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### AGRICULTURAL DIVISION

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OCTOBER, 1906.

# THE COST OF PRODUCING FARM PRODUCTS.

*ST. ANTHONY PARK, RAMSEY COUNTY, MINNESOTA.*

EAGLE PRINTING CO., PRINTERS, DELANO.

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FIG. 1.—GOOD ROADS AND A GOOD ARTIFICIALLY PLANTED FARM GROVE IN RICE COUNTY, MINN.

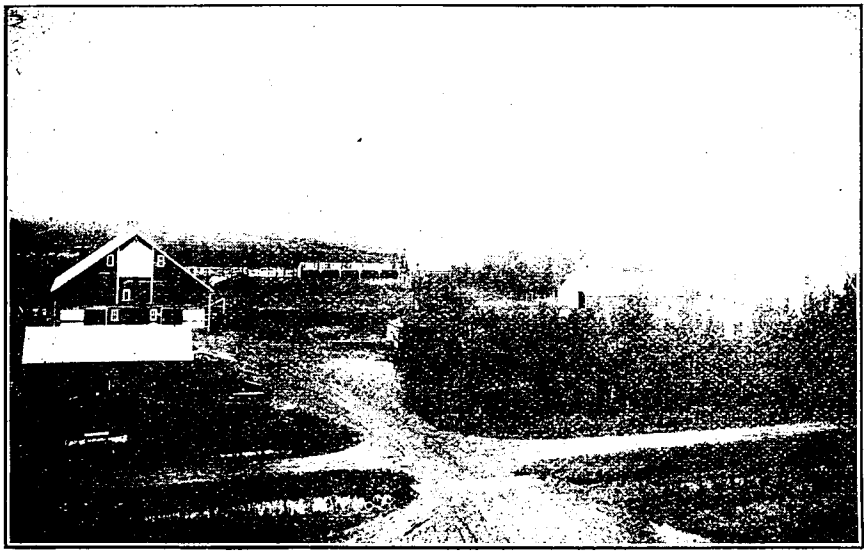

FIG. 2.—FARMSTEAD AND BUILDINGS OF A LARGE GRAIN FARM IN NORMAN COUNTY, NORTHWESTERN MINNESOTA.

In the foreground of this picture a well-constructed earth road with deep roadside ditches may be seen. Roadside ditches, similar to these, made with elevating graders and reversible road machines, are the most practical ditches which can be constructed for the draining of large areas of flat land.

# THE COST OF PRODUCING FARM PRODUCTS.

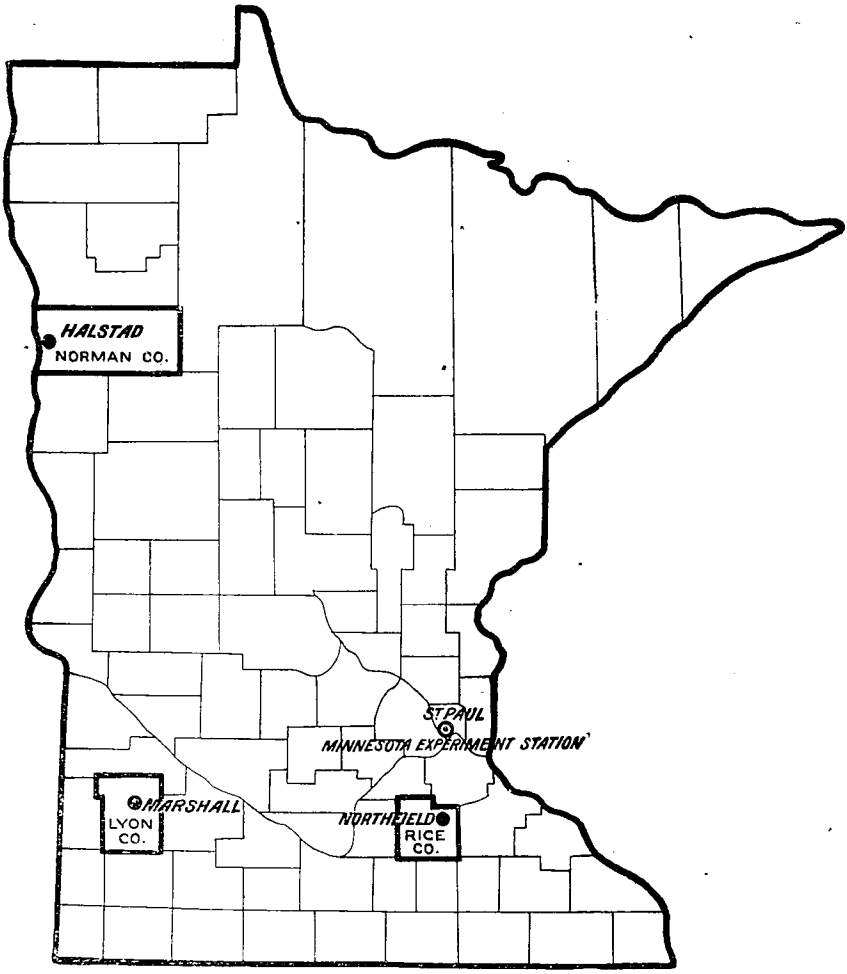


FIG. 1.—Localities in which the statistics were obtained.

This sketch map of Minnesota is given to show the location of communities in which statistics concerning the cost of producing farm products and concerning the entire business of agriculture have been collected by the Minnesota Agricultural Experiment Station in cooperation with the Bureau of Statistics of the U. S. Department of Agriculture. Grain farming is practiced almos exclusively at Halstad, in Norman County, and grain is also the chief product of the farms at Marshall, Lyon County, although corn, beef, and pork are also marketed to some extent. The agriculture at Northfield, Rice County, is chiefly dairying, supplemented by the growing and marketing of oats and hogs.

# PREFACE.

The following named gentlemen have served as special agents of the Minnesota Experiment Station and the Bureau of Statistics of the U. S. Department of Agriculture in collecting the statistics on agricultural production presented in this bulletin: Messrs. E. C. Parker, H. H. Mowry, H. G. Krum, F. B. Headley, W. A. Peck, J. W. Schneider, Thomas Cooper, H. R. Danielson, Earl Hacking, William Mackenzie, and John Gregor.

The authors acknowledge the assistance rendered by Profs. Andrew Boss, T. L. Haecker, C. P. Bull, D. A. Gaumnitz, and A. D. Wilson, and Supt. L. B. Bassett, of the Minnesota Agricultural Experiment Station, in suggesting methods of work and in reviewing the compiled statistics. Special commendation is also due to Messrs. W. A. Peck, F. B. Headley, and Thomas Cooper, student assistants at the Minnesota Agricultural Experiment Station, who have rendered faithful work in collating and interpreting the data.

Thanks are due the following farmers for their cooperation with the route statisticians during the years 1902, 1903, 1904, and 1905:

NORTHFIELD (RICE COUNTY).

W. H. Holden, Nicholas Lamberty, John Melvin, John Linster, John and James Bruce, W. E. Chester, John Miller, John Morrison, Patrick Heffernan, Samuel Kennedy, Charles O. Nichols, John Clifford, Charles E. Taylor, Fred Hibbard, George Lyman, Simon LaPoint, James Sheridan, Hyland Taylor, Robert A. Whitson, Charles Drentlaw, George Miller.

MARSHALL (LYON COUNTY).

B. Snyder and Henry Snyder, Henry E. Meehl, J. W. Pike, W. E. Heagle, Henry Preston, Vernon Tubbs, C. J. Spong, F. Fligge, Rasmus Nelson, C. C. Rock, Charles Middleton, Fred Marks, John Myhrvold, Herman Marks, H. J. Newhouse.

HALSTAD (NORMAN COUNTY).

Henry Henderson, I. L. Hauske, J. K. Hage, Martin Rasmusson, Matt Rasmusson, Oscar Olson, Halvor Helgeson, Knute Olson, B. O. Hellerud, Joseph Henderson, Sivert Viig, Anthony Sheie, Nels Enger, L. J. Enger, John Gunderson, Knute Haugen, Edw. Salverson, A. Stennes, J. Hellerud, S. Aarrestad, L. Aarrestad, Hans P. Olson, Oscar Carlson, Nels H. Nelson, R. I. Steen, A. O. Sandvold, Simeon Rasmusson, Sven Carlson.

THE AUTHORS.

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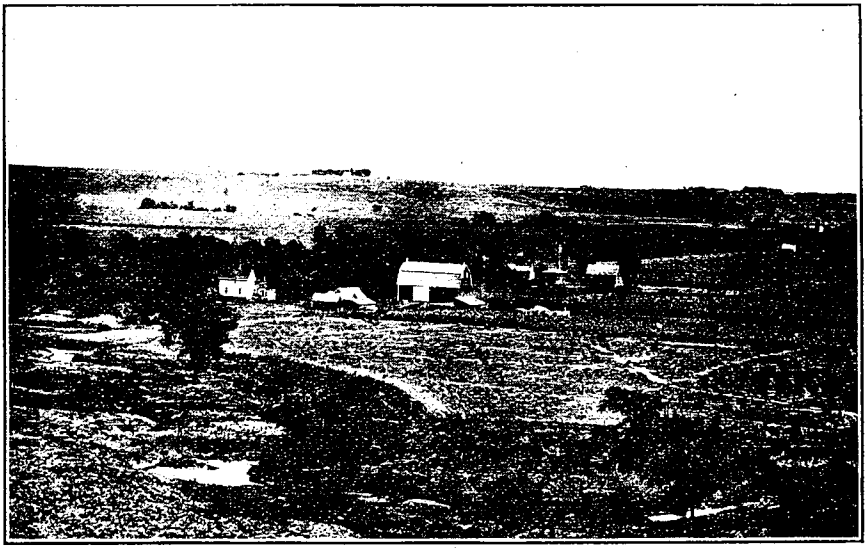

FIG. 1.—GENERAL VIEW OF A DAIRY FARM ON THE STATISTICAL ROUTE AT NORTHFIELD, IN RICE COUNTY, MINN.

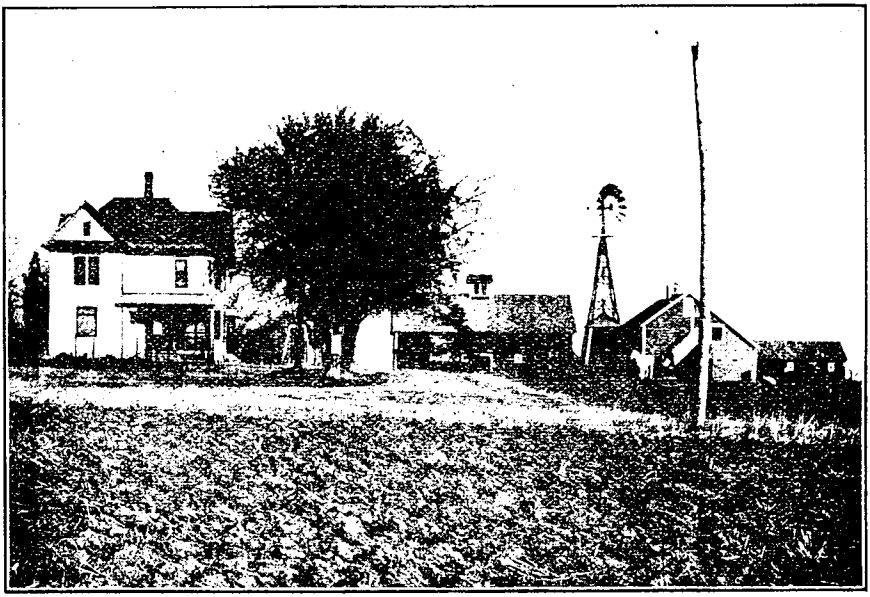

FIG. 2.—THE FARMSTEAD OF A 320-ACRE FARM IN LYON COUNTY, SOUTHWESTERN MINNESOTA.

# THE COST OF PRODUCING FARM PRODUCTS.

BY WILLET M. HAYS AND EDWARD C. PARKER.

## FARMING AS A BUSINESS.

Industry in the United States has enjoyed and will continue to enjoy natural advantages that can not be duplicated in any other region of the earth. All classes of productive workers have shared in these natural advantages. Progress in mining, lumbering, manufacturing, railroading, and agriculture has been rapid and comparatively easy in the United States because of the abundance and accessibility of the raw materials for production. American industries are leading the world to-day partly by reason of natural advantages, partly by reason of the American faculty for discovery and invention, and partly by reason of the American's application of system and organization to industry. American manufacturing, railroading, and merchandizing are conducted with a system and precision in management that is indeed wonderful. Waste from idle capital and idle labor is guarded against, the by-products are completely utilized, and the product created by each machine and each laborer is kept at a high standard by frequent tests. The evolution of manufacturing from the village mechanic's shop to the city factory has taken place in deference to system. Industrial combinations have taken place to more efficiently use capital, labor, and managing ability. System and efficient management are undoubtedly greater factors in the success of American manufactories and railroads than natural advantages.

Although agriculture is the largest industry in the United States and is pursued by 35 per cent of our workers, it must be admitted by anyone who has closely observed the progress of agriculture that system and good business management are not as highly developed in agriculture as in our other great industries. The success and prosperity of the American farmer are due to the unbounded fertility of the soils, the cheapness of farm lands, and the privilege of utilizing modern inventions in machinery rather than to systematic organization and efficient farm management. Appreciation in land values has not been met in most instances by a corresponding increase in the efficiency of farm managers. Land which bears a high rent is often

tilled by men whose managing ability is more in accord with cheap land than high-priced land, and as a result the actual productiveness of the land does not correspond with the theoretical productiveness as shown by the land values. In some instances a realization of this discrepancy between land values and actual productiveness leads men to sell the high-priced land and move to cheaper lands, where profits may be secured with less managing ability. This apparent anomaly between rents and actual productiveness in some instances is caused by the pressure of population upon land, by land speculation, and a lack of realization, by the tiller of the soil, of the relation of rent to net profits. The man who has purchased land for $10 an acre is slow to realize that when land values have appreciated to $50 an acre the value of the product above the cost of production must be nearly five times as great to yield the same rate of profit. Fifteen bushels of wheat per acre at 70 cents per bushel on $10 land will return a profit of 60 per cent on the investment, but the profit is diminished to 6 per cent on the $50 land. (The cost of producing wheat is shown in Table XXXV.) The day of cheap productive lands is coming to a close in the United States. The possibility of disposing of high-priced lands in well-settled communities and purchasing equally productive land at a lower price in the West will soon be at an end. System and more efficient management must enter the realm of agriculture if reasonable profits are to be extracted from the soil and its fertility be conserved for the use of future generations.

The present systems of farm management on large as well as on small farms devoted mainly to growing grain, or other special crops, create an acute demand for farm labor at special seasons of the year and little demand at other seasons. The demand for transient labor—always unsatisfactory—is thus augmented, or else t e farmer is put to the necessity of hiring men on long-time contracts, and keeping them partially unproductive at some seasons, in order to have labor available when the season of activity begins. The cost of horse labor likewise is an enormous expense on the majority of western farms devoted to grain production. The average length of the working day for horses on Minnesota farms is shown by Table I to be little more than three hours, and Table VII shows the total cost of keeping one horse for a year to be $75 to $90. The cost of horse labor on any farm operation can be materially reduced if the system of farm management provides regular work for the horses, for a horse can work an average throughout the year of five to eight hours a day with about the same cost of keep as he can work three hours.

TABLE I.—*Hours worked per day by men and horses on statistical routes at Northfield, Marshall, and Halstad, Minnesota.*

[Average for three years, 1902, 1903, 1904.]

| Month. | Northfield (Rice County). | | | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|---|---|---|
| | Daily. | | Sunday. | Daily. | | Sunday. | Daily. | | Sunday. |
| | Man. | Horse. | Man. | Man. | Horse. | Man. | Man. | Horse. | Man. |
| January | 6.57 | 1.20 | 4.22 | 5.80 | 0.71 | 3.60 | 4.69 | 0.85 | 2.57 |
| February | 6.48 | 1.22 | 4.16 | 5.86 | 0.77 | 3.33 | 5.32 | 1.02 | 2.53 |
| March | 7.59 | 1.41 | 4.03 | 7.00 | 1.59 | 3.12 | 5.83 | 1.01 | 2.53 |
| April | 9.67 | 4.47 | 3.71 | 8.74 | 4.61 | 2.81 | 6.36 | 1.86 | 2.21 |
| May | 8.69 | 4.04 | 3.10 | 9.46 | 5.02 | 2.48 | 8.90 | 5.84 | 2.14 |
| June | 9.22 | 3.49 | 2.82 | 9.36 | 3.68 | 2.34 | 8.14 | 3.38 | 1.94 |
| July | 9.23 | 3.33 | 2.72 | 9.17 | 3.50 | 2.16 | 9.30 | 3.72 | 1.96 |
| August | 9.79 | 4.81 | 2.66 | 10.04 | 5.31 | 3.04 | 9.67 | 5.27 | 1.92 |
| September | 10.11 | 4.18 | 2.79 | 9.42 | 5.13 | 2.55 | 9.07 | 5.97 | 1.99 |
| October | 9.67 | 4.35 | 2.79 | 9.23 | 4.61 | 2.60 | 9.05 | 6.81 | 1.93 |
| November | 8.94 | 3.11 | 3.43 | 8.83 | 3.40 | 3.21 | 7.42 | 2.95 | 2.17 |
| December | 7.17 | 1.38 | 4.33 | 6.52 | 1.13 | 3.38 | 5.45 | 0.90 | 2.34 |
| Average | 8.59 | 3.08 | 3.40 | 8.29 | 3.29 | 2.89 | 7.43 | 3.30 | 2.19 |

NOTE.—These figures are compiled and averaged from eight to fifteen farms on each route and include the work of hired laborers, resident laborers of all ages, and all horses kept on the farms as work horses. The figures in the daily column are averaged for 313 working days in the year, no account being taken of holidays. The number of hours worked by the horses seems exceedingly small; but it should be remembered that under ordinary methods of farm management farm horses are idle a considerable portion of the year, and that the farmer, in order to have the use of a number of good teams in seeding and in harvest, is obliged to feed and maintain them through the entire year.

Concentration in farming by managing the lands in large estates would result in a more systematic organization of some features of farm production. The values consumed in farm machinery, for example, can undoubtedly be decreased under extensive farming conditions, and transient labor also can be more easily employed and more effectively utilized.

While consolidation of farm lands under a few managers having exceptional ability would undoubtedly have many advantages in furthering system and efficient use of capital and labor on farms, the disadvantages in such a system must not be overlooked. The creation of large estates would tend to create a large wage-earning or peasant-like labor class, and to greatly disorganize the development of good American citizens in the independent home on the farm of family size. It is a question, also, whether the fertility of the soil can be conserved as well under "large estate" farming as under a system where a small piece of land is under the supervision of a man who will care for the soil and husband its strength because of an innate love for the land which makes his home and is to be the home of his children.

And yet it must be admitted that, under our present methods of farm management in the Middle West, a majority of the farms of medium size are not as well planned nor as well managed to yield good

profits at the least expense of capital, labor, and fertility as are the large farms superintended by men of unusual business ability. Waste of machinery and other capital, waste of labor, and waste of fertility

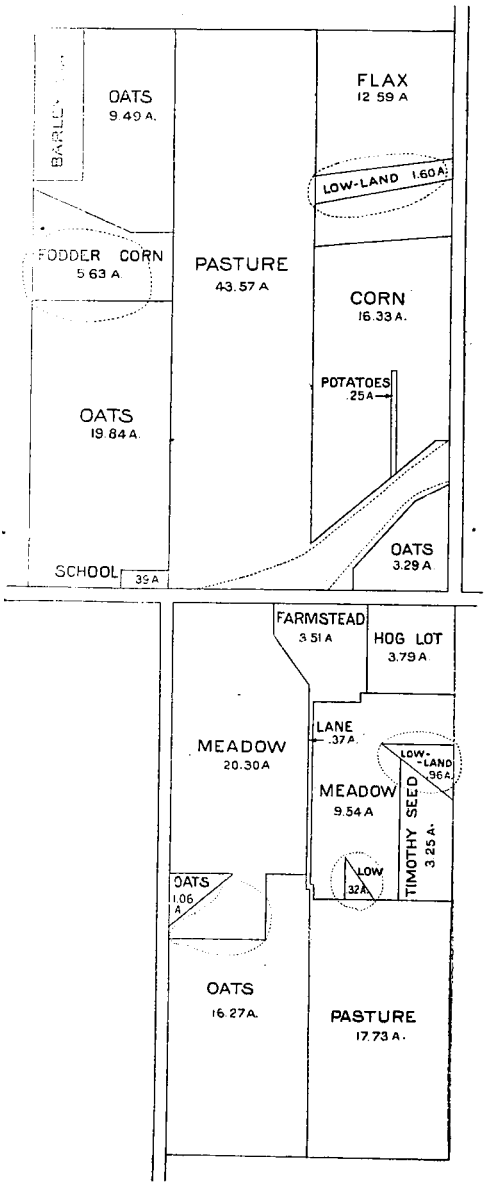


FIG. 2.—A typical 200-acre farm in southeastern Minnesota.

The land is worth $75 an acre, and is 50 miles from city markets. The soil is a light clay loam. Dent corn is easily matured in this section of Minnesota. Areas within the dotted lines need drainage, although they can be cultivated in dry years. The products marketed are oats, milk, and pork. Fourteen cows are kept, twenty-five head of young stock, eight horses, four brood sows, and fifty chickens. The owner rarely looks more than one or two years ahead in deciding upon the crops to be grown. No systematic scheme of cropping is followed under which each crop has the land prepared for it by the previous crop; under which weeds are cheaply kept in subjection; under which labor requirements are distributed economically throughout the year, and the maximum of profit from crops and live stock is secured at the least expense and with an increase rather than a decrease in the fertility of the land.

are conspicuous features of the agriculture of the Middle West. The settler has sacrificed soil fertility and great values of farm machinery in order to obtain quick profits and ready cash, and then as the country

has grown older he has neglected to remodel his business to meet the new and changed conditions. It is not idle prophecy to sound this warning, that, unless the next generation which tills the soils of the Middle West puts the fields under systematic crop rotation and better systems of farm management, fertilizer problems such as now confront the East and the South will have to be met before many decades.

Two systematic rotations are permanently projected, beginning with the year 1909. During the transition years the low spots in the fields have been drained, fields readjusted in order to equalize their size, and fields D and E seeded down. The arable land is divided into five large fields, A, B, C, D, and E, and three small fields, L, M, and N, adjoining the farmstead. A five-course rotation planned for the five large fields provides each year approximately thirty-four acres of corn, sixty-eight acres of oats, thirty-four acres of hay, and thirty-four acres of pasture. The crops are arranged in the following sequence: First year, corn; second year, oats; third year, oats (seeded to clover and timothy); fourth year, meadow; fifth year pasture (manured during winter preceding corn). A three-year rotation planned for the small fields, L, M, and N, adjoining the farmstead, provides annually for about three acres fodder corn (rape sown at last cultivation for fall pasture), three acres barley (seeded to clover), and three acres of clover to be used as hog pasture.

In the five-course rotation on the large fields the timothy and clover sod, when well plowed in the fall, manured during the winter, and disked in the spring, gives excellent conditions for the corn crop. The corn stubble, if well disked and harrowed, will provide a good seed bed for oats, and, if the oat-stubble land be early fall-plowed medium deep, excellent conditions will be given on this soil for a second crop of oats. Clover and timothy can be successfully sown with this second crop of oats, especially if the oat stubble be plowed early so as to become compacted, although spring wheat and barley are generally considered better nurse crops than oats. The succeeding clover and grass crops enrich the land for the crop of corn that is to follow. Corn on the sod land is preferable to oats in this region, owing to the liability of the oat crops to lodge on the rich pasture sod.

In the three-course rotation on the small fields the fodder corn is to be heavily manured, the corn stubble disked for barley, and clover sown with the barley will provide excellent hog pasture the third year.

The amount and distribution of labor involved in a systematic rotation of this kind, as compared with a haphazard system, are as worthy of consideration as the effect of systematic and unsystematic cropping on soil fertility. The expense of plowing, for example, is required only twice in the five-course rotation and once in the three-course rotation. Labor also is better distributed throughout the entire year, and the demand for seeding and harvest help is not so intense as in "one-crop" farming.

Catch crops, such as fodder corn and millet, can be sown, if the occasion demands, but where timothy and clover are sown together in a firm, well-compacted seed bed failure to secure a good stand is most unusual.

All the fields are eventually to be fenced so that rape may be sown with the corn and with the oats, and sheep and young stock turned out on the stubble fields for fall pasture.

The rotations outlined contemplate a general system of diversified farming in which grain, milk, and pork are the chief products and sheep, poultry, and fruit the minor products. The products of these rotations would support more stock than was carried under the old system and produce as much or more grain for market.

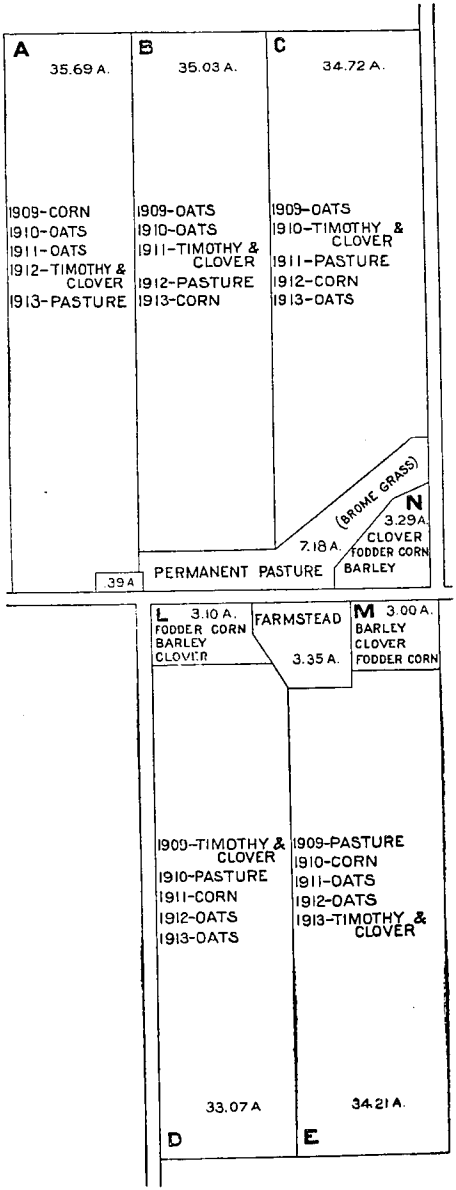


FIG. 3.—The same farm shown in fig. 2, replanned.

On the other hand, if the proper physical conditions for soil decomposition are maintained by systematic crop rotations and intelligent methods of farm management, the producing capacity of the prairie soils can be maintained indefinitely. Land on which crops are rotated systematically demands more intelligent methods of field management,

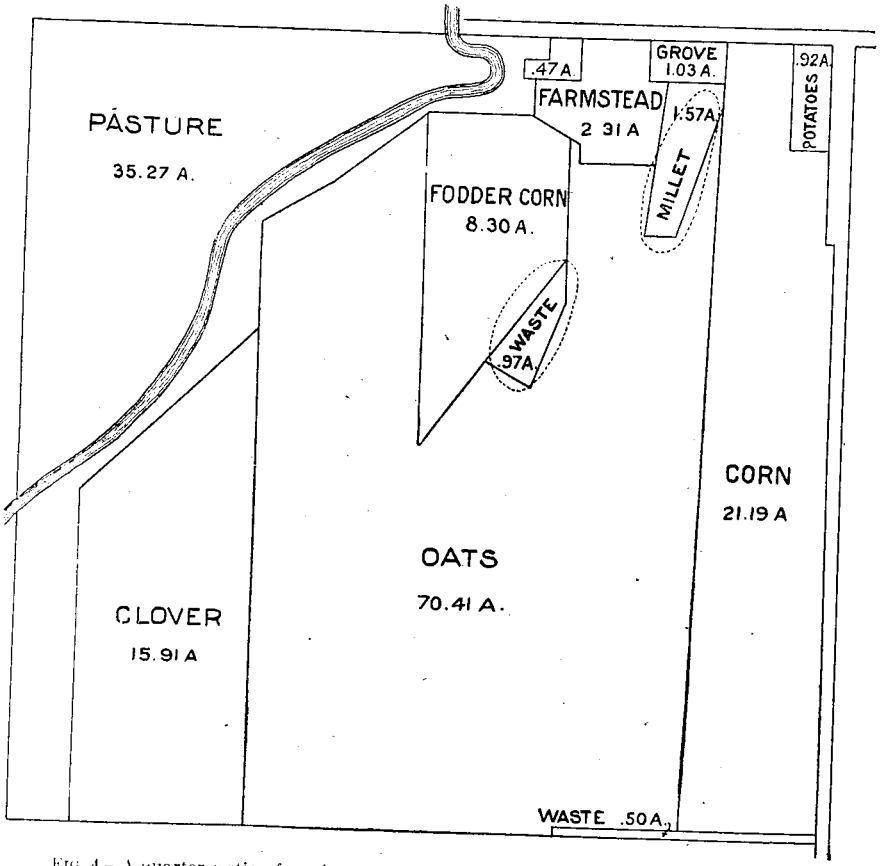


FIG. 4.—A quarter section farm in southeastern Minnesota located on the bottom lands of an old river.

Distance from city markets is 50 miles. The soil is a sandy loam, easily worked and easily drained. Dent corn thrives luxuriantly on these bottom lands and is easily matured. Improved land is worth $75 an acre. Areas within the dotted lines need drainage and can be cheaply drained to the creek flowing through the farm. The products marketed are oats, milk, and corn. Twenty cows are kept, fifteen head of young stock, ten horses, and one hundred and fifty chickens. Thirty-five acres are in permanent pasture, and this land is too rough to be put into rotation with the arable fields. No systematic scheme of cropping is followed, although more corn and clover are grown than on the average farm in the same county. The farm is stocked as heavily as it will stand as long as grain is to be part of the market product.

more intelligent use of live stock, machinery, and other capital and labor. All these are corollaries of crop rotation, and the result of systematic crop rotation must always be increasing profits due to greater productiveness in the soil, more effective employment of capital and labor, and sounder business methods. The intensive systems of farm-

ing practiced near the great cities of the eastern part of the United States, where grain and mill feeds are shipped in from the West, can not be extended to a majority of the farms in the United States. Such systems of farming can only be practiced at the expense of the fertility in other agricultural regions from which concentrated feed stuffs

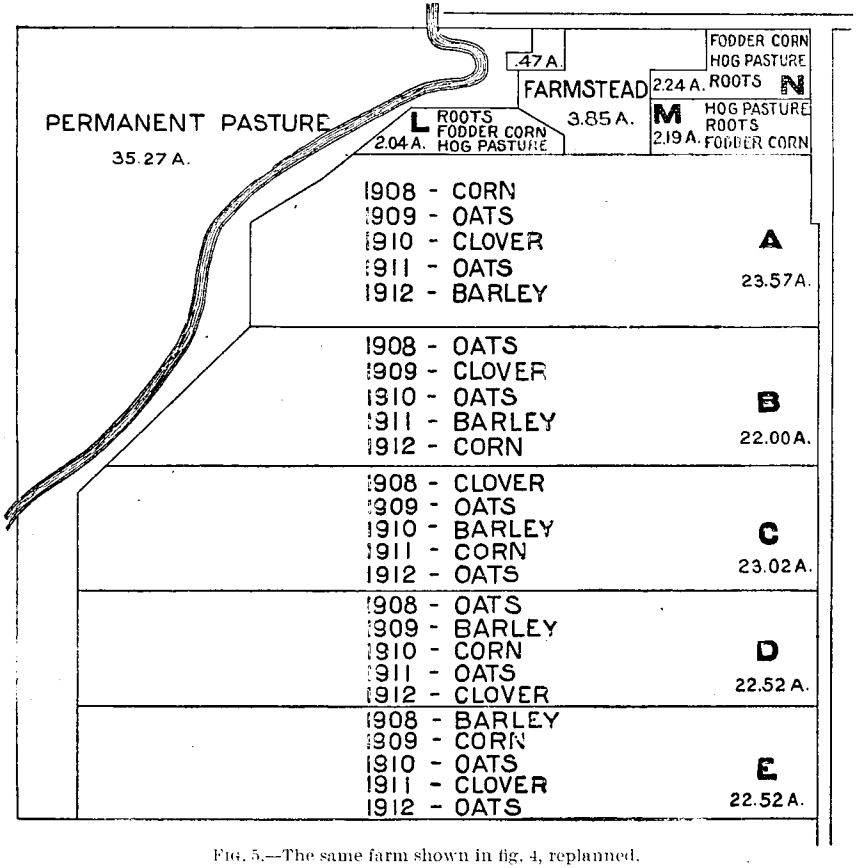


FIG. 5.—The same farm shown in fig. 4, replanned.

The arable land has been placed under systematic rotations permanently projected, beginning with the year 1908. In preceding years the low spots have been drained, field C seeded down in 1907, and the outside lines of the farm permanently fenced. The small fields adjoining the farmstead have been fenced with hog fencing.

The five-course rotation on the five large fields, A, B, C, D, and E, provides each year approximately twenty-two acres of corn, forty-four acres of oats, twenty-two acres of barley, and twenty-two acres of clover meadow. The crops are arranged in the following sequence: First year, corn (manured); second year, oats (seeded down); third year, clover; fourth year, oats; and fifth year, barley. Corn, flax, or wheat instead of the oats could be grown, following the clover sod, as a market crop if desired. Oats are placed on the sod land because they are the chief market crop in this region and can be grown successfully on the light clover sod if desired.

The three-course rotation of small fields L, M, and N provides two acres for fodder corn each year, two acres for annual hog pasture, and two acres for root crops such as potatoes and mangels. These crops are arranged in the following sequence: First year, fodder corn; second year, annual hog pasture; third year, roots. The land in the five-course rotation would have to be plowed three times in five years and the small fields twice in three years.

The cattle and other stock may be allowed to pasture over the entire farm as soon as the corn crop is harvested.

While this rotation can not be considered as nearly ideal as those outlined in figures 3 and 7 it is eminently practical and fits in well with the requirements of a farm having a permanent pasture. The live stock will produce enough manure to give each field a good dressing once in five years, and the manure with one crop of clover in five years will undoubtedly keep the soil in a good state of fertility.

are purchased, and they are therefore undesirable for the majority of American farms.

*Systematizing farm management.*—In figs. 2, 4, 6, and 8 are shown the survey maps of four Minnesota farms from which statistics have been gathered during the past four years, with the present methods of cropping and field management outlined. Figs. 3, 5, 7, and 9 show the possibilities in replanning and reorganizing these same farms to

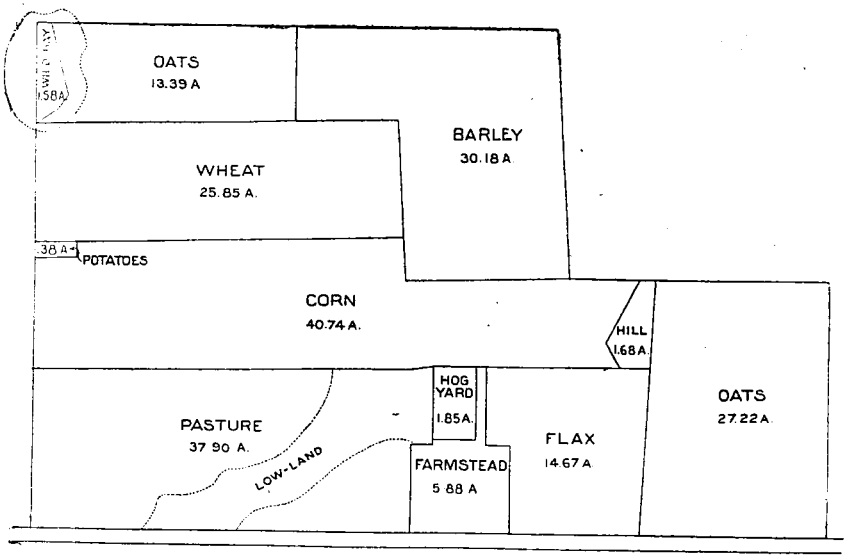


FIG. 6.—A 200-acre farm in southwestern Minnesota.

Improved land is worth $55 to $60 per acre. Distance from city markets, 200 miles. The soil is a clay loam, very retentive. Areas within the dotted lines need drainage. Dent corn matures easily and is extensively grown. Wheat, flax, and other cereals form the chief market products of the farm, although beef and pork are also produced. Eight cows are kept, ten head of young cattle, ten horses, two brood sows, one hundred and twenty-five chickens, and fifteen to twenty steers, mostly purchased, are fattened each year on corn.

No systematic scheme of cropping is followed, and clovers and tame grasses have never been grown on the farm except in permanent pastures.

secure systematic crop rotation on the fields, and a more systematic farm business. The planning and reorganizing of an old farm can not always be done in the course of a year or two without disrupting the business. Reorganization must usually be gradual to be practical. Drainage and fencing must be accomplished, and hay and pasture lands seeded down without serious inconvenience. If reorganization be gradual, drainage, fencing, etc., can be accomplished with small outlays of cash.

The maps shown in figs. 2 to 9, inclusive, with the suggested rotations and more businesslike methods of farm management, are presented in this bulletin merely to show the lack of business system that too often prevails in the methods of farming on the high-priced lands of the Middle West. The practicability of reorganizing farms and putting them on a more businesslike basis by the methods herein suggested will be reported upon later.

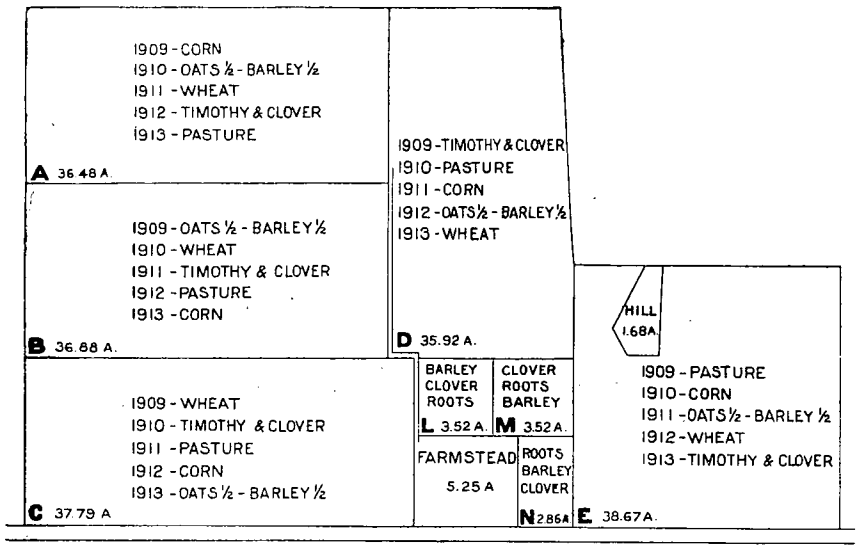


FIG. 7.—The same farm shown in fig. 6, replanned.

The arable fields have been placed under systematic rotations permanently projected, beginning with the year 1909. In the preparatory years the lowlands of the farm have been drained, fields D and E seeded down, and fields D, E, L, M, and N fenced.

The five-course rotation on the five large fields A, B, C, D, and E provides each year approximately thirty-six acres of corn, eighteen acres of oats, eighteen acres of barley, thirty-six acres of wheat, thirty-six acres of hay land, and thirty-six acres of pasture. The crops are arranged in the following sequence: First year, corn; second year, oats and barley; third year, wheat (seeded down); fourth year, timothy and clover; and fifth year, pasture (manured).

The three-course rotation of small fields L, M, and N provides each year approximately three acres of barley, three acres of clover, and three acres of root crops. These crops are arranged in the following sequence: First year, barley (seeded down); second year, clover (hog pasture); third year, roots (manured).

Fields in the five-course rotation will have to be plowed twice in five years and fields in the three-course rotation twice in three years.

This farm is well adapted to the outlined rotation. The farm is naturally divided into five large fields, with fifteen acres of land for farmstead, pasture lots, etc. The rotation is exceedingly flexible, and will support the present amount of stock on the farm, allowing nearly two-fifths of the products to be marketed directly, or nearly double the present amount of stock could be carried by growing more feed grains and fodder corn in place of the market grains and ear corn.

The growth of clover and tame grasses on the heavy soils typified by the soil of this farm would be of immense benefit in improving the physical texture of the soil, making the soil more friable and better drained.

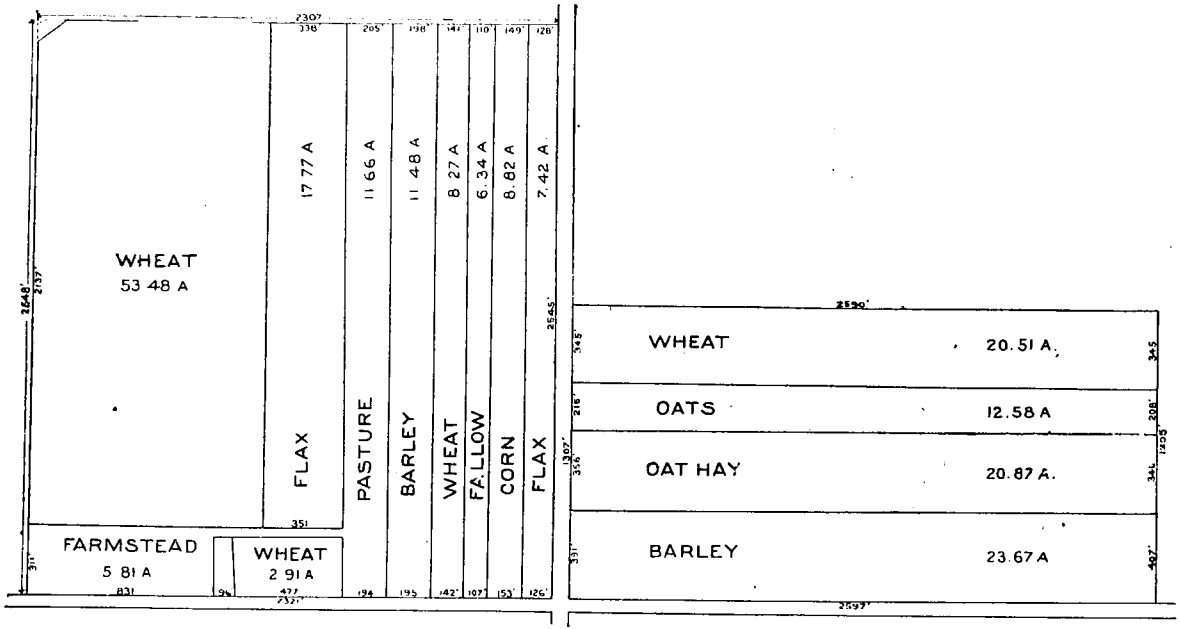


FIG. 8.—A 210-acre farm in the Red River Valley region of northwestern Minnesota.

Improved land is worth $30 to $35 per acre. Distance from city markets is 300 miles. The soil is a heavy clay, very retentive, and cold and wet in the spring. The farms of this region are so level that surface drainage is very difficult. Cooperation among farmers in building deep roadside ditches and high turnpikes is necessary before the low pockets in the fields can be drained. Corn is not grown to any extent in this region on account of the late springs and short growing seasons. Some early varieties of dent corn and early flint varieties can be matured, however, and luxuriant crops of Minnesota dent varieties thickly planted for fodder corn can be grown.

Wheat, flax, and barley are the chief market products of this farm as well as of all adjoining farms. A small amount of cream is marketed. Eight cows are kept, nine head of young stock, two brood sows, five horses, and eighty chickens.

No systematic scheme of cropping is followed. Not more than 5 per cent of the farm is used for cultivated crops, and clover and tame grasses are not seeded at all for hay. Wild hay is cut from adjoining sections of unoccupied virgin land that are too low for cultivation.

Wild oats, giant ragweed, French weed, chess, mustard, cockle, and other foul weeds are infesting the farms of this section of the State, and becoming more numerous each year. Fallowing 10 per cent to 20 per cent of the farm each year is often resorted to as a means for destroying these weeds.

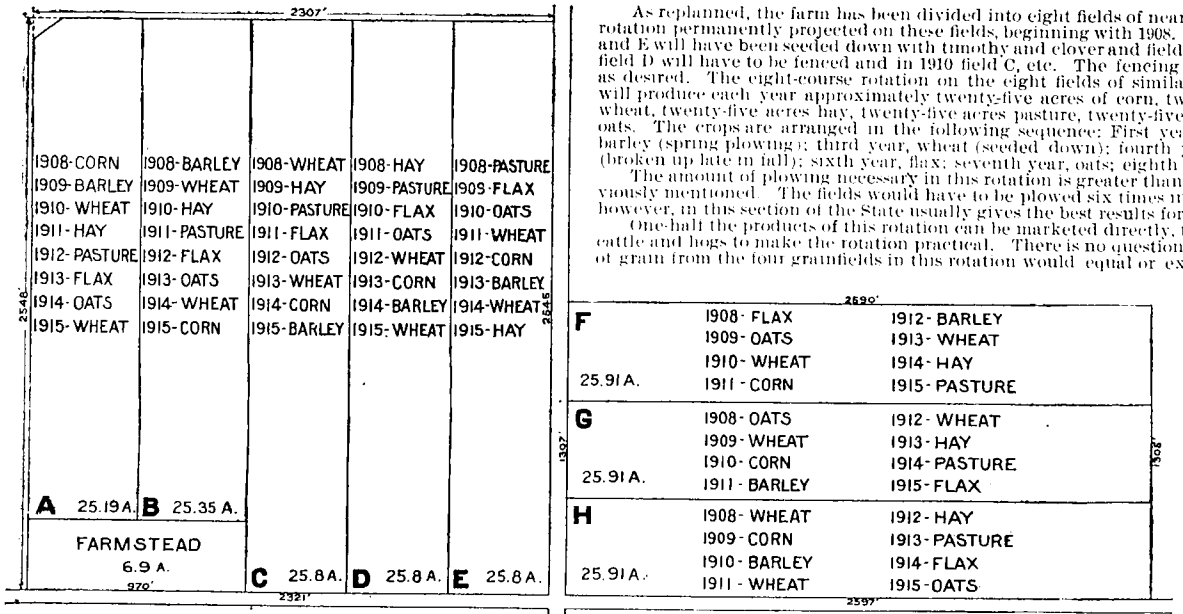


FIG. 9.—The same farm shown in fig. 8, replanned.

As replanned, the farm has been divided into eight fields of nearly equal size, and an eight-course rotation permanently projected on these fields, beginning with 1908. In the preparatory years fields D and E will have been seeded down with timothy and clover and field E will have been fenced. In 1909 field D will have to be fenced and in 1910 field C, etc. The fencing can be temporary or permanent, as desired. The eight-course rotation on the eight fields of similar size, A, B, C, D, E, F, G, and H, will produce each year approximately twenty-five acres of corn, twenty-five acres barley, fifty acres wheat, twenty-five acres hay, twenty-five acres pasture, twenty-five acres flax, and twenty-five acres oats. The crops are arranged in the following sequence: First year, corn (manured); second year, barley (spring plowing); third year, wheat (seeded down); fourth year, meadow; fifth year, pasture (broken up late in fall); sixth year, flax; seventh year, oats; eighth year, wheat.

The amount of plowing necessary in this rotation is greater than in the short-course rotations previously mentioned. The fields would have to be plowed six times in eight years. Early fall plowing, however, in this section of the State usually gives the best results for small grains.

One-half the products of this rotation can be marketed directly, the other half must be utilized by cattle and hogs to make the rotation practical. There is no question but that the total market product of grain from the four grainfields in this rotation would equal or exceed the present product that is being marketed under unsystematic field management. The land would be quickly freed from foul weeds if cropped by this system. Weeds would be cultivated out in the corn crop, the spring plowing for barley would bring a fresh supply of weed seeds to the surface, and the resulting plants could be partially destroyed by thorough harrowing before the barley was sown. Barley matures early enough for a portion of the wild oat seeds to be taken from the land in the barley crop, and a majority of those seeds which do shell before barley harvest can be germinated the same fall by early shallow plowing and harrowing, and the resulting plants will freeze out during the succeeding winter. Weed seeds buried in the soil will also lose their vitality during those years when the land is in grass.

Corn, clover, and the tame grasses will also improve the physical texture of these heavy soils wonderfully by making them more porous, more friable, and, therefore, better drained and warmer. Profitable utilization of the corn and grass crops in this rotation is the problem of greatest importance. No succession of crops can materially aid the soil in this region unless corn and the grass crops are included in the rotation. Corn can take the place of bare fallow on the grain farm, and the difference in cost per acre will only be a matter of about $1.50. That is to say, a crop of corn can be raised (up to harvest) with a cash and labor outlay of about $4 per acre (see Table XV), and bare fallow if properly done (two plowings and several harrowings) will cost about $2.50 per acre. A corn crop well cultivated will benefit succeeding crops of small gr in more than bare fallow, because grain on fallow land tends to grow rank and not fill well on the rich soils of the Red River Valley. The crop of standing corn is certainly worth much more than $1.50 per acre. It is worth more than that as fall pasture for cattle and hogs, so that the folly of fallowing land is apparent wherever the corn crop can be even partially utilized. Fifteen good beef cows and their offspring could utilize the roughage in this rotation and with a small amount of care yield a fair profit under these conditions. By having the calves come in April and May, they could suckle and pasture with the cows the first summer, then feed through the first winter on cheap feeds, like clover hay and fodder corn, pasture the second summer on grass and cornstalk pasture in the fall, and be sold for "feeders" when one and one-half years old at an exceedingly small cost of production. The corn crop of twenty-five acres could be partially cut for fodder, partially picked on the hill and the grain ground for winter feed, and the cattle turned in the fields during the fall and winter to utilize the remainder of the crop.

## THE NEED FOR STATISTICS CONCERNING THE BUSINESS OF FARMING.

In the study of crop rotation and farm management there is great need for statistical literature concerning agriculture. The exact cost of producing farm products, the capital required for various types of agriculture, the net profit in various types of agriculture, the cost of man and horse labor on farms, and many other important basic facts are as yet unknown to a majority of farmers and even to the technical agricultural workers and investigators. Occasionally the farmer who is a close student of agriculture has worked out a few statistics concerning agricultural production, but exact data on the general business of farming are wanting.

Agricultural investigators naturally have attacked those problems first which were easier solved with the means at hand and which would easily yield results. Beginners in experimental work, as in business, are anxious to follow lines which will bring "quick returns." The problems of farm management have been deemed so complex that few experimenters have as yet entered this field, and the general facts of farm management and of the management of the farm home have been little investigated. The parts of the farm have been studied, but the farm as a whole has received but little attention. While methods have been devised for investigating the soil, the plant, and the animal, little effort has been given to devising ways of studying the general farm plan and the farm business. The relation of one part of the farm to another and the relation of the farm to the markets and to other industries have not been brought under scientific investigation. The facts derived from detailed investigations concerning the soils, plants, and animals are of great importance, but they are useful only as the farmer's training enables him to make proper use of these facts. A literature must be created based on facts which are largely yet to be worked out and illustrated by many successful plans of reorganized farms, and the pedagogics of farm management must be so developed and simplified that this subject may be taught in all farmers' schools. Experience with agricultural high school classes, in teaching farm management to young men who are to return to the farm, has demonstrated that this line of instruction can be made very practical and can be given a very high degree of educational value. As more results of investigation become available the teaching of farm management can be placed on an educational footing comparable with the teaching of other engineering subjects. Studies in farm management, as soon as they are better worked out, can be adapted to instruction in the consolidated rural school, as well as to classes in the agricultural high school and in the collegiate course in agriculture. It is of interest to find that such practical studies as farm management may be so developed as to have quite as high value in giving clearness of thought,

power of concentration, and zest for learning as the most highly developed academic studies. To organize a general effort to investigate the subject of farm management, and to carry to all farms the results of such investigations in a form that will be found useful, is a large undertaking. The long-continued efforts required for the necessary experiments with plans of crop rotation and of fertilizer requirements, and with cultural methods, for investigation to determine the cost of production of crops and live stock, and for the work of comparing one system of farming with another, make the work both tedious and difficult.

## RELATION OF STATISTICS ON THE COST OF PRODUCING FARM PRODUCTS TO THE STUDY OF CROP ROTATION AND FARM MANAGEMENT.

Experiments in the rotation of crops begun nearly fifteen years ago by the Minnesota and North Dakota agricultural experiment stations led to the investigation of the cost of producing each crop and each kind of live-stock product. In order to determine the values of certain arrangements or rotations of field crops, it is necessary that the cost of production be known.

Rotation values through a series of years should be measured in net profits (see note under Table XIII). By recording the gross product of various systems of rotation through a series of years, and then deducting from the value of this product, for the respective systems, the cost of producing the various crops that enter into the rotation, the net profit from the rotation may be determined and the average annual profits compared from the various systems. In the study of crop rotation the main index of comparative value between various systems of rotation is net profit averaged through a long series of years.

The study of the physical and chemical condition of soils subjected to various systems of crop rotation is of secondary importance to the main index of value, "net profit," but is useful in that it aids in explaining the reasons for the profits which have been secured by the various schemes of cropping. The final test of rotation values is net profit, because that arrangement or succession of crops which yields the largest net profit in cash through a long term of years is the rotation which has kept the soil in the best chemical and physical condition and is best adapted to its environment of soil, climate, and markets.

From the standpoint of agricultural economics the study of crop rotation and cost of producing field crops should be accurately carried out in their relation to the law of diminishing returns—that cost of production beyond which increasing applications of capital and labor fail to yield a proportionate return. What amount of labor and machinery values can be applied to the soil that will yield the greatest

proportional profit? Would a $10 application of labor and capital to an acre of land yield a greater proportional profit in wheat than the average application of $6? And would an application of $15 per acre yield a larger proportional profit in corn than the average application of $10? Deductions from long-time investigations of this sort would undoubtedly be of practical value in the business of farming.

Cost of production and market conditions are the basis from which all study of methods should be made in agriculture as well as in other industries. Knowing these facts, the adaptability of various crops to economic production on various soils and in various climates may be ascertained. The difference between the cost of producing a crop and the value of the gross product indicates to the practical farmer the correctness or incorrectness of his methods as well as the adaptability of the crop to his soil and to his needs. The same method of analysis holds true in the production of beef, pork, and milk. Could every hog feeder know in figures the exact cost of producing a pound of pork with clover pastures, barley, and shorts, as compared with dry feeding in pens, it is a safe prophecy to make that there would be more money made in hogs than is now being made. Many problems in crop and live-stock management should be solved from the cost of production standpoint.

## FIELD METHODS EMPLOYED IN COLLECTING STATISTICS CONCERNING THE BUSINESS OF FARMING.

The investigations into the cost of growing crops and of producing live stock were begun in 1893 at the North Dakota Agricultural Experiment Station. The college farm of 640 acres was divided into rectangular fenced fields on which the labor and other items of cost for each crop were recorded daily. While it was soon found that the cost per acre of growing crops on an experiment farm was higher than on private farms, because of greater care and because of experiments in progress, this work suggested a plan of securing the data of the normal cost of production from farms that were being worked for profit.

On January 1, 1902, the Bureau of Statistics of the U. S. Department of Agriculture joined in cooperation with the division of agriculture of the Minnesota Agricultural Experiment Station to gather data from Minnesota farms on the cost of producing field crops and live-stock products. The expense was shared about equally, and the work was directed from the Minnesota Agricultural Experiment Station. Three young men, students of the Minnesota College of Agriculture, were employed as *route statisticians*, and three statistical routes were established: one in southeastern Minnesota, in Rice County, near Northfield; another in southwestern Minnesota, in Lyon County, near Marshall; and another in northwestern Minnesota, in Norman County, near Halstad. Fifteen farmers on each route, chosen as *farm-statistics*

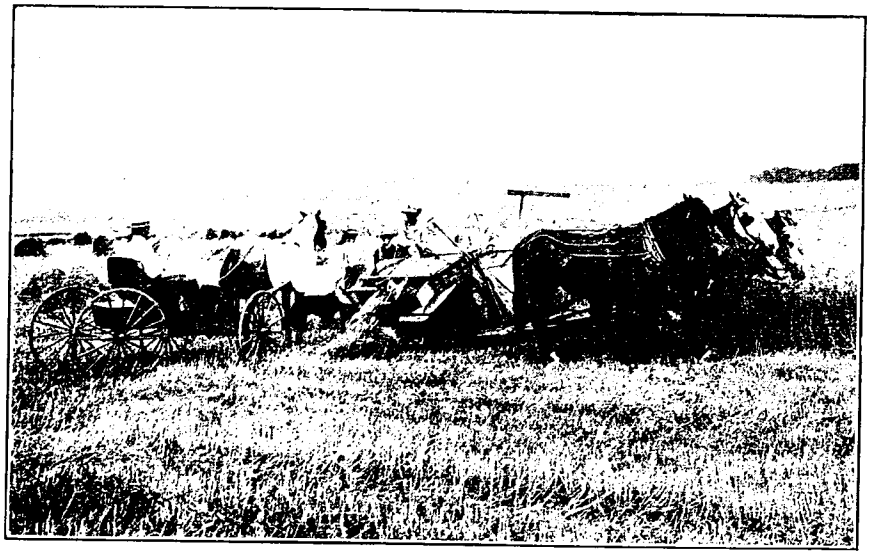

FIG. 1.—THE ROUTE STATISTICIAN COLLECTING HIS DAILY LABOR REPORT FROM A FARMER WHO IS A COOPERATOR WITH THE BUREAU OF STATISTICS AND THE MINNESOTA AGRICULTURAL EXPERIMENT STATION IN STUDYING THE COST OF PRODUCING FARM PRODUCTS.

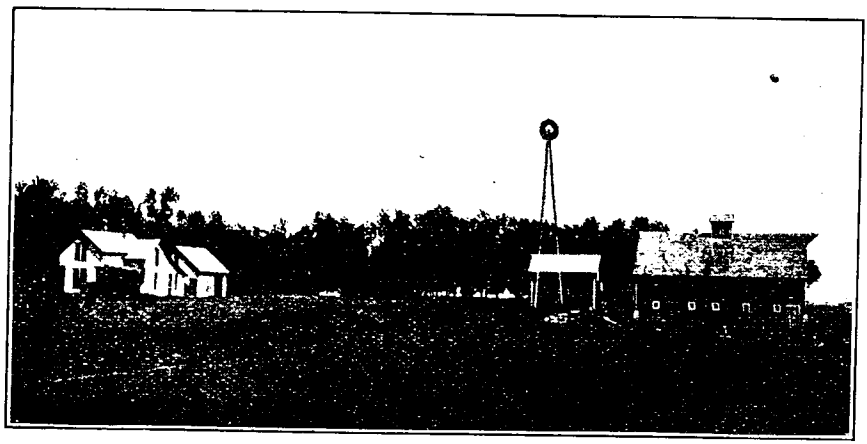

FIG. 2.—A PRAIRIE FARMSTEAD ON THE MARSHALL ROUTE IN SOUTHWESTERN MINNESOTA WHICH ILLUSTRATES THE POSSIBILITIES IN GROWING WIND-BREAKS AND WOOD LOTS ON THE OPEN PRAIRIE

*cooperators*, agreed to be interviewed daily throughout the entire year by the route statisticians, giving a record of each hour of labor performed by each man and by each horse, and giving the field crop or other enterprise upon which the labor was used. A map, based upon accurate measurements of each field, was made of each farm, that the data might be so collected and classified as to show the cost per acre for each crop, on each farm, also the average for each route and for the State.

At the beginning and close of each year complete inventories were taken of all live stock, machinery, feeds, etc., and during the year all cash items were secured which had to do with the receipts and expenditures on field crops, machinery, horses, and labor. During the years 1902 and 1903 very few data were secured except those which related to crop production, after which the data were extended to live stock and other affairs of the farm and the farm home. The first two years' work was in a way experimental. Methods for collecting and recording the statistics had to be devised, and many difficult problems, like finding the exact rate of wages per hour for men and horses, were not worked out by the most exact methods until the second year.

In 1904 some departure was made from the plan first inaugurated. The number of farms on each route was reduced from fifteen to eight. The scope of the investigations was extended along many lines, as with live stock and household affairs. The route statisticians no longer board with one family as they did the first two years, but live at each of the eight farms three days each month, maintaining an office room at one of the farms. All the farms on the route are visited each day, however, to obtain the labor record for the previous day. The route statisticians assist in doing the chores, and, with a simple equipment, record for these three days—thirty-six days at each farm during the year—the amount of feed stuffs used by each group of animals, and the yield of milk and the per cent of butter fat from each cow in the herd. Practically no changes were made during these three years in the methods of farm management previously in vogue.

The feeding records and yields of products thus obtained are reduced to a daily average and multiplied into the number of days in the month, thus giving the approximate record for the entire month. Dates are recorded when changes of rations are made or when cows are freshened or dried up, and corrections are made at the close of the month. The route statisticians also secure an accurate record of the time required to feed and care for each class of live stock. A printed card is left in every house each month on which the women of the family record the number of eggs laid by the poultry, the number of eggs consumed by the family, and the pounds of milk, butter, poultry, and other kinds of farm produce consumed.

A complete cash account is kept on each farm, and this record of receipts and expenditures, together with labor records, feeding records, etc., is mailed to the experiment station each month, where the various figures are posted into a double-entry set of books for each farm.

The route statistician keeps a history card for each field and each live-stock enterprise on the farm. The field histories are useful in keeping a record of the methods of rotation, soil preparation, planting, and harvesting used by the farmer, and other data concerning the crops. Histories of live-stock enterprises are useful in that they may be used to record explanatory notes and data supplementary to the ledger accounts.

By living with each family on the route three days in the month the route statistician gets in close touch with the farmer and is thus enabled to secure accurate data along the desired lines.

The farmers especially appreciate having the milk of each cow tested monthly, and having a record given them each year of the amount of butter fat produced by each cow, the total value of her product, and the cost of her feed. In 1905 eight wagon scales were purchased by the U. S. Department of Agriculture and placed on the Northfield route in order to assist in securing more accurate information concerning crop yields and the growth of live stock.

The compass of this bulletin does not permit detailed discussions of more than a part of the data secured, hence in future pages little is mentioned besides data concerning the cost of producing field crops.

## METHODS EMPLOYED IN COMPILING STATISTICS ON THE COST OF PRODUCING FIELD CROPS.

The compilation of the data from the statistical routes has been quite as much a problem as gathering the facts from the farmers. In the system of records first devised large ledger sheets were used, but this method has been supplanted by a vertical, loose-leaf filing system that is much simpler and more comprehensive than the original method. During the growth of the work several practical methods for keeping farm accounts have been devised that are simple enough to be used by any man of average intelligence. Data from one farm for two years have been used as the basis for a manual on farm bookkeeping in use at the Minnesota School of Agriculture.

### COST PER ACRE AS A BASIS FOR STUDYING COST OF PRODUCTION.

Cost per acre has been made the basis for studying cost of producing field crops rather than cost per bushel or cost per ton. Cost per bushel or per ton varies so greatly with yield that such figures mean little except as long-time averages of yield are obtained. As a general rule the cost of producing a 20-bushel crop of wheat, for example, will vary but little from the cost of producing a 10-bushel crop, and this little difference will occur mainly in harvesting and thrashing. This

Bul 48, Bureau of Statistics, U. S. Dept. of Agriculture.

FIG. 1.—WEIGHING GRAIN FOR THE LIVE STOCK.

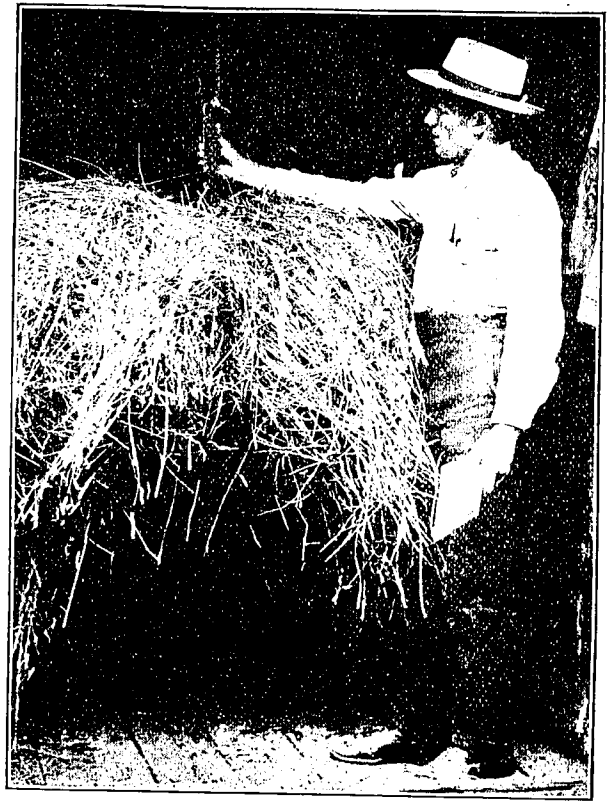

FIG. 2.—WEIGHING THE DAY'S RATION OF HAY FOR THE WORK HORSES.

FIG. 3.—WEIGHING TO TEST THE OVERRUN OR UNDERRUN FROM A THRASHING MACHINE.

does not mean that yield can not be made to vary with cost of production, but that yield varies greatly through the changes in climatic conditions when land is given the same preparation in successive seasons. Average yields for three years are published with the tables, and cost of production per unit of product can be figured, if desired, but a longer period than three years would be necessary to obtain average yields upon which safe conclusions could be based. In some cases, on Minnesota farms, higher yields than those secured on those farms from which statistics were collected are obtained by a more thorough tillage of the soil, thus increasing the cost of production; but on the other hand, when diversified farming is practiced, the yields are greater, not because of a higher cost of production, but on account of the more productive condition of the soil, freedom from foul weeds, etc.

Many items which make up the total cost of producing a crop need explanation; otherwise the statistics given in this bulletin can not be properly interpreted. The classification of farm labor, the rates of wages per hour for men and horses, the cost of board per month per man, the values per acre of farm machinery consumed, and the rental value of the land are all special problems in statistical research that need explanation.

### THE CASH VALUE OF MAN AND HORSE LABOR ON FARMS.

In 1902 no attempt was made to classify the farm labor any furtner than into man labor, boy labor, and horse labor. The wages paid to men and boys were recorded, and an attempt was made to estimate the amount of hay and grain consumed by the horses. At the close of that year the rate of wages per hour for man labor was determined by adding the yearly wages for a hired man to the cost of his board (estimated at $10 per month), and dividing this sum by the average number of hours worked during the year by each man. Cost per hour of boy labor was figured by the same process; and rates per hour for horse labor were ascertained by adding the estimated cost of feed, the labor cost of care, cost of shoeing, interest on investment, and depreciation, and dividing this sum by the average number of hours worked during the year by each horse.

Man labor in 1902 was found by this process to be worth 12½ cents per hour, boy labor 7½ cents, and horse labor 7½ cents. All labor in 1902 was converted into terms of cash by using these rates, with the exception of thrashing labor, which was figured at harvest wages. These methods were unsatisfactory, because they were not absolutely exact.

Since the beginning of 1903 the labor has been classified, and the rates of wages per hour determined by the methods illustrated in Tables II to VII.

TABLE II.—*Labor record used on statistical routes to classify farm labor.*

DAILY LABOR REPORT OF HENRY JONES, MARSHALL ROUTE, APRIL, 1904.

| Labor (itemized). | Number of men. | Number of horses. | Hours. | | | |
|---|---|---|---|---|---|---|
| | | | Day labor. | Rate labor. | Other labor. | Horse labor. |
| April 15: | | | | | | |
| Cleaning seed wheat | 2 | | | 6 | 6 | |
| Hauling manure, field C | 1 | 2 | 10 | | | 20 |
| April 16: | | | | | | |
| Seeding wheat, field B | 1 | 4 | | | 9 | 36 |
| Seeding oats, field A | 1 | 3 | | 9 | | 27 |
| Harrowing, field B | 1 | 4 | 10 | | | 40 |
| April 17: | | | | | | |
| Seeding oats, field A | 1 | 4 | | | 8 | 32 |
| Harrowing, field A | 1 | 4 | | 9 | | 36 |
| Harrowing, field B | 1 | 2 | 10 | | | 20 |
| April 18: | | | | | | |
| Fencing, field P | 2 | 2 | | 10 | 10 | 20 |
| Hauling manure, field C | 1 | 2 | 10 | | | 20 |

NOTE.—A labor report for four days during April from one farm. All hours of man and horse labor are recorded in terms of one man and one horse. "Day labor" is labor hired and paid by the day, and must be separated from other farm labor because of the higher rate usually paid for it. "Rate labor" is the labor of the hired men who are working by the month or season. To determine the cash value per hour of all farm labor except day labor one or more regular hired laborers are selected on each farm, the hours of labor kept separate from the other workers, as in the columns for rate labor, and the total number of hours worked during the month is transferred to a rate-of-wages card, as shown in Table III. "Other labor" is all farm labor not classed as day labor or rate labor, including the labor of proprietors and boys. Boy labor is converted into terms of man labor by the route statistician and entered in the column for "other labor." Whenever a boy does a man's work he is given full time; otherwise his hours of labor are scaled down to the equivalent of man hours.

TABLE III.—*Method for determining rate of wages per hour for all farm labor except day help.*

NORTHFIELD ROUTE, MONTH OF AUGUST, 1904.

| Owner of farm. | Name of laborer. | Hours. | Wages. | Board. | Total cost. | Rate per hour. |
|---|---|---|---|---|---|---|
| John Jones | James Cheney | 278 | $25 | $10 | $35 | |
| Geo. Marsh | Peter Johnson | 296½ | 20 | 10 | 30 | |
| Fred Jenks | Tim McClure | 321 | 26 | 10 | 36 | |
| Jas. Woodward | Ole Peterson | 255½ | 25 | 10 | 35 | |
| Chas. Underwood | Hans Schmidt | 272½ | 25 | 10 | 35 | |
| Oscar Nelson | Edw. Jensen | 311½ | 25 | 10 | 35 | |
| Total | | 1,735 | 146 | 60 | 206 | **$0.119** |

NORTHFIELD ROUTE, MONTH OF DECEMBER, 1904.

| | | | | | | |
|---|---|---|---|---|---|---|
| John Jones | James Cheney | 222 | $12 | $10 | $22 | |
| Geo. Marsh | Peter Johnson | 316½ | 15 | 10 | 25 | |
| Fred Jenks | Tim McClure | 221 | 13 | 10 | 23 | |
| Jas. Woodward | Ole Peterson | 148½ | 13 | 10 | 23 | |
| Chas. Underwood | Hans Schmidt | 141½ | 13 | 10 | 23 | |
| Oscar Nelson | Edw. Jensen | 213 | 13 | 10 | 23 | |
| Total | | 1,262½ | 79 | 60 | 139 | **$0.110** |

NOTE.—Each month the hours of labor from at least six regular hired men (hired by the month or season) on the route are transferred to this card from the daily

V. SUMMARY—RATE OF WAGES PER HOUR—ALL FARMS.

Route Northfield Year 1904

| MONTH. | No. Men. | Hours. | Wages. | Board. | Total Cost. | Rate per Hour. | |
|---|---|---|---|---|---|---|---|
| January, | 3 | 741 | $43.50 | $30 | $73.50 | $.099 | |
| February, | 3 | 749 | 43.50 | 30 | 73.50 | .098 | |
| March, | 3 | 894 | 43.50 | 30 | 73.50 | .082 | |
| April, | 3 | 966 | 75.00 | 30 | 105.00 | .109 | |
| May, | 5 | 1482 | 126.00 | 50 | 176.00 | .119 | |
| June, | 6 | 1505 | 146.00 | 60 | 206.00 | .137 | |
| July, | 5 | 1251 | 126.00 | 50 | 176.00 | .141 | |
| August, | 6 | 1735 | 146.00 | 60 | 206.00 | .119 | |
| September, | 6 | 1802 | 151.00 | 60 | 211.00 | .117 | |
| October, | 6 | 1657 | 151.00 | 60 | 211.00 | .127 | |
| November, | 6 | 1583 | 151.00 | 60 | 211.00 | .133 | |
| December, | 6 | 1262½ | 79.00 | 60 | 139.00 | .110 | |
| | | | | | | | |

FIG. 10.—Facsimile of card used in recording and compiling statistics.

labor reports (Table II). The amounts of their wages and the cost of their board are also recorded. The total cost to the farm manager of keeping a hired man is represented by the wages paid in cash and the cost of his board. Dividing this sum by the total number of hours the man worked during the month gives the rate of wages per hour. The totals from this card are transferred each month to a summary shown in Table IV.

TABLE IV.—*Summary of the rates of wages, by months, for all farms on the Northfield, Marshall, and Halstad routes for 1904.*

NORTHFIELD ROUTE, 1904.

| Month. | Number of men. | Hours. | Wages. | Board. | Total cost. | Rate per hour |
|---|---|---|---|---|---|---|
| January | 3 | 741 | $43.50 | $30 | $73.50 | **$0.099** |
| February | 3 | 719 | 43.50 | 30 | 73.50 | **.098** |
| March | 3 | 891 | 43.50 | 30 | 73.50 | **.082** |
| April | 3 | 961 | 75.00 | 30 | 105.00 | **.109** |
| May | 5 | 1,482 | 126.00 | 50 | 176.00 | **.119** |
| June | 6 | 1,705 | 145.00 | 60 | 205.00 | **.137** |
| July | 5 | 1,271 | 126.00 | 50 | 176.00 | **.141** |
| August | 6 | 1,735 | 146.00 | 60 | 206.00 | **.119** |
| September | 6 | 1,802 | 151.00 | 60 | 211.00 | **.117** |
| October | 6 | 1,657 | 151.00 | 60 | 211.00 | **.127** |
| November | 6 | 1,583 | 151.00 | 60 | 211.00 | **.133** |
| December | 6 | 1,262½ | 79.00 | 60 | 139.00 | **.110** |

MARSHALL ROUTE, 1904.

| | | | | | | |
|---|---|---|---|---|---|---|
| January | 4 | 852 | $56 | $44 | $94 | **$0.110** |
| February | 4 | 800 | 50 | 44 | 94 | **.117** |
| March | 3 | 810 | 42 | 33 | 75 | **.093** |
| April | 3 | 891 | 80 | 33 | 113 | **.127** |
| May | 5 | 1,625 | 129 | 55 | 184 | **.113** |
| June | 5 | 1,518 | 132 | 55 | 187 | **.123** |
| July | 5 | 1,395 | 145 | 55 | 200 | **.143** |
| August | 5 | 1,480 | 150 | 55 | 205 | **.139** |
| September | 5 | 1,466 | 145 | 55 | 200 | **.136** |
| October | 5 | 1,377 | 140 | 55 | 195 | **.142** |
| November | 5 | 1,280 | 111 | 55 | 166 | **.130** |
| December | 5 | 1,065 | 65 | 55 | 120 | **.113** |

HALSTAD ROUTE, 1904.

| | | | | | | |
|---|---|---|---|---|---|---|
| January | 5 | 1,045½ | $60.00 | $50.00 | $110.00 | **$0.105** |
| February | 5 | 1,018½ | 60.00 | 50.00 | 110.00 | **.108** |
| March | 5 | 1,315½ | 60.00 | 50.00 | 110.00 | **.083** |
| April | 4 | 1,103 | 100.00 | 44.25 | 144.25 | **.131** |
| May | 8 | 2,356½ | 197.00 | 92.18 | 289.18 | **.123** |
| June | 8 | 2,254 | 197.00 | 92.18 | 289.18 | **.128** |
| July | 8 | 2,374 | 202.00 | 92.18 | 294.18 | **.124** |
| August | 8 | 2,176½ | 188.00 | 77.98 | 265.98 | **.122** |
| September | 8 | 2,096½ | 199.00 | 81.62 | 280.62 | **.134** |
| October | 7 | 2,040½ | 177.00 | 73.78 | 250.78 | **.123** |
| November | 6 | 1,617 | 141.36 | 60.83 | 202.19 | **.125** |
| December | 5 | 1,083 | 65.00 | 53.68 | 118.68 | **.110** |

NOTE.—These tables exhibit, in concise form, the rates of wages per hour, by months, as determined by the methods shown in Table III. It is thought wiser to establish a rate of wages per hour from averages on each route than to try to determine a rate for each individual farm. Some farms are worked by proprietors, boys, and other labor, for which no cash outlay is made, and yet, in determining cost of production and net profit, labor must be converted into terms of cash. An average rate per hour, determined from hired men working on a number of farms in the same locality, seems to overcome this difficulty in the most feasible manner.

TABLE V.—*Day labor classified and rates per hour determined by months and by enterprises.*

FARM OF WILLIAM CURTIS, HALSTAD ROUTE, 1904.

| Month. | Marketing wheat. | Seeding wheat. | Harrowing wheat. | Building barn. | Stacking barley. | Shocking wheat. | Threshing wheat. | Masonry. | Stacking wheat | Total. Hours. | Wages. | Board. | Rate per hour. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 22¼ | | | | | | | | | 22¼ | $1.75 | $1.40 | $0.142 |
| February | | | | | | | | | | | | | |
| March | | | | | | | | | | | | | |
| April | | | | | | | | | | | | | |
| May | | 31 | 23 | | | | | | | 62 | 6.00 | 2.80 | .142 |
| June | | | | 186 | | | | | | 186 | 50.00 | 10.80 | .237 |
| July | | | | 70 | | | | | | 70 | | | |
| August | | | | | 10 | 44½ | | | | 54½ | 39.00 | 7.47 | .246 |
| September | | | | | | 33 | | | 101½ | 134½ | | | |
| October | | | | | | | 152 | | | 152 | 27.00 | 5.33 | .213 |
| November | | | | | | | | 20 | | 20 | 3.00 | .75 | .187 |
| December | | | | | | | | | | | | | |

NOTE.—To determine the cash value of the amounts of day labor employed on various enterprises, hours of labor by day help are transferred to the above card each month from the labor record (Table II) and classified by operations and by enterprises. Wages and cost of board are also recorded and the rate of wages per hour determined for the various enterprises.

TABLE VI.—*Method of obtaining cost of board per month per man.*

FARM NO. 1, NORTHFIELD ROUTE, 1905.

| | | |
|---|---|---|
| Food—groceries, meat, farm products, etc | | $166.88 |
| Fuel—coal, wood, gasoline, and kerosene | | 32.89 |
| Garden—cash cost of seeds, labor, rent of land, etc | | 8.76 |
| Labor—(man) household work | | 18.86 |
| Labor—(woman) household work | | 156.00 |
| Total for 12 months | | 383.39 |
| Regular boarders (equivalent to 2 men) | days | 730 |
| Regular hired help—2½ months | days | 75 |
| School-teacher | days | 100 |
| Extra hired help | days | 124 |
| Total | days | 1,029 |

Dividing $383.39 by 1,029 gives 37.3 cents per day, or $11.19 cents per month per man.

FARM NO. 2, NORTHFIELD ROUTE, 1905.

| | | |
|---|---|---|
| Food—groceries, meat, farm produce, etc | | $365.82 |
| Fuel—coal, wood, gasoline, and kerosene | | 54.91 |
| Garden—cash cost of seeds, labor, rent of land, etc | | 13.33 |
| Labor—(man) household work | | 23.21 |
| Labor—(woman) household work | | 240.00 |
| Total for 12 months | | 697.27 |
| Regular boarders (equivalent to 5 men) | days | 1,825 |
| Extra hired help | days | 166 |
| Total | days | 1,991 |

Dividing $697.27 by 1,991 gives 35 cents per day, or $10.50 per month per man.

FARM NO. 3, NORTHFIELD ROUTE, 1905.

| | |
|---|---|
| Food—groceries, meat, farm produce, etc | $243.11 |
| Fuel—coal, wood, and kerosene | 56.66 |
| Garden—cash cost of seeds, labor, rent of land, etc | 9.34 |
| Labor—(man) household work | 26.70 |
| Labor—(woman) household work | 240.00 |
| Total for 12 months | 575.81 |
| Regular boarders (equivalent to 3½ men) ....days.. | 1,272½ |
| Extra hired help....days.. | 107 |
| Board to a relative....days.. | 30 |
| Total ....days.. | 1,409½ |

Dividing $575.81 by 1,409½ gives 40.9 cents per day, or $12.27 per month per man.

NOTE.—In determining the cost of board on farms per day and per month, it is necessary to figure the total cost of the table board each year, and then divide this sum by the total number of days' board in terms of one man. It is impossible to figure this cost of board month by month during the year, because the purchase of supplies may be great one month and very small the next month. Inventoried supplies of flour, sugar, farm produce, etc., are consumed during a number of months, and the exact amount consumed each month can not be determined. Cost of board per month per man is, therefore, figured from a yearly average, and the data secured in 1904, for example, are used in determining the rate of wages per hour in 1905 (see Table III). This is done merely to keep up to date the work of converting labor values into cash values.

Wages for household work are not actually paid on a majority of farms, but a yearly cash value is placed upon the household work on each farm, so that the cost of board may be reduced to cost per month per man and be used in determining rates of wages for man labor. The amount of wages paid in each case is determined by the standard of living, the size of the family, and the prevailing wages for housekeepers and hired women.

TABLE VII.—*Cost of horse labor per hour.*

FARM OF FRED JENKS, NORTHFIELD ROUTE, 1904.

| Month. | Number of work horses. | Value. | Interest on investment. | Depreciation. | Harness depreciation. | Shoeing. | Cost of feed. | Labor cost. | Miscellaneous expense. | Total. Hours work. | Total. Cost of keep. | Rate per hour. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 4 | ..... | ..... | ..... | ..... | $1.20 | $10.70 | $2.30 | ..... | 103½ | ..... | ..... |
| February | 4 | ..... | ..... | ..... | ..... | ..... | 13.31 | 2.13 | $0.25 | 156 | ..... | ..... |
| March | 4 | ..... | ..... | ..... | ..... | ..... | 17.04 | 1.90 | .25 | 174½ | ..... | ..... |
| April | 4 | ..... | ..... | ..... | ..... | ..... | 27.55 | 3.24 | ..... | 601 | ..... | ..... |
| May | 4 | ..... | ..... | ..... | ..... | .40 | 23.46 | 3.65 | 1.10 | 691 | ..... | ..... |
| June | 4 | ..... | ..... | ..... | ..... | ..... | 27.18 | 3.06 | ..... | 360½ | ..... | ..... |
| July | 4 | ..... | ..... | ..... | ..... | ..... | 24.23 | 3.25 | .40 | 461½ | ..... | ..... |
| August | 4 | ..... | ..... | ..... | ..... | ..... | 27.90 | 2.74 | ..... | 965½ | ..... | ..... |
| September | 4 | ..... | ..... | ..... | ..... | ..... | 23.85 | 3.51 | ..... | 763½ | ..... | ..... |
| October | 4 | ..... | ..... | ..... | ..... | ..... | 23.93 | 3.93 | 1.60 | 548 | ..... | ..... |
| November | 4 | ..... | ..... | ..... | ..... | ..... | 15.42 | 3.99 | 4.00 | 353 | ..... | ..... |
| December | 4 | ..... | ..... | ..... | ..... | ..... | 12.48 | 3.53 | ..... | 223½ | ..... | ..... |
| Year | ..... | $400 | $20 | $25 | $6.50 | 1.60 | 247.81 | 37.23 | 7.00 | 5,401½ | $345.17 | $0.064 |

TABLE VII.—*Cost of horse labor per hour*—Continued.

FARM OF JAS. PATTERSON, NORTHFIELD ROUTE, 1904.

| Month. | Number of work horses. | Value. | Interest on investment. | Depreciation. | Harness depreciation. | Shoeing. | Cost of feed. | Labor cost. | Miscellaneous expense. | Total. Hours work. | Total. Cost of keep. | Rate per hour. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 4 | $750 | ..... | ..... | ..... | $2.40 | $14.57 | $5.37 | $4.00 | 134 | ..... | ..... |
| February | 4 | ..... | ..... | ..... | ..... | ..... | 19.72 | 4.97 | .10 | 126 | ..... | ..... |
| March | 4 | ..... | ..... | ..... | ..... | ..... | 12.65 | 5.68 | .20 | 155 | ..... | ..... |
| April | 7 | 1,200 | ..... | ..... | ..... | 1.60 | 56.63 | 9.72 | ..... | 647½ | ..... | ..... |
| May | 7 | ..... | ..... | ..... | ..... | ..... | 42.44 | 7 31 | ..... | 729 | ..... | ..... |
| June | 7 | ..... | ..... | ..... | ..... | ..... | 35.32 | 6.12 | ..... | 420½ | ..... | ..... |
| July | 7 | ..... | ..... | ..... | ..... | ..... | 30.91 | 5.42 | ..... | 467½ | ..... | ..... |
| August | 7 | ..... | ..... | ..... | ..... | ..... | 35.79 | 4.57 | ..... | 608½ | ..... | ..... |
| September | 7 | ..... | ..... | ..... | ..... | ..... | 34.98 | 5.26 | ..... | 1,376½ | ..... | ..... |
| October | 7 | ..... | ..... | ..... | ..... | ..... | 35.26 | 5.99 | .50 | 1,062 | ..... | ..... |
| November | 7 | ..... | ..... | ..... | ..... | ..... | 21.51 | 5.98 | ..... | 430 | ..... | ..... |
| December | 7 | ..... | ..... | ..... | ..... | ..... | 13.63 | 5.60 | ..... | 197 | ..... | ..... |
| Year | ..... | ..... | $54.37 | ..... | $9.00 | $4.00 | 353.74 | 71.00 | 4.80 | 6,443½ | $496.91 | $0.077 |

NOTE.—The methods employed in determining the cost of horse labor per hour are the same as for man labor (Table III), with the exception that the rate is determined on a yearly basis instead of monthly. The rate per hour is determined from an average of twelve months and employed in converting all horse-labor values to cash values in the succeeding year. A more exact method would be to convert labor values into cash values by the rates per hour for the same year in which the labor was performed, but work can not be kept up to date by this method. The yearly average is employed for ascertaining the cost of horse labor because in ordinary farm practice the farm horses are boarded and cared for through the entire year in order to keep "motive power" ready and available at all times. This is a necessity in the farm business, and rates per hour must be determined from yearly averages. Horse labor, like man labor, can in some localities be hired at various rates during the different seasons of the year, but comparatively little horse labor is bought and sold on farms. Rates for horse labor should cover the cost to the farmer of keeping his teams through the year.

During the years 1902 and 1903 the charges made for the depreciation of farm horses and the interest on investment were made on a theoretical instead of an actual basis. The experience of many farmers would indicate that the average working life of a farm horse is about ten years. Thus, valuing a horse 4 years old at $150, and assuming ten years to be the length of his working life, the depreciation charge per year would amount to $15, and interest would have to be figured on an average investment during the ten years of $75. This method, while undoubtedly just, was discarded in 1904 and actual figures on investment and depreciation used.

The cost of keeping a farm horse for a year, including interest on investment, depreciation, harness depreciation, shoeing, feed, labor for care, etc., amounts to a total sum ranging from $75 to $90.

In placing a cash value upon farm labor employed in the production of crops and various other farm enterprises, the following method has been used: The number of man and horse hours utilized in performing any operation—such as plowing—on a given acreage are compiled and then separated into labor by day help (as shown in Table V) and all other man labor, including the labor of regular hired men, proprietors, and boys. The hours of labor by *day help* are converted into terms of cash by multiplying the number of hours into the rate per

hour previously determined in Table V. The remaining hours of man labor are multiplied into the rate per hour for *regular labor* in any given month as shown in Table IV. Hours of *horse labor* on the operation are multiplied into the rate per hour for horse labor as shown in Table VII. The sum of these three products represents the cash cost of plowing under actual farm conditions. Labor of proprietors is always figured in at the same rate as the labor of hired men. The manual labor performed by a proprietor is usually of no more value than that of the hired laborer, and the rewards for his managing ability will be recovered in the net profits of his business.

## YEARLY VALUES OF FARM MACHINERY CONSUMED PER ACRE OF CROP.

The value of farm machinery consumed yearly on the various field crops is a most difficult factor to determine. In ordinary farm bookkeeping the depreciation and repair of machinery should be considered as a general expense of the farm business, but in determining the cost of producing field crops it is necessary to distribute this cost to the various crops. The values of farm machinery consumed yearly must include not only depreciation, but cash and labor repairs. The problem is still further complicated by the fact that many farm machines are not special machines, but are used on all the farm crops. For the purpose of distributing machinery charges to the various field crops farm machinery has been separated into five classes: (1) Grain machinery; (2) corn machinery; (3) hay machinery; (4) all-crop machinery; (5) miscellaneous machinery and tools. Depreciation charges as well as all cash and labor repairs have been kept separate on these various classes of farm machinery since 1902. Inventories have been recorded in the manner shown in Table VIII.

TABLE VIII.—*Method of inventorying farm machinery to obtain average depreciation per year.*

FARM OF HENRY JONES (MARSHALL ROUTE)—CLASS, GRAIN.

| Kind. | Date bought. | Original value. | Value 1902. | Value 1903. | Value 1904. | Value 1905. |
|---|---|---|---|---|---|---|
| Binder | 1898 | $125 | $75 | $65 | $65 | $60 |
| Drill | 1901 | 60 | 50 | 50 | 45 | 40 |
| Fanning mill | 1899 | 24 | 20 | 18 | 17 | 17 |

FARM OF HENRY JONES (MARSHALL ROUTE)—CLASS, ALL-CROP.

| | | | | | | |
|---|---|---|---|---|---|---|
| Heavy wagon | 1901 | $65 | $60 | $55 | $55 | $50 |
| Heavy wagon | 1891 | 55 | 30 | 30 | 25 | 20 |
| Boss harrow | 1901 | 10 | 10 | 8 | 8 | 7 |
| Lever harrow | 1892 | 10 | 3 | 3 | 2 | 2 |
| Disk harrow | 1892 | 25 | 15 | 15 | 12 | 10 |
| Gang plow | 1903 | 60 | ..... | 60 | 55 | 50 |
| Sulky plow | 1902 | 40 | 40 | 30 | 25 | 25 |
| Walking plow | 1897 | 14 | 5 | 5 | 5 | 2 |
| Walking plow | 1898 | 15 | 8 | 8 | 8 | 6 |
| Bobsleds | 1901 | 10 | 10 | 10 | 9 | 8 |

TABLE IX.—*Method employed in determining the total value consumed per acre of each machine used in crop production: Grain binders.*

NORTHFIELD (RICE COUNTY).

| Farm. | Original investment. | Number of years in use. | Closing invoice. | Depreciation per year. | Yearly cash and labor repairs. | Yearly number of acres cut, average 1902, 1903, 1904. |
|---|---|---|---|---|---|---|
| Farm No. 1 | $125.00 | 2 | $95.00 | $15.00 | $1.85 | 72.29 |
| Farm No. 2 | 125.00 | 7 | 70.00 | 7.85 | 2.46 | 92.61 |
| Farm No. 3 | 66.00 | 4 | 45.00 | 5.25 | 2.13 | 84.61 |
| Farm No. 4 | 115.00 | 9 | 10.00 | 11.66 | 4.14 | 70.85 |
| Farm No. 5 | 115.00 | 9 | 6.00 | 12.11 | 1.66 | 64.15 |
| Total | 546.00 | 31 | 226.00 | 51.87 | 12.24 | 383.91 |
| Average per farm | 109.20 | 6.2 | 45.20 | 10.37 | 2.45 | 76.78 |

Average investment per farm, 6.2 years, $82.38.

| | |
|---|---|
| Interest on $82.38, 1 year, at 5 per cent | $4.12 |
| Cost of repairs, 1 year | 2.45 |
| Depreciation, 1 year | 10.37 |
| Total value consumed per farm per year | 16.94 |

Average number of acres of grain cut per farm per year, 76.78.
Cost per acre equals $16.94 divided by 76.78, or 22 cents.

MARSHALL (LYON COUNTY).

| Farm. | Original investment. | Number of years in use. | Closing invoice. | Depreciation per year. | Yearly cash and labor repairs. | Yearly number of acres cut, average 1902, 1903, 1904. |
|---|---|---|---|---|---|---|
| Farm No. 1 | $125.00 | 7 | $40.00 | $12.14 | $1.20 | 113.87 |
| Farm No. 2 | 120.00 | 12 | 10.00 | 9.17 | 3.05 | 116.30 |
| Farm No. 3 | 135.00 | 8 | 30.00 | 13.12 | 3.41 | 147.14 |
| Farm No. 4 | 125.00 | 6 | 35.00 | 15.00 | 2.02 | 141.95 |
| Farm No. 5 | a260.00 | 16 | 42.00 | 13.63 | 2.32 | 188.33 |
| Farm No. 6 | a215.00 | 14 | 60.00 | 11.07 | 1.77 | 101.81 |
| Farm No. 7 | a250.00 | 18 | 40.00 | 11.66 | 8.97 | 170.85 |
| Farm No. 8 | a250.00 | 10 | 90.00 | 16.00 | 9.85 | 211.63 |
| Total | 1,480.00 | 91 | 347.00 | 101.79 | 32.59 | 1,191.88 |
| Average per farm | 185.00 | 7.6 | 43.37 | 12.72 | 4.07 | 148.98 |

a Two binders.

Average investment per farm, 7.6 years, $120.54.

| | |
|---|---|
| Interest on $120.54 at 5 per cent, 1 year | $6.03 |
| Cost of repairs, 1 year | 4.07 |
| Depreciation, 1 year | 12.72 |
| Total value consumed per farm per year | 22.82 |

Average number of acres of grain cut per farm per year, 148.98.
Cost per acre equals $22.82 divided by 148.98, or 15.3 cents.

TABLE IX.—*Method employed in determining the total value consumed per acre of each machine used in crop production: Grain binders*—Continued.

HALSTAD (NORMAN COUNTY).

| Farm. | Original investment. | Number of years in use. | Closing invoice. | Depreciation per year. | Yearly cash and labor repairs. | Yearly number of acres cut, average 1902, 1903, 1904. |
|---|---|---|---|---|---|---|
| Farm No. 1 | $100.00 | 7 | $40.00 | $8.57 | $3.30 | 150.79 |
| Farm No. 2 | 120.00 | 4 | 85.00 | 8.75 | 1.17 | 103.41 |
| Farm No. 3 | 135.00 | 10 | 20.00 | 11.50 | 1.29 | 107.61 |
| Farm No. 4 | 125.00 | 9 | 30.00 | 10.55 | 13.13 | 160.20 |
| Farm No. 5 | 125.00 | 12 | 20.00 | 8.75 | 1.92 | 94.95 |
| Farm No. 6 | 90.00 | 15 | 7.00 | 5.53 | 5.52 | 99.98 |
| Farm No. 7 | 100.00 | 7 | 20.00 | 11.43 | 5.65 | 271.42 |
| Total | 795.00 | 64 | 222.00 | 65.08 | 31.98 | 988.36 |
| Average per farm | 113.57 | 9.14 | 31.71 | 9.30 | 4.57 | 141.19 |

Average investment per farm, 9.14 years, $77.28.

| | |
|---|---|
| Interest on $77.28, 1 year, at 6 per cent | $4.64 |
| Cost of repairs, 1 year | 4.57 |
| Depreciation, 1 year | 9.30 |
| Total value consumed per farm per year | 18.51 |

Average number of acres of grain cut per farm per year, 141.19.
Cost per acre equals $18.50 divided by 141.19, or 13.1 cents.

NOTE.—It may be seen from this table that the values consumed yearly in grain binders on average Minnesota farms range from $16 to $23, or from 13 cents to 22 cents per acre. Depreciation of binders, as well as other farm machines, is not exactly proportional to the acreage cut or acreage covered. Age is a factor that reduces values as well as usage of the machine. A binder which cuts 1,000 acres of grain in two years will not be reduced as low in value as the binder which cuts 1,000 acres in ten years.

The acreage cut by the machines used in this table is made up from the total acreage cut by the machines during the years 1902, 1903, and 1904, reduced to a yearly average for each route. The average investment in a machine for a given period of years is obtained by adding the inventory values of the machine for the given period and dividing this sum by the number of years in the period. A concrete example may be had in a machine the original value of which is $100, and which depreciates $10 per year for ten years. The first year the investment is $100, the second year $90, the third year $80, and so on. Adding the investments for ten years gives a sum of $550, and dividing this sum by the number of years in the period (ten), the average investment per year is found to be $55. The same result can be obtained by adding the original investment to the closing invoice plus the average depreciation per year, and dividing by 2. Thus original investment ($100), plus closing invoice ($0), plus average depreciation per year ($10), equals $110. Dividing by 2, the result is $55, or average investment for ten years.

The methods employed in this table in determining machinery cost per acre could be improved if statistics on depreciation, repairs, and acreages cut were obtainable for a long period of years. In so far as these statistics represent average conditions they are approximately correct.

TABLE X.—*Method for distributing the total value consumed yearly in farm wagons, sleds, and wagon racks to the corn, grain, and hay crops.*

[Average of all farms on each route, 1902, 1903, 1904.]

| Crop. | Northfield (Rice County). | | | | Marshall (Lyon County). | | | | Halstad (Norman County). | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hours in use. | Value consumed per year. | Number of acres. | Cost per acre. | Hours in use. | Value consumed per year. | Number of acres. | Cost per acre. | Hours in use. | Value consumed per year. | Number of acres. | Cost per acre. |
| Corn | 368 | $4.75 | 36.00 | $0.132 | 456 | $4.66 | 42.30 | $0.110 | 22.1 | $0.32 | 7.40 | $0.043 |
| Grain | 205 | 2.64 | 76.78 | .034 | 479 | 4.89 | 148.98 | .033 | 515.5 | 7.55 | 129.50 | .058 |
| Hay | 73 | .91 | 18.38 | .051 | 116 | 1.18 | 23.00 | .051 | 379.4 | 5.56 | 43.80 | .127 |
| Miscellaneous | 243 | 3.16 | ..... | ..... | 448 | 4.57 | ..... | ..... | 338.0 | 4.96 | ..... | ..... |
| Total | 889 | 11.49 | ..... | ..... | 1,499 | 15.30 | ..... | ..... | 1,255 | 18.39 | ..... | ..... |

NOTE.—The yearly values consumed in farm wagons are distributed to the crops and other enterprises of the farm in proportion to the number of hours the wagons were used in each enterprise. The number of hours the wagons were used on each crop is determined from the yearly summaries of labor for any enterprise by adding together the hours of team labor for those operations in which wagons were employed. Thus at Marshall (in southwestern Minnesota) the total value in wagons consumed yearly per farm was found to be $15.30, and the total number of hours the wagons were in use was 1,499. The proportion of $15.30 to be charged against the grain crops is determined by the proportion of hours the wagons were used on grain to total hours the wagons were in use. Thus: Total hours (1,499) : hours on grain crops (479) :: total value consumed ($15.30) : $x$. Working out this proportion the total yearly charge against the grain crops for values consumed in farm wagons, sleds, and racks is found to be $4.89. Dividing this sum by the average number of acres of grain per farm on the Marshall route, the wagon cost per acre for grain is found to be 3.3 cents. The wagon cost per acre for the corn and hay crops is found by the same process.

TABLE XI.—*Values consumed yearly per acre in a thrashing outfit on a large grain farm in northwestern Minnesota.*

| Original investment. | Number of years in use. | Closing invoice. | Average depreciation per year. | Yearly cash and labor repairs. | Packing, oil, etc. | Yearly acreage thrashed. |
|---|---|---|---|---|---|---|
| $3,000 | 4 | $1,700.00 | $325.00 | $51.74 | $9.42 | 1,762.23 |

Average investment, 4 years, $2,512.50.

| | | |
|---|---|---|
| To interest on $2,512.50, at 6 per cent | $150.75 | |
| To cash and labor repairs | 51.74 | |
| To packing, oil, etc | 9.42 | |
| To depreciation | 325.00 | |
| By credit for use in grinding feed | | $30.00 |
| Total value consumed in thrashing | | 506.91 |
| | 536.91 | 536.91 |

Cost per acre equals $506.91 divided by 1,762.23, or 28.8 cents.

TABLE XII.—*Values consumed per acre—farm machinery.*

| Machines. | Northfield (Rice County). | Marshall (Lyon County). | Halstad (Norman County). | Minnesota average. | Large farm in northwestern Minnesota. |
|---|---|---|---|---|---|
| Grain machinery: | | | | | |
| Binders | $0.220 | $0.153 | $0.131 | $0.168 | $0.110 |
| Reapers | | | | | .051 |
| Drills and seeders | .059 | .094 | .087 | .080 | .031 |
| Fanning mills | .028 | | | .028 | .002 |
| Grain tanks | | | | | .009 |
| Wagons, sleds, and racks | .034 | .033 | .058 | .042 | .030 |
| Corn machinery: | | | | | |
| Binders | .789 | .770 | .440 | .666 | |
| Planters | .069 | .115 | | .092 | |
| Cultivators | .107 | .090 | .129 | .109 | |
| Wagons, sleds, and racks | .132 | .110 | .043 | .095 | |
| Hay machinery: | | | | | |
| Mowers | .287 | .213 | .139 | .213 | .155 |
| Rakes | .102 | .114 | .067 | .094 | .016 |
| Wagons, sleds, and racks | .051 | .051 | .127 | .076 | .057 |
| All-crop machinery: | | | | | |
| Plows | .088 | .065 | .052 | .068 | .041 |
| Harrows | .017 | .011 | .014 | .014 | .005 |
| Disks | .025 | .098 | | .061 | |
| Thrashing outfit | | | | | .288 |

NOTE. The values in farm machinery consumed annually per acre have been ascertained from an average of four years by the methods shown in Table IX. The values consumed in harrows and disks do not represent the proper charge for one harrowing and one disking, but for the number of harrowings and the number of diskings that are commonly given the total acreage covered by these implements in the various sections of Minnesota where the statistics were collected. The number of harrowings on which this depreciation charge is based is approximately three and the number of diskings two.

The total value of machinery consumed per acre by any field crop may be obtained from this table by adding the values consumed in those machines which are used in planting, filling, and harvesting. Thus at Halstad, in Norman County, the machinery charge for producing an acre of wheat is as follows: Plows, 5.2 cents; harrows, 1.4 cents; drills, 8.7 cents; binders, 13.1 cents; wagons, 5.8 cents; fanning mills, 0.2 cent,[a] making a total of 34.4 cents. The total machinery charge for a corn crop at Northfield, Rice County, is: Plows, 8.8 cents; harrows, 1.7 cents; planters, 6.9 cents; cultivators, 10.7 cents; wagons, 13.2 cents; binders, 78.9 cents, making a total of $1.202.

## THE RENTAL VALUE OF LAND.

The rental value of land is not ordinarily considered by farmers as an item of expense in the farm business, especially in new farming regions where prospective rises in land values are included in the expectancy of profits. This item can not be ignored, however, in determining cost of production or net profit. A reasonable charge must be made for the productive capacity of capital as well as for labor. The two are inseparable in carrying on production, and wages must be paid to labor and interest to capital in order to induce them to enter any industry. There is undoubtedly a great deal of capital

[a] In some cases during these preliminary years the route men failed to get full data on one farm or route in some of the minor matters, and there have been a few substitutions in the tables, as here the cost per acre of fanning mills was secured only on the large farm.

invested in agriculture that is not drawing interest at commercial rates. Nevertheless, wherever capital can be withdrawn from agriculture and draw 6 per cent in other investments, the business of agriculture must be debited with an expense of 6 per cent interest charges on the investment. Receipts over and above the charges for labor, general expense, and capital in the form of land and machinery may be considered as net profit.

The rental value of the land, as given in the tables of cost of production presented in this bulletin, is based upon an interest charge of 5 per cent on the investment in land at Northfield, Rice County; 5 per cent at Marshall, Lyon County, and 6 per cent at Halstad, Norman County. Improved land at Northfield is valued at $70 per acre; Marshall, $60, and Halstad, $30. Thus the rental value of land at Northfield is $3.50 per acre; Marshall, $3, and Halstad, $1.80. Rental value of land, as the term is used in this bulletin, covers interest charges, taxes, and insurance.

## CLIMATIC CONDITIONS IN MINNESOTA, 1902, 1903, 1904.

The crop seasons of 1902, 1903, and 1904 in Minnesota were marked by excessive rainfall and a mean temperature during the crop seasons that was somewhat lower than the average for years preceding. At Moorhead, in northwestern Minnesota, the average annual rainfall for the years 1902, 1903, and 1904 was 27.92 inches, greater by 4.15 inches than the average for 22 years preceding, and the average mean temperature for the crop seasons—April 1 to September 30—was 57.28 degrees, or 0.8 degree lower than the average for 21 years preceding. At Farmington, in southeastern Minnesota, the average annual rainfall for the years 1902, 1903, and 1904 was 34.20 inches, greater by 4.55 inches than the average for 15 years preceding, and the average mean temperature for the three crop seasons of six months each was 59.52 degrees, or 2.02 degrees lower than the average for 15 years preceding. At Lynd, in southwestern Minnesota, the average annual rainfall for the years 1902, 1903, and 1904 was 26.20 inches, greater by 1.66 inches than the average for the 11 years preceding, and the average mean temperature for the three crop seasons of six months each was 58.99 degrees, lower by 2.55 degrees than the average for 11 years preceding.

The general effect of these seasons of excessive rainfall and low temperature upon crop growth was to increase the yields of pasture and hay crops above normal and to decrease the yields of corn. Wheat and other small grains grew an unusual proportion of straw during these years, with the exception of the oat crop at Northfield, in Rice County, for 1904. Excessive rainfall at Marshall in 1903 reduced the

acreage of grain actually cut, as compared with the acreage planted, and also considerably reduced the yield.

The seasons of 1902, 1903, and 1904, therefore, can not be considered as average seasons for Minnesota. The effect of the ranker growth of straw was to increase slightly the cost of harvesting and thrashing the small grains above the cost during drier crop seasons. The cost of putting up hay at Northfield likewise is undoubtedly somewhat higher than for the average season, owing to the frequency of showers in the haying seasons of 1902 and 1903. The excess of rainfall in these years also increased the cost of soil tillage to some extent. The autumn of 1903 and the spring of 1904 were unusually wet at Marshall, making the soil heavy to work and drowning out large areas of crops. The spring of 1904 at Halstad was nearly a month later than usual and the soil so heavy and wet as to increase the cost of spring work by fully one-fourth. The wheat yield at Halstad for 1904 was lowered materially by the wheat-rust epidemic that caused such widespread damage over the wheat areas of the Northwest.

## THE COST OF PRODUCING FIELD CROPS IN MINNESOTA.

The tables presented herewith on the cost of producing field crops represent averages for the years 1902, 1903, and 1904 from all the farms on each statistical route. The acreages vary in some instances for the different operations in producing a crop, because of occasional failures by the route statistician to secure data on certain operations, and because of the varying methods employed on different farms in producing a certain crop. Certain charges against the crop, like seeds, machinery depreciation, land rental, etc., are averaged from all farms, but labor operations are averaged in some cases from 5 farms, and in other cases from 7, 8, or 9 farms. The various labor operations charged against the crops represent the operations performed by the majority of farmers in the community where the statistics were gathered. The cost of harrowing, cultivating, etc., is based upon the total number of harrowings or cultivations the crop received. The average cost per acre has been determined by obtaining the total acreage for every operation during the three years and then dividing the total cost of labor, etc., by the total acreage.

More kinds of data were secured on the Northfield route than on either the Marshall or the Halstad route, for the reason that the farming is more diversified in southeastern Minnesota than in the newer communities in the southwestern and northwestern sections of the State. For the details entering into the summarized figures presented in Table XIII on the cost of growing each crop see Tables XIV to XXXV.

In most cases the cost per acre is greatest at Northfield and lowest at Halstad. This is caused by the higher land rental and more thorough tillage of the soil at Northfield and also by the use in many instances of less improved machinery than is used at Halstad and Marshall. A large share of the plowing, dragging, seeding, and harvesting is done at Northfield with two or three-horse machinery while gang-plows and other four-horse machinery are used almost exclusively at Halstad. The average size of the farms on the Halstad route is 210 acres, Marshall 250 acres, and Northfield 170 acres.

The individuality of the farms and of the farmers has been almost entirely eliminated in the results presented in these tables because these results are made up from many fields during a series of three consecutive years.

The individuality of one farmer has been preserved in the data from a large farm in northwestern Minnesota. This farm of 1,800 acres, situated in Norman County, in the Red River Valley region of Minnesota, is typical of the large farms and extensive methods of grain growing found in this region. The statistics collected from this farm on the cost of producing field crops are not included in the general averages for all farms in Norman County, but are presented separately, as conditions of labor, machinery, size of fields, etc., make the data noncomparable with the data taken from a number of smaller sized farms in the same region.

The cost per acre of marketing farm products has not been here included in the statistics of cost of production. The cost per acre of marketing varies so greatly with distance hauled, size of load, condition of roads, and yield per acre that it was deemed advisable to omit it from these tables. It is an expense that must not be ignored, however, and will fall heaviest on those crops which are marketed directly as wheat and flax, and least on those crops which are condensed by feeding them to live stock. By using the rates of wages for man and horse labor given in Tables IV and VII the cost of marketing a given unit of product may easily be determined.

The cost of marketing grains was found to be 14 to 20 cents per ton per mile under the conditions of these farms, which were 2 to 10 miles from town. The roads, mostly earth roads, some graveled, are comparatively level.

TABLE XIII.—*Total cost per acre of producing field crops.*

[Averages for three years, 1902, 1903, and 1904.]

| Crop. | Number of table which shows detailed cost. | Northfield (Rice County). | Marshall (Lyon County). | Halstad (Norman County). | Minnesota Experiment Station. | Large farm, northwestern Minnesota. |
|---|---|---|---|---|---|---|
| Barley—spring plowing | XIV | $9.135 | $8.576 | $6.410 | ..... | $5.967 |
| Corn—earshucked from standing stalks | XV | 11.770 | 9.956 | ..... | ..... | ..... |
| Corn—cut, shocked, and shredded | XVI | 14.745 | ..... | ..... | ..... | ..... |
| Corn—cut, shocked, and hauled in from the field | XVII | ..... | 11.020 | ..... | ..... | ..... |
| Corn—grown thickly and siloed | XVIII | ..... | ..... | ..... | $18.212 | ..... |
| Flax—thrashed from windrow | XIX | 9.828 | ..... | 6.871 | ..... | 6.139 |
| Flax—unbound, stacked, thrashed | XX | ..... | 8.861 | 6.727 | ..... | ..... |
| Flax—bound, shocked, stacked, and thrashed | XXI | ..... | 9.260 | ..... | ..... | ..... |
| Fodder corn—cut and shocked in field | XXII | 10.526 | ..... | 8.073 | ..... | 7.518 |
| Fodder corn—cut, shocked, and stacked | XXIII | 12.197 | ..... | ..... | ..... | ..... |
| Hay (timothy and clover), two cuttings | XXIV | 6.966 | ..... | ..... | ..... | ..... |
| Hay (millet) | XXV | 9.184 | 8.162 | 5.973 | ..... | ..... |
| Hay (wild grasses) | XXVI | 5.850 | 5.179 | 2.872 | ..... | 2.286 |
| Hay (timothy) | XXVII | ..... | ..... | ..... | ..... | 3.302 |
| Mangels | XXVIII | ..... | ..... | ..... | 31.081 | ..... |
| Millet—cut for seed | XXIX | 9.383 | ..... | 6.584 | ..... | ..... |
| Oats—fall plowing | XXX | 9.837 | 8.829 | 6.314 | ..... | 5.878 |
| Oats—disked corn stubble | XXXI | 9.002 | ..... | ..... | ..... | ..... |
| Potatoes—garden cultivation | XXXII | 24.925 | 26.890 | 25.444 | ..... | 30.488 |
| Rye—spring sown | XXXIII | ..... | ..... | ..... | ..... | 6.090 |
| Timothy—cut for seed | XXXIV | 5.957 | ..... | ..... | ..... | 4.079 |
| Wheat—fall plowing | XXXV | ..... | 7.890 | 6.262 | ..... | 5.324 |

NOTE.—The figures in Table XIII are for the most part from well-tilled fields where the crops are given a chance to produce good average yields, somewhat better than statistics show for the entire State of Minnesota. Farmers who secure smaller yields usually expend less for labor and other items of expense than was used on this land. Whenever comparisons between the costs of production for various crops are to be made the statistics should be used from the same section of the State and not from different sections. This is necessary to make a just comparison, as land rental, machinery cost, and labor vary with the different sections in which the statistics were gathered.

Using the figures in this table as a basis for computation, the average annual net value of the products in a given rotation of crops may be determined. For example, a popular five-course rotation in Minnesota is: First year, corn, cost, $9.956; second year, wheat, cost, $7.090; third year, hay, cost, $6.617; fourth year, pasture, cost, $3.452; and fifth year, oats, cost, $8.829. The cost of production per acre for these five crops (as taken from the statistics gathered at Marshall, in southwestern Minnesota) is therefore $35.94, or an average of $7.19 per acre per year. This last-named sum subtracted from the gross average annual value of the crops would give the average annual net value or net income.

The cost of producing wheat per acre as entered in this computation has been reduced by 80 cents because the figures in Table XIII are for wheat on fall plowing, whereas the wheat grown in the rotation named is sown on disked corn stubble (see Table XXXI). The cost of the seed for the hay and pasture crops has likewise been placed on a two-year basis to fit this particular rotation instead of a three-year basis, as in Table XXIV. Rental value of land for the hay crop produced at Northfield has been made the same as for the corn and grain crops produced at Marshall.

The average net profit per year from this rotation is shown by the difference between $7.19 and the cash value of the average gross product per year. The comparative value of various successions of crops should be measured in net value of product or net profits.

TABLE XIV.—*Cost of producing barley—spring plowing.*

| Operation. | Northfield (Rice County). | | | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 240.67 | $232.53 | $0.966 | 750.29 | $750.54 | $1.000 | 455.84 | $341.88 | $0.750 |
| Cleaning seed | 142.52 | 5.60 | .039 | 696.91 | 22.10 | .032 | 368.04 | 11.18 | .036 |
| Plowing | 138.55 | 153.60 | 1.110 | 289.89 | 308.24 | 1.063 | 562.48 | 645.59 | 1.148 |
| Dragging | 242.78 | 72.97 | .301 | 662.19 | 104.01 | .157 | 553.13 | 183.02 | .331 |
| Seeding | 248.90 | 60.75 | .244 | 731.20 | 190.66 | .261 | 519.83 | 136.29 | .262 |
| Cutting | 257.54 | 105.38 | .409 | 787.03 | 259.92 | .330 | 498.74 | 181.00 | .363 |
| Twine | 146.70 | 45.00 | .307 | 695.39 | 223.99 | .322 | 229.94 | 42.80 | .186 |
| Shocking | 257.54 | 38.35 | .149 | 772.51 | 101.05 | .131 | 488.52 | 67.12 | .137 |
| Stacking | 128.93 | 72.89 | .565 | 787.03 | 450.50 | .572 | 258.79 | 120.81 | .467 |
| Stack-thrashing (labor) | 113.42 | 60.59 | .534 | 534.60 | 148.30 | .259 | 142.77 | 28.24 | .198 |
| Cash cost thrashing | | | .565 | 534.60 | 584.32 | 1.093 | 142.77 | 55.34 | .388 |
| Machinery cost | | | .446 | | | .256 | | | .344 |
| Land rental | | | 3.500 | | | 3.000 | | | 1.800 |
| Total | | | 9.135 | | | 8.576 | | | 6.410 |

LARGE FARM IN NORTHWESTERN MINNESOTA.

| Operation. | Total acreage, three years. | Total cost. | Cost per acre. | Operation. | Total acreage, three years. | Total cost. | Cost per acre. |
|---|---|---|---|---|---|---|---|
| Seed value | 306.59 | $233.34 | $0.761 | Shocking | 306.59 | $48.65 | $0.158 |
| Cleaning seed | 306.59 | 20.54 | .067 | Shock-thrashing (labor) | 188.04 | 137.44 | .731 |
| Plowing | 306.59 | 269.19 | .878 | Values consumed (in thrashing outfit) | | | .288 |
| Dragging | 306.59 | 82.39 | .269 | Machinery cost | | | .248 |
| Seeding | 306.59 | 65.02 | .212 | Land rental | | | 1.800 |
| Weeding | 117.01 | 1.40 | .012 | | | | |
| Cutting | 306.59 | 104.21 | .340 | Total | | | 5.367 |
| Twine | 306.59 | 68.37 | .223 | | | | |

NOTE.—The average yield of barley for the years 1902, 1903, and 1904 on the cooperating farms of the Northfield route was 31 bushels; Marshall, 28.5 bushels; Halstad, 27.4 bushels; and for the large farm in northwestern Minnesota, 21.9 bushels.

The average cash price for No. 4 malt barley at Minneapolis for all months during the years 1902, 1903, and 1904 was 55 cents. Freight tariffs and marketing charges must be subtracted from this price to give the *farm* value in any locality.

TABLE XV.—*Cost of producing corn—ears husked from the standing stalks.*

| Operation. | Northfield (Rice County). | | | Marshall (Lyon County). | | |
|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Manuring | 602.68 | $868.08 | $0.576 | 775.41 | $1,140.48 | $0.588 |
| Seed value | 509.35 | 108.68 | .213 | 776.71 | 128.36 | .165 |
| Shelling seed | 411.07 | 9.57 | .023 | 467.37 | 13.06 | .028 |
| Plowing | 605.89 | 730.18 | 1.205 | 579.78 | 602.50 | 1.039 |
| Dragging | 791.75 | 380.37 | .480 | 681.97 | 305.12 | .447 |
| Planting (horse planter) | 670.83 | 150.72 | .225 | 711.08 | 180.27 | .254 |
| Cultivating | 776.34 | 1,256.61 | 1.619 | 701.16 | 934.71 | 1.333 |
| Weeding | | | | 133.04 | 14.57 | .110 |
| Husking on hill | 331.32 | 1,164.77 | 3.516 | 169.21 | 440.09 | 2.601 |
| Machinery cost | | | .413 | | | .391 |
| Land rental | | | 3.500 | | | 3.000 |
| Total | | | 11.770 | | | 9.956 |

NOTE.—The average yield of corn at Northfield and Marshall for the years 1902, 1903, and 1904 was from 40 to 45 bushels per acre, and the average price for No. 3 yellow corn at Minneapolis during the three years was 50 cents. No accurate data

are at hand on the value of an acre of the standing stalks for pasture. Fifty farmers in Minnesota, in answer to an inquiry from the experiment station, estimated the pasture value of an acre of cornstalks at $1 to $1.50.

Statistics gathered from a small acreage show that marking the land and hand planting increases the cost of production by 34 cents per acre. Forty per cent of the total cost of manuring is charged to the corn crop. It is manifestly unfair to debit the crop of corn with the entire cost of manuring when the effects of manuring land can be traced in at least four or five succeeding crops. In the absence of specific data concerning the draft of crops on a dressing of manure, the corn crop is debited with 40 per cent of the cost of manuring, it being assumed that as corn is the first crop to follow the manuring, and as it is an exceedingly gross feeder, it will utilize 40 per cent of the fertility in the manure. The cost of manuring the corn crop is distributed over the entire acreage devoted to corn, although a majority of the fields are only partially manured. This accounts for the low cost of manuring per acre shown in this table and succeeding tables for the corn crop.

In figuring the cost per acre of husking ears from the standing stalks, all labor of men and horses was charged at the rates per hour for October and November as shown in Tables IV and VII. Practically all the husking done in these sections of Minnesota is done by regular month labor and by proprietors. Labor is therefore charged at the rates for *month labor* instead of *day labor* wages, or wages paid by the bushel, as is the custom in some localities. Horse labor is charged at regular rates, as an item of expense in husking corn, in order to make the expense of this operation comparable with the cost of cutting and shredding corn and because there is no justification for omitting this charge from the cost of husking corn. It is true that the work of husking is easy for a team and that horses will increase rather than decrease in value while performing this work; yet while horses may be easily kept at this work, it is done at the expense of the corn crop. It takes a reliable team, moreover, to do this work satisfactorily, and if a team is used in husking instead of plowing, there is no good reason why horse labor should not be charged to husking the same as the plowing or seeding.

Husking ears from the standing stalks is undoubtedly done somewhat cheaper farther south in the corn belt than in Minnesota, owing to the greater proficiency of labor in this particular operation and to the larger-sized ears, which are more readily handled. The figures in this table are representative of the sections in which they are gathered, and are comparable with all figures for handling the corn crop by other methods described in this bulletin. Statistics secured by correspondence with a number of farmers in the corn regions of Minnesota indicate that husking corn out of the shock costs from 75 cents to $1 more per acre than to husk from the standing stalks.

TABLE XVI.—*Cost of producing corn—cut, shocked, and shredded.*

| Operation. | Northfield (Rice County). | | | Operation. | Northfield (Rice County). | | |
|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | | Total acreage, three years | Total cost. | Cost per acre. |
| Manuring | 602.68 | $868.08 | $0.576 | Shocking and tying | 270.28 | $142.24 | $0.526 |
| Seed value | 509.35 | 108.68 | .213 | Twine | 248.20 | 115.84 | .467 |
| Shelling seed | 411.07 | 9.57 | .023 | Picking up ears | 138.23 | 34.60 | .249 |
| Plowing | 605.89 | 730.28 | 1.205 | Shredding | 138.18 | 524.23 | 3.791 |
| Dragging | 791.75 | 380.57 | .480 | Machinery cost | | | 1.202 |
| Planting (horse planter) | 670.83 | 150.72 | .225 | Land rental | | | 3.500 |
| Cultivating | 776.34 | 1,256.61 | 1.619 | | | | |
| Cutting (corn binder) | 294.10 | 195.95 | .666 | Total | | | 11.745 |

NOTE.—Forty per cent of the total cost of manuring is charged to the corn crop (see note under Table XV). Yields and prices for corn during the years 1902, 1903,

and 1904 are also given under Table XV. The average yield of corn stover per acre at Northfield is from 1¼ tons to 1½ tons. The feeding value of a ton of shredded stover is estimated by T. L. Haecker at $2.84, as compared with timothy at $6 per ton.

The cost of shredding is made up of several items: First, cash paid per acre or per hour for the use of the shredder, the motive power, and the labor of machinists; second, the labor of the proprietor, hired men, and horses; third, board for that portion of the crew whose wages do not cover the cost of board.

TABLE XVII.—*Cost of producing corn—cut, shocked, and hauled in from the field.*

| Operation. | Marshall (Lyon County). | | | Operation. | Marshall (Lyon County). | | |
|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | | Total acreage, three years. | Total cost. | Cost per acre. |
| Manuring | 775.41 | $1,140.48 | $0.588 | Shocking and tying | 172.69 | $58.35 | $0.338 |
| Seed value | 776.71 | 128.36 | .165 | Twine | 218.90 | 80.18 | .366 |
| Shelling seed | 467.37 | 13.06 | .028 | Hauling in | | | 1.640 |
| Plowing | 579.78 | 602.50 | 1.039 | Machinery cost | | | 1.161 |
| Dragging | 681.97 | 305.12 | .447 | Land rental | | | 3.000 |
| Planting (horse planter) | 711.08 | 180.27 | .254 | | | | |
| Cultivating | 701.16 | 934.71 | 1.333 | Total | | | 11.020 |
| Cutting (corn binder) | 194.69 | 128.22 | .661 | | | | |

NOTE.—Forty per cent of the total cost of manuring is charged to the corn crop (see note under Table XV). Yield and cash values of grain and stover are given in notes under Tables XV and XVI.

The corn crop is often harvested by this method in some sections of Minnesota and the bundles hauled in and fed to the cattle, sheep, and hogs in the yards without husking.

TABLE XVIII.—*Cost of producing corn—thickly planted and siloed.*

| Operation. | Minnesota Experiment Station. | | | Operation. | Minnesota Experiment Station. | | |
|---|---|---|---|---|---|---|---|
| | Acreage. | Total cost. | Cost per acre. | | Acreage. | Total cost. | Cost per acre. |
| Manuring | 181.15 | $329.32 | $0.727 | Packing corn in silo | 45.00 | $13.33 | $0.296 |
| Seed value | 194.54 | 97.27 | .500 | Hire of power machinery | 45.00 | 72.00 | 1.600 |
| Plowing | 173.76 | 230.67 | 1.328 | Values consumed in ensilage cutter | 45.00 | 18.00 | .400 |
| Dragging | 184.85 | 98.13 | .531 | Machinery cost | | | 1.202 |
| Planting (horse planter) | 166.59 | 48.45 | .291 | Land rental | | | 3.500 |
| Cultivating | 166.01 | 175.30 | 1.056 | Interest on silo investment | | 8.00 | .533 |
| Cutting (corn binder) | 75.00 | 23.05 | .512 | Silo depreciation (150-ton silo) | | 20.00 | 1.333 |
| Twine (270 pounds, at 10 cents) | 45.00 | 27.00 | .600 | | | | |
| Hauling in (distance, one-half mile) | 45.00 | 119.58 | 2.657 | Total | | | 18.212 |
| Cutting ensilage | 45.00 | 24.56 | .546 | | | | |
| Coal (9,000 pounds, at $6 per ton) | 45.00 | 27.00 | .600 | | | | |

NOTE.—Forty per cent of the total cost of manuring is charged to the corn crop (see note under Table XV). Yield of green fodder on 45 acres was 460 tons, or 10.2 tons per acre. The cash value of a ton of ensilage for feed is estimated by T. L. Haecker at $1.88 as compared with timothy at $6 per ton. This table is partly made up from statistics gathered on the Northfield route for fodder corn, and partly from statistics on the cost of producing ensilage at the Minnesota experiment farm. The amounts of labor employed in the various operations at the experiment farm have been converted into terms of cash by using the rates of wages per hour as determined on the Northfield route (Table IV). The entire cost of producing this crop has been reduced, therefore, to actual farm conditions.

The cost of power machinery used in cutting ensilage is figured on the basis of a cost of $8 a day for nine days' work, the $3 to cover engineers' wages and the rental of an engine with sufficient power to cut at least 50 tons per day. Coal has been considered as a separate item. In some instances an engine and engineer can not be hired for this sum, and, especially if engines are in demand for thrashing, the cost of power machinery will amount to $10 or $15 per day. Gasoline engines can be rented and operated at an expense of $6 to $7 per day that will cut 30 to 40 tons per day. The owner of a 10 or 12 horsepower gasoline engine can operate it for a cost of $4 to $5 per day, this sum covering fuel, wages for operator, depreciation, etc. Eight dollars per day is thought to be an average charge for power machinery, for a majority of farmers prefer to rent power for this work unless the farm is large enough to make a large engine a useful machine for other work.

The depreciation, repairs, and interest on investment on a $200 ensilage cutter amount to a total of $15 to $25 annually. The value consumed annually in the machine in use at the Minnesota Agricultural Experiment Station is about $18. Forty-five acres of fodder corn are raised annually, making the cost per acre 40 cents. The cost per acre would be somewhat larger where only 15 or 20 acres are cut annually.

In the absence of exact statistics on silos, the depreciation charges and interest on the silo investment have been estimated as follows: A good wood silo, capacity 150 tons, costing $300, will last about fifteen years. This makes an average annual depreciation charge of $20. While repairs might prolong the life of the silo beyond fifteen years, it is not probable that repair and depreciation charges could be reduced below $20 per year. The average investment (see note under Table IX) in the silo per year is $160. At 5 per cent this makes an annual expense of $8 for interest on investment. A 150-ton silo will require about 15 acres of fodder corn each year to fill it. Therefore, total annual charges for depreciation and interest on investment are divided by 15 to reduce to cost per acre.

It is impracticable to make exact charges for interest on investment and depreciation in buildings against such crops as hay, fodder corn, and shredded stover, which are either shocked or stacked in the field or stored in the mows of barns that are built primarily for the shelter of live stock. Special hay sheds are, of course, an exception. When corn is siloed, however, a special and expensive building must be erected for storing the crop, and therefore the entire charges for interest on investment and depreciation must be debited against the ensilage.

TABLE XIX.—*Cost of producing flax—stubble plowing, thrashed from windrow.*

| Operation. | Northfield (Rice County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 110.33 | $118.60 | $1.075 | 467.57 | $368.35 | $0.788 |
| Cleaning seed | 111.90 | 2.77 | .021 | 231.00 | 14.33 | .062 |
| Plowing | 97.50 | 117.17 | 1.202 | 472.49 | 483.04 | 1.022 |
| Dragging | 97.50 | 49.99 | .513 | 151.63 | 52.11 | .344 |
| Seeding | 140.97 | 36.20 | .257 | 467.57 | 122.47 | .262 |
| Weeding | | | | 142.39 | 33.50 | .235 |
| Cutting (binder) | 139.37 | 52.73 | .378 | 343.77 | 108.76 | .316 |
| Turning | 25.42 | 2.61 | .103 | | | |
| Thrashing (labor) | 149.71 | 214.99 | 1.435 | 151.81 | 121.89 | .803 |
| Cash cost thrashing | 149.71 | 134.03 | .895 | 151.81 | 135.82 | .85 |
| Machinery cost | | | .446 | | | .344 |
| Land rental | | | 3.500 | | | 1.800 |
| Total | | | 9.828 | | | 6.871 |

TABLE XIX.—*Cost of producing flax—stubble plowing, thrashed from windrow*—Con.

LARGE FARM, NORTHWESTERN MINNESOTA.

| Operation. | Total acreage, three years. | Total cost. | Cost per acre. | Operation. | Total acreage, three years. | Total cost. | Cost per acre. |
|---|---|---|---|---|---|---|---|
| Seed value | 592.19 | $438.25 | $0.740 | Values consumed in thrashing outfit | | | $0.288 |
| Cleaning seed | 197.62 | 2.93 | .015 | Machinery depreciation | | | .169 |
| Plowing | 442.03 | 378.47 | .856 | Land rental | | | 1.800 |
| Dragging | 592.19 | 174.95 | .295 | | | | |
| Seeding | 442.03 | 81.80 | .185 | Total | | | 6.139 |
| Cutting (reaper) | 441.41 | 145.42 | .329 | | | | |
| Thrashing (labor) | 563.09 | 823.09 | 1.462 | | | | |

NOTE.—When flax is grown on tame sod an additional cost of 50 cents to 60 cents per acre must be added for disking, also the cost for breaking the sod, which is usually greater than the cost of plowing stubble land. The average cost of breaking tame sod land on the farms of the Northfield route is $1.67 per acre, and at Halstad $1.42. A small acreage of wild sod land was broken at Marshall during the years 1902, 1903, and 1904 at a cost of $2.18 per acre.

The average yield of flax at Northfield during the years 1902, 1903, and 1904 was 11.8 bushels; at Marshall, 12.2 bushels; at Halstad, 9.1 bushels; and for the large farm in northwestern Minnesota, 9.9 bushels. The average cash price for flax during the years 1902, 1903, and 1904 in Minneapolis was $1.09.

The flax crops on the large farm in northwestern Minnesota are cut with a self-rake reaper, thus causing a different machine cost per acre than is charged to the other grain crops.

In Minnesota flax is commonly cut with a grain binder, but without binding into bundles. The flax is thus dropped on the ground in windrows and is pitched to the wagon from the windrow.

In the Dakotas flax is sometimes sown on virgin prairie sod (broken in June), when no other crop could be profitably grown. The figures here presented are not applicable to such conditions.

TABLE XX.—*Cost of producing flax—stubble plowing, stacked from windrow.*

| Operation. | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 204.72 | $163.78 | $0.800 | 467.57 | $368.35 | $0.788 |
| Cleaning seed | 21.90 | 2.00 | .080 | 231.00 | 14.33 | .062 |
| Plowing | 376.89 | 407.16 | 1.081 | 472.49 | 483.04 | 1.022 |
| Dragging | 117.61 | 33.60 | .286 | 151.63 | 52.11 | .344 |
| Seeding | 234.27 | 73.09 | .312 | 467.57 | 122.47 | .262 |
| Weeding | | | | 142 39 | 33.50 | .235 |
| Cutting (binder) | 186.06 | 75.20 | .404 | 343.77 | 108.76 | .316 |
| Turning | 84.29 | 9.02 | .107 | | | |
| Stacking | 119.94 | 96.28 | .803 | 35.72 | 18.51 | .518 |
| Thrashing (labor) | 123.58 | 50.69 | .410 | 35.72 | 11.30 | .316 |
| Cash cost thrashing | 128.24 | 156.70 | 1.222 | 35.72 | 25.74 | .720 |
| Machinery cost | | | .356 | | | .344 |
| Land rental | | | 3.000 | | | 1.800 |
| Total | | | 8.861 | | | 6.727 |

NOTE.—Average yields and Minneapolis cash prices for flax are given in note under Table XIX.

TABLE XXI.—*Cost of producing flax—stubble plowing, bound, shocked, and stacked.*

| Operation. | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 204.72 | $163.78 | $0.800 | | | |
| Cleaning seed | 24.90 | 2.00 | .080 | | | |
| Plowing | 376.59 | 107.16 | 1.081 | | | |
| Dragging | 117.61 | 33.60 | .286 | | | |
| Seeding | 234.27 | 73.09 | .312 | | | |
| Cutting (binder) | 24.18 | 10.00 | .414 | 44.81 | $16.29 | $0.364 |
| Twine | 24.18 | 5.12 | .212 | 27.75 | 4.03 | .145 |
| Shocking | 24.18 | 2.93 | .121 | 44.81 | 4.33 | .098 |
| Stacking | 24.18 | 16.47 | .681 | 13.06 | 5.03 | .385 |
| Thrashing (labor) | 20.50 | 5.80 | .283 | | | |
| Cash cost thrashing | 20.50 | 33.50 | 1.634 | | | |
| Machinery cost | | | .356 | | | |
| Land rental | | | 3.000 | | | |
| Total | | | 9.260 | | | |

NOTE.—Average yields and Minneapolis cash prices for flax are given in note under Table XIX.

Statistics on the cost of thrashing bundle flax on the Halstad route were not collected by the route statistician at that place. Harvest figures at Halstad are given as supplements to the statistics from the small acreage of flax at Marshall that was handled by this method.

TABLE XXII.—*Cost of producing fodder corn planted thick for forage—cut and shocked in the field.*

| Operation. | Northfield (Rice County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Manuring | 181.15 | $329.32 | $0.727 | | | |
| Seed value | 194.54 | 53.88 | .277 | 201.37 | $135.32 | $0.672 |
| Plowing | 173.76 | 230.67 | 1.327 | 245.98 | 280.77 | 1.141 |
| Dragging | 184.85 | 98.13 | .531 | 288.32 | 156.60 | .543 |
| Planting (horse planter) | 166.59 | 48.45 | .291 | | | |
| Planting (grain drill) | | | | 201.37 | 52.59 | .261 |
| Cultivating | 166.01 | 175.30 | 1.056 | 283.64 | 357.04 | 1.259 |
| Cutting (binder) | 167.98 | 103.73 | .618 | 184.58 | 115.93 | .628 |
| Shocking, tying | 167.98 | 82.52 | .491 | 129.99 | 76.12 | .586 |
| Twine | 148.44 | 75.07 | .506 | 89.34 | 37.59 | .421 |
| Machinery cost | | | 1.202 | | | .765 |
| Land rental | | | 3.500 | | | 1.800 |
| Total | | | 10.526 | | | 8.076 |

LARGE FARM IN NORTHWESTERN MINNESOTA.

| Operation. | Total acreage, three years. | Total cost. | Cost per acre. | Operation. | Total acreage, three years. | Total cost. | Cost per acre. |
|---|---|---|---|---|---|---|---|
| Seed value | 118.86 | $42.50 | $0.358 | Shocking, tying | 118.86 | $34.87 | $0.293 |
| Plowing | 118.86 | 99.51 | .837 | Twine | 118.86 | 26.64 | .224 |
| Dragging | 118.86 | 37.82 | .318 | Machinery cost | | | .765 |
| Planting (grain drill) | 118.86 | 33.27 | .280 | Land rental | | | 1.800 |
| Cultivating | 118.86 | 257.12 | 2.163 | | | | |
| Cutting (binder) | 118.86 | 57.00 | .480 | Total | | | 7.518 |

NOTE.—Forty per cent of the total cost of manuring is charged to the corn crop (see note under Table XV).

The average yield of field-cured fodder corn on the farms of the Northfield route is between 2½ and 2¾ tons per acre and at Halstad 3 tons per acre. The yield of fodder corn at Halstad was obtained by weighing the bundles in several shocks,

thus obtaining the average weight per shock, and then estimating the yield per acre by multiplying this figure into the total number of shocks in the field. Yields at Northfield were obtained from wagon-scale weights.

The feeding value of a ton of field-cured fodder corn is estimated by T. L. Haecker at $4.90 as compared with timothy hay at $6 a ton.

The machinery cost for a fodder corn crop on the large farm in northwestern Minnesota has not been accurately determined, as only one crop of fodder corn has been cut since statistics have been kept on that farm. Machinery cost has, therefore, been substituted from the Halstad route.

Fodder corn cut and shocked in the field has no market value until hauled to the barn or feed lot. The cost of hauling fodder from the fields is between $1.50 and $2 per acre, varying with distance from barn, ease of loading, etc.

TABLE XXIII.—*Cost of producing fodder corn planted thick for forage—cut, shocked, and stacked in the farmstead.*

| Operation. | Northfield (Rice County). | | | Operation. | Northfield (Rice County). | | |
|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | | Total acreage, three years. | Total cost. | Cost per acre. |
| Manuring | 181.15 | $329.32 | $0.727 | Shocking, tying | 167.98 | $82.52 | $0.491 |
| Seed value | 94.54 | 53.88 | .277 | Twine | 148.44 | 75.07 | .506 |
| Plowing | 173.76 | 230.67 | 1.328 | Hauling and stacking | 119.61 | 199.79 | 1.670 |
| Dragging | 184.85 | 98.13 | .531 | Machinery cost | | | 1.202 |
| Planting (horse planter) | 165.59 | 48.45 | .291 | Land rental | | | 3.500 |
| Cultivating | 166.01 | 175.50 | 1.056 | | | | |
| Cutting (corn binder) | 167.98 | 103.73 | .618 | Total | | | 12.197 |

NOTE.—Forty per cent of the total cost of manuring is charged to the corn crop (see note under Table XV). Yield and cash value per ton of fodder corn are given in note under Table XXII.

TABLE XXIV.—*Cost of producing hay—timothy and clover (two cuttings).*

FIRST CROP.

| Operation. | Northfield (Rice County). | | |
|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | | | $0.301 |
| Mowing | 574.43 | $187.46 | .326 |
| Raking | 449.40 | 80.10 | .178 |
| Cocking and spreading | 515.72 | 104.15 | .202 |
| Hauling in | 422.53 | 433.23 | 1.025 |
| Machinery cost | | | .440 |
| Land rental | | | 3.500 |
| Total | | | 5.972 |

SECOND CROP.

| | | | |
|---|---|---|---|
| Mowing | 166.03 | $35.65 | $0.215 |
| Raking | 152.03 | 16.80 | .111 |
| Cocking—spreading | 47.18 | 10.04 | .213 |
| Hauling in | 118.23 | 53.81 | .455 |
| Total | | | .994 |
| Total cost per acre, two cuttings | | | $6.966 |

NOTE.—The seed value was determined as follows: Amount sown, timothy, 8 pounds; clover, 4 pounds, at 3 cents and 16 cents, respectively, making the total cost

per acre $0.904. Dividing this sum by 3 for three years of grass gives the annual cost per acre $0.301.

Two cuttings of timothy and clover hay yield from 2 to 2½ tons per acre on the Northfield route. Prices in the local market range from $5 to $10 per ton. The feeding value of timothy and clover hay (two-thirds clover and one-third timothy) is estimated by T. L. Haecker at $6.35, as compared with timothy at $6.

TABLE XXV.—*Cost of producing hay—millet.*

| Operation. | Northfield (Rice County). | | | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 13.61 | $3.47 | $0.474 | 64.56 | $22.46 | $0.348 | 138.97 | $144.25 | $0.763 |
| Plowing | 15.01 | 16.29 | 1.083 | 27.95 | 31.91 | 1.240 | 188.72 | 210.80 | 1.117 |
| Dragging | 15.01 | 5.97 | .397 | 71.51 | 31.99 | .447 | 178.46 | 67.75 | .380 |
| Seeding | 12.07 | 4.51 | .376 | 64.56 | 20.35 | .315 | 188.97 | 48.69 | .258 |
| Mowing | 13.64 | 6.27 | .460 | 55.13 | 22.36 | .406 | 78.11 | 33.99 | .435 |
| Raking | 12.07 | 1.81 | .150 | 15.75 | 5.22 | .333 | 78.11 | 14.80 | .189 |
| Hauling in | 13.61 | 29.13 | 2.140 | | | | | | |
| Stacking | | | | 54.11 | 31.74 | 1.511 | 86.56 | 47.19 | .546 |
| Machinery cost | | | .691 | | | .543 | | | .485 |
| Land rental | | | 3.530 | | | 3.000 | | | 1.800 |
| Total | | | 9.184 | | | 8.122 | | | 5.973 |

NOTE.—The yield of hay from common millet grown on all the routes is from 1 to 1½ tons per acre. Millet hay has no regular sale in the local markets. The food value of well-cured millet hay is nearly comparable with timothy hay. The higher cost of production for millet hay, as compared with timothy and clover, makes it an unprofitable crop to grow except as a catch crop. As a catch crop it has great value, because of its early maturing qualities. Millet can not be classed with timothy, bromus, clover, and alfalfa in beneficial effect on soil fertility and on the physical texture of soils.

TABLE XXVI.—*Cost of producing hay—wild grasses.*

| Operation. | Northfield (Rice County). | | | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Mowing | 70.30 | $27.87 | $0.396 | 511.08 | $205.76 | $0.403 | 566.10 | $146.15 | $0.258 |
| Raking | 60.29 | 11.50 | .191 | 511.08 | 132.63 | .260 | 566.10 | 89.16 | .157 |
| Cocking—spreading | 53.83 | 8.01 | .149 | 315.49 | 22.90 | .073 | | | |
| Hauling in | 46.88 | 55.06 | 1.174 | | | | | | |
| Stacking and hauling in | | | | 478.36 | 509.53 | 1.065 | 566.10 | 715.59 | 1.264 |
| Machinery cost | | | .440 | | | .378 | | | .333 |
| Land rental | | | 3.500 | | | 3.000 | | | .860 |
| Total | | | 5.850 | | | 5.179 | | | 2.872 |

TABLE XXVI.—*Cost of producing hay—wild grasses*—Continued.

LARGE FARM IN NORTHWESTERN MINNESOTA.

| Operation. | Total acreage, two years. | Total cost. | Cost per acre. |
|---|---|---|---|
| Mowing | 81.25 | $30.18 | $0.371 |
| Raking and bunching | 81.25 | 12.61 | .155 |
| Stacking | 41.25 | 21.94 | .532 |
| Machinery cost | | | .228 |
| Land rental | | | 1.000 |
| Total | | | 2.286 |

NOTE.—Yields of wild hay range from 1 ton per acre to 1½ tons on all the routes. Prices in local markets usually range from $2.50 to $4 per ton. The feeding value of wild hay is estimated by T. L. Haecker at $5.78 per ton, as compared with timothy at $8 per ton.

The wild hay crops at Halstad and on the large farm in northwestern Minnesota are cut from low-lying sections of land that are unfit for cultivation until they are drained. Such wild lands can be rented for meadows for 75 cents to $1.25 per acre. The wild hay crops at Northfield and Marshall are cut from small fields of unbroken prairie sod and small pockets and undrained sloughs on improved farms. Whenever such meadows exist on improved farms they are included in the valuation per acre of the farm and must be debited with the same rental value as improved land. Growing wild hay on improved farms is bad farm management and causes an appreciable loss in the profits of the farm. Wherever wild hay is grown it puts a stop to systematic crop rotation, because if hay is grown continuously on the lowlands grain must be grown continuously on the uplands. Tame grasses not only yield a much larger product of forage per acre than the wild grasses, but they improve the productivity of the soil when properly rotated with the grain and cultivated crops.

TABLE XXVII.—*Cost of producing hay—timothy.*

| Operation. | Large farm in northwestern Minnesota. | | |
|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | | | $0.090 |
| Mowing | 77.7 | $22.39 | .288 |
| Raking | 77.7 | 10.93 | .141 |
| Cocking—spreading | 77.7 | 11.16 | .144 |
| Stacking at barn | 77.7 | 47.48 | .611 |
| Machinery cost | | | .228 |
| Land rental | | | 1.800 |
| Total | | | 3.302 |

NOTE.—Seed value was determined as follows: Twelve pounds of seed per acre at 3 cents equals 36 cents. Dividing this sum by 4 for four years of grass gives 9 cents per acre per crop.

Yields of timothy hay on the large farm in northwestern Minnesota rarely exceed 1 ton per acre, owing to the aged and sod-bound condition of the meadows. Timothy gives better yields when sown with clover, one or two crops cut for hay, and then either broken up or pastured.

Prices for timothy hay in the local markets range from $4 to $7 per ton. Timothy hay at $6 has been made the basis for computing the cash feeding values of all kinds of roughage published in this bulletin.

TABLE XXVIII.—*Cost of producing mangels.*

| Operation. | Minnesota Experiment Station. Acreage, 1902 and 1905. | Total cost. | Cost per acre. |
|---|---|---|---|
| Manuring | 4.25 | $10.540 | $1.488 |
| Plowing | 4.25 | 5.100 | 1.200 |
| Harrowing and planking | 4.25 | 4.633 | 1.090 |
| Planting | 4.25 | 2.455 | .578 |
| Cost of seed (42½ pounds at 15 cents) | 4.25 | 6.375 | 1.500 |
| Wheel hoeing (twice) | 4.25 | 12.100 | 2.847 |
| Hand hoeing and thinning | 4.25 | 30.570 | 7.193 |
| Cultivating (horse) three times | 4.25 | $4.925 | $1.159 |
| Harvesting and storing | 4.25 | 56.270 | 13.240 |
| Machinery cost | | | .286 |
| Land rental | | | 3.500 |
| Total | | | 34.081 |

NOTE.—The above table represents the cost per acre of producing mangels; the various operations and amounts of labor being taken from records at the Minnesota experiment farm for the years 1902 and 1905, and the labor converted into terms of cash with rates of wages obtained on farms at Northfield, Minn. (see Table IV).

Manure was spread at the rate of 16 tons per acre and 60 per cent of the total cost of manuring is charged to the mangel crop (see Table XV). Well-prepared clover sod will usually give the best possible seed-bed for mangels. The average yield of the two crops was 20 tons per acre. The feeding value of a ton of mangels is estimated by T. L. Haecker at $1.30, as compared with timothy at $6.

TABLE XXIX.—*Cost of producing millet—cut for seed.*

| Operation. | Northfield (Rice County). Total acreage, three years. | Total cost. | Cost per acre. | Halstad (Norman County). Total acreage, three years. | Total cost. | Cost per acre. |
|---|---|---|---|---|---|---|
| Seed value | 3.10 | $1.16 | $0.374 | 34.53 | $22.70 | $0.657 |
| Cleaning seed | | | | 16.01 | .25 | .016 |
| Plowing | 3.10 | 3.86 | 1.245 | 34.53 | 38.33 | 1.110 |
| Disking | 3.10 | 1.05 | .339 | | | |
| Dragging | 3.10 | 1.05 | .339 | 30.75 | 7.49 | .244 |
| Seeding | 3.10 | .82 | .264 | 34.53 | 9.65 | .279 |
| Cutting (binder) | 3.10 | 1.40 | .452 | 2.12 | .53 | .250 |
| Twine | 3.10 | 1.08 | .348 | 2.12 | .49 | .231 |
| Shocking | 3.10 | .50 | .161 | 2.12 | .35 | .165 |
| Stacking | 3.10 | | .903 | 2.12 | 1.20 | .566 |
| Stack-thrashing (labor) | 3.10 | | 1.015 | 2.12 | 1.06 | .500 |
| Cash cost thrashing | | | | 2.12 | | .424 |
| Machinery cost | | | .443 | | | .342 |
| Land rental | | | 3.500 | | | 1.800 |
| Total | | | 9.383 | | | 6.584 |

NOTE.—Millet grown for seed does not improve the soil for succeeding crops as do such crops as clover, alfalfa, and timothy. The relation of this crop to soil fertility is much the same as that of the cereal crops.

TABLE XXX.—*Cost of producing oats on fall plowing.*

| Operation. | Northfield (Rice County). | | | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 2,293.02 | $2,205.19 | $0.962 | 996.95 | $929.42 | $0.932 | 879.03 | $527.06 | $0.600 |
| Cleaning seed | 1,455.57 | 30.01 | .021 | 491.68 | 15.90 | .032 | 416.30 | 21.43 | .051 |
| Plowing | 1,927.90 | 2,371.31 | 1.230 | 1,313.57 | 1,437.56 | 1.094 | 752.65 | 855.52 | 1.137 |
| Dragging | 1,927.90 | 497.88 | .258 | 985.56 | 164.92 | .167 | 842.24 | 232.28 | .276 |
| Seeding | 2,369.28 | 571.89 | .241 | 1,078.84 | 271.04 | .251 | 879.03 | 226.71 | .258 |
| Weeding | | | | | | | 168.55 | 4.53 | .027 |
| Cutting | 2,359.50 | 896.24 | .380 | 1,039.36 | 339.77 | .327 | 864.32 | 295.11 | .341 |
| Twine | 1,364.90 | 514.56 | .377 | 992.57 | 318.02 | .320 | 519.61 | 94.57 | .182 |
| Shocking | 2,289.57 | 361.62 | .158 | 938.30 | 135.74 | .145 | 815.75 | 106.52 | .130 |
| Stacking | 1,028.44 | 788.81 | .767 | 918.81 | 596.13 | .649 | 426.38 | 194.73 | .457 |
| Stack-thrashing (labor) | 1,028.44 | 650.41 | .632 | 603.76 | 187.58 | .311 | 168.20 | 39.20 | .233 |
| Cash cost threshing | 1,028.44 | 890.00 | .865 | 603.76 | 751.77 | 1.245 | 168.20 | 80.48 | .478 |
| Machinery cost | | | .446 | | | .356 | | | .344 |
| Land rental | | | 3.500 | | | 3.000 | | | 1.800 |
| Total | | | 9.837 | | | 8.829 | | | 6.314 |

LARGE FARM IN NORTHWESTERN MINNESOTA.

| Operation. | Total acreage, three years. | Total cost. | Cost per acre. | Operation. | Total acreage, three years. | Total cost. | Cost per acre. |
|---|---|---|---|---|---|---|---|
| Seed value | 386.21 | $237.69 | $0.615 | Shock-thrashing (labor) | 217.49 | $198.62 | $0.913 |
| Cleaning seed | 386.21 | 12.74 | .033 | Values consumed in thrashing rig | | | .288 |
| Plowing | 386.21 | 324.03 | .839 | Machinery cost | | | .228 |
| Dragging | 386.21 | 97.28 | .252 | Land rental | | | 1.800 |
| Seeding | 386.21 | 89.26 | .231 | | | | |
| Cutting (binder) | 386.21 | 126.58 | .328 | Total | | | 5.878 |
| Twine | 386.21 | 86.51 | .224 | | | | |
| Shocking | 386.21 | 49.05 | .127 | | | | |

NOTE.—The average yield of oats on the Northfield farms during the years 1902, 1903, and 1904 was 47 bushels; Marshall, 47 bushels; Halstad, 29½ bushels; and on the large farm in northwestern Minnesota 31½ bushels. The average cash price for No. 3 white oats at Minneapolis during the years 1902, 1903, and 1904 was 36 cents.

TABLE XXXI.—*Cost of producing oats on disked corn stubble.*

| Operation. | Northfield (Rice County). | | | Operation. | Northfield (Rice County). | | |
|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 2,293.02 | $2,205.19 | $0.962 | Shocking | 2,289.57 | $361.62 | $0.158 |
| Cleaning seed | 1,455.57 | 30.01 | .021 | Stacking | 1,028.44 | 788.81 | .767 |
| Breaking and burning stalks | 209.56 | 42.20 | .201 | Stack-thrashing (labor) | 1,028.44 | 650.41 | .632 |
| Disking | 545.84 | 141.69 | .260 | Cash cost thrashing | 1,028.44 | 890.00 | .865 |
| Dragging | 273.43 | 69.77 | .255 | Machinery cost | | | .383 |
| Seeding | 2,369.28 | 571.89 | .241 | Land rental | | | 3.500 |
| Cutting (binder) | 2,359.50 | 896.24 | .380 | | | | |
| Twine | 1,364.90 | 514.56 | .377 | Total | | | 9.002 |

NOTE.—Yields and cash prices for oats are given in note under Table XXX. Tables XXX and XXXI clearly show that it costs about 80 cents per acre less to prepare corn stubble land for grain by disking than by plowing. The cost of disking corn land as shown in this table is based upon one disking only. If the disk is

lapped each round, or if cross-disking is practiced, the total cost of disking per acre will range from 50 cents to 75 cents. Since the yields are also better and fewer weeds ripen where the oats are planted on the side of the furrow slice that was cleared of weeds by cultivating the corn crop the previous year than on the land inverted by the plow, there is a double reason for seeding the grain on the disked corn stubble. Where grass seeds are sown with the grain there is the third advantage of securing a better stand, due to the fact that the roots of small grass plants thrive better in the compacted lower half of the furrow slice than in recently plowed soil.

TABLE XXXII.—*Cost of producing potatoes—garden cultivation.*

| Operation. | Northfield (Rice County). | | | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 18.11 | $71.34 | $3.939 | 8.82 | $37.68 | $4.272 | 3.35 | $20.78 | $6.203 |
| Plowing | 11.07 | 17.79 | 1.607 | 5.62 | 7.92 | 1.49 | 1.41 | 4.37 | 3.035 |
| Dragging | 8.59 | 7.90 | .920 | 5.62 | 3.66 | .61 | .50 | .212 | .424 |
| Planting (hand) | 17.26 | 56.55 | 3.276 | 12.92 | 40.88 | 3.164 | 4.06 | 16.27 | 4.007 |
| Cultivating | 16.59 | 28.36 | 1.709 | 11.66 | 45.94 | 3.940 | | | |
| Hoeing | 11.93 | 34.18 | 2.865 | | | | 2.06 | 4.37 | 2.121 |
| Spraying | 15.97 | 23.83 | 1.492 | 3.68 | 8.92 | 2.424 | 5.29 | 5.25 | .992 |
| Digging (hand) | 18.26 | 98.70 | 5.405 | 12.92 | 101.60 | 7.864 | 3.96 | 26.60 | 6.717 |
| Machinery cost | | | .212 | | | .166 | | | .195 |
| Land rental | | | 3.500 | | | 3.000 | | | 1.800 |
| Total | | | 24.925 | | | 26.890 | | | 25.494 |

LARGE FARM IN NORTHWESTERN MINNESOTA.

| Operation. | Total acreage, one year. | Total cost. | Cost per acre. | Operation. | Total acreage, one year. | Total cost. | Cost per acre. |
|---|---|---|---|---|---|---|---|
| Seed value | 1.09 | $6.40 | $5.872 | Paris green | 1.09 | $1.25 | $1.147 |
| Plowing, harrowing, and furrowing | 1.09 | 3.07 | 2.817 | Digging (hand) | 1.09 | 5.28 | 4.844 |
| Cutting seed | 1.09 | .58 | .532 | Machinery cost | | | .046 |
| Planting (hand) | 1.09 | 5.87 | 5.385 | Land rental | | | 1.800 |
| Cultivating and hoeing | 1.09 | 7.60 | 6.972 | Total | | | 30.488 |
| Spraying | 1.09 | 1.17 | 1.073 | | | | |

NOTE.—The statistics presented in this table can not be considered applicable to the commercial culture of potatoes. These figures have been taken from small fields of potatoes on a number of farms where potatoes are grown merely to supply the needs of the family. The average yield of potatoes grown under these conditions is very small, ranging from 75 bushels to 100 bushels per acre. The potatoes grown under these conditions are not thoroughly sprayed for blight or for protection against potato beetles. The cost of digging and picking up the potatoes is small, owing to the light yields.

It is to be regretted that statistics on the cost of producing potatoes on a commercial scale can not be presented in this bulletin. The cost of production can be materially reduced below the figures given in this table by the use of machines for planting, spraying, and harvesting the crop. Planting by machinery can be done for about 60 cents an acre, spraying four times with copper sulphate and Paris green for $3.60, and the crop can be harvested with a potato digger (including picking up) for about $3.75 per acre.

Potatoes can be produced commercially for about $19 per acre on land valued at $60 per acre, not including the cost of marketing. One hundred bushels per acre at 20 cents will pay the cost of production. Yields of 200 bushels or over can be grown on many Minnesota soils if the crop and the soil are properly handled.

The possibilities in potato culture are not realized as yet by the farmers of Minnesota. In many regions of Minnesota, where corn can not be easily matured, the potato crop for food, starch, and alcohol purposes can be substituted for corn as a cultivated crop, and not only yield a handsome profit but clean the land for succeeding grain crops.

TABLE XXXIII.—*Cost of producing rye—spring-sown.*

| Operation | Large farm in northwestern Minnesota. | | | Operation. | Large farm in northwestern Minnesota. | | |
|---|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 163.36 | $144.20 | $0.883 | Shock-thrashing (labor) | 52.67 | $38.43 | $0.730 |
| Cleaning seed | 163.36 | 11.44 | .070 | Values consumed in thrashing outfit | | | .288 |
| Plowing | 163.36 | 137.06 | .839 | Machinery cost | | | .228 |
| Dragging | 163.36 | 36.76 | .225 | Land rental | | | 1.800 |
| Seeding | 163.36 | 54.73 | .335 | | | | |
| Cutting (binder) | 163.36 | 67.77 | .415 | Total | | | 6.090 |
| Twine | 163.36 | 24.67 | .151 | | | | |
| Shocking | 163.36 | 20.63 | .126 | | | | |

NOTE.—The average yield per acre of this crop grown on the large farm in northwestern Minnesota in 1903 was 10.7 bushels. Minneapolis cash prices for rye during 1903 averaged 4[illegible] cents; during 1904, 68 cents. Spring rye is rarely grown in Minnesota, because of the poor yield commonly obtained and because of the prevailing prices, usually lower than wheat. It is a valuable crop, however, to grow on land badly infested with wild oats, because of its early maturity. The crop can be cut before many of the wild oats shell out, and thus clean a great many seeds from the land. The average yield of winter rye on the Minnesota experiment farm for the past five years has been 30 bushels per acre. To secure the best results with winter rye in Minnesota, this grain should be sown not later than September 1, on a well compacted seed bed.

TABLE XXXIV.—*Cost of producing timothy—cut for seed.*

| Operation. | Northfield (Rice County). | | | Large farm in northwestern Minnesota. | | |
|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | | | $0.090 | | | $0.090 |
| Cutting (binder) | 5.99 | $3.25 | .542 | 77.7 | $25.50 | .328 |
| Twine | 5.99 | 1.09 | .182 | 77.7 | 11.50 | .148 |
| Shocking | 4.14 | .69 | .167 | 77.7 | 7.13 | .092 |
| Stacking | 3.58 | 1.60 | .447 | | | |
| Stack-thrashing | 5.99 | 4.64 | .775 | | | |
| Shock-thrashing | | | | | | 1.481 |
| Machinery cost | | | .254 | | | .140 |
| Land rental | | | 3.500 | | | 1.800 |
| Total | | | 5.957 | | | 4.079 |

NOTE.—Seed value was determined as follows: 12 pounds of seed per acre at 3 cents equals 36 cents. Dividing this sum by 4, for four years of grass, gives 9 cents per acre per crop.

Yields of timothy seed range from 5 to 10 bushels per acre on these farms. The actual yield on the large farm in northwestern Minnesota was 5.8 bushels per acre. Farm prices for timothy seed range from $1 to $1.50 per bushel.

TABLE XXXV.—*Cost of producing wheat on fall plowing.*

| Operation. | Marshall (Lyon County). | | | Halstad (Norman County). | | |
|---|---|---|---|---|---|---|
| | Total acreage, three years. | Total cost. | Cost per acre. | Total acreage, three years. | Total cost. | Cost per acre. |
| Seed value | 3,075.63 | $2,979.05 | $0.969 | 4,248.15 | $3,420.91 | $0.805 |
| Cleaning seed | | | | 4,017.32 | 106.11 | .026 |
| Plowing | 2,167.81 | 2,194.04 | 1.012 | 3,883.63 | 4,117.62 | 1.060 |
| Dragging | 3,394.83 | 542.56 | .160 | 4,236.15 | 1,139.40 | .269 |
| Seeding | 3,492.17 | 796.32 | .228 | 4,248.15 | 1,145.52 | .270 |
| Weeding | | | | 3,501.44 | 278.27 | .079 |
| Cutting (binder) | 3,501.38 | 1,088.30 | .311 | 4,209.03 | 1,388.22 | .330 |
| Twine | 3,017.83 | 902.23 | .299 | 2,126.25 | 377.37 | .177 |
| Shocking | 3,174.76 | 321.34 | .101 | 4,209.03 | 508.66 | .121 |
| Stacking | 2,259.22 | 1,097.13 | .486 | 1,869.19 | 823.78 | .441 |
| Stack-thrashing (labor) | 1,104.64 | 271.57 | .246 | 718.65 | 143.23 | .199 |
| Cash cost thrashing | 1,104.64 | 797.06 | .722 | 718.05 | 244.90 | .341 |
| Machinery cost | | | .356 | | | .344 |
| Land rental | | | 3.000 | | | 1.800 |
| Total | | | 7.890 | | | 6.262 |

LARGE FARM IN NORTHWESTERN MINNESOTA.

| Operation. | Total acreage, three years. | Total cost. | Cost per acre. | Operation. | Total acreage, three years. | Total cost. | Cost per acre. |
|---|---|---|---|---|---|---|---|
| Seed value | 3,200.41 | $2,869.05 | $0.896 | Shock-thrashing (labor) | 1,536.80 | $895.10 | $0.583 |
| Cleaning seed | 3,198.41 | 54.37 | .017 | Values consumed in thrashing rig | | | .289 |
| Plowing | 3,200.41 | 2,685.14 | .839 | Machinery cost | | | .228 |
| Dragging | 3,200.41 | 863.40 | .270 | Land rental | | | 1.800 |
| Seeding | 3,200.41 | 763.22 | .238 | | | | |
| Weeding | 3,200.41 | 99.21 | .031 | | | | |
| Cutting (binder) | 3,200.41 | 1,032.16 | .323 | Total | | | 5.824 |
| Twine | 3,200.41 | 579.27 | .181 | | | | |
| Shocking | 3,200.41 | 411.86 | .129 | | | | |

NOTE.—The average yield of wheat at Marshall during the years 1902, 1903, 1904, and 1905 was 14.5 bushels; at Halstad, 13.3 bushels. These yields of wheat are below the average for these sections of Minnesota. The rust epidemic of 1904 and the wet year of 1905 reduced the yields by fully one-third. The average cash price for No. 1 northern wheat in Minneapolis during the years 1902, 1903, and 1904 was 85 cents.

The average yield of wheat in Minnesota for the years 1895 to 1904, according to the Bureau of Statistics of the U. S. Department of Agriculture, was 14.3 bushels, having an average farm value of $8.87 per acre.[a] The cost of marketing wheat is 25 cents to 50 cents per acre, leaving a net profit per acre of about $2 to the farmer producing wheat on improved farms in Minnesota. The margin of profit is somewhat greater on the big wheat farms, as the cost of production is usually less than that on the smaller farms.

Wheat can be grown in Minnesota to much greater profit if rotated with other field crops, as suggested in fig. 9. The same methods employed in growing wheat on $30, $40, and $50 land as were employed in the early days of continuous grain growing on $10 land will yield little or no net profit, and the future grain growers of the Northwest must realize this fact if wheat is to be grown successfully and profitably.

[a] See Yearbook of the U. S. Department of Agriculture, 1904, pp. 642, 643.

## APPLICATION OF STATISTICS CONCERNING THE BUSINESS OF FARMING TO PROBLEMS IN FARM MANAGEMENT.

It is not the purpose of this bulletin to discuss at any length the problems of farm and crop management. As previously stated, cost of production in agriculture, as well as in all other industries, is the basic point from which the management and conduct of the business can best be studied. Profit and loss should determine all methods of management, and it is hoped that the statistics presented in this bulletin on cost of production, if properly interpreted, will be of much value to teachers and practical farm managers, in outlining methods of farm and crop management.

A few problems in farm management are presented herewith; statistical analysis is applied to them, and conclusions are drawn, with the purpose of illustrating the use of business system in solving problems in farm organization and farm management. The problems presented are everyday problems which arise in the conduct of the farm, and concerning which little exact information has heretofore been obtainable. Local conditions of soil, adaptability of crops to the climate, roads, markets, etc., all affect the various problems of farm management.

### PROBLEMS IN THE RENTING AND LEASING OF FARM LANDS: CHARGES FOR PIECEWORK.

More definite knowledge concerning the business of farming will be of advantage to both tenant and landlord in the leasing of farm lands. Both parties entering into a contract of this sort should know more concerning the possibility of profits in various systems of management, concerning the value of man and horse labor on farms, and the depreciation charges for machinery. In contracting for piecework on farms the depreciation charges for machinery per acre, the actual cost of horse labor, and other similar information will be found useful in making a just and equitable agreement.

### SHOCK-THRASHING VS. STACKING AND STACK-THRASHING.

It is a well-known fact that stacking largely prevents the deterioration in the quality of all small grains. Wheat, oats, and barley, when thrashed from the stack, have better color, plumper kernels, and a smaller percentage of sprouted and weather-damaged seeds than when thrashed from the shock. It costs more, however, to stack and stack-thrash the grain than to thrash directly from the shock, and it is a much-disputed question whether the benefits of stacking are sufficient to pay for the additional cost. Statistics on this problem are shown

in Tables XXXVI to XLI, and have especial merit in that they have been collected from farms in the same neighborhood where wages and prices paid for thrashing are the same.

TABLE XXXVI.—*Wheat thrashing—cost per acre.*

MARSHALL (LYON COUNTY).

| Item. | Shock-thrashed. | | | Stacked and stack-thrashed. | | |
|---|---|---|---|---|---|---|
| | Acres. | Total cost. | Cost per acre. | Acres. | Total cost. | Cost per acre. |
| Labor—stacking | | | | 2,259.22 | $1,097.13 | $0.486 |
| Labor—thrashing | | | | 1,104.64 | 271.57 | .246 |
| Thrashing bill | | | | 1,104.64 | 797.06 | .722 |
| Total | | | | | | 1.454 |

HALSTAD (NORMAN COUNTY).

| | | | | | | |
|---|---|---|---|---|---|---|
| Labor—stacking | | | | 1,869.19 | $826.78 | $0.441 |
| Labor—thrashing | 531.13 | $226.31 | $0.426 | 718.05 | 143.23 | .199 |
| Thrashing bill | 531.13 | 204.41 | .385 | 718.05 | 244.50 | .341 |
| Total | | | .811 | | | .981 |

NOTE.—Rate per bushel paid to owner of machine was 5 cents at Marshall and 3½ cents at Halstad. At Marshall the owner of the machine furnished a larger proportion of the thrashing crew than at Northfield or Halstad.

TABLE XXXVII.—*Oats thrashing—cost per acre.*

NORTHFIELD (RICE COUNTY).

| Item. | Shock-thrashed. | | | Stacked and stack-thrashed. | | |
|---|---|---|---|---|---|---|
| | Acres. | Total cost. | Cost per acre. | Acres. | Total cost. | Cost per acre. |
| Labor—stacking | | | | 1,028.44 | $788.81 | $0.767 |
| Labor—thrashing | 1,278.4 | $1,315.41 | $1.029 | 1,028.44 | 650.41 | .632 |
| Thrashing bill | 1,278.4 | 1,107.09 | .866 | 1,028.44 | 890.00 | .865 |
| Total | | | 1.895 | | | 2.264 |

MARSHALL (LYON COUNTY).

| | | | | | | |
|---|---|---|---|---|---|---|
| Labor—stacking | | | | 918.81 | $596.13 | $0.649 |
| Labor—thrashing | | | | 603.76 | 187.58 | .317 |
| Thrashing bill | | | | 603.76 | 760.74 | 1.260 |
| Total | | | | | | 2.226 |

HALSTAD (NORMAN COUNTY).

| | | | | | | |
|---|---|---|---|---|---|---|
| Labor—stacking | | | | 426.38 | $194.73 | $0.457 |
| Labor—thrashing | 130.69 | $56.40 | $0.432 | 168.20 | 39.20 | .233 |
| Thrashing bill | 130.69 | 70.80 | .542 | 168.20 | 80.48 | .478 |
| Total | | | .974 | | | 1.168 |

NOTE.—Rate per bushel paid to owner of machine was 2 cents at Northfield, 3 cents at Marshall, and 2 cents at Halstad.

TABLE XXXVIII.—*Barley threshing—cost per acre.*

NORTHFIELD (RICE COUNTY).

| Item. | Shock-threshed. | | | Stacked and stack-threshed. | | |
|---|---|---|---|---|---|---|
| | Acres. | Total cost. | Cost per acre. | Acres. | Total cost. | Cost per acre. |
| Labor—stacking | | | | 128.93 | $72.89 | $0.565 |
| Labor—threshing | 113.08 | $97.30 | $0.860 | 113.42 | 60.59 | .534 |
| Threshing bill | 72.11 | 44.66 | .619 | 128.93 | 72.84 | .565 |
| Total | | | 1.479 | | | 1.664 |

MARSHALL (LYON COUNTY).

| | | | | | | |
|---|---|---|---|---|---|---|
| Labor—stacking | | | | 787.03 | $450.50 | $0.572 |
| Labor—threshing | | | | 534.60 | 148.30 | .259 |
| Threshing bill | | | | 750.18 | 819.94 | 1.093 |
| Total | | | | | | 1.924 |

HALSTAD (NORMAN COUNTY).

| | | | | | | |
|---|---|---|---|---|---|---|
| Labor—stacking | | | | 258.79 | $120.81 | $0.467 |
| Labor—threshing | 127.30 | $76.37 | $0.597 | 142.77 | 28.24 | .198 |
| Threshing bill | 127.90 | 64.86 | .507 | 142.77 | 55.34 | .388 |
| Total | | | 1.104 | | | 1.053 |

NOTE.—Rate per bushel paid to owner of machine was 2 cents at Northfield, 2 cents at Halstad, and 3½ cents at Marshall.

TABLE XXXIX.—*Flax threshing—cost per acre.*

NORTHFIELD (RICE COUNTY).

| Item. | Thrashed from windrow. | | | Thrashed from stack. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Unbound. | | | Bound. | | |
| | Acres. | Total cost. | Cost per acre. | Acres. | Total cost. | Cost per acre. | Acres. | Total cost. | Cost per acre. |
| Labor—threshing | 149.71 | $214.99 | $1.436 | | | | | | |
| Cash cost—threshing | 149.71 | 134.03 | .895 | | | | | | |
| Total | | | 2.331 | | | | | | |

MARSHALL (LYON COUNTY).

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Labor—stacking | | | | 119.94 | $96.27 | $0.803 | 24.18 | $16.47 | $0.681 |
| Labor—threshing | | | | 123.58 | 50.69 | .410 | 20.50 | 5.80 | .283 |
| Cash cost—threshing | | | | 128.21 | 156.70 | 1.222 | 20.50 | 33.50 | 1.634 |
| Total | | | | | | 2.435 | | | 2.598 |

HALSTAD (NORMAN COUNTY).

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Labor—stacking | | | | 35.72 | $18.51 | $0.518 | | | |
| Labor—threshing | 151.81 | $121.89 | $0.803 | 35.72 | 11.30 | .316 | | | |
| Cash cost—threshing | 151.81 | 135.82 | .895 | 35.72 | 25.74 | .721 | | | |
| Total | | | 1.698 | | | 1.555 | | | |

NOTE.—Rate per bushel paid to owner of machine was 8 cents at Northfield, 10 cents at Marshall, and 8 cents at Halstad.

Tables XXXVI to XXXIX illustrate, in a general way, the comparative cost of shock-thrashing grain per acre and stack-thrashing grain. The cost is less under both methods at Halstad than at Marshall or Northfield, on account of the more powerful and efficient machinery employed and on account of smaller yields making a smaller thrashing bill. A comparison on the basis of cost per acre is not absolutely exact and conclusive unless the yield per acre is the same for those fields thrashed from the shock and from the stack in any community. The comparative cost of thrashing grain by different methods, to be absolutely exact, should be determined by the varying amounts of labor necessary to the different methods, the cash cost per acre (based upon yield and rate paid per bushel for thrashing) being a constant factor in each case. In the actual work of collecting statistics on this subject it is impossible to secure records from an acreage of grain thrashed from the shock where the yield per acre will be exactly the same as from another acreage stacked and stack-thrashed. To avoid this difficulty the cost of thrashing grain by various methods may be placed on a more comparable basis by considering the labor cost per acre alone, or by reducing the entire cost to the cost per bushel instead of the cost per acre. The labor cost of thrashing a crop of grain by any method will not vary with yield to the same extent that the cash cost or thrashing bill will vary. The amount of labor per acre involved in thrashing a 40-bushel crop of oats, for example, will vary but little from the amount necessary to thrash a 50-bushel crop, whereas the cash cost or thrashing bill varies by 2 cents per bushel with every bushel of difference in yield. Thus, labor cost forms an equitable basis for the comparative study of methods of thrashing grain as illustrated in Table XL, providing the various methods are compared in the same farming regions. The comparative cost of thrashing grain per bushel by various methods is shown in Table XLI. Here the cash cost of thrashing is a constant factor for each method, and, by reducing the amounts of labor per acre necessary to each method to the basis of amounts per bushel and adding this to the cash cost per bushel, a more accurate comparison of methods is made than when comparisons are made on the acreage basis.

TABLE XL.—*Labor cost per acre of thrashing grain.*

| Crop. | Route. | Shock-thrashed. | Stacked and stack-thrashed. | Thrashed from windrow. | Stacked from windrow and stack-thrashed. | Bundle flax stack-thrashed. |
|---|---|---|---|---|---|---|
| Wheat | Marshall | | $0.732 | | | |
| Wheat | Halstad | $0.426 | .610 | | | |
| Oats | Northfield | 1.029 | 1.389 | | | |
| Oats | Marshall | | .966 | | | |
| Oats | Halstad | .432 | .690 | | | |
| Barley | Northfield | .860 | 1.099 | | | |
| Barley | Marshall | | .831 | | | |
| Barley | Halstad | .597 | .665 | | | |
| Flax | Northfield | | | $1.136 | | |
| Flax | Marshall | | | | $1.213 | $0.964 |
| Flax | Halstad | | | .803 | .831 | |

TABLE XLI.—*Cost per bushel of thrashing grain.*

| Crop. | Route. | Shock-thrashed. | Stacked and stack-thrashed. | Thrashed from windrow. | Stacked from windrow and stack-thrashed. | Bundle flax stack-thrashed. |
|---|---|---|---|---|---|---|
| Wheat | Marshall | | $0.101 | | | |
| Wheat | Halstad | $0.074 | .101 | | | |
| Oats | Northfield | .043 | .052 | | | |
| Oats | Marshall | | .053 | | | |
| Oats | Halstad | .036 | .049 | | | |
| Barley | Northfield | .048 | .059 | | | |
| Barley | Marshall | | .062 | | | |
| Barley | Halstad | .044 | .054 | | | |
| Flax | Northfield | | | $0.208 | | |
| Flax | Marshall | | | | $0.139 | $0.159 |
| Flax | Halstad | | | .152 | .172 | |

NOTE.—Table XLI indicates the fact that the additional cost of stacking and stack-thrashing wheat, oats, barley, and flax can be met, and in some cases exceeded, by a difference of one grade in the quality of the grain marketed. The average difference in price between No. 1 Northern wheat and No. 2 Northern is about 2 cents, and the difference in the cost per bushel of thrashing wheat from the shock and from the stack is approximately 2¾ cents, as indicated by the statistics collected at Halstad. The average difference in price between No. 3 or No. 4 malt barley and No. 1 feed barley is 2 cents to 4 cents per bushel, and the difference in the cost per bushel of thrashing barley from the shock and from the stack is 1.1 cents at Northfield and 1 cent at Halstad.

The possibility of improving the grade of grain enough to pay for the additional cost of stacking and stack-thrashing depends in any locality upon the availability of machines, the availability of labor, and the climatic conditions prevailing at harvest. Intelligent stacking of grain during a majority of Minnesota harvests is cheap insurance against bleached, sprouted, and bin-burnt grain. If the weather is favorable and a machine can be put in the field as soon as the grain is fit to thrash, a slight saving will be made as compared with stacking and stack-thrashing. On the other hand, if the shocks must weather for several days or in some cases several weeks before a machine can be obtained, the loss in grade is considerable, and stacking the grain would have been profitable.

On a majority of the small farms in Minnesota the labor question must also be taken into consideration, in discussing the relative merits of shock and stack-thrashing. At stacking time a small crew with the home teams can stack the grain, while if the grain is to be thrashed out of the shock a large crew and a large number of teams must be had at a very busy season. If a rainy spell comes at this season of the year, the minute the grain is dry stacking can begin with the regular help, whereas if shock-thrashing is to be done the grain must stay out and risk another wetting while the machine and the necessary labor are being brought together. Exchanging help for shock-thrashing usually prevents early fall plowing, a practice which is very important in Minnesota with all stubble land not seeded to grass.

The conclusion may be drawn that for a majority of Minnesota farms producing grain under the prevailing conditions of climate, availability of labor and machines, stacking and stack-thrashing of grain is better farm management than shock-thrashing. This is particularly true of all grain intended for seed.

### FORAGE PRODUCTION ON MINNESOTA FARMS.

Many forage crops have been tried in Minnesota and have not proved as profitable for the general conditions of the State as corn, timothy, red clover, and alsike. Alfalfa and bromus are valuable forage plants in permanent meadows and pastures, but corn, red clover, and timothy have become the standard forage crops in Minnesota because of hardiness, productivity, adaptability to rotations with other crops, and the ease with which good stands may be secured.

In growing such field crops as clover, timothy, and fodder corn, which ordinarily have no market value and must be marketed in live-stock products, preference should be given to the crop that, under the given conditions, will yield the largest money value in digestible nutrients per acre above the expense for production. Good principles of farm management will modify this statement somewhat from the fact that soil fertility, eradication of weeds, etc., demand crop rotation, and in the long run it is better management to grow several classes of forage crops in the rotation than to grow one forage crop continuously. Crop failures and the exigencies of the season also modify this statement in that they force upon the farmer the necessity of growing "catch crops" or quick-maturing crops in some seasons. Fodder corn thickly sown is a valuable forage crop, not only on account of the large product per acre, but because of its value as a cleaning crop and as a catch crop which may be sown late in the season. Red clover is valued not only as a food for domestic animals but as a crop which greatly benefits the chemical and physical condition of the soil for succeeding crops. Timothy, although it usually yields less cured forage per acre than corn or red clover, is valued for its ease of seeding, hardiness, and persistent growth.

Soil and climate are potent factors which influence the yields of forage crops, and yields secured in one locality may not be possible under conditions which prevail in other localities. Corn when thickly grown as a fodder crop and field-cured or stored in the silo usually gives larger yields per acre in Minnesota than either clover or timothy, though seasons of excessive rainfall occasionally raise the yields of timothy and clover to the equivalent of fodder-corn yields. The cost of producing an acre of fodder corn, however, is considerably higher than for the clover and timothy hay, and cost of production as well as yield must be considered in the selection and growing of forage crops. The cost of producing forage is an exceedingly important factor in

determining the net profits which may be secured in feeding live stock, for in the methods of feeding practiced on most Minnesota farms one-half to two-thirds of the cost of the ration during the six winter months is made up of the cost of roughage.

As cost of production represents the farm value of most forage crops, and as forage crops constitute from one-half to two-thirds of the winter food of live stock, the importance of the cost of producing roughage as a factor in live-stock production becomes apparent. Maximum net profit is not necessarily a corollary of maximum gross product obtained by growing and feeding that forage crop which yields the largest product per acre. The greatest net profit results from the widest margin between cost of production and gross product. Intensive methods of agriculture, by means of which a large number of animals can be supported on a small acreage, will not yield a greater net profit per acre than diversified or extensive methods of farming if the large gross product has been obtained at such an increased cost of production as leaves the margin between cost of production and gross product smaller than in case of the less intensive farming with a less proportionate cost of production.

The relation which cost of production bears to the net profits in feeding the product from a given area of land devoted to the growth of various forage crops is shown in the accompanying Tables XLII–LII. The statistics on the cost of producing mixed clover and timothy hay and fodder corn were gathered on the Northfield statistical route in Rice County, Minn. The statistics on the cost of producing ensilage and mangels were determined by converting the amounts of labor on these crops at the Minnesota Agricultural Experiment Station into terms of cash by using the rates of wages for the Northfield farms. Detailed accounts of the cost of producing these crops are given in Tables XVIII, XXIII, XXIV, and XXVIII. The figures on gross products of cows, labor in caring for the cattle, and their grain rations are taken from records on a large dairy farm at Northfield, Rice County, Minn., and are here used merely to show the methods of using those figures in making comparisons of the relative profits from forage crops. The comparative cash values per ton of the various forage crops are taken from experimental data compiled by T. L. Haecker, professor of dairy husbandry at the Minnesota Agricultural Experiment Station. These cash values are based on comparisons of nutritive value and digestibility of forage crops as compared with ground concentrates—as corn, barley, oats, and bran—and are compared directly with timothy hay at $6 per ton..

The statistics presented herewith on cost of production are based upon 2-ton yields for hay, 3 tons for fodder corn, 10½ tons for corn ensilage, and 20 tons for mangels. Yields of timothy and clover hay at Northfield range from 2 tons to 2½ tons per acre, and fodder corn

from 2½ to 3 tons per acre. For ten years the average yield of clover and timothy hay on the Minnesota experiment farm has been 2.7 tons, and of field-cured fodder corn 3.8 tons. Three tons of hay can be produced for nearly the same expense as 2 tons, and 4 tons of fodder corn for approximately the same cost as 3 tons. As statistics are not available at the present writing on the cost of production for a varying tonnage, the same cost of production per acre for a given crop has been used in all tables comparing forage crops, in the knowledge that it will not vary more, usually much less, than 50 cents per acre from the figures based on tonnage, and will not therefore materially affect the general conclusions.

For purposes of showing methods of making comparative studies between forage crops, a yield of 2 tons per acre for two cuttings of clover and timothy has been taken as a basis for comparison, and T. L. Haecker's calculated feeding values of forage crops have been utilized as a basis for determining the number of animals that can be furnished forage from a given acreage of the various forage crops compared. Feeding records from the farms at Northfield show that 10 acres of clover and timothy, producing a total product of 20 tons, will furnish sufficient roughage for 10 cows for the six winter months, November to May. The calculated cash value of the nutrients in this product is $127. (Table XLII.) When fodder corn yields 3 tons per acre, the calculated cash value of the nutrients from 10 acres is $147. If $127 worth of nutrients in hay will furnish forage for 10 cows for six months, $147 worth of nutrients in fodder corn will furnish forage for 11 cows for six months ($127 : 10 :: $147 : $x$, or 11).

More stock can be supported per given area of land with fodder corn yielding 3 tons per acre than with hay yielding 2 tons per acre; but because gross receipts are thus increased, it does not follow that the net receipts are also increased. The cost of producing the forage must now be taken into consideration, and the accompanying tables show the relation which cost of producing forage crops bears to net profits from the varying number of cows which it is possible to support on a given acreage of land with the various forage crops compared at average, maximum, and minimum yields. Product, labor, and grain rations per cow are constant factors in these tables of comparison, whereas the cost of forage per cow is variable, the variation arising from the difference in the cost of producing the respective forage crops. In order to show the influence which cost of producing forage has upon the profits in feeding cattle and thus to compare the relative profits from various forage crops, the entire profits arising from the manufacturing of grain and forage into milk products are reduced finally to profit per acre of forage crop.

TABLE XLII.—*Ten acres of clover and timothy hay at 2 tons per acre v. ten acres of fodder corn at 3 tons per acre.*

[Fed to cows of high productiveness—average butter-fat product per cow for 6 months = $33.90.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Clover and timothy: | | |
| To cost of producing 10 acres hay, at $6.97 | $69.70 | |
| By value 10 acres hay, 20 tons, at $6.35 | | $127.00 |
| **Net value** of food nutrients | **57.30** | |
| | 127.00 | 127.00 |
| Fodder corn: | | |
| To cost of producing 10 acres fodder corn, at $12.20 | 122.00 | |
| By value 10 acres fodder corn, 30 tons, at $4.90 | | 147.00 |
| **Net value** of food nutrients | **25.00** | |
| | 147.00 | 147.00 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for hay roughage 6 months | **$6.97** |
| Cost per cow for fodder-corn roughage 6 months | **11.09** |

3. COMPARATIVE NET PROFITS.

| | | |
|---|---|---|
| Clover and timothy—10 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 10 cows 6 months | | $339.00 |
| To interest charges (10 cows, at $40), $400 at 5 per cent per annum for 6 months | $10.00 | |
| To labor, 10 cows 6 months | 105.00 | |
| To grain rations, 10 cows 6 months | 71.00 | |
| To cost of producing hay roughage | 69.70 | |
| **Net profit** | **83.30** | |
| | 339.00 | 339.00 |
| Fodder corn—11 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 11 cows 6 months | | 372.90 |
| To interest charges (11 cows, at $40), $440 at 5 per cent per annum for 6 months | 11.00 | |
| To labor, 11 cows 6 months | 115.50 | |
| To grain rations, 11 cows 6 months | 78.10 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net profit** | **46.30** | |
| | 372.90 | 372.90 |

NOTE.—The net profit derived from feeding the product of ten acres of clover and timothy hay, yielding 2 tons per acre, to ten cows is $37 greater than the profit in feeding the product of ten acres of fodder corn, yielding 3 tons per acre, to eleven cows. On an acreage basis the profit from the hay crop amounts to $3.33 per acre and from the fodder corn $4.63, or a difference of $3.70 per acre in favor of the hay crop. The margin between the total expense and the gross product has been so greatly influenced by the cheap cost of hay production that the net profit is greater for ten cows than for the eleven cows which have been fed the more expensive roughage.

TABLE XLIII.—*Ten acres of clover and timothy hay at 2 tons per acre v. ten acres of fodder corn at 3½ tons per acre.*

[Fed to cows of high productiveness—average butter-fat product per cow for 6 months=$33.90.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Clover and timothy: | | |
| To cost of producing 10 acres hay, at $6.97 | $69.70 | |
| By value 10 acres hay, 20 tons, at $6.35 | | $127.00 |
| **Net value** of food nutrients | **57.30** | |
| | 127.00 | 127.00 |
| Fodder corn: | | |
| To cost of producing 10 acres fodder corn, at $12.20 | 122.00 | |
| By value 10 acres fodder corn, 35 tons, at $4.90 | | 171.50 |
| **Net value** of food nutrients | **49.50** | |
| | 171.50 | 171.50 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for hay roughage 6 months | **$6.97** |
| Cost per cow for fodder-corn roughage 6 months | **9.38** |

3. COMPARATIVE NET PROFITS.

| | | |
|---|---|---|
| Clover and timothy—10 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 10 cows 6 months | | $339.00 |
| To interest charges (10 cows, at $40), $400 at 5 per cent per annum for 6 months | $10.00 | |
| To labor, 10 cows 6 months | 105.00 | |
| To grain rations, 10 cows 6 months | 71.00 | |
| To cost of producing hay roughage | 69.70 | |
| **Net profit** | **$83.30** | |
| | 339.00 | 339.00 |
| Fodder corn—13 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 13 cows 6 months | | 440.70 |
| To interest charges (13 cows, at $40), $520 at 5 per cent per annum for 6 months | 13.00 | |
| To labor, 13 cows 6 months | 136.50 | |
| To grain rations, 13 cows 6 months | 92.30 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net profit** | **76.90** | |
| | 440.70 | 440.70 |

NOTE.—The net profit derived from feeding the product of ten acres of clover and timothy hay, yielding 2 tons per acre, to ten cows is $6.40 greater than the profit in feeding the product of ten acres of fodder corn, yielding 3½ tons per acre, to thirteen cows. On an acreage basis the profit from the hay crop amounts to $8.33 per acre and from the fodder corn $7.69, or a difference of 64 cents per acre in favor of the hay crop. The margins between total expense and gross product are nearly identical when hay yields 2 tons per acre and fodder corn 3½ tons.

TABLE XLIV.—*Ten acres of clover and timothy hay at 2 tons per acre v. ten acres of fodder corn at 4 tons per acre.*

[Fed to cows of high productiveness—average butter-fat product per cow for 6 months=$33.90.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Clover and timothy: | | |
| To cost of producing 10 acres hay, at $6.97 | $69.70 | |
| By value 10 acres hay, 20 tons, at $6.35 | | $127.00 |
| **Net value** of food nutrients | **57.30** | |
| | 127.00 | 127.00 |
| Fodder corn: | | |
| To cost of producing 10 acres fodder, at $12.20 | 122.00 | |
| By value 10 acres fodder, 40 tons, at $4.90 | | 196.00 |
| **Net value** of food nutrients | **74.00** | |
| | 196.00 | 196.00 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for hay roughage 6 months | **$6.97** |
| Cost per cow for fodder-corn roughage 6 months | **8.13** |

3. COMPARATIVE NET PROFITS.

| | | |
|---|---|---|
| Clover and timothy—10 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 10 cows 6 months | | $339.00 |
| To interest charges (10 cows, at $40), $400 at 5 per cent per annum for 6 months | $10.00 | |
| To labor, 10 cows 6 months | 105.00 | |
| To grain rations, 10 cows 6 months | 71.00 | |
| To cost of producing hay roughage | 69.70 | |
| **Net profit** | **83.30** | |
| | 339.00 | 339.00 |
| Fodder corn—15 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 15 cows 6 months | | 508.50 |
| To interest charges (15 cows, at $40), $600 at 5 per cent per annum for 6 months | 15.00 | |
| To labor, 15 cows 6 months | 157.50 | |
| To grain rations, 15 cows 6 months | 106.50 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net profit** | **107.50** | |
| | 508.50 | 508.50 |

NOTE.—Fodder corn yielding 4 tons per acre increases the margin of profit from ten acres of this crop fed to fifteen cows to a point where the profit is $24.20 greater than that derived from ten acres of hay yielding 2 tons per acre and fed to ten cows. On an acreage basis the profit from the hay crop amounts to $8.33 per acre and from the fodder corn $10.75, or a difference of $2.42 per acre in favor of the fodder-corn crop.

This table and Tables XLII and XLIII indicate clearly that when fodder corn is raised and fed to highly productive cows the yields of this crop must be nearly double those of clover and timothy, in order to yield equal profits.

TABLE XLV.—*Ten acres of clover and timothy at 2½ tons per acre v. ten acres of fodder corn at 4 tons per acre.*

[Fed to cows of high productiveness—average butter-fat product per cow for 6 months = $33.90.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Clover and timothy: | | |
| To cost of producing 10 acres hay, at $6.97 | $69.70 | |
| By value 10 acres hay, 25 tons, at $6.35 | | $158.75 |
| **Net value** of food nutrients | **89.05** | |
| | 158.75 | 158.75 |
| Fodder corn: | | |
| To cost of producing 10 acres fodder, at $12.20 | 122.00 | |
| By value 10 acres fodder, 40 tons, at $4.90 | | 196.00 |
| **Net value** of food nutrients | **74.00** | |
| | 196.00 | 196.00 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for hay roughage 6 months | **$5.21** |
| Cost per cow for fodder-corn roughage 6 months | **8.13** |

3. COMPARATIVE NET PROFITS.

| | | |
|---|---|---|
| Clover and timothy—12 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 12 cows 6 months | | $406.80 |
| To interest charges (12 cows, at $40), $480 at 5 per cent per annum for 6 months | $12.00 | |
| To labor, 12 cows 6 months | 126.00 | |
| To grain rations, 12 cows 6 months | 85.20 | |
| To cost of producing hay roughage | 69.70 | |
| **Net profit** | **113.90** | |
| | 406.80 | 406.80 |
| Fodder corn—15 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 15 cows 6 months | | 508.50 |
| To interest charges (15 cows, at $40), $600 at 5 per cent per annum for 6 months | 15.00 | |
| To labor, 15 cows 6 months | 157.50 | |
| To grain rations, 15 cows 6 months | 106.50 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net profit** | **107.50** | |
| | 508.50 | 508.50 |

NOTE.—Clover and timothy hay yielding 2½ tons per acre will produce enough forage on ten acres to support twelve cows six months, and yield a net profit $6.40 greater than that derived from fifteen cows fed roughage in the form of fodder corn yielding 4 tons per acre. On an acreage basis the profit from the hay crop amounts to $11.39 per acre, and from the fodder corn $10.75, or a difference of 64 cents in favor of the hay crop.

TABLE XLVI.—*Ten acres of fodder corn at 3½ tons per acre v. ten acres of ensilage corn at 10½ tons per acre.*

[Fed to cows of high productiveness—average butter-fat product per cow for 6 months=$83.90.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Fodder corn: | | |
| To cost of producing 10 acres fodder corn, at $12.20 | $122.00 | |
| By value 10 acres fodder corn, 35 tons, at $4.90 | | $171.50 |
| **Net value** of food nutrients | **49.50** | |
| | 171.50 | 171.50 |
| Ensilage: | | |
| To cost of producing 10 acres ensilage corn, at $18.21 | 182.10 | |
| By value 10 acres ensilage, 105 tons, at $1.88 | | 197.40 |
| **Net value** of food nutrients | **15.30** | |
| | 197.40 | 197.40 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for fodder-corn roughage 6 months | **$9.38** |
| Cost per cow for ensilage roughage 6 months | **12.14** |

3. COMPARATIVE NET PROFITS.

| | | |
|---|---|---|
| Fodder corn—13 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 13 cows 6 months | | $440.70 |
| To interest charges (13 cows, at $40), $520 at 5 per cent per annum for 6 months | $13.00 | |
| To labor, 13 cows 6 months | 136.50 | |
| To grain rations, 13 cows 6 months | 92.30 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net profit** | **76.90** | |
| | 440.70 | 440.70 |
| Ensilage—15 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 15 cows 6 months | | 508.50 |
| To interest charges (15 cows, at $40), $600 at 5 per cent per annum for 6 months | 15.00 | |
| To labor, 15 cows 6 months | 157.50 | |
| To grain rations, 15 cows 6 months | 106.50 | |
| To cost of producing ensilage roughage | 182.10 | |
| **Net profit** | **47.40** | |
| | 508.50 | 508.50 |

NOTE.—The relative merits of fodder corn cured in the field as compared with corn stored in the silo are indicated in this table. A yield of 10½ tons of green fodder corn is the equivalent of a yield of 3½ tons of field-cured fodder. It should be remembered that the amount and digestibility of the food nutrients in the two foods form the basis for determining the comparative number of cows that may be fed on each product, and therefore the net profit.

The net profit from thirteen cows fed field-cured fodder corn exceeds the profit from fifteen cows fed silage by $29.50 for six months. On an acreage basis the profit from the fodder-corn crop amounts to $7.69 per acre and from the ensilage $4.74, or a difference of $2.95 per acre in favor of the fodder corn.

As is well known, a given acreage of fodder corn when cut and stored in the silo will support more stock than when field cured. The high cost of producing ensilage, however ($18.21 an acre), reduces the margin of profit for fifteen cows in this instance below the margin of profit received from feeding thirteen cows the cheaper roughage in the form of field-cured fodder corn.

TABLE XLVII.—*Ten acres of timothy and clover at 3 tons per acre v. ten acres of fodder corn at 5 tons per acre v. ten acres ensilage corn at 15 tons per acre.*

[Fed to cows of high productiveness—average butter-fat product per cow for 6 months=$33.90.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Timothy and clover hay: | | |
| To cost of producing 10 acres hay, at $6.97 | $69.70 | |
| By value 10 acres hay, 30 tons, at $6.35 | | $190.50 |
| **Net value** of food nutrients | **120.80** | |
| | 190.50 | 190.50 |
| Fodder corn: | | |
| To cost of producing 10 acres fodder corn, at $12.20 | 122.00 | |
| By value 10 acres fodder corn, 50 tons, at $4.90 | | 245.00 |
| **Net value** of food nutrients | **123.00** | |
| | 245.00 | 245.00 |
| Ensilage corn: | | |
| To cost of producing 10 acres ensilage corn, at $18.21 | 182.10 | |
| By value 10 acres ensilage corn, 150 tons, at $1.88 | | 282.00 |
| **Net value** of food nutrients | **99.90** | |
| | 282.00 | 282.00 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for hay roughage 6 months | **$4.63** |
| Cost per cow for fodder-corn roughage 6 months | **6.42** |
| Cost per cow for ensilage roughage 6 months | **8.28** |

3. COMPARATIVE NET PROFITS.

| | | |
|---|---|---|
| Timothy and clover hay—15 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 15 cows 6 months | | $508.50 |
| To interest charges (15 cows, at $40), $600 at 5 per cent per annum for 6 months | $15.00 | |
| To labor, 15 cows 6 months | 157.50 | |
| To grain rations, 15 cows 6 months | 106.50 | |
| To cost of producing hay roughage | 69.70 | |
| **Net profit** | **159.80** | |
| | 508.50 | 508.50 |
| Fodder corn—19 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 19 cows 6 months | | 644.10 |
| To interest charges (19 cows, at $40), $760 at 5 per cent per annum for 6 months | 19.00 | |
| To labor, 19 cows 6 months | 199.50 | |
| To grain rations, 19 cows 6 months | 134.90 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net profit** | **168.70** | |
| | 644.10 | 644.10 |

| | | |
|---|---|---|
| Ensilage corn—22 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 22 cows 6 months | | $745.80 |
| To interest charges (22 cows, at $40), $880 at 5 per cent per annum for 6 months | $22.00 | |
| To labor, 22 cows 6 months | 231.00 | |
| To grain rations, 22 cows 6 months | 156.20 | |
| To cost of producing ensilage roughage | 182.10 | |
| **Net profit** | **154.50** | |
| | 745.80 | 745.80 |

NOTE.—This table compares the profits in feeding clover and timothy hay, fodder corn, and ensilage from a given area of land producing maximum yields of each forage crop.

Fodder corn yielding 5 tons to the acre returns a greater net profit than either the hay crop or ensilage at the given yields. On an acreage basis the profit from the hay crop amounts to $15.98 per acre, from the fodder corn $16.87, and from the ensilage $15.45, or a difference of 89 cents per acre in favor of the fodder corn as compared with hay, and $1.42 per acre as compared with ensilage.

TABLE XLVIII.—*Nine and one-half acres of clover and timothy hay at 2 tons per acre and one-half acre of mangels at 16 tons per acre v. 10 acres of ensilage corn at 10 tons per acre.*

[Fed to cows of high productiveness—average butter-fat product per cow for 6 months=$33.90.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS

| | | |
|---|---|---|
| Clover and timothy and mangels: | | |
| To cost of producing 9½ acres hay, at $6.97 | $66.22 | |
| To cost of producing ½-acre mangels, at $34.081 | 17.04 | |
| By value 9½ acres hay, 19 tons, at $6.35 | | $120.65 |
| By value ½-acre mangels, 8 tons, at $1.30 | | 10.40 |
| **Net value** of food nutrients | **47.79** | |
| | 131.05 | 131.05 |
| Ensilage: | | |
| To cost of producing 10 acres ensilage, at $18.21 | 182.10 | |
| By value 10 acres ensilage, 100 tons, at $1.88 | | 188.00 |
| **Net value** of food nutrients | **5.90** | |
| | 188.00 | 188.00 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for hay and mangels roughage 6 months | **$8.33** |
| Cost per cow for ensilage roughage 6 months | **13.01** |

3. COMPARATIVE NET PROFITS.

| | | |
|---|---|---|
| Clover and timothy and mangels—10 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 10 cows 6 months | | $339.00 |
| To interest charges (10 cows, at $40), $400 at 5 per cent per annum for 6 months | $10.00 | |
| To labor, 10 cows 6 months | 105.00 | |
| To grain rations, 10 cows 6 months | 71.00 | |
| To cost of producing hay and mangels roughage | 83.26 | |
| **Net profit** | **69.74** | |
| | 339.00 | 339.00 |

| Ensilage—14 cows supplied roughage for 6 months from 10 acres: | | |
|---|---|---|
| By cash—product 14 cows, 6 months | | $474.60 |
| To interest charges (14 cows, at $40), $560 at 5 per cent per annum for 6 months | $14.00 | |
| To labor, 14 cows, 6 months | 147.00 | |
| To grain rations, 14 cows 6 months | 99.40 | |
| To cost of producing ensilage roughage | 182.10 | |
| **Net profit** | **32.10** | |
| | 474.60 | 474.60 |

NOTE.—Mangels are not grown to any extent in the Middle West on account of the high cost of production, and because popular credence is given to the statement that green food in the form of ensilage can be prepared much cheaper. An average yield of mangels of 16 tons per acre is used in this table in comparison with hay at 2 tons and ensilage corn at 10 tons per acre. This table compares the relative profits from feeding a given acreage of hay, and an additional feed of 8 pounds to 10 pounds of roots, with ensilage feeding. Ten acres of land will produce roughage in the form of ensilage (at 10 tons per acre) for fourteen cows for six months, and the same acreage devoted to hay and mangels (nine and one-half acres of hay and one-half acre mangels) will furnish roughage for ten cows for six months. The net profit, however, is in favor of the hay and mangels by $37.64, owing to the less proportional cost of production to gross product. On the basis of acreage devoted to forage production the profit from the hay and mangel crops amounts to $6.97 per acre, and from the ensilage $3.21, or an increase in net profit per acre in favor of the hay and mangels of $3.76.

The preceding tables, Nos. XLII to XLVIII, illustrate most forcibly the great influence which the cost of producing forage has upon the net profits derived from dairy cows. The relative net profits illustrated by these tables are not applicable to any and all herds of cattle, but illustrate in a general way the comparative effects of cheap and expensive forage on the net profits in feeding and managing live stock. The net profits will vary with the productive capacity of the animals fed and with market prices for products sold. With cows yielding a large gross product the net profits may be greater when a large number of animals are fed expensive roughage from a given acreage than when a small number are fed cheap roughage from the same acreage. This fact is illustrated in Table XLIV and in fig. 11, and may be explained by the fact that when cows are highly productive the total product from a large number of animals is increased to that sum above the total expense, which leaves a greater margin of profit than is secured with a smaller number of cows that are fed at a much smaller expense.

With cows of low productive capacity, however, the greatest net profit is usually secured with low expense, secured by feeding forage crops low in cost of production. This condition is explained by the fact that the expense of keeping "scrub cattle" can not be reduced in proportion to the decrease in product as compared with good cattle. Food of maintenance and labor cost of keep are approximately the same for a poor cow as for a good cow. Interest charges and grain

rations are usually less for the poor cow than for the good cow, but it is impossible for any feeder to reduce the total expense for a poor cow in proportion to the decrease in her product as compared with the product of a good animal. Thus, when gross product per animal is low and cost of producing forage is high, the margin of profit from a large number of cows is less than the margin of profit

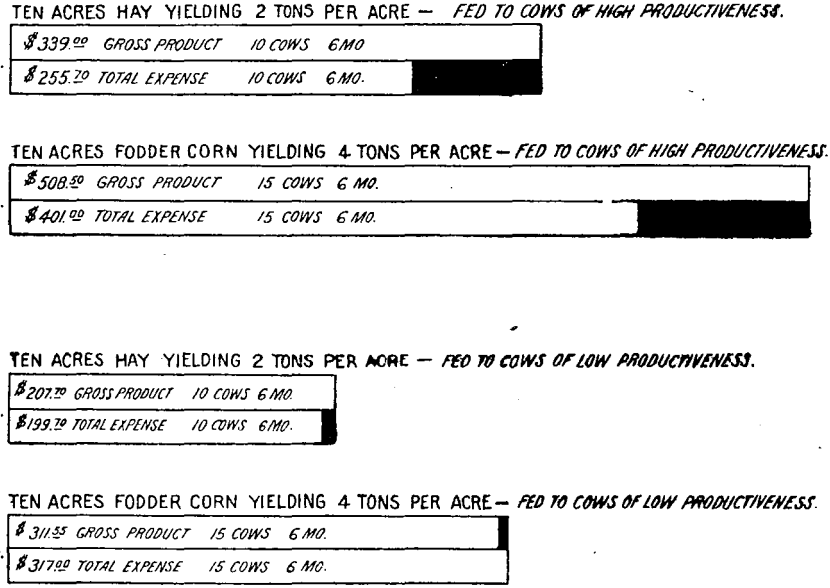


FIG. 11.—The effects of cheap and expensive forage crops on the net profits from cows of high and low productiveness graphically illustrated.

The chart is based on figures shown in Tables XLIV and XLIX. The black rectangles indicate profit or loss. When fed to cows yielding a large product, fodder corn yielding 4 tons per acre and costing $12.20 an acre to produce is shown by 1 and 2 in this chart to be more profitable than mixed clover and timothy hay yielding 2 tons per acre and costing $6.97 per acre to produce. The larger yields of fodder corn allow more cows to be fed forage from a given acreage than in case of hay, and, with each additional cow fed forage in the form of fodder corn, the gross product is increased by $33.90 and the expenses by only $26.73. Thus the gross product increases with each additional cow fed on a given acreage at a faster rate than the expenses, and the net profit—or margin between expenses and gross product—is widened to a point which is greater than the net profit from ten cows fed the less expensive forage in the form of clover and timothy hay.

When these same forage crops, under the same conditions, are fed to cows of lower productiveness, the results are the exact converse of those obtained from cows of relatively high productiveness. The gross product obtained from the cows of low productiveness, as shown in 3 and 4, is 61 per cent of the gross product obtained from the cows of relatively high productiveness, as shown in 1 and 2, and the expenses for production 78 per cent for those cows fed hay and 79 per cent for those fed fodder corn. It may be seen that the expenses for production—in case of the cows of low productiveness—have not been reduced in the same proportion as has the gross product as compared with cows of high productiveness. The net profits, therefore, can not be as high as for the cows yielding a relatively high gross product, and the proportionately higher expenses for production when fodder corn is fed indicate that the smaller group of cows of low productiveness fed hay will return the greatest net profit. The larger yields of fodder corn permit more cows to be furnished forage from a given acreage, but when the cows are of low productiveness the gross product increases with each additional cow by $20.77 and the expenses for production by $21.13, and as the expenses increase at a faster rate than the gross product, the result is a small loss from the group of cows fed fodder corn, whereas a small profit results from the smaller group of cows fed forage in the form of hay.

from a smaller number of cows sustained on cheap forage. This fact is well illustrated in Tables XLIX, L, and LI, and in fig. 11, in which the net profit from a small group of poor cows fed cheaply is compared with the net profit from a larger group of poor cows fed on more expensive roughage. These tables are made up from statistics

collected at Northfield, Rice County, Minn., on a farm where the cows are less productive than those whose records have been used in Tables XLII to XLVIII.

TABLE XLIX.—*Ten acres of clover and timothy hay at 2 tons per acre v. ten acres of fodder corn at 4 tons per acre.*

[Fed to cows of low productiveness—average butter-fat product per cow for 6 months=$20.77.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Clover and timothy: | | |
| To cost of producing 10 acres hay, at $6.97 | $69.70 | |
| By value 10 acres hay, 20 tons, at $6.35 | | $127.00 |
| **Net value** of food nutrients | **57.30** | |
| | 127.00 | 127.00 |
| Fodder corn: | | |
| To cost of producing 10 acres fodder, at $12.20 | 122.00 | |
| By value 10 acres fodder, 40 tons, at $4.90 | | 196.00 |
| **Net value** of food nutrients | **74.00** | |
| | 196.00 | 196.00 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for hay roughage 6 months | **$6.97** |
| Cost per cow for fodder-corn roughage 6 months | **8.13** |

3. COMPARATIVE NET RETURN.

| | | |
|---|---|---|
| Clover and timothy—10 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 10 cows 6 months | | $207.70 |
| To interest charges (10 cows, at $28), $280 at 5 per cent per annum for 6 months | $7.00 | |
| To labor, 10 cows 6 months | 98.30 | |
| To grain rations, 10 cows 6 months | 24.70 | |
| To cost of producing hay roughage | 69.70 | |
| **Net profit** | **8.00** | |
| | 207.70 | 207.70 |
| Fodder corn—15 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 15 cows 6 months | | 311.55 |
| To interest charges (15 cows, at $28), $420 at 5 per cent per annum for 6 months | 10.50 | |
| To labor, 15 cows 6 months | 147.45 | |
| To grain rations, 15 cows 6 months | 37.05 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net loss** | | **5.45** |
| | 317.00 | 317.00 |

NOTE.—It may be seen from Table XLIX that when fodder corn yields 4 tons per acre and clover and timothy hay 2 tons the profit is greatest for the hay, which has been fed to five cows less than the number to which fodder corn was fed.

On an acreage basis the profit from the hay crop amounts to 80 cents per acre, and the loss from the fodder corn amounts to 54 cents per acre—a difference of $1.34 per acre in favor of the hay crop.

When the gross product of the cows was large, as in Table XLIV, the greatest profit was made from the fodder corn. In Table XLIX it may be seen that the

gross product of the ten poor cows is 61 per cent of the gross product of the ten good cows (Table XLIV) and the total expense for the ten poor cows is 78 per cent of the total expense for the ten good cows. For the fifteen cows fed fodder corn the gross product is 61 per cent of the product of the good cows, and the total expense 79 per cent.

Thus, while the gross products have decreased to 61 per cent of the products of the good cows, the expenses have not decreased in the same proportion, and, moreover, the expense is proportionately less for the cows fed on hay than for those fed on fodder corn; hence the greater net profit from those fed on hay.

TABLE L.—*Ten acres of fodder corn at 3½ tons per acre v. ten acres of ensilage corn at 10½ tons per acre.*

[Fed to cows of low productiveness—average butter-fat product per cow for 6 months=$20.77.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Fodder corn: | | |
| To cost of producing 10 acres fodder corn, at $12.20 | $122.00 | |
| By value 10 acres fodder corn, 35 tons, at $4.90 | | $171.50 |
| **Net value** of food nutrients | **49.50** | |
| | 171.50 | 171.50 |
| Ensilage: | | |
| To cost of producing 10 acres ensilage corn, at $18.21 | 182.10 | |
| By value 10 acres ensilage, 105 tons, at $1.88 | | 197.40 |
| **Net value** of food nutrients | **15.30** | |
| | 197.40 | 197.40 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for fodder corn roughage 6 months | **$9.38** |
| Cost per cow for ensilage roughage 6 months | **12.14** |

3. COMPARATIVE NET LOSS.

| | | |
|---|---|---|
| Fodder corn—13 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 13 cows 6 months | | $270.01 |
| To interest charges (13 cows, at $28), $364 at 5 per cent per annum for 6 months | $9.10 | |
| To labor, 13 cows 6 months | 127.79 | |
| To grain rations, 13 cows 6 months | 32.11 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net loss** | | **20.99** |
| | 291.00 | 291.00 |
| Ensilage—15 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 15 cows 6 months | | 311.55 |
| To interest charges (15 cows, at $28), $420 at 5 per cent per annum for 6 months | 10.50 | |
| To labor, 15 cows 6 months | 147.45 | |
| To grain rations, 15 cows 6 months | 37.05 | |
| To cost of producing ensilage roughage | 182.10 | |
| **Net loss** | | **65.55** |
| | 377.10 | 377.10 |

NOTE.—In this comparison neither group of cows has created any net profits, but the loss is least for those animals fed on the cheapest forage. On an acreage basis the net loss from the fodder-corn crop amounts to $2.10 per acre and from the ensilage corn $6.55 per acre, or a difference of $4.45 per acre in favor of the fodder corn.

The gross product of the thirteen poor cows fed fodder corn is 61 per cent of the gross product of the thirteen good cows, shown in Table XLVI, fed fodder corn, and the total expense 80 per cent. For the fifteen poor cows fed ensilage, the gross product is 61 per cent of the gross product of the fifteen good cows shown in Table XLVI fed ensilage, and the total expense 82 per cent. Thus the total expense is proportionately less for the cows fed fodder corn than for those fed ensilage; hence, the net loss is least from the group of animals fed fodder corn.

TABLE LI.—*Ten acres of clover and timothy at 2½ tons per acre v. ten acres of fodder corn at 4 tons per acre.*

[Fed to cows of low productiveness—average butter-fat product per cow for 6 months = $20.77.]

1. COMPARATIVE NET VALUES OF FOOD NUTRIENTS.

| | | |
|---|---|---|
| Clover and timothy: | | |
| To cost of producing 10 acres hay, at $6.97 | $69.70 | |
| By value 10 acres hay, 25 tons, at $6.35 | | $158.75 |
| **Net value** of food nutrients | **89.05** | |
| | 158.75 | 158.75 |
| Fodder corn: | | |
| To cost of producing 10 acres fodder corn, at $12.20 | 122.00 | |
| By value 10 acres fodder corn, 40 tons, at $4.90 | | 196.00 |
| **Net value** of food nutrients | **74.00** | |
| | 196.00 | 196.00 |

2. COMPARATIVE COST OF ROUGHAGE PER COW.

| | |
|---|---|
| Cost per cow for hay roughage 6 months | **$5.81** |
| Cost per cow for fodder-corn roughage 6 months | **8.13** |

3. COMPARATIVE NET RETURN.

| | | |
|---|---|---|
| Clover and timothy—12 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 12 cows 6 months | | $249.24 |
| To interest charges (12 cows, at $28), $336 at 5 per cent per annum for 6 months | $8.40 | |
| To labor, 12 cows 6 months | 117.96 | |
| To grain rations, 12 cows 6 months | 29.64 | |
| To cost of producing hay roughage | 69.70 | |
| **Net profit** | **23.54** | |
| | 249.24 | 249.24 |
| Fodder corn—15 cows supplied roughage for 6 months from 10 acres: | | |
| By cash—product 15 cows 6 months | | 311.55 |
| To interest charges (15 cows at $28), $420 at 5 per cent per annum for 6 months | 10.50 | |
| To labor, 15 cows 6 months | 147.45 | |
| To grain rations, 15 cows 6 months | 37.05 | |
| To cost of producing fodder-corn roughage | 122.00 | |
| **Net loss** | | **5.45** |
| | 317.00 | 317.00 |

NOTE.—With clover and timothy hay yielding 2½ tons per acre enough forage can be produced on ten acres to support twelve cows for six months. Twelve cows of small productiveness when fed hay for forage give a net return of $23.54. Fifteen

cows fed on fodder corn from the same acreage return no net profit, but are fed at a loss of $5.45. On an acreage basis the profit from the hay crop amounts to $2.35 per acre and the net loss from the fodder corn 54 cents per acre, or a difference of $2.89 per acre in favor of the hay crop.

The gross product of the twelve poor cows fed hay is 61 per cent of the gross product of twelve good cows fed hay, as shown in Table XLV, and the total expense 77 per cent. For the fifteen poor cows fed fodder corn the gross product is 61 per cent of the gross product of the fifteen good cows fed fodder corn, as shown in Table XLV, and the total expense 79 per cent.

Thus the total expense is proportionately less for the cows fed clover and timothy hay than for those fed fodder corn and the margin of profit is greatest for the cows fed on hay.

TABLE LII.—*Relative net profits from ten acres of land devoted to the growth of forage crops and the product fed to cows of high and low productiveness.*

| Forage crop. | Yield per acre, in tons. | Number of animals fed forage six months. | Productiveness of animals. | Gross product of cows, six months. | Total expense, six months. | Net profit, six months. | Net loss, six months. |
|---|---|---|---|---|---|---|---|
| Clover and timothy | 1½ | 7 | High | $237.30 | $199.90 | 37.40 | |
| Clover and timothy | 1½ | 7 | Low | 145.39 | 160.70 | | $15.31 |
| Clover and timothy | 2 | 10 | High | 339.00 | 255.70 | 83.30 | |
| Clover and timothy | 2 | 10 | Low | 207.70 | 199.70 | 8.00 | |
| Clover and timothy | 2½ | 12 | High | 406.80 | 292.90 | 113.90 | |
| Clover and timothy | 2½ | 12 | Low | 249.24 | 225.70 | 23.54 | |
| Clover and timothy | 3 | 15 | High | 508.50 | 348.70 | 159.80 | |
| Clover and timothy | 3 | 15 | Low | 311.55 | 264.50 | 47.05 | |
| Fodder corn | 3 | 11 | High | 372.90 | 326.60 | 46.30 | |
| Fodder corn | 3 | 11 | Low | 228.47 | 265.00 | | 36.53 |
| Fodder corn | 3½ | 13 | High | 440.70 | 363.80 | 76.90 | |
| Fodder corn | 3½ | 13 | Low | 270.01 | 291.00 | | 20.99 |
| Fodder corn | 4 | 15 | High | 508.50 | 401.00 | 107.50 | |
| Fodder corn | 4 | 15 | Low | 311.55 | 317.00 | | 5.45 |
| Fodder corn | 5 | 19 | High | 644.10 | 475.40 | 168.70 | |
| Fodder corn | 5 | 19 | Low | 394.63 | 368.90 | 25.73 | |
| Clover and timothy<br>Mangels | 2<br>16 | 10 | High | 339.00 | 269.26 | 69.74 | |
| Clover and timothy<br>Mangels | 2<br>16 | 10 | Low | 207.70 | 213.25 | | 5.55 |
| Clover and timothy<br>Mangels | 2½<br>20 | 13 | High | 440.70 | 325.05 | 115.65 | |
| Clover and timothy<br>Mangels | 2½<br>20 | 13 | Low | 270.01 | 252.25 | 17.76 | |
| Ensilage | 10 | 14 | High | 474.60 | 442.50 | 32.10 | |
| Ensilage | 10 | 14 | Low | 290.78 | 364.10 | | 73.32 |
| Ensilage | 10½ | 15 | High | 508.50 | 461.10 | 47.40 | |
| Ensilage | 10½ | 15 | Low | 311.55 | 377.10 | | 65.55 |
| Ensilage | 12 | 17 | High | 576.30 | 498.30 | 78.00 | |
| Ensilage | 12 | 17 | Low | 353.09 | 403.10 | | 50.01 |
| Ensilage | 15 | 22 | High | 745.80 | 591.30 | 154.50 | |
| Ensilage | 15 | 22 | Low | 456.94 | 468.10 | | 11.16 |

NOTE.—Figures on net profit and loss presented in this table have been determined by the methods shown in Tables XLII to LI.

An examination of those figures in Table LII showing the returns from the least productive cows reveals the important influence which cost of producing forage has upon the profits from cows yielding a low gross product. With such animals the margin of profit is greatest from the fifteen cows furnished hay for roughage that yielded 3 tons per acre. Fodder corn yielding 5 tons per acre gave the second largest returns, and hay at 2½ tons per acre the third. The margin of profit is wiped out entirely when expensive feeds like ensilage are fed to poor cows.

These statistics, which have been presented in order to show the influence of cost of producing forage upon the net profits recovered from the feeding of cattle, warrant the conclusion that whenever any factors, such as low prices, low productivity in cattle, or long distance from markets causing low local prices, cause a relatively small gross product from the cattle, the greatest net profit will be recovered by the use of cheap forage crops. This fact is of particular importance in the feeding of beef cattle, where the margin of profit is normally narrower than for dairy cattle. In such cases the margin of profit can be materially widened by the use of cheap roughage, such as clover and timothy hay, whereas the margin of profit tends to be narrowed and even obliterated if expensive roughage, such as ensilage, is fed to a larger number of cattle. On the other hand, when high prices for products prevail, when cattle are highly productive, as in case of intensely bred milk cows, and where good markets are close at hand, the gross product from cattle may be increased to a point where the widest margin of profit is obtained by feeding the maximum number of cattle on a given acreage with expensive forage crops, such as fodder corn and ensilage. An increase in gross product from cattle, made possible by high-yielding forage crops, such as fodder corn and ensilage, will not yield a greater profit to the feeder than a small gross product obtained from feeding the low-yielding hay, unless the increase in product is proportionately greater than the increased expense of production.

From a purely business standpoint these investigations show that cheap forage in the form of well-cured clover and timothy, alsike, alfalfa, and bromus will return larger profits from a given area of land under average conditions in the Middle West than either fodder corn or ensilage. Certain conditions, previously cited, modify this statement, but, with the present size of farms in the Middle West, with the present average distances from markets, and the present types of dairy and beef cattle that are being fed by the majority of farmers, cheap forage, such as clover and timothy hay, is to be considered the most profitable roughage. The extensive use of alfalfa in the far West, of alsike and red clover in the New England States, and red clover in Wisconsin, Iowa, and Illinois shows that the majority of farmers consider that "cheap forage is usually the most profitable."

Systems of farming which keep the labor and machinery expense at a minimum by the extensive use of grass and legume crops for the production of pasture and forage for the live stock are popular in many agricultural regions, such as southern Minnesota, Iowa, and Illinois. The economic worth of these systems of farming is shown in the relatively large net profit per acre which is secured on the farms of these regions.

The relation which these various forage crops have to the fertility of the soil has not been included in this discussion. Were this done

the clover and timothy crop must receive a larger credit per acre for the improvement which the crop has made in the physical and chemical condition of the soil for succeeding crops than can be given to the corn crop.[a]

A scarcity of labor in any community also favors the hay crop. Larger applications of labor must be made to produce forage in the form of fodder corn or ensilage than in the form of hay, and harvest time for the fodder corn and ensilage conflicts in many communities with the thrashing and plowing season, when labor is particularly scarce and expensive. Increasing the number of cattle, as may be done when ensilage is fed, also creates a demand for more labor in milking and feeding, and securing additional reliable labor for this work is a serious problem in many regions.

The most serious objections that can be made to the use of timothy and clover hay for forage are, first, the risk of having clover freeze out; second, the difficulty of properly curing clover every year so that the hay may be digestible and free from dust. The risk of having clover freeze out in Minnesota is much lessened if the seed is sown early in the spring in a well-compacted seed bed, such as may be obtained on disked corn land or well compacted early fall plowing. Clover is killed more by heaving in the soil than by hard winters, and the heaving of soil is greatly lessened if the seed bed was well compacted. The difficulty of having clover hay spoiled by excessive rainfall can not, of course, be always guarded against, except as experience teaches the best methods for handling the crop. If clover is grown and relied upon as the main forage crop, occasional losses from freezing out can be easily met by growing such catch crops as fodder corn and millet, and occasional losses from wet weather during haying time can be met by shredding a portion of the corn crop. Unfavorable weather does not ordinarily injure the quality of fodder corn and ensilage to the extent that it will injure the quality of hay, although a wet fall will often decrease the value of fodder corn considerably through mold and heat in the shocks and the freezing of the bundles to the ground

The possibilities in yields from the various forage crops have much to do with the relative profits which may be secured. Fodder corn yielding less than 3½ tons per acre of field-cured fodder can not, under any circumstances, be considered as profitable a forage crop as clover

[a] The consideration of values of manure has been left for future publications, when investigations may have given bases for determining the values per acre of the constituents of manure, so that the manure from clover, with its larger content of nitrogen, and the manure from fodder corn and silage, with their larger bulk and greater amount per acre of humus-making materials, may be compared. The relative amounts and values per acre of the manure from different numbers of cows supported by the several kinds of roughage will also need to be determined when the necessary data are made available

and timothy hay yielding 2 tons per acre, and under average Minnesota conditions a yield of 4 tons per acre must be secured to make the two crops comparable as regards profit. It is more difficult to raise the yields of hay above 2½ tons per acre than to raise the yields of fodder corn above 3½ tons. Wet years will favor the comparative yields of hay and dry years the fodder corn. Yields of 4½ to 5 tons per acre from clover and timothy have been secured during the past four years at the Minnesota Agricultural Experiment Station in a five-year rotation of corn, wheat, hay, pasture, and oats, while the highest yields of field-cured fodder corn ever there recorded have not exceeded 5 tons per acre. Cultural experiments in growing fodder corn at the Minnesota Agricultural Experiment Station show that the highest yields have been secured by sowing not less than 3 pecks of seed per acre of the short-stalked varieties of dent corn commonly grown in Minnesota in double rows 42 inches apart, on centers, or in single rows 21 inches apart. Yields are not only larger where the fodder corn is sown in this manner, but the fodder is more digestible, and there is less waste in feeding than where less seed per acre is used. By sowing the crop somewhat later than field corn many weeds can be destroyed by harrowing, and if the crop is harrowed several times after it is up the heavy growth of fodder, after being twice cultivated, will smother the remaining weeds and leave the land in good condition for succeeding crops.

While the statistics presented in this problem may vary to some extent with local conditions, they illustrate in a general way the trend of net profits in feeding cattle with various forage crops under certain imposed conditions.

### SHREDDING CORN STOVER FOR WINTER ROUGHAGE.

In the corn-growing sections of Minnesota, as well as in those sections of the corn belt farther south, the practice of shredding the corn stover and husking the corn by machinery is becoming quite common. The advantages generally attributed to this method of handling the corn crop are, first, that it saves a by-product otherwise wasted; second, that fall work may be completed with more regularity; third, that the waste stover makes good bedding and leaves no long cornstalks in the manure; and, fourth, that the fields are cleaned up better than when the stalks are left standing, and can be tilled more thoroughly for the succeeding crop.

Were all these advantages attained when the corn crop is husked and shredded by machinery the practice would not be justified in good farm management unless the profits from the acreage of corn shredded had been increased to a point in advance of what might be secured by handling the crop by any other method. Leaving profit and loss for the moment out of consideration, the advantages attributed to the practice of shredding corn, as previously enumerated, are

not all justifiable. Shredded stover can not be considered as a by-product saved, which would otherwise be wasted, because at least one-third to one-half the food value of the mature cornstalks can be saved by pasturing the stalks, and some feeders state that in favorable autumns the pasture value is as great as the shredded stover value. Fall work can, perhaps, be completed with more regularity if the corn is cut, shocked, and shredded than if the corn is husked from the standing stalks during those days when fall plowing should be hurried. The supply of labor and the availability of shredders influence this factor materially. The waste stover undoubtedly makes better bedding and more valuable manure than the coarse cornstalks. When straw is cheap, however, and shredded stover expensive, the bedding value of the waste stover is of little real importance. When cornstalks are pastured and tramped down by the cattle during the fall and winter months no great difficulty is experienced in disking and preparing the land for small grains, or if the land is plowed the long stalks when plowed under leave as smooth a seed bed as the corn stubs.

Table LIII illustrates the relative profit in shredding a given acreage of corn as compared with producing the same amounts of nutrients in fodder corn and cornstalk pasture, and devoting the remainder of the acreage to field corn and picking the ears from the standing stalks. The comparison is based on this condition: That 30 acres of field corn are cut and the stover shredded to provide winter roughage for the cattle. This acreage represents the average corn acreage on 160-acre farms in southern Minnesota. Statistics showing the cost of producing fodder corn, corn cut and shredded, and corn husked on the hill will be found in detail in Tables XV, XVI, and XXIII.

TABLE LIII.—*Thirty acres of field corn cut and the stover shredded v. five acres of fodder corn and twenty-five acres of field corn husked from the hill.*

| | | |
|---|---|---|
| 1. Field corn—30 acres cut and shredded: | | |
| To cost of production, 30 acres, at $14.74 | $442.20 | |
| By 1,350 bushels grain at 30 cents | | $405.00 |
| By 38 tons stover (1¼ tons per acre), at $2.84 | | 107.92 |
| **Profit,** or difference between cost of production and value of products | **70.72** | |
| | 512.92 | 512.92 |
| 2. Field corn—25 acres husked from stalks, 5 acres fodder corn: | | |
| To cost of production, 25 acres, at $11.77; 5 acres, at $12.20 | 355.25 | |
| By 1,125 bushels grain at 30 cents | | 337.50 |
| By 17½ tons fodder corn (3½ tons per acre), at $4.90 | | 85.75 |
| By cornstalk pasture, 25 acres, at $1.25 | | 31.25 |
| **Profit,** or difference between cost of production and value of products | **99.25** | |
| | 454.50 | 454.50 |

NOTE.—The feeding value of a ton of stover is estimated by T. L. Haecker at $2.84 as compared with timothy hay when the latter is worth $6. Thus the total value of 38 tons of shredded stover secured from the thirty acres of field corn is $107.92.

In Table XLII it was shown that $127 worth of nutrients in clover and timothy hay would provide roughage for ten cows six months. Thus the $107.92 worth of nutrients in corn stover would furnish sufficient roughage for eight cows for six months ($127 : 10 :: $107.92 : $x$, or 8). Five acres of thickly planted fodder corn yielding 3½ tons per acre will give a product the nutritive value of which is $85.75, and if the value of cornstalks for pasture is considered as only one-third that of the shredded stover the value per acre may be conservatively placed at $1.25, or a total of $31.25 for twenty-five acres. The total value of the nutrients from five acres of fodder corn and twenty-five acres of cornstalk pasture is $117, or a trifle more than the value of the shredded stover from thirty acres. The cost of producing an acre of corn, cut and shredded, is $2.97 higher than the cost of production when the ears are picked from the standing stalks, the difference being chiefly due to the rental, or expense, for shredding machinery and the values consumed in corn binders. The smaller cost of production for the fodder corn and the field corn husked from the standing stalks leaves the greatest net profit, or difference between cost of production and value of products, in favor of the plan of devoting a small portion of the corn ground to thickly planted fodder corn and the larger portion to corn grown for ears, which are to be husked from the standing stalks, and the stalks to be pastured off by cattle.

Statistical analysis of the cost of producing shredded stover and the cash value of the nutrients secured in the product would seem to show conclusively that shredding corn stover is poor, and not good, farm economy. The figures here given indicate that much cheaper forage can be provided in the form of fodder corn or clover hay than in the form of shredded stover, and that shredding corn stover for winter roughage should be resorted to only in case the hay crop is badly weathered or other unforeseen conditions demand an additional supply of roughage when it is too late to sow a special forage crop.

### COOPERATIVE OWNERSHIP OF HIGH-PRICED MACHINERY ON SMALL FARMS.

The average cost of cutting an acre of corn with a corn binder and three horses at Northfield, Rice County, Minn., is $1.93, of which 67 cents is labor (see Table XVI), 79 cents depreciation of machinery (see Table XII), and 47 cents twine, with an additional charge of 53 cents per acre for shocking and tying (see Table XVI), and 25 cents for the cost of picking up the ears broken off by the corn binder, making a total of $2.71 per acre for cutting and shocking by machinery. The average number of acres of corn cut each year on these farms is approximately 20. It is obvious that an acre of check-rowed corn can be cut cheaper by hand than by machine, for one man can cut and shock about 1 acre a day by hand (wages $1.50). In the case of fodder corn the cost per acre will be only slightly raised for the machine cutting, but nearly doubled for the hand cutting.

These statistics are not presented as an argument against machine cutting, but merely to emphasize the great cost of cutting corn by machinery when only a few acres are cut each year by a machine. Even though the cost of machine cutting be greater than for hand cut-

ting, the machine cutting is altogether desirable, because when corn reaches the proper degree of maturity the cutting should be done as rapidly as possible in order to escape frost, and very often laborers are not available, even at prices much above $1.50 per day.

The yearly values consumed per acre in corn binders are, approximately, four times as great as in grain binders, and this difference is due principally to the difference in acreage cut. The average yearly cut of corn per farm on these statistical routes is about 20 acres, and for grain 90 acres. Undoubtedly the depreciation per acre charges for corn binders could be decreased to nearly the same level as for grain binders if the same acreages were cut each year of each class of crops, although the wear and tear on a corn binder is somewhat heavier than on a grain binder.

In those sections of Minnesota where comparatively small acreages of corn are grown cooperation in the ownership of high-priced machines, such as corn binders, will aid in reducing the expenses for producing a crop which under the most favorable conditions has a high cost of production.

Cooperation in owning high-priced machines, such as corn binders, ensilage cutters, etc., is often found good business policy. On many farms of 160 acres or less in size the annual expense for machinery is so large as to materially reduce the profits of the business. The tendency in western agriculture is to invest heavily in farm machinery on account of the scarcity of labor, and, while this is undoubtedly necessary, it should be remembered that no machine can be employed and yield a fair profit unless it be employed to nearly its full capacity. The "bonanza farmer" has a great advantage over the "small farmer" in this respect, and the advantage can be met only by cooperating in the ownership of such farm machines as are adapted to cooperative use.

## SUMMARY OF OBJECTS AND RESULTS.

### OBJECTS SOUGHT IN COLLECTING STATISTICS OF THE BUSINESS OF FARMING.

1. To aid in making a study of the business of the farm that it may be systematically conducted under the best possible plans.

2. To supply many averages which the farmer rarely secures from his own business, as cost per acre of various labor operations, and cost of producing field crop products and live stock products.

3. To determine the cost per hour of man labor and horse labor on farms.

4. To determine the yearly values consumed in farm machinery, and the values consumed per acre for the various farm crops.

5. To collect data on the feeding of farm animals as actually carried out and make comparisons of methods.

6. To secure practical data concerning the profits from the different farm animals, and to devise simple methods of making records which will determine the value of each individual animal as a producer, and the breeding value of the blood of each animal used as a breeder.

7. To keep the performance records of dairy cows, and show reasons for profit and loss on the individual animals.

8. To secure the data necessary to supplement the records of experiments in crop rotations made by experiment stations, that the net profits from the various rotations may be compared.

9. To determine and compare the net profits in various systems of present day agriculture.

10. To assist the farmer to so organize his business that such arrangement of crops and live stock may be made as will give the largest net returns.

11. To collect maps of actual surveys from many farms to be used in working out examples of reorganized field plans with systematic crop rotations.

12. To assist in inaugurating simple systems of accounts for the farm business and the farm household.

13. To secure data concerning the farm home, as the cost of living, the value of foods grown on the farm, and the cost of boarding hired help.

14. To provide practical data to be used in schools, as consolidated rural schools, agricultural high schools, and agricultural colleges, in teaching the facts and principles of farm management.

15. To aid in developing a literature on farm management, and a class of effective teachers, editors, and general writers; and to assist in overcoming the indifference to antiquated methods in farm management.

## RESULTS OBTAINED FROM THE WORK OF COLLECTING STATISTICS ON THE COST OF PRODUCING FIELD CROPS IN MINNESOTA, 1902, 1903, AND 1904.

1. The average length of the working day for men on the farms at Northfield, southeastern Minnesota, is 8.59 hours, with 3.40 hours for Sunday work. At Marshall, in southwestern Minnesota, 8.29 hours for the week days and 2.89 hours for Sundays; and at Halstad, in northwestern Minnesota, 7.43 hours for the week days and 2.19 hours for Sundays. The average length of the working day for horses at Northfield, southeastern Minnesota, is 3.08 hours; at Marshall, southwestern Minnesota, 3.29 hours, and at Halstad, northwestern Minnesota, 3.30 hours. (See Table I, p. 11.)

2. The cash value per hour of farm labor ranges from 9 cents in the winter months to 14 cents in the seasons of greatest activity, and an average of all months is approximately 12 cents per hour. Cash

value of farm labor is based upon wages paid to men hired by the month or season, plus the cost of their board. (See Tables III and IV, pp. 26, 28.)

3. The cost of board on farms is approximately $11 per month per man, or 37½ cents per day. (See Table VI, p. 29.)

4. The average cash value per hour of horse labor on farms is approximately 7½ cents. Cash value of horse labor is based upon the cost to the farmer of maintaining the horse. The total cost of feeding and maintaining a farm work horse for one year, including interest on investment and depreciation, is from $75 to $90. (See Table VII, p. 30.)

5. The values in farm machinery consumed per acre for the grain, corn, and hay crops are as follows: Northfield, southeastern Minnesota, grain, 44.6 cents; corn, $1.20; hay, 44 cents. Marshall, southwestern Minnesota, grain, 35.6 cents; corn, $1.16; hay, 37.8 cents. Halstad, northwestern Minnesota, grain, 34.4 cents; corn, 76.5 cents; hay, 33.3 cents. Large farm in northwestern Minnesota, grain, 22.8 cents; hay, 22.8 cents. (See Table XII, p. 36.)

6. The total cost per acre of producing the staple crops of ear corn, fodder corn, hay, oats, barley, and wheat is as follows: Northfield, southeastern Minnesota, corn, husked from standing stalks, $11.77; fodder corn, $12.20; clover and timothy hay, $6.97; wild hay, $5.85; oats, $9.84, and barley, $9.13. Marshall, southwestern Minnesota, corn, husked from the standing stalks, $9.96; wild hay, $5.18; oats, $8.83; barley, $8.58, and wheat, $7.89. Halstad, northwestern Minnesota, fodder corn (shocked in the field), $8.08; wild hay, $2.87; oats, $6.31; barley, $6.41, and wheat, $6.26. Large farm in northwestern Minnesota, fodder corn (shocked in field), $7.52; wild hay, $2.29; oats, $5.88; barley, $5.97, and wheat, $5.82. (See Table XIII, p. 40.)

7. The total cost per bushel of thrashing wheat from the shock at Halstad, northwestern Minnesota, is 7.4 cents, and when stacked and stack-thrashed, 10.1 cents. Oats when thrashed from the shock at Northfield, southeastern Minnesota, cost 4.3 cents per bushel to thrash, and when stacked and stack-thrashed, 5.2 cents per bushel. Thrashing oats from the shock at Halstad, northwestern Minnesota, cost 3.6 cents per bushel, and stacking and stack-thrashing, 4.9 cents per bushel. Barley, thrashed from the shock at Northfield, southeastern Minnesota, cost 4.8 cents per bushel, and when stacked and stack-thrashed, 5.9 cents; and at Halstad, northwestern Minnesota, barley cost 4.4 cents per bushel to thrash from the shock, and when stacked and stack-thrashed, 5.4 cents. (See Tables XXXVI to XLI.)

For the majority of farmers stacking and stack-thrashing the grain crops is advisable, particularly so in those localities where labor is scarce and thrashing machinery not readily available. Well stacked

grain is cheap insurance against bleached, sprouted, and bin-burned grain, and helps toward early fall plowing.

8. The cost per acre of producing winter forage for cattle in the form of mixed clover and timothy hay is $6.97; field-cured fodder corn, $12.20, and corn silage, $18.21, at Northfield, southeastern Minnesota. The use of the more expensive forage crops is profitable only where farms are located close to large city markets, where the cattle to be fed are highly bred and highly productive, and when the soil is productive and the crop so well handled as to yield maximum yields of forage (4 to 5 tons per acre for field-cured fodder corn and 14 to 15 tons per acre for corn silage). Mixed clover and timothy hay, alsike, and alfalfa are undoubtedly the most profitable forage crops for a vast majority of the farms of the upper Mississippi Valley. (See Tables XLII to LII, pp. 63–75.)

9. The cost per acre of raising field corn at Northfield, in southeastern Minnesota, and cutting and shocking the crop and shredding and husking by machinery is $14.74. The cost of raising field corn and husking the ears from the standing stalks is $11.77 per acre, and a crop of thickly planted fodder corn can be raised and the fodder hauled in to the barn for $12.20 per acre.

The most profitable plan of growing a given acreage of corn, partly for grain and partly for forage, in this agricultural region, is to devote a small portion of the corn ground to thickly planted fodder corn, and the remainder of the acreage to corn grown for ears which are to be husked from the standing stalks, and the stalks pastured off by cattle. Shredding corn stover is a costly practice that should be resorted to only in case the hay crop is badly weathered or other unforeseen conditions demand an additional supply of winter forage. (See Table LIII, p. 79.)

10. The large values consumed per acre in certain farm machines—such as corn binders and ensilage cutters—when the annual acreage cut is small, show that cooperation in the ownership of such machines is, when possible, good business policy. The farmer who manages large areas of land has a distinct advantage over the farmer managing a small farm, in the matter of making the most profitable use of his investment in machinery. This advantage can be met on farms of family size only by means of cooperation, thus causing machines to be worked to their full capacity.

The statistics presented in this bulletin, giving the results of the first three years' investigations into the cost of producing farm products, are believed to be more valuable than any data on this subject heretofore collected, because they represent actual farm conditions and have been gathered by exact methods. Still better averages will be secured when the work—now well past its experimental stage—

shall have extended over a longer number of seasons and covered a wider range of subjects.

These data collected in three agricultural regions in one State which differ in climate, soil, character of labor, and methods of farming, indicate that statistics of the cost of producing field crops, pork, beef, dairy products, etc., and general studies of the actual business of farming are needed in each agricultural region of the country. Statistics of this character, for example, gathered in Minnesota are not adapted for use in those agricultural regions where entirely different conditions exist and where other kinds of field crops are grown.

While the data secured in these investigations are deemed of sufficient value to justify the effort and expense, the most important results are the methods devised for investigating the cost of producing farm products and for studying at first hand the business of the farmer. Methods of collecting and compiling the statistics have been perfected so that wherever needed this work may be done in an exact and business-like manner. Suggestions for further perfecting the methods or broadening the scope of these investigations are solicited from farmers, agricultural investigators, economists, and others.

The statistics on the cost of producing field crops gathered in these preliminary investigations and here presented are capable of wide use, especially in the upper Mississippi Valley. Teachers and agricultural writers will find that data from investigations of this kind will guide them into making lines of instruction more definite and exact than has previously been possible. In the work of teaching farm management, crop management, and live-stock production in the Minnesota Agricultural High School the available portions of these data have already proven very useful in classes of young farmers. These data will greatly aid in making it possible to introduce the elements of instruction in farm organization and farm management into consolidated rural schools.

It is hoped that agricultural investigators will find these studies of actual farm conditions useful in interpreting results from experiments in crop rotation and other phases of farm management. Definite knowledge concerning the business of farming is as necessary to agricultural investigators as to the farmer, for the work of the chemist, the physicist, the plant breeder, and the animal husbandman should be in accord with the actual conditions and the best principles of the farm business.

If these investigations into the cost of producing farm products had accomplished nothing else than the supplying of material for developing practical schemes of farm bookkeeping they would be more than justified.

The reorganized plan of teaching farm bookkeeping in the Minnesota Agricultural High School, made possible by these investigations,

is proving to be of much greater value and interest to students who expect to make farming their business than the customary forms of bookkeeping, which are not applicable to farming. Comprehensive methods of systematically planning the management of the fields and live stock, supplemented by simple methods of bookkeeping, are needed in placing the agriculture of the future on a more business-like basis.

The fact that many farmers have made money without the aid of systematic plans for field management and farm accounts does not signify that they could not have made more money had their business been more systematically conducted with the aid of well-kept accounts, and the failures of many farmers to make financial success of agriculture are due in many instances to the lack of system and intimate knowledge of the business, which can be acquired only by means of systematic farm plans and profit and loss figures. Mistakes once made in conducting an enterprise, and which are clearly outlined and recorded in the books of the business, may be rectified in succeeding years, whereas poor methods may remain in vogue for a long period if no means are at hand for knowing the exact status of the enterprise.

Many farm enterprises are carried at a loss, which must be met by the profits from other enterprises if the farm as a whole is to be remunerative to the owner. The remedy for such conditions lies in a system of bookkeeping which will clearly show each year the financial status of each enterprise, and thus lead the wide-awake farm manager either to eliminate unprofitable enterprises or to put them on a remunerative basis.

The successful farmer of the future must know not only something of the science of farming but also something concerning the business side of farming, and business knowledge of farming can best be developed by studying the markets for agricultural products on the one hand and cost of production and the internal management of the farm on the other.

Statistics on the cost of production and concerning the general business of the farm, gathered under the methods here employed, together with data from plat experiments with crop rotations, from plat and laboratory experiments with fertilizers, from physical studies of the soil, and from the general practical experiences of proficient farm managers must be secured and made the common knowledge of our farmers if the farms of the United States are to be so planned and reorganized as to yield profits commensurate with the rapid appreciation of land values that is bound to follow the increase of population and wealth in the United States.

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