu. or ton	Sales, bu. or ton
Oats and barley	10	44	440	30	410	...
Alsike, red clover, and timothy hay	20	1.75	35	..	35	..
Wild hay	3	0.9	2.75	..	2.75	...
Potatoes	5	160*	800	55	90†	655
Rutabagas	5	12‡	60	..	22	38
Total crop area	43	...	...	..	...	...

* Includes 20 bu. of No. 2 and cull potatoes.
† Includes 10 bu. used in house.
‡ Includes 1 ton of culls.

Table 43

Probable Returns from Reorganization Plan B

Crop and Livestock Sales					
Crop sales:					
Potatoes	655	bu.	@ $0.40	$262.00	
Rutabagas	38	tons	@ 6.00	228.00	
Total crop sales					$ 490.00
Livestock and livestock product sales:					
Same as present organization (Table 39)					1,180.25
Total crop and livestock sales					$1,670.25

Table 43—Continued

Probable Returns from Reorganization Plan B

	Direct Cash Costs					
Cost of materials and services for crops:						
Twine	30	lb.	@ $0.08	$ 2.40		
Threshing	440	bu.	@ 0.03	13.20		
Fertilizer, 4-8-6	625	cwt.	@ 1.75	10.94		
Fertilizer, 4-16-4	625	cwt.	@ 2.10	13.13		
Paris green	10	lb.	@ 0.40	4.00		
Alsike seed	40	lb.	@ 0.20	8.00		
Red clover seed	40	lb.	@ 0.20	8.00		
Timothy seed	20	lb.	@ 0.06	1.20		
Rutabaga seed	7½	lb.	@ 0.40	3.00		
Total cash crop costs					$ 63.87	
Cost of materials and services for livestock:						
Same as present organization (Table 39)				$187.21		
Additional feed purchased, corn	125	bu.	@ $0.40	50.00		
Total cash livestock costs					237.21	
Total cash costs of material and services						301.08
Cash returns to present organization (above cash costs that vary with the organization)						$1,369.17
Probable difference in favor of reorganization Plan B						395.57

Reorganization Plan C.—A third organization plan involving a change in the livestock as well as the crops was also computed on the same basis as the plans suggested previously. The number of cows would be increased from 9 to 12. Three more veal calves would be sold. One of the heifers sold under the present plan would be retained to replace the additional cow sold each year. The cropping plan is shown in Table 44. The four-year rotation would be retained with one year of grain, two years of hay, and one year of inter-tilled crops, largely silage. The only crop sold is a small quantity of potatoes. The probable cash returns from this organization over the cash costs that vary directly with the organization are shown in Table 45. The increase in returns over the present plan is 15 per cent, less than in case of either of the two plans previously discussed. Under this plan 794 hours of additional man labor would be required as compared with the present. A considerable proportion of this would be performed during the winter months and the plan could still be operated easily with the present labor supply.

Table 44

Distribution of Acreage and Production and Disposal of Crops
Reorganization Plan C

Crop	Acreage	Yield per acre, bu. or ton	Total production, bu. or ton	Disposal		
				Seed, bu.	Feed, bu. or ton	Sales, bu. or ton
Oats and barley	10	44	440	30	410	...
Corn silage	9	6	54	..	54	...
Alsike, red clover, and timothy hay	20	1.75	35	..	35	...
Wild hay	3	0.9	2.75	..	2.75	...
Potatoes	½	160*	80	6	20†	54
Rutabagas	½	12‡	6	..	6	...
Total crop acres	43	...	...	..	...	...

* Includes 20 bu. of No. 2 and cull potatoes.
† Includes 10 bu. used in house.
‡ Includes 1 ton culls.

Each of the three suggested reorganizations provides more productive work and a material increase of the income. Each provides a definite crop rotation that should maintain the productivity of the land better than does the present plan. Any one of them can be operated with the present resources of the farmer except as provided in the statement of expenses. Other possible plans for this farm could be suggested but these are sufficient to indicate the method of approaching the problem. Other factors to be considered will be discussed later.

Table 45

Probable Returns from Reorganization Plan C

Crop and Livestock Sales						
Crop sales:						
Potatoes	54	bu.	@	$0.40	$ 21.60	
Livestock and livestock product sales:						
Butterfat	3,460	lb.	@	$0.30	$1,038.00	
3 cows	3,300	lb.	@	0.02	66.00	
1 heifer	925	lb.	@	0.04	37.00	
7 veal calves	875	lb.	@	0.06	52.50	
Hogs	3,435	lb.	@	0.05	171.75	
Poultry	55	lb.	@	0.10	5.50	
Eggs	510	doz.	@	0.15	76.50	
Total livestock sales					1,447.25	
Total crop and livestock sales						$1,468.85

Table 45—Continued
Probable Returns from Reorganization Plan C

	Direct Cash Costs					
Cost of materials and services for crops:						
Twine	45	lb.	@ $0.08	$ 3.60		
Threshing	440	bu.	@ 0.03	13.20		
Silo filling	54	tons	@ 0.30	16.20		
Fertilizer, 4-8-6	63	cwt.	@ 1.75	1.10		
Fertilizer, 4-16-4	63	cwt.	@ 2.10	1.32		
Paris green	1	lb.	@ 0.40	.40		
Alsike seed	40	lb.	@ 0.20	8.00		
Red clover seed	40	lb.	@ 0.20	8.00		
Timothy seed	20	lb.	@ 0.06	1.20		
Rutabaga seed	¾	lb.	@ 0.40	0.30		
Seed corn	153	lb.	@ 0.04	6.10		
Total cash crop costs					$ 59.42	
Cost of materials and services for livestock:						
Veterinary services and medicine				$ 37.06		
Bull service	12	cows	@ $2.00	24.00		
Baby chicks	125		@ 0.07	8.75		
Dairy feeds	132.15	cwt.	@ 0.90	118.94		
Hog feeds	81.23	cwt.	@ 0.73	59.30		
Poultry feeds	29.42	cwt.	@ 1.25	36.77		
Total cash livestock costs					284.82	
Total cash costs of materials and services						344.24
Cash return to organization (above cash costs that vary directly with changes in organization)						$1,124.61
Probable difference in favor of reorganization plan C						150.11

Illustration No. 2

A Pine County farm of 126 acres has been selected for the second illustration of the method of reorganization. Farms of from 100 to 140 acres are very common in this section of the state. The present resources of this farm are as follows:

Inventory of Resources

Real Estate:	
Total crop area	68 acres
Permanent pasture	50 acres
Farmstead, road, and waste	8 acres
Total	126 acres

Labor Supply:

The operator's time for the entire year.

Time of a grown son for the entire year.

Assistance of the operator's wife in chores and care of chickens. Some assistance at chore work and during the summer vacation by children attending school.

Power and Equipment:

4 work horses.

All machinery needed for the crops grown or suggested.

Buildings:

Present buildings are sufficient to house 4 work horses, 12 cows, 1 bull, 10 head of young cattle, 4 brood sows, and 150 hens.

The present cropping system and the disposal of the crops are shown in Table 46. The normal amounts of material, man labor, and horse work used in crop production on this farm are shown in Table 47. These have been computed on the same basis as in the previous illustration. The present livestock organization and the disposal of livestock and livestock products is indicated in Table 48. The normal amounts of labor, horse work, feed, materials, and services for livestock are presented in Table 49. A statement of the probable cash returns from the present organization above costs that vary directly with changes in organization based on the prices in Table 33 is given in Table 50.

Table 46

Distribution of Acreage and Production and Disposal of Crops

Crop	Acreage	Yield per acre, bu. or ton	Total production, bu. or ton	Disposal		
				Seed, bu.	Feed, bu. or ton	Sales, bu. or ton
Oats	18	45 bu.	810	63	747	...
Barley	10	31 bu.	310	25	285	...
Corn silage	6	6 t.	36	..	36	...
Corn fodder	3	2 t.	6	..	6	...
Alsike, red clover, and timothy	20	1¾ t.	35	..	35	...
Wild hay	4	½ t.	2	..	2	...
Potatoes	2	160* t.	320	24	165†	131
Rutabagas	5	10‡ t.	50	..	4¾	45¼
Total crop area	68	...	...	..	...	...

* Includes 15 bu. of No. 2 and cull potatoes.

† Includes 50 bu. used in house.

‡ Includes ¾ ton of culls.

Table 47

Normal Amounts of Materials, Man Labor, and Horse Work per Acre for Crops

Crop	Materials		Man labor	Horse work
	Kind	Quantity		
			hr.	hr.
Oats	Seed	3½ bu.	16	30
	Twine	3 lb.	..	..
Barley	Seed	2½ bu.	16	30
	Twine	3 lb.	..	..
Oats and barley	Seed	3 bu.	16	30
	Twine	3 lb.	..	..
Corn silage	Seed	17 lb.	38	65
	Twine	4½ lb.	..	..
Corn fodder	Seed	17 lb.	27	49
	Twine	4½ lb.	..	..
Tame hay	Seed, alsike	4 lb.	10	11
	red clover	3 lb.	..	..
	timothy	3 lb.	..	..
Wild hay	————	..	6	9
Potatoes	Seed	12 bu.	39	67
	Paris green	4 lb.	..	..
Rutabagas	Seed	1¾ lb.	99	71

Table 48

Numbers, Production, and Disposal of Livestock and Livestock Products

Kind of livestock	Number	Production		Disposal		
		Kind	Amount	Fed to livestock	Used in home	Sold
Dairy cows	9	Butterfat	2,340 lb.	66 lb.	160 lb.	2,114 lb.
		Skimmilk	62,000 lb.	55,500 lb.	6,500 lb.	....
		2 cull cows	2,200 lb.	.....	....	2,200 lb.
Young dairy cattle	10	4 veal calves	500 lb.	.....	....	500 lb.
		2 heifers	1,500 lb.	.....	....	1,500 lb.
Brood sows	4	Marketable hogs	4,600 lb.	.....	800 lb.	3,800 lb.
Hens	100	Eggs	1,250 doz.	.....	200 doz.	1,050 doz.
		Meat	350 lb.	.....	245 lb.	105 lb.

Table 49

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

	Dairy cows	Young dairy cattle	Bull	Hogs	Poultry	Work horses
Unit	1 head	1 head	1 head	100 lb.	100 hens	1 head
Concentrates, lb.	1,300	400	600	300	7,400	1,400
Legume hay, lb.	3,000	1,500	5,000	...	....	4,000
Wild hay and corn fodder, lb.	1,000	400	1,500	...	....	1,500
Corn silage, lb.	6,200	1,400	2,000	...	....	....
Rutabagas, lb.	500	....	....	75	1,500	....
Potatoes, lb.	....	....	....	150	....	....
Whole milk, lb.	....	200	....	...	....	....
Skimmilk, lb.	....	2,000	....	680	3,600	....
Pasture, days	160	125	70	35	....	95
Veterinary services, medicine, etc., dollars	0.75	0.25	....	0.05	5.50	1.00
Man labor, hr.	225	30	35	9	375	85
Horse work, hr.	3½	....	....	¼	2	....

Table 50

Normal Returns From Present Organization

Crop and Livestock Sales						
Crop sales:						
Potatoes	131	bu.	@ $0.40	$ 52.40		
Rutabagas	45¼	ton	@ 6.00	271.50		
Total crop sales					$ 323.90	
Livestock and livestock product sales:						
Butterfat	2,114	lb.	@ $0.30	$634.20		
2 cows	2,200	lb.	@ 0.02	44.00		
2 heifers	1,500	lb.	@ 0.04	60.00		
4 veal calves	500	lb.	@ 0.06	30.00		
Hogs	3,800	lb.	@ 0.05	190.00		
Poultry	105	lb.	@ 0.10	10.50		
Eggs	1,050	doz.	@ 0.15	157.50		
Total livestock sales					1,126.20	
Total crop and livestock sales						$1,450.10
Direct Cash Costs						
Cost of materials and services for crops:						
Twine	124½	lb.	@ $0.08	$ 9.96		
Threshing	1,120	bu.	@ 0.03	33.60		
Silo filling	36	ton	@ 0.30	10.80		
Paris green	8	lb.	@ 0.40	3.20		
Alsike seed	80	lb.	@ 0.20	16.00		
Red clover seed	60	lb.	@ 0.20	12.00		
Timothy seed	60	lb.	@ 0.06	3.60		
Rutabaga seed	8¾	lb.	@ 0.40	3.50		
Seed corn	153	lb.	@ 0.04	6.12		
Total cash crop costs					$98.78	

Table 50—Continued

Normal Returns From Present Organization

Cost of materials and services for livestock:					
Veterinary services and medicine			$ 21.05		
Baby chicks	200	@ $0.07	14.00		
Oilmeal	15	cwt. @ 1.60	24.00		
Poultry feed	40	cwt. @ 1.25	50.00		
Total cash livestock costs				109.05	
Total cash costs of materials and service					$207.83
Cash returns to organization (above cash costs that vary with changes in organization)					$1,242.27

The present organization does not utilize the land to best advantage. Too large a proportion of the farm is devoted to such crops as small grain and corn fodder, which produce less digestible feed per acre than others that are equally well adapted (see Table 32). Because of the limited number of livestock and the limited area of more intensive crops, the labor available is not fully utilized. During most of the year, there is insufficient productive work to keep the owner and his son fully employed and the available family help is more than sufficient to take care of the peak loads.

Table 51

Distribution of Acreage and Production and Disposal of Crops
Reorganization Plan A

Crop	Acreage	Yield per acre, bu. or ton	Total production, bu. or ton	Disposal		
				Seed, bu.	Feed, bu. or ton	Sales, bu. or ton
Oats and barley	16	40	640	120	520	....
Corn silage	8	6	48	...	48	....
Alsike, red clover, and timothy hay	24	1¾	42	...	42	....
Wild hay	4	½	2	...	2	....
Potatoes	8	160	1,280	96	125	1,059
Rutabagas	8	10	80	...	5	75
Total crop area	68	...	....	...	...	....

Reorganization Plan A.—A suggested reorganization of the cropping plan for this farm is shown in Table 51. This plan provides for a four-year rotation on four 16-acre fields. One field is in oats and barley seeded to a mixture of alsike, red clover, and timothy. The second field is in tame hay. The third field includes 8 acres of tame hay and 8 acres of rutabagas. In the fourth field are 8 acres of silage

corn and 8 acres of potatoes. One half of the seeded hay is plowed after the first-year crop and is followed by rutabagas. Hay is cut from the other half for two years and is then followed by potatoes. Corn silage follows the rutabagas. Since the wild hay is on non-tillable land, it is left as it is.

The suggested livestock organization is shown in Table 52. The number of dairy cows is increased from 9 to 12 and the number of hens from 100 to 150. The production of hogs is reduced one-half. The probable returns from this organization above cash costs that vary directly with the organization are shown in Table 53.

Table 52

Numbers, Production, and Disposal of Livestock and Livestock Products Reorganization Plan A

Kind of livestock	Number	Production		Disposal		
		Kind	Amount	Fed to livestock	Used in home	Sold
Dairy cows	12	Butterfat	3,120 lb.	116 lb.	160 lb.	2,844 lb.
		Skimmilk	82,500 lb.	76,000 lb.	6,500 lb.	....
		3 cull cows ...	3.300 lb.	.....	....	3,300 lb.
Young dairy cattle	10	7 veal calves ...	875 lb.	.....	....	875 lb.
		1 heifer	750 lb.	.....	....	750 lb.
Brood sows	2	Market hogs ...	2,300 lb.	.....	800 lb.	1,500 lb.
Hens	150	Eggs	1,875 doz.	.....	200 doz.	1,675 doz.
		Meat	525 lb.	.....	245	280 lb.

The increase in returns over the present plan is largely due to an increase in feed production per acre and an increase in size of business. By shifting from the less to the more productive crops, the production of digestible feed per acre is increased 8.5 per cent. The increases in the dairy herd, the poultry flock, and the acreage of intensive cash crops add 1,000 hours of productive work annually. This is sufficient to furnish full employment throughout most of the year to the farmer and his family, but can easily be done without hiring additional labor. Considerable feed must be purchased to provide for the increase in livestock and to compensate for the smaller acreage of feed crops. The hog enterprise is reduced to the point where it is just sufficient to provide a market for the cull potatoes. As there was a surplus of family labor, it seems desirable to increase the classes of stock that will utilize this most advantageously. The additional skimmilk produced by the larger dairy herd and made available by the reduction in hog production, can be used by the young dairy cattle and poultry to displace some of the present grain ration. This plan provides amply for the maintenance of soil productivity. The acreage of legumes is increased, and the additional feed purchases more than offset the larger crop sales.

Table 53
Probable Returns from Reorganization Plan A

Crop and Livestock Sales					
Crop sales:					
Potatoes	1,059 bu.	@ $0.40	$423.60		
Rutabagas	75 ton	@ 6.00	450.00		
Total crop sales				$ 873.60	
Livestock and livestock product sales:					
Butterfat	2,844 lb.	@ $0.30	$853.20		
3 cows	3,300 lb.	@ 0.02	66.00		
1 heifer	750 lb.	@ 0.04	30.00		
7 veal calves	875 lb.	@ 0.06	52.50		
Hogs	1,500 lb.	@ 0.05	75.00		
Poultry	280 lb.	@ 0.10	28.00		
Eggs	1,675 doz.	@ 0.15	251.25		
Total livestock sales				1,355.95	
Total crop and livestock sales					$2.229.55
Direct Cash Costs					
Cost of materials and services for crops:					
Twine	84 lb.	@ $0.08	$ 6.72		
Threshing	640 bu.	@ 0.03	19.20		
Silo filling	48 ton	@ 0.30	14.40		
Paris green	32 lb.	@ 0.40	12.80		
Alsike seed	64 lb.	@ 0.20	12.80		
Red clover seed	48 lb.	@ 0.20	9.60		
Timothy seed	48 lb.	@ 0.06	2.88		
Rutabaga seed	14 lb.	@ 0.40	5.60		
Seed corn	136 lb.	@ 0.04	5.44		
Total cash crop costs				$ 89.44	
Cost of materials and services for livestock:					
Veterinary services and medicine			$ 24.90		
Baby chicks	200	@ $0.07	14.00		
Dairy feed	78 cwt.	@ 0.90	70.20		
Poultry feed	55 cwt.	@ 1.25	68.75		
Corn	75 bu.	@ 0.40	30.00		
Middlings	20 cwt.	@ 0.85	17.00		
Total cash livestock costs				224.85	
Total cash costs of materials and services					314.29
Cash returns to organization (above costs that vary with changes in organization)					$1,915.26
Probable difference in favor of plan A					672.99

Budgets with Varying Prices

A given set of assumed prices has been used in computing the returns from the various plans of organization suggested. A farmer should select, as has already been suggested, the prices that, in the light of the best information he can secure, seem likely to prevail in the future. It is more important, from a long-time viewpoint, that the schedule of prices represents the correct relationship between the prices of the different elements of income and cost than that the absolute price be exact. However, the long-time price relations are bound to change as the result of unforeseen circumstances and even if the average prices over a period of time hold a fairly uniform relationship, there is bound to be considerable variation from year to year in individual commodity price relations. It is, therefore, advisable to compute the returns for suggested plans for comparison with the present plan on the basis of several possible price relationships. Such a computation for Illustration No. 1 is presented in Table 54. Higher and lower prices than those assumed in Table 33 have been suggested for butterfat, potatoes, and rutabagas, the principal sale products. Since purchased feeds make up more than half of the total direct cash costs, a variation of 50 per cent above the assumed feed prices is suggested. Nine different combinations in addition to that used previously in the illustration have been assumed. In every case, reorganization plans A and B show increases over the present plan and in six of the nine cases the advantage is greater than that in the original illustration. Reorganization plan C shows an advantage over the present plan in eight out of the nine cases but in six of the nine the advantage is less than under the prices originally assumed. This method of budgeting with varying prices is helpful in selecting the organization that promises the most consistent advantage over the present plan of operation.

Applicability of Suggested Systems to Other Farms

The suggested systems of organization presented in the foregoing illustrations apply especially to the particular farms selected. No general or ideal plan can be devised that will fit exactly the conditions on all farms of a given size. The resources as well as the abilities of individual farmers vary widely. Any general plan must be modified to meet an individual situation. The plans suggested could easily be modified to meet the needs of other farms of approximately the same size as those used in the illustrations. The problems on the farms for which the reorganized plans are offered as solutions are common in northeastern Minnesota. A definite rotation with a balance between livestock and feed supplies is one of the first essentials in planning a farm budget. The method, if not the actual solution, can be applied generally to

Table 54

Returns from Actual and Suggested Reorganization Plans with Differing Price Relations

Item	Probable cash returns above cash expenses which vary directly with changes in organization when prices are as follows									
Butterfat, per lb.	$ 0.30*	$ 0.20	$ 0.20	$ 0.20	$ 0.30	$ 0.30	$ 0.30	$ 0.40	$ 0.40	$ 0.40
Potatoes, per bu.	0.40*	0.20	0.40	0.60	0.20	0.40	0.60	0.20	0.40	0.60
Rutabagas, per ton	6.00*	4.00	6.00	9.00	4.00	6.00	9.00	4.00	6.00	9.00
Price of purchased feeds (in percentage of assumed prices*)	100	100	100	150	100	150	150	100	100	150
Present plan	$ 974†	$ 695	$ 715	$ 675	$ 954	$ 910	$ 934	$1,113	$1,134	$1,219
Reorganization Plan A—probable returns	1,237‡	838	978	1,085	1,098	1,173	1,344	1,357	1,497	1,604
per cent of present plan	127	121	137	161	115	129	144	122	132	132
Reorganization Plan B—probable returns	1,369§	903	1,110	1,290	1,162	1,304	1,549	1,422	1,629	1,809
per cent of present plan	141	130	155	191	122	143	166	128	144	148
Reorganization Plan C—probable returns	1,125‖	768	779	682	1,114	1,017	1,028	1,460	1,471	1,028
per cent of present plan	115	111	109	101	117	112	110	131	130	84

* See Table 33.
† See Table 39.
‡ See Table 41.
§ See Table 43.
‖ See Table 45.

others farms. The principle of selecting crops that will produce the most digestible feed per acre of the kind adapted to the feeding needs of livestock on the farm can be applied on any farm. The actual crops to be selected depend on local conditions. Where alfalfa can be grown successfully, it would have an advantage over the mixed seeding recommended for the Pine County farms. In the northern counties, sunflower silage would have to be used instead of corn silage or the cropping systems of reorganization plan B in Illustration 1 could be used. The small grain crop selected would depend on the relative yield of different feed crops on the particular farm.

A common problem in this section of the state for which a solution was suggested in these illustrations is that of increasing the size of the business and providing more productive employment for the available labor. This usually can be met as is done in these illustrations by increasing the acreage of the intensive crops, such as rutabagas and potatoes, and by increasing the classes of livestock, such as dairy cattle and poultry, which utilize more labor relative to the other factors of production. The selection of the intensive crops to be increased depends on soils and available markets. Potatoes are generally well adapted to this area. Rutabagas are best adapted to the heavy clay soils and should be grown only where markets for them have been developed. Other intensive crops, such as carrots, cabbage, head lettuce, and similar truck crops, may be grown where adapted to soil and markets. An increase in dairy cattle and poultry, especially if this increase necessitates the purchase of considerable concentrated feed, is likely to be profitable only in case a fairly high degree of efficiency in production can be maintained or a special market offers a price advantage.

Another problem in adapting systems of farming to cut-over farms in the process of development is the adjustment that becomes necessary as additional land is cleared and brought into cultivation. The systems of organization suggested in these illustrations can be scaled up or down according as the acreage varies from that for which the computations have been made. This adjustment is limited by the available labor. If a farm is fully developed, the labor formerly used in land clearing becomes available for crop and livestock production and hence some increase is possible without the necessity of hiring labor. On the larger farms with a limited labor supply, it is possible to increase the size of the business by adding sheep, which require little labor and can be maintained largely on pasture and roughage and also are relatively low in labor demands.

SUMMARY AND CONCLUSIONS

The agricultural development of the cut-over lands of northeastern Minnesota has taken place largely within the last thirty years. Settlement followed the cutting of the original stand of timber, but usually after an interval sufficient to permit a second growth, which, together with the stumps left from the original stand, made land development laborious and expensive. Settlement was haphazard and unguided. Settlers frequently lacked capital, farming experience, and the ability to judge timber land soils. Because of the wide distribution of settlers throughout the area, there is often insufficient concentration in any one section to furnish the needed support for roads, schools, and other public services.

There is a wide range in both topography and soil type in northeastern Minnesota. In general, the soils are deficient in organic matter and in lime. Many soils are too stony for the use of farm machinery. Much rock out-crop occurs in some sections and the surface stones are often so numerous as to make their removal uneconomical. Most of the soils are fairly heavy, altho there are some areas of light, drouthy sands. Huge areas of peat bogs occur and small bogs are scattered throughout the section. The wide diversity of soil even within a limited area makes it difficult to develop a contiguous settlement. Much land is permanently unfit for agriculture and might better be used for forest or recreational purposes.

Both soil and climate are favorable to hay and pasture production. The summers are cool and rather short, with sufficient rainfall for grasses and legumes. Potatoes and root crops are well adapted to the natural conditions of the area. The small grains, especially oats and barley, produce yields comparable with other parts of the state but the seasons are too cool and short for corn to mature except in the southern counties. Dairy cattle are the major class of livestock and poultry is second as a source of income. Local markets offer a limited outlet for dairy and poultry products, vegetables, and fruits, but the surplus over local needs must be shipped to markets at a considerable distance.

The principal farming problems of the northeast cut-over section are land development, maintenance of soil fertility, lack of capital and credit, sparsity of settlement, and a heavy tax burden. In planning systems of farming for this area the physical and economic conditions within the area, such as soil, climate, labor supply, feed supply, and available capital, and certain characteristics of present organizations must be considered. Soil and climate are such as to give hay and pasture crops a prominent place in the cropping system. The cleared acreage is usually small, and intensive crops, such as potatoes and rutabagas, make possible the profitable utilization of more labor on a small area of tillable

land than do the hay and grain crops. A four-year rotation consisting of one year of intertilled crops, one year of grain, and two years of legume hay or pasture is well suited to maintaining soil fertility and to providing a fairly well balanced business. On large farms, this may be expanded to a five-year rotation with an extra year of hay or pasture. Dairy cattle have an advantage in that they can utilize hay and pasture and provide productive employment for considerable labor, especially in winter. Since concentrate feeds are higher in price than in other sections of the state, beef production and also pork production, except as the latter is based on the utilization of by-products such as skimmilk and cull potatoes, are at a disadvantage. Poultry, altho they require concentrate feeds, furnish productive employment for labor and require relatively little capital outlay.

Two farms in Pine County have been used to illustrate the use of the data presented in budgeting the organization for a particular farm. The changes suggested are designed to solve for these farms, as far as possible, the important types of farm organization problems commonly encountered on cut-over farms in this area such as: (1) Increasing the volume of business. (2) Converting salable and unsalable farm products into salable products of higher market value. (3) Maintaining the productivity of the soil. (4) Concentrating salable feed products in less bulky products to reduce shipping costs. (5) Distributing the use of labor, power, and equipment, most advantageously.

In presenting this study, the authors have not attempted to discuss all the agricultural problems of the northeast cut-over section. One of the most important of these is the general problem of a land utilization and development program for the area. This involves questions of state and national policies. This study, however, deals only with conditions as they now are and seem likely to be in the near future. Settlers are already in the area. They have made investments of capital and effort. Even tho these investments were not always so wisely made as they might have been under a carefully planned program of development for the area, it is too late now to withdraw many of them. The authors have, therefore, dealt with the problem of how to make the most of the situation and the resources as they now exist.

Considerable emphasis has been placed upon the farming problems of the area and upon certain physical and economic disadvantages under which settlers are working as compared with farmers in other sections of the state. This was not done primarily to emphasize these handicaps but rather as a background for a discussion of how the effect of these handicaps might be overcome or minimized by careful planning.

This section of the state is not without advantages. The settler with limited capital who is primarily interested in the farm as a home has

found it possible to establish himself here with a minimum outlay of cash. Usually the timber on the farm afforded building material as well as fuel. The sale of timber products supplemented the farm income during the earlier years of development. Game abounded in the woods and fish were plentiful in the lakes and streams. Land prices, while frequently excessive in view of the productivity of the soil, were not inflated during the post-war boom, nor have they fallen as rapidly during recent years as has been the case in other sections of the state. The burden of farm debts, while excessive in many individual cases, is, in general, relatively lighter than in other sections of the state. Many settlers who were unable to borrow funds for as rapid a development of their farms as they would have liked now find that what seemed to be a handicap at that time has saved them from burdensome financial obligations at the present time. Since most farmers in this section of the state are interested in the farm as a home rather than as an investment and in farming as a "way of living" rather than as a commercial venture, they are closer to a self-sufficing type of agriculture and hence are weathering the price situation relatively better than those in other sections where farming is on a more commercialized basis. The discussion of farm planning presented here has been confined to the crop and livestock enterprises that are already fairly well established in the northeast cut-over section. The reader should, however, keep in mind the relatively short period during which the present agriculture has been established. Undoubtedly, as time goes on, new crops especially suited to the physical environment or adapted varieties of crops not now suited to the area will be selected and developed. The more rapid movement of air and water resulting from the removal of the timber cover may improve growing conditions for certain crops. The culture of fruits, such as the blueberry, which is particularly well adapted to the peat bogs and acid soils and to the cool, short summers of northeastern Minnesota, may be developed on a commercial scale. Other crop specialties may be found that are well adapted to the small farms of the area.

The authors have placed major emphasis on a method of planning a well balanced farm business rather than on setting up definite more or less ideal organizations recommended for general adoption. As new enterprises develop and conditions change, this method as outlined can be used to effect the reorganization needed to meet the new situation. Permanent plans can not safely be set up and adopted in any area but a permanent system of planning and of comparing possible alternative lines of production is likely to keep systems of farming more closely adjusted to changing conditions than would otherwise be possible.