

THE UNIVERSITY OF MINNESOTA
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RECENT TENDENCIES IN THE ECONOMICS OF THE DAIRY
INDUSTRY IN MINNESOTA

A THESIS SUBMITTED TO THE FACULTY OF THE
GRADUATE SCHOOL OF THE UNIVERSITY OF MINNESOTA

by

KNUTE BJORKA
|

IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE

of

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RECENT TENDENCIES IN THE ECONOMICS OF THE DAIRY

INDUSTRY IN MINNESOTA

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RECENT TENDENCIES IN THE ECONOMICS OF THE DAIRY

INDUSTRY IN MINNESOTA

Chapter 1.

INTRODUCTION

PURPOSE AND METHOD OF THE STUDY

Purpose. - The purpose of this study is to show the importance of the dairy industry in the various sections of Minnesota, to determine the recent changes in dairying as it relates itself to the other farm enterprises and to ascertain the causes for the changes.

Method of Study. - It seems desirable to divide this study into three parts.

1. To make a brief survey of the dairy industry in the United States, in order to determine the position Minnesota holds in relation to other states, and to discuss the forces commonly considered favorable to live stock production in general, and dairying in particular.

2. To study the geography of the dairy industry in Minnesota for 1920, to show the changes in dairying from 1910 to 1920 and to show what other changes have occurred during the period.

3. To analyse the causes for the changes of location and extent of dairying in Minnesota from 1910 to 1920.

BRIEF SURVEY OF THE DAIRY INDUSTRY IN THE UNITED STATES

There are several outstanding dairy areas in the United States. The greatest center of dairy production consists of the so-called Elgin district in northern Illinois and the adjoining counties of southwestern Wisconsin. A scarcely less important district includes central New York, the St. Lawrence Valley, and northwestern Vermont. A third district extends northeasterly from Baltimore, Maryland, to the Hudson Valley of New York. This is primarily a market milk district supplying the adjacent large cities. Other important dairy districts are northeastern Ohio, northeastern Iowa and southeastern Minnesota. Outside of these more definite dairy areas there is a rather uniform distribution of dairy cattle in the eastern half of the United States. This represents largely cows kept on farms to supply domestic needs. (1)

Over one-fourth of the dairy cows in the United States in 1910 were found in four states, Wisconsin, New York, Iowa and Minnesota. The receipts from sale of dairy products of the above four states together with Pennsylvania and Illinois were in 1909 over one-half those of the entire country. (2)

According to the federal census of 1910 (3) there were 20,625,432 dairy cows in the United States, of which Minnesota had 1,085,388 or 5.25 per cent. The total value of dairy products on farms (excluding home use of milk and cream) in the United States for 1909 was \$596,413,463, of which Minnesota is credited with a value of \$29,129,406, or 4.9 per cent. Minnesota

(1) Geography of World Agriculture, page 124.

(2) Geography of World Agriculture, page 120.

(3) Thirteenth Census of the U. S. - 1910.

(3)

ranked fourth in the United States in 1910 in the number of dairy cows on farms, while in 1900 she held ninth position. In 1910 Minnesota was exceeded by New York, Wisconsin and Iowa.⁽¹⁾ In the value of dairy products (excluding home use of milk and cream) for the same period she held seventh place, being surpassed by the three above named states together with Pennsylvania, Illinois and Ohio.⁽²⁾ By 1920 Minnesota had advanced to third place among the states in the number of dairy stock, being surpassed by Wisconsin and New York. In the value of dairy products for 1919 she held fourth position, being exceeded by Wisconsin, New York and Pennsylvania.

FACTORS ENCOURAGING LIVESTOCK PRODUCTION

There are certain forces commonly considered influential in determining the location and extent of the livestock industry. It must be kept in mind, however, that live stock production in Minnesota is carried on almost entirely as an enterprise of diversified farming, and not as an industry by itself. Altho some specific live stock enterprise, as dairying or beef raising may be a major one in a certain section, the study of forces which influence its location and extent must be in its relation to the entire farm business. The factors which encourage live stock production, whether dairy or beef will first be considered.

PRODUCTION OF HAY AND FORAGE

Utilization of Unmarketable Forage. - Andrew Boss⁽³⁾ states that

(1) Thirteenth Census of U.S.- Abstract - page 348.

(2) Fourteenth Census of U.S. Agricultural Reports to separate states.

(3) Farm Management, Andrew Boss - page 128.

investigations of cost of production indicate that the greatest profit of live stock is made when the animals are fed on cheap feeds as silage and pasture. He further says,⁽¹⁾ "The most of the profits from live stock raising are derived from (1) a conversion into concentrated marketable product of cheap bulky foods that would otherwise be wasted. (2) By the use of labor that does not have full value but which must be supported, whether employed or not". H. C. Taylor⁽²⁾ calls attention to the large amount of unmarketable forage on the farm annually, as soft corn, corn fodder, second growth of grain fields and meadows and grass grown on land suited for tillage or hay crops. This can be converted into valuable products by means of live stock. G. F. Warren⁽³⁾ states, that most of the cattle of the world is grown on pasture, too wet, too dry, too steep, too stony, or otherwise not adapted for the growth of crops. Where land is well adapted to crops, cattle production is usually a minor business, altho cattle are often fattened there. There are fewer cattle in the corn-belt because of the small amount of rough pasture.

Utilization of Marketable Forage and Grain. - Marketable coarse grains and forage are largely consumed where they are produced. H. C. Taylor says⁽⁴⁾ "Four out of every five of the corn producers of the United States feed their entire crops. From 80 to 82 per cent of the corn is consumed on the farms where produced, and much of that sold is consumed on other farms. About one-fourth of the oats is sold from the farms where grown, and nearly ninety-ninths of the hay and coarse food is consumed on the farms where grown". This he accredits to the higher freight charges on coarse fodder and grain

(1) Farm Management, Andrew Boss - page 132.

(2) Agricultural Economics, H. C. Taylor - page 54.

(3) Dairy Farming, Eckles and Warren - pages 203 and 204.

(4) Agricultural Economics, H. C. Taylor - page 56.

over live stock and live stock products, due to their bulkiness. Live stock rates are about twice that for corn in carload lots for the same distance. However, since it is assumed that the feeding of corn to hogs and cattle condenses the product to one-sixth of its original weight, there would be a saving of two-thirds the freight by sending the condensed product.⁽¹⁾

Table 1 shows the existence of a correlation between the production of cattle and hay and forage, and also between the number of cattle and tons of hay and forage per 100 acres of improved land. Naturally, the geography of the regions will tend to modify the relationship somewhat. The warmer climate of the south favors a longer grazing season so that relatively less hay and forage need to be provided than in the areas further north where the climate is more severe and the sheltering period is longer. This evidently accounts for the small amount of hay and forage produced in the west South Central region in proportion to the number of cattle.

Beef production is limited by the amount of grazing area available, while the amount of pasture and roughage grown limits the number of dairy cows, except for dairymen located near a favorable market.⁽²⁾

(1) Agricultural Economics, H. C. Taylor - page 57.

(2) Farm Management, Andrew Boss - page 134.

Table 1. - Relation Between Cattle and Production of Hay and Forage. (1)

Region	: Improved : Land in : Farms : (acres)	: All : Cattle	: Tons of Hay : and Forage	: Cattle : per 100 A. : Improved : Land	: Tons of : Hay and : Fodder : per 100 A. : Improved : Land
New England	: 7,254,904	: 1,336,550	: 4,659,906	: 18.4	: 64.2
Mid. Atlantic	: 29,320,894	: 4,232,521	: 11,302,178	: 14.4	: 38.5
E.N. Central	: 88,947,228	: 9,819,097	: 20,391,562	: 11.1	: 22.9
W.N. Central	: 164,284,862	: 17,647,714	: 36,326,167	: 10.7	: 22.1
S. Atlantic	: 48,479,733	: 4,839,321	: 2,917,870	: 10.0	: 6.0
S.E. Central	: 43,946,846	: 3,942,526	: 2,565,716	: 9.0	: 5.8
W.S. Central	: 58,264,273	: 10,721,012	: 3,383,010	: 18.4	: 5.8
Mountain	: 15,915,002	: 6,060,725	: 8,600,736	: 38.1	: 54.0
Pacific	: 22,038,008	: 3,204,400	: 7,306,590	: 14.5	: 33.2

(1) Table obtained from Thirteenth Census of U.S. - 1910.

Soil and Climate as it Affects Hay and Forage Growth. - The soil and climate, therefore, influence live stock production, inasmuch as they are factors affecting pasture and forage growth. The productivity of the soil is a limiting factor in the amount of crops produced. The climate affects the crops grown, which in turn has a bearing on the animals raised. (1) A sufficient amount of moisture is necessary for plant growth. Still more important than a sufficient amount, is to have rain at the right time. (2)

Better Utilization of Labor. - Live stock farming or general farming, where live stock has a definite place, can make better utilization of

(1) Farm Management, G. F. Warren - page 51.

(2) Farm Management, Jacob H. Arnold - Chap. 3.

labor than where only crops are grown.⁽¹⁾ Stock requires the greatest attention in the winter in sections where sheltering is necessary, consequently, live stock fits into the general farming program nicely. As referred to previously, children of the family usually assist with some of the work with live stock, which means that labor having oftentimes no market value is put to profitable service. Diversified farming makes it easier to employ a uniform amount of labor thruout the year.⁽²⁾

Soil Fertility More Easily Maintained. - The fertility of the soil can best be maintained by means of live stock. Charles F. Curtis says,⁽³⁾ "If fertilizing material must be bought for the farm, it can, under all ordinary conditions, be bought in vastly cheaper form as feedstuffs and utilized as such, and the residue applied to the soil, than by purchasing fertilizers outright. The very best of fertilizers are often obtained in this way without any direct outlay. The use of feedstuffs, rich in fertility, may even return a handsome profit as a separate proposition, and thus fertilizing constituents come on to the farm under most advantageous circumstances - - -". The manure value per cow, based on the increase of yield on the land to which it was applied was calculated as follows in Minnesota Agricultural Extension Division Special Bulletin No. 19⁽⁴⁾: It was estimated a 1,000 pound cow voided 13.5 tons of manure annually, which with bedding was 14.6 tons. It was further assumed that 70 per cent was saved, which meant 10.2 tons per cow. Based on the prices of feedstuffs in 1917 a reasonable value of \$2.00 per ton at the barn was used. The manure value would be approximately \$20. per

(1) Profitable Stock Feeding, H. R. Smith - page 5.

(2) Farm Management, Fred W. Cord - page 74.

(3) Chas. F. Curtis, Dean of the Iowa Agricultural College. Extract from a paper entitled "Economic Functions of Live Stock", read before the Economic Section of the A. A. A. S., St. Louis, Dec. 1903, quoted in Agricultural Economics, H. C. Taylor - page 55.

(4) The Cost of Milk Production, By F. W. Peck and Andrew Boss - page 4.

cow, per year. The Cornell Experiment Station⁽¹⁾ when determining the value of manure from a cow, based on the fertilizing constituents, placed the value at \$2.26 per ton. In its studies in "Cost of Milk Production"⁽²⁾ at the same station, a uniform credit of \$15 a year as the value of manure obtained from a dairy cow and \$10 for a bull was used. The estimated value of manure per ton varies. Altho farmers as a rule do not place a stipulated value on the manure, their opinion is general, that the soil responds to its application and that it aids in making the land more productive.

CONDITIONS FAVORING DAIRYING IN PREFERENCE TO OTHER

LIVE STOCK

The above factors are ordinarily considered as encouraging the live stock industry in general. We may now consider the forces which favor dairying, rather than other live stock production.

Areas Favorable to the Market Milk Industry. - The centers of population are consuming large quantities of milk, as such. About one-third of all the milk produced by the twenty million dairy cows in the United States is sent to town to be used as milk, cream or condensed milk. About twenty per cent of the total milk produced is sold to consumers of milk, the major portion being used as food for infants and young children. Fully two-thirds of the 2,250,000 infants in the United States, or 1,500,000, are being raised wholly, or very largely, upon milk of the cow rather than at the breast.⁽³⁾ The annual per capita consumption of milk in cities is about 112 quarts, and in the farm family about 288 quarts.⁽⁴⁾ About two-thirds of the American people

(3) Productive Dairying, R. M. Washburn, - page 383.

(1) Feeds and Feeding, Henry - page 249, Figures adapted from N. Y. (Cornell) Exp. Sta. Bul. No. 56.

(2) Cost of Milk Production, Cornell Bul. 357 - page 141.

(4) U.S.D.A. Bulletin No. 177, pp. 17, 18.

live in towns and cities and milk must be carried from the farms to them daily.⁽¹⁾

Since milk and cream are such perishable commodities, the areas producing them must be reasonably near consuming centers. The Twin City Milk Producers Association, which furnish approximately three-fourths⁽²⁾ of the milk consumed in Minneapolis and St. Paul, received its supply within forty miles of the cities. New York goes out 200 miles for its supply and Chicago 150 miles.⁽³⁾ Due to the market milk industry, dairying is stimulated near cities and larger towns, the larger the center of population the further out dairying will extend.

AREAS FAVORABLE TO THE ICE CREAM INDUSTRY

The ice cream industry is consuming a large quantity of milk and cream. The Preliminary Report of the Joint Committee on Dairy Products, Live Stock and Poultry, of the State of New York⁽⁴⁾ is quoted as follows: "While there was considerable more than one hundred and fifty million gallons of ice cream manufactured this year in the United States,⁽⁵⁾ we will take that as a basis of figures showing the amount of dairy products which the ice cream industry uses annually.

"The great bulk of commercial ice cream is made from milk, cream and whole condensed milk. The milk and cream are the basis of the ice cream flavor and the condensed milk, through its high total solid content, provides

(1) Marketing Agricultural Products - B. H. Hibbard - page 343.

(2) An estimate made by C. A. Borncamp of the Traffic Department of the Association.

(3) Twin City Milk Producers Bulletin Vol. V. No. 9, Sept. 1921, p.2.

(4) The report was transmitted to the legislature Feb. 15, 1917, page 775.

(5) Report covers 1916.

body and substance for the ice cream. On the basis mentioned, the ice cream industry used this year thirty million gallons, or two hundred and fifty million pounds of cream; two hundred fifty-five million pounds of whole milk, and fifteen million gallons, or one hundred and thirty-two million pounds of condensed. The cream represents one hundred and fifty million gallons of raw milk. The condensed represents forty-five million gallons of raw milk, and this added to the thirty million gallons of whole milk used and mixed with the cream and condensed makes a total of two hundred and twenty-five million gallons of whole milk."

The cream and milk for ice cream purposes should be sweet⁽¹⁾. Consequently, it must be produced near the places of manufacture and where transportation is efficient. Since the product is practically like that furnished as market milk, which has previously been discussed, dairying will naturally tend to develop close to centers of population.

AREAS FAVORABLE TO PRODUCTION OF BUTTER, CHEESE AND
CONDENSED MILK

The areas favorable for the production of butter, cheese and condensed milk are similar, in general, as distinct from the areas suited for market milk and milk and cream for ice cream purposes. Powdered milk is not considered separately as it is an industry conducted mainly in connection with the market milk industry, in order to take care of the surplus during flush periods. Cheese production has the special peculiarity that it is nearly all produced in cool regions that have a limestone soil or have a soil fairly

(1) The Book of Ice Cream, Walter W. Fisk, page 11.

well supplied with lime.⁽¹⁾ The Americans are bread eaters, and uniformly consume butter with the bread. This calls for a large butter-producing industry.⁽²⁾ Since butter, cheese and the condensed milk industries are so similar in nature, they will be considered together.

Definite lines of demarkation cannot be drawn between dairy sections producing butter and cheese and sections producing market milk and milk for ice cream purposes. When demand for one increases or decreases, the farmers, on the margin, can quite readily adjust their marketing so as to secure the greatest profit. If the market milk industry offers larger profits than the creamery, some of the creamery patrons will sell their milk, while if greater returns are obtained from making the dairy product into butter, some of market milk producers will dispose of their product to the creamery. However, dairy farmers living farther away from the consuming market, or a greater distance from a direct transportation route, are not so favorably situated for disposing of their product, as milk and cream, as those located nearer. Because of the perishability of the product, it must reach the market without much delay. Then, too, the bulky character of the milk and cream makes transportation costs higher than for farmers located nearer consuming centers. Butter, cheese, condensed milk and milk powder are easily shipped. Consequently, these products can be produced satisfactorily at a greater distance from the consuming centers than milk and cream sold as such.

Since the areas furnishing market milk and products for the making of ice cream develop near the larger cities, and since live stock production in general is largely dependent on pasture, hay and other forage, the question must be considered as to what factors influence the outlying regions in

(1) Dairy Farming - Eckles and Warren - page 215.

(2) Principales of Rural Economics, Carver - page 105.

determining the type of live stock raised.

Beef animals can thrive on ranges that are too poor to support good dairy cows.⁽¹⁾ The very poor ranges, however, are fit only for sheep and goats.⁽²⁾ The corn belt is preeminently the hog belt, and the region for finishing beef cattle. In the corn belt the farmer finds it profitable to put in a full day in the corn field. Labor demands made by hogs and beef cattle are almost negligible during the time of the year when corn is demanding attention, whereas the dairy makes a heavy drain on the farmer's time thruout the summer, and hence the dairy cow is relatively a stronger competitor in the region where corn is a less profitable crop than in the heart of the corn belt.⁽³⁾ Beef cattle can also be shipped long distances conveniently, so that they can be grown farther from the centers of population.⁽⁴⁾ The desirable combination of growing the beef cattle on ranges of the west, and grazing areas of the south, where pastures are usually scant, and shipping them into the corn belt for fattening, makes both these areas more suited for beef than dairy production.⁽⁵⁾

The north edge of the corn belt is the principal dairy region of the country, partly because of the demands made by cities for whole milk, and partly because the corn is in danger of being damaged by frosts and can be more safely handled thru the silo.⁽⁶⁾ In Europe, where corn is not a dependable crop, root crops are grown for dairy cows to furnish succulent feed, instead of silage. Silage is cheaper than roots, yields more per acre and requires less labor, consequently is preferred where it can be grown.⁽⁷⁾

(1) Dairy Farming, Eckles and Warren - page 210.

(2) Farm Science, W. J. Spillman - page 303.

(3) Agricultural Economics, H. C. Taylor - page 59.

(4) Dairy Farming, Eckles and Warren - page 210.

(5) Principles of Rural Economics, Carver - page 104.

(6) Agricultural Economics, H. C. Taylor - page 59.

(7) Principles of Rural Economics, Carver - page 106.

The north is more important in dairying than the regions further south. W. J. Spillman⁽¹⁾ states, the reason for this is that the dairy cows is a means for furnishing winter employment to the farmer, and that it is difficult to handle milk and cream in the hot summers of the south. G. F. Warren⁽²⁾ says, "Cool regions are more favorable than hot ones for the dairy cow as well as for the manufacture of dairy products".

Dairying is a more intensive type of industry than beef raising. It requires more labor for the same number of animals kept, than does beef production. The labor is more evenly distributed over the year in dairying than in beef raising. Beef cattle are ordinarily pastured during the summer and sheltered and fed only during the winter months. Dairy cows are also pastured during the summer, but they require daily attention at the time of milking. Often, too, silage or soiling feeds are provided for dairy cows on pasture, which require additional labor. The children of the family, and frequently the wife, generally assist with the milking.⁽³⁾ This often means that additional income can be obtained from the use of family labor, which would otherwise not be secured. The utilization of unmarketable labor is often a factor with farmers having families of several children.

Because of the more intensive nature of the industry, either more labor must be used on a dairy farm or less acres taken care of by the family. G. F. Warren says,⁽⁴⁾ "The typical American farm is a family-farm; one of such a size that the family does most of the farm work, with some hired help. In 1909, only 46 per cent of the farms had any hired labor". Since it is so common for a farmer with his family to take care of his own labor, dairying being of a more intensive nature than beef raising, is better suited to the smaller farms.

- (1) Farm Science, Spillman - page 306&307.
(2) Dairy Farming, Eckles and Warren - page 203.
(3) Farm Management, G. F. Warren - page 123-124.
(4) " " " " " - page 239.

A satisfactory market must be provided if dairying shall develop in the regions away from the larger cities. This has been done by providing local plants which manufacture the milk and cream of the farm, into butter, cheese, condensed milk, or other products. The invention and general use of the centrifugal cream separator, and the Babcock milk tester, have helped to make these plants adaptable to the producing communities. Localities otherwise favorable to dairying were often given additional encouragement by the building of co-operative creameries or cheese factories in the producing areas, where satisfactory privately owned plants were not found. The local manufacture of the raw, bulky, product into milk, cheese, condensed milk or powdered milk, which can be easily disposed of at distant markets, at a minimum cost of transportation, has been favorable to the dairy industry in regions more remote from the larger cities.

Other things being equal, dairying is favored rather than other live stock because of its fairly certain and regular income thruout the year. Other live stock ordinarily bring in income once or twice a year, while the dairy herd furnishes an income at quite regular intervals. Beef cattle are usually sold off the pasture, or from the feed lot in the spring. Hogs may be marketed at various times of the year, but the disposal is at irregular intervals. Creameries pay once or twice a month, some even daily. Those furnishing market milk are paid semi-weekly, weekly or oftener. Farmers retailing their own milk and cream have a daily income. This has the advantage that current expenses of the home may be paid as contracted.⁽¹⁾ The more regular income is a factor in favor of the dairy industry.

In summarizing the factors favorable to dairying, in preference to

(1) Productive Dairying, R. M. Washburn - page 16.

other live stock production, the areas adjoining the centers of population, and extending out, when provided with efficient transportation facilities, will tend to develop into dairy districts, supplying milk and cream for market milk and ice cream purposes. Areas further out, supplied with rough land suited for pasture rather than crops, and growing plenty of hay and forage will tend to dairying. The cooler climate of the north is more favorable than the south. This being outside of the corn-belt can still produce corn for silage purposes, which provides succulent feed for the dairy cow. Dairying being suited to more intensive farming than beef raising, will be encouraged by farmers having available family labor, or living on smaller farms. Local creameries, cheese factories and condenseries aid in furnishing a satisfactory market for the dairy products. The regularity of the income obtained, is an added inducement. These are factors favorable to dairying in preference to other live stock production.

CHAPTER II.

GEOGRAPHY OF THE DAIRY INDUSTRY IN MINNESOTA - 1920.PURPOSE OF A MEASURE OF IMPORTANCE OF A FARM ENTERPRISE

To determine the geography of the dairy industry in Minnesota some comparison must be made that will measure the importance of dairying in the various counties of the state. In this study, the aim is to show the importance of dairying in its relation to the other farm enterprises, rather than as an enterprise by itself. This may be approached in one of several ways.

THE IMPORTANCE OF DAIRYING AS SHOWN BY NUMBER OF DAIRY COWS.

The number of dairy cows is a common measure of the importance of dairying. In reporting to the census enumerators, farmers know more accurately the number of dairy cows they have than the amount of dairy products produced during the year, or the value of those products. The amount of dairy products and the value of the products produced in a year usually necessitates an estimate. Consequently, we may expect the figures on the number of dairy cows to be more reliable than the data on the amount or the value. The importance of dairying as shown by the number of dairy cows may be used in several different ways.

Number of Dairy Cows per County. - The number of dairy cows per county is sometimes used. The Bureau of the Census present their figures in this way in the original tables. These statistics are readily accessible. However, the area of the counties vary so that it makes it an unsatisfactory basis for comparison. Otter Tail County had 1,095,739 acres of land in farms

in 1920, while Cook County had only 18,334 acres. The rest of the counties came somewhere in between. The improved land in farms shows equally wide variations, with Polk County having 842, 208 acres of improved land and Cook County 2,733 acres.

Number of Dairy Cows per 100 Acres of land. - Basing the calculation upon the number of dairy cows per 100 acres of all land in the various counties, eliminates the objection of variation in size of counties. However, no differentiation is made between land used for productive purposes, and land which is not. The cut-over region in northern Minnesota, with millions of acres yielding no income whatever, will thereby show the dairy industry relatively less important than it actually is as a farm enterprise, compared with regions where the major portion of the land is used for farming purposes. The per cent of land area in farms in 1920 ranged from 1.9 per cent in Cook County to 95.6 per cent in Yellow Medicine County. Consequently, comparing the number of dairy cows per 100 acres of all land is not satisfactory.

Number of Dairy Cows per 100 Acres of Improved Land. - The number of dairy cows per 100 acres of improved land is frequently used. It has the advantage over the other methods referred to in that it comprises most of the productive land. There are exceptions to this, however, as some land classified "unimproved", as meadows, cut-over land, swampy and stony land is used for pasture for dairy cows. Land lying fallow and land in farmstead is classed "improved" but may not be productive. Then, too, all land classed "improved" is not equally important. The five year average value of hay in Minnesota is given by the U. S. Department of Agriculture⁽¹⁾ as \$10.44 per

(1) U.S.D.A. Yearbook, 1914 - (5 year average 1910-1914)

acre while potatoes for the same period were valued at \$47.44 per acre. It will be seen from this that to evaluate all crops the same does not give to each its relative importance.

Number of Dairy Cows Per 100 Acres of Crops, Weighted. - In basing the study on the number of dairy cows per 100 acres of crops, weighted, the various crops are valued according to their importance. Difficulties arise in attempting to arrive at weights that will serve as satisfactory indices. Uniform weights for each crop must necessarily be adapted and used in all counties of the state. Discrepancies arise here as the value of the crops often vary among the different counties of the state. Even tho the weights can be only approximate, basing the study on the weighted crops is more significant than basing it on crop acres, or improved land, without applying any weights. Consequently, this study will be made on the basis of the number of dairy cows per 100 acres of crops, weighted.

Weighting of Crops. - In studying dairying on the basis of acres of crops, weighted, only crops that are relatively important in the state are used. They are corn, wheat, oats, barley, rye, flaxseed, hay and potatoes. Some other crops are important in certain sections, but relatively of less importance in the state as a whole. In order to give some consideration to these, and other productive land omitted, the difference between the total acreage of improved land and the acreage comprising the crops specified is given a uniform weight. This includes all land regularly tilled or mowed, land in pasture which has been cleared or tilled, land lying fallow, land in gardens, orchards, vineyards, and nurseries, and land occupied by farm buildings,⁽¹⁾ not used for the crops listed above. Most of this is pasture. Con-

(1) Fourteenth Census of U. S. 1920. Explanation of terms in Agricultural Report for Minnesota. - page 3.

sequently, when using a uniform weight, the weight is based on pasture.

Some measure of importance of the various crops must be adopted. The value of the crops per acre, and the labor requirements per acre, would both serve this purpose. Since the value of the crop reflects, in a measure, the labor required by the crop, and since data on the value per acre is more complete and more accessible than data on labor requirements, the weights will be determined upon the value of the crops per acre.

In determining the weights to use for the various crops, based on the value per acre, a five year average (1910-1914) for Minnesota, as given by the U. S. Bureau of Crop Estimates⁽¹⁾ is used. Pasture is more difficult to evaluate. This value is not given by the above source. The value of pasture per acre is estimated on the same basis as was used by the Minnesota Station in its "Cost of Milk Production"⁽²⁾ studies, where pasture for the year was valued at 6 per cent of the land value. The average land value per acre given for 1910 was \$36.82⁽³⁾ on which the 6 per cent was figured, or \$2.21 per acre. New York in its "Cost of Milk Production"⁽⁴⁾ studies used 5 per cent of the land value per acre and added \$1 per acre for general expense. Pasture, having the lowest value per acre is given the weight of one. The weights of the other crops bear the same relation to the pasture weight as the value of these crops bear to the value of pasture. All crops, represented by improved land not in the crops given weights, is given the same importance as pasture, with a weight of one. This is because pasture is not classified separately in the U. S. Census and constitutes the largest portion of the improved land, after removing the important crops that are weighted. The

(1) From U. S. D. A. Yearbook - 1914.

(2) Minn. Agr. Exp. Sta. Bul. 173.

(3) Obtained from U.S.D.A. Yearbook of 1914. Figures based on census of 1910.

(4) N. Y. Exp. Sta. Bul. 357.

crops, value of crops per acre, and the weights used, are given in Table II.

TABLE II. - CROPS, AVERAGE VALUE PER ACRE AND WEIGHTS USED.

Crop	Average Value per acre (1910-1914)	Weight
Corn	\$16.95	8
Wheat	11.75	5
Oats	10.49	5
Barley	13.22	6
Rye	12.56	6
Flaxseed	13.40	6
Hay & Forage	10.44	5
Potatoes	47.44	21
Pasture	2.21	1
All other crops on improved land		1

The source of the data used in the U. S. Census report. The figures on number of dairy cows per county include the two classes, "Cows and heifers 2 years old and over", and "heifers 1 year old and under 2 years". Cows and heifers 2 years old and over would more nearly represent the productive animals, but one year old cows and heifers were included in order to facilitate comparison between 1910 and 1920 figures, which will be discussed later. In 1910 a different classification was used by the census. Including one year old cows and heifers will not tend to modify the results any.

Figure 1 is a map showing the number of dairy cows per 100 acres of crops, weighted. The map shows at a glance the relative importance of the

different counties in dairying when the number of dairy cows are compared with the weighted crop acres. The same information is also found in column three of Table III.

COMPARING NUMBER OF COWS, GALLONS OF MILK AND VALUE OF PRODUCT

In Basing the study upon the number of dairy cows per 100 acres of crops, weighted, the gallons of milk per 100 acres of crops, weighted, and the value of dairy products per 100 acres of crops, weighted, were used as a check.

Number of Cows Per County. - The number of dairy cows per county, as shown by the census report may involve some error. It is difficult where animals are kept for both dairy and beef purposes for enumerator and farmers to know under what classification the animals correctly belong.⁽¹⁾

Gallons of Milk Per County. - The gallons of milk produced per county is more difficult to obtain. Records of production are not commonly kept by farmers, and estimates must be made.⁽²⁾ Consequently, we may assume that this is the least authentic of the three bases. Its purpose is as a check, however.

Value of Dairy Products Per County.⁽³⁾ - The value of dairy products is also subject to error. However, farmers selling their butter fat, cream and milk to creameries, milk distributors, ice cream manufacturers or condensaries, where they receive payment at regular intervals, as once, or twice a month, can ascertain quite accurately, and often exactly their total dairy

(1) In 1920 dairy cows were defined as those "kept mainly for milk production".

(2) The 1920 U. S. Census report states that the quantity of milk produced includes, in addition to the amount of milk reported, an estimate of the amount of milk produced on farms which reported dairy cows but failed to report any milk. Where milk was reported from farms which reported no dairy cows it is included in the total on the assumption that it was either produced by beef cows milked as part of the year or by dairy cows on farms during the year, but were not there on Jan. 1st, 1920 when the census was taken.

(3) Fourteenth U.S.Census-1920. Includes value of milk, cream and butter and cheese made, excluding milk and cream consumed as such, on the farm where produced.

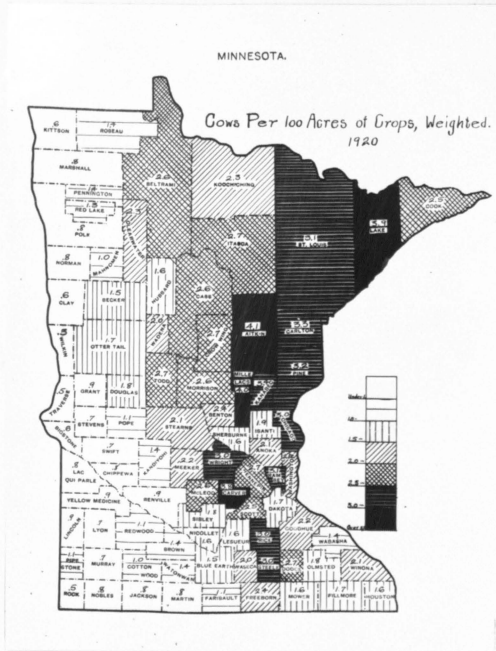


Figure 1.

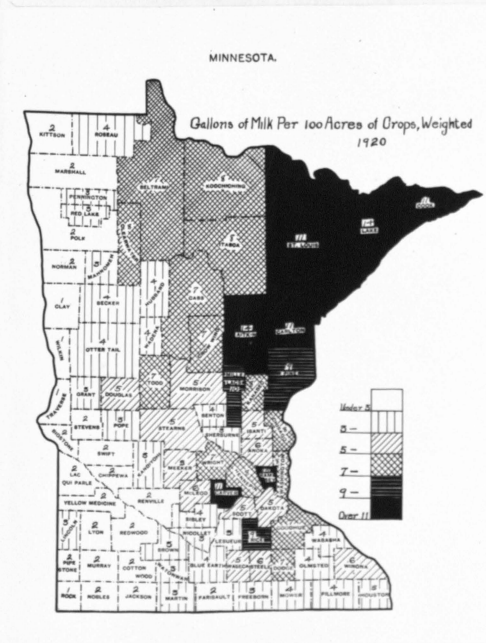


Figure 2.

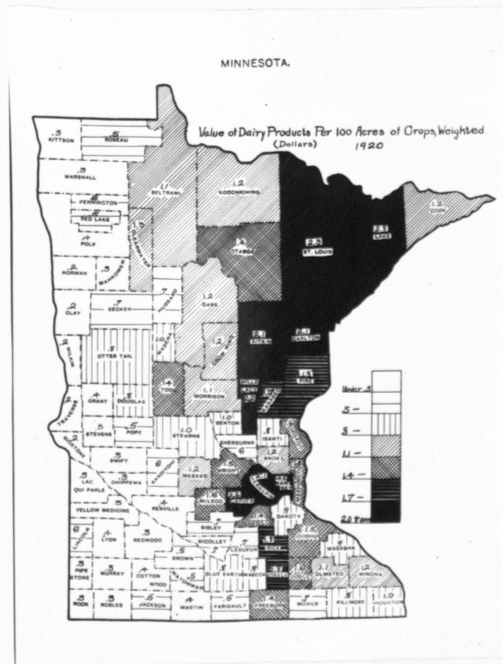


Figure 3.

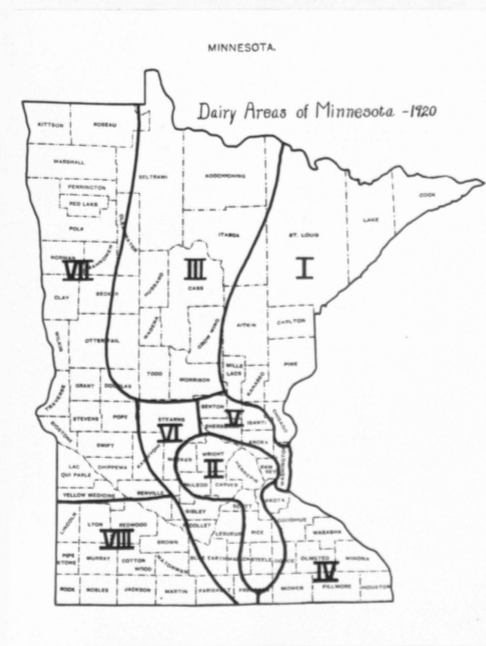


Figure 4.

The study of the importance of dairying in Minnesota on the basis of the number of dairy cows, gallons of milk and value of dairy products per 100 acres of crops, weighted, gives very similar results. Figures 1, 2, and 3 furnish the basis for locating the dairy areas in Figure 4.

TABLE III. - DAIRY COWS, GALLONS OF MILK AND VALUE OF DAIRY PRODUCTS PER 100
ACRES OF CROPS, WEIGHTED - 1920.

County	: Acres of : crops, : weighted	: Dairy Cows : per 100 A. of : crops, weighted	: Gallons of Milk : per 100 A. of : crops weighted	: Value of Dairy : Products per 100 A. : of crops, weighted
Aitkin	: 299	: 4.1	: 14	: 2.1
Anoka	: 725	: 2.1	: 6	: 1.2
Becker	: 1311	: 1.5	: 4	: .7
Beltrami	: 442	: 2.6	: 7	: 1.1
Benton	: 746	: 2.4	: 4	: 1.0
Big Stone	: 1133	: .6	: 2	: .2
Blue Earth	: 1657	: 1.5	: 4	: .8
Brown	: 1377	: 1.4	: 3	: .5
Carlton	: 303	: 3.3	: 11	: 2.1
Carver	: 727	: 3.8	: 11	: 2.6
Cass	: 377	: 2.6	: 7	: 1.2
Chippewa	: 1531	: .8	: 2	: .3
Chisago	: 775	: 3.0	: 8	: 1.6
Clay	: 2707	: .6	: 1	: .2
Clearwater	: 321	: 2.3	: 8	: 1.3
Cook	: 15	: 2.5	: 11	: 1.2
Cottonwood	: 1433	: 1.0	: 2	: .4
Crow Wing	: 366	: 2.7	: 7	: 1.2
Dakota	: 1174	: 1.7	: 5	: .9
Dodge	: 883	: 2.7	: 7	: 1.6
Douglas	: 1210	: 1.8	: 5	: .8
Faribault	: 1834	: 1.1	: 2	: .5
Fillmore	: 1639	: 1.7	: 4	: .8
Freeborn	: 1441	: 2.4	: 3	: 1.4
Goodhue	: 1559	: 2.2	: 7	: 1.5
Grant	: 1267	: .9	: 3	: .4
Hennepin	: 1128	: 2.7	: 8	: 2.1
Houston	: 834	: 1.6	: 5	: 1.0
Hubbard	: 402	: 1.6	: 4	: .7
Isanti	: 933	: 1.9	: 5	: .8
Itasca	: 183	: 2.7	: 8	: 1.4
Jackson	: 1734	: .8	: 2	: .5
Kanabec	: 439	: 3.4	: 8	: 1.7
Kandiyohi	: 1753	: 1.4	: 3	: .6
Kittson	: 1573	: .6	: 2	: .3
Koochiching	: 97	: 2.3	: 8	: 1.2
Lac Qui Parle	: 1778	: .8	: 2	: .3
Lake	: 19	: 3.9	: 14	: 2.8
LeSueur	: 967	: 1.6	: 3	: .7
Lincoln	: 1211	: .9	: 3	: .6
Lyon	: 1497	: .7	: 2	: .4
McLead	: 1165	: 2.6	: 6	: 1.6
Mahnomen	: 422	: 1.0	: 3	: .3
Marshall	: 2208	: .8	: 2	: .3
Martin	: 1914	: .8	: 3	: .4

TABLE III. (continued)

County	: Acres of : crops, : weighted	: Dairy Cows : per 100A. of : crops, weighted	: Gallons of Milk : per 100 A. of : crops weighted	: Value of Dairy : Products per 100 : A. of crops, weighted
Meeker	: 1323	: 2.2	: 5	: 1.2
Mille Lacs	: 473	: 4.0	: 10	: 2.2
Morrison	: 1248	: 2.6	: 5	: 1.1
Mower	: 1548	: 1.6	: 4	: .7
Murray	: 1701	: .7	: 2	: .3
Nicollet	: 1001	: 1.6	: 3	: .7
Nobles	: 1948	: .8	: 2	: .3
Norman	: 1965	: .8	: 2	: .2
Olmstead	: 1345	: 1.8	: 4	: 1.1
Otter Tail	: 3423	: 1.7	: 4	: .8
Pennington	: 755	: 1.4	: 3	: .6
Pine	: 741	: 3.2	: 9	: 1.8
Pipestone	: 1156	: 1.1	: 2	: .3
Polk	: 3717	: .8	: 2	: .4
Pope	: 1383	: 1.1	: 3	: .5
Ramsey	: 200	: 3.1	: 15	: 4.8
Red Lake	: 636	: 1.3	: 3	: .5
Redwood	: 1905	: 1.1	: 2	: .3
Renville	: 2338	: .9	: 2	: .4
Rice	: 1024	: 3.0	: 9	: 1.8
Rock	: 1406	: .5	: 1	: .3
Roseau	: 825	: 1.4	: 4	: .5
St. Louis	: 481	: 3.1	: 11	: 2.3
Scott	: 659	: 2.5	: 5	: 1.4
Sherburne	: 809	: 1.6	: 3	: .6
Sibley	: 1376	: 1.8	: 4	: .7
Stearns	: 2541	: 2.1	: 5	: 1.0
Steele	: 911	: 3.0	: 6	: 1.8
Stevens	: 1302	: .7	: 2	: .3
Swift	: 1879	: .7	: 2	: .3
Todd	: 1356	: 2.7	: 7	: 1.4
Traverse	: 1397	: .5	: 1	: .2
Wabasha	: 1041	: 1.4	: 4	: .9
Wadena	: 585	: 2.0	: 4	: 1.0
Waseca	: 949	: 2.0	: 5	: .9
Washington	: 800	: 2.1	: 8	: 1.5
Watonwan	: 1034	: 1.4	: 3	: .5
Wilkin	: 1777	: .3	: 1	: .2
Winona	: 1104	: 2.1	: 6	: 1.2
Wright	: 1366	: 3.0	: 7	: 1.5
Yellow Med.	: 1619	: .9	: 2	: .3

receipts. The butter and cheese made on the farm, which is mostly consumed in the home, necessarily involves an estimate.

The three methods of comparison, as illustrated by maps in Figures 1, 2, and 3, and is shown on Table III, correspond quite closely. It will be noticed that the map in Figure 2, giving the gallons of milk per 100 acres of crops, weighted, shows the least regularity of the three, altho the difference is slight. The uniformity of the results obtained by the three different methods indicates that the census data is reasonably reliable.

Defect in Using Number of Dairy Cows as Measure of Importance. -

There are certain defects in using the number of dairy cows as a measure of the importance of the dairy industry which it is well to call attention to. The productivity of the animals is not taken into consideration. Reliable figures on productivity are difficult to obtain. In this method, cows producing 150 pounds of butter fat a year and cows furnishing 500 pounds butter fat are given the same importance. Then, too, some use dual purpose cows, which give a relatively small amount of milk, and additional income is obtained by disposing of the animals for meat purposes. Regardless of the proportion of income obtained from the milk or meat supplied by the dual-purpose animal, if the animal was enumerated as a dairy animal, it is considered on the basis of dairying alone, and given the same importance as a strictly dairy cow. Statistics of the number of dairy cows are fairly reliable, which is essential in a study of this nature.

Designating Dairy Areas in Minnesota.

As a result of the study, based upon the maps in Figures 1, 2, and 3, the state has been divided into eight areas. The border lines for these areas are arbitrarily drawn, and are approximate. They do not follow

county lines, as is shown by Figure 4. Questions as to the justification of placing the lines where they are will, naturally, arise. Sharp lines of demarkation, of course, do not exist. It is difficult to decide where some of the border lines should be. The lines are placed where it seems the most reasonable to place them, based on the information furnished by Figures 1, 2, and 3. These areas are designated by Roman numerals and titles, to aid in identification for purposes of reference. They are as follows:

- I North East Cut-Over Area
- II Twin City Area
- III North Central Area
- IV South East Area
- V Sandy Potato Area
- VI South Central Area
- VII Western Spring Wheat Area
- VIII South West Area

North East Cut-Over Area - Area I, The North East Cut-Over Area, includes approximately the east one-third of the state from the north border, extending south to the sandy potato section. The southern boundry of this area is the northern part of Isanti and Benton counties. Chisago County is included in the above area. It is distinctly a cut-over pine region⁽¹⁾. Dairying is an important farm industry in this region.

Twin City Area - Area II, The Twin-City Area embraces the section adjacent to the Twin Cities. It extends north-west, west and south-west further than east and north. One arm of this area extends south, including Rice, Steele, and parts of Waseca, Freeborn, Dodge and Goodhue counties.

(1) Shown by map in Minnesota Geological Survey Bul. 14, page 20.

Most of this is in the region furnishing market milk to the Twin Cities.⁽¹⁾

North-Central Cut-Over Area - Area III, The North Central Cut-Over Area is located between the North East Cut-Over Area and the wheat area to the west. It constitutes approximately the center one-third of the northern part of the state from east to west. It extends from the north border and southward to the same latitude as the south border of the North East Cut-Over area which is the southern limit of the pine area.⁽²⁾ Dairying here is relatively less important than in the two areas described above. It is an older settled section than the North East Cut-Over Area, and has more improved land.

South East Area - Area IV, The South East Area includes approximately the area south and east of St. Paul. It is an important barley area of the state. Dairying is not highly developed.

Sandy Potato Area - Area V, The Sandy Potato Area. This includes only five counties in the so-called potato region north of the Twin Cities. It is set off by itself primarily because of its sandy soil, and extensive potato production. Dairying is practiced to a considerable extent, but the extensive potato production reduces the relative importance of the dairy industry.

South Central Area - Area VI, The South Central Area. This designation is not explanatory, but is used for the want of a better one. The west border extends from the southwest edge of the North Central Cut-Over Area, and in a southeasterly direction, to the southern part of the division line between Faribault and Freeborn counties. It borders the Twin City Area

(1) Twin City Milk Producers Bulletin Vol. V, No. 11, Nov. 1921, page 3, states that one of their largest plants is located at Northfield, Rice County.

(2) Shown by map in Minnesota Geological Survey Bul. 14, page 20.

and the Sandy Potato Area on the east. Dairying here is of about the same importance as in the Sandy Potato Area but less important than in the Twin City Area.

Western Spring Wheat Area - Area VII, The Western Spring Wheat Area. It constitutes the west third of the northern part of the state, extending south to a line running east and west near the south border of Yellow Medicine County. It includes the Red River Valley and extends some distance east and south therefrom. It is the wheat area of the state. The Red River Valley potato section is also in this region.

South West Area - Area VIII, The South West Area. This is the portion of the state south of the Western Spring Wheat Area and west of the South Central Area. It is prominently a beef, hog and corn section, and relatively unimportant as a dairy region.

CHAPTER III.

CHANGES IN GEOGRAPHY OF THE DAIRY INDUSTRY IN MINNESOTA-1910 to 1920.

The number of dairy cows per 100 acres of crops, weighted, served a satisfactory basis for studying the importance of dairying in 1920. It should be equally suitable as a basis for showing the changes in the dairy industry between 1910 and 1920, provided the census data for the two periods are comparable. A comparison of the two censuses is made by the 1920 census report⁽¹⁾ as follows:

Comparability of Census Data - "In 1910 the census called for 'cows and heifers kept for milk' and 'cows and heifers not kept for milk'. The instructions read: 'Report as cows kept for milk those whose milk is used in some form for human food. Cows milked for three months during the year should be reported as kept for milk, although a part of the year they run with their calves'.

"In 1920 the census called for 'dairy cattle' and 'beef cattle'. Dairy cattle were defined as those 'kept mainly for milk production', and the following instructions were given the enumerators: 'Classify all cattle as beef cattle or as dairy cattle according to the principal purpose for which they are kept'. It is believed that under this rule the fully established dairy and beef breeds have been properly reported, with few errors, and that cattle of dual-purpose breeds or of no definite breeding have been placed in one class or the other, according to the principal purpose for which they are kept.

"In states where cattle are raised extensively for beef production
(1) Fourteenth Census of U.S.-1920. Agricultural Report for Minn.
page 6.

the result of this new classification will be to reduce materially the proportion of cows classified as dairy cows, and even in states having few strictly beef cattle the 1920 classification may be expected to give a somewhat smaller proportion of dairy cows than the 1910 classification."

The census of 1920 was taken as of January 1st and that of 1910 as of April 15th (1) "Since a great many animals are born during the period between January 1st and April 15th and, on the other hand, a number of older animals are disposed of during the same period, the numbers in the different classes of animals for the two censuses are not fully comparable. The discrepancies do not appear to be serious, however.

"In Minnesota the number of 'dairy cows' including heifers one year old and over, reported for January 1st, 1920 was 1,532,458, as compared with 1,085,388 'cows kept for milk' reported April 1st, 1910. This represents an increase of 477,000, or 41.2 per cent." (2) The number of dairy cows increased in all counties of the state, except Houston, Lyon, Murray, Rock, Jackson and Martin which showed slight decreases.

CHANGES IN DAIRYING IN MINNESOTA.

In showing the changes of the dairy industry in Minnesota from 1910 to 1920, based upon the number of dairy animals, only dairy cows and heifers one year old and over are used. As was mentioned in Chapter II, the number of dairy cows two years old and over would better represent the productive animals, but these figures are not available for 1910. Including the one year old heifers will not modify the results. The weights used for the various crops in 1910 were the same as the weights used for the 1920 crops.

- (1) Fourteenth Census of U.S.-1920-Agricultural Report for Minn. page 6.
(2) Fourteenth Census of U.S.-1920.

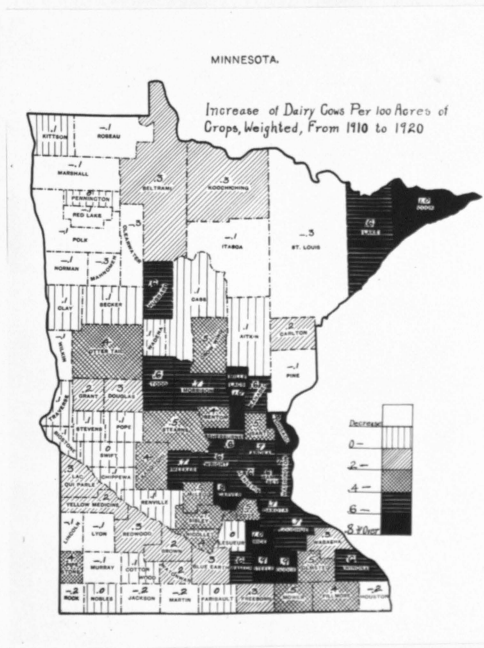


Figure 5.

The map in Figure 5 shows the increase, or decrease, in dairy cows in relation to the increase in weighted crop acres. It does not mean that the counties designated by a minus (-) and left unshaded on the map have not increased in dairying, but it means that they have not increased in proportion to the increase in crops. St. Louis County, as an example, has increased 125 per cent in the number of dairy cows, but has increased proportionately more, namely 148 per cent in the weighted crop acres. It has decreased three-tenths of a cow per 100 acres of crops weighted. Houston County shows an actual 8 per cent reduction in the number of dairy cows while about a one per cent increase in the number of crop acres, weighted. It shows a reduction of three-tenths of a cow per 100 acres of crops, weighted.

TABLE IV. - INCREASE OF DAIRY COWS PER 100 ACRES OF CROPS, WEIGHTED, FROM

1910 to 1920.

County	: Acres of crops, : Dairy Cows per 100 : Increase*of Dairy Cows:	
	: weighted	: Acres of crops, : per 100 acres of crop, :
	: 1910 : 1920	: weighted : weighted, from 1910 to : 1920
Aitkin	: 132 : 299	: 4.0 : 4.1 : .1
Anoka	: 599 : 725	: 1.4 : 2.1 : .7
Becker	: 806 : 1311	: 1.4 : 1.5 : .1
Beltrami	: 141 : 442	: 2.3 : 2.6 : .3
Benton	: 533 : 746	: 2.0 : 2.4 : .4
Bigstone	: 1056 : 1133	: .5 : .6 : .1
Blue Earth	: 1713 : 1657	: 1.2 : 1.5 : .3
Brown	: 1337 : 1377	: 1.2 : 1.4 : .2
Carlton	: 133 : 303	: 3.1 : 3.3 : .2
Carver	: 666 : 727	: 3.0 : 3.8 : .8
Cass	: 150 : 377	: 2.5 : 2.6 : .1
Chippewa	: 1352 : 1531	: .7 : .8 : .1
Chisago	: 664 : 775	: 2.2 : 3.0 : .8
Clay	: 2187 : 2707	: .5 : .6 : .1
Clearwater	: 175 : 321	: 3.6 : 2.3 : -.3
Cook	: 8 : 15	: 1.5 : 2.5 : 1.0
Cottonwood	: 1438 : 1433	: .9 : 1.0 : .1
Crow Wing	: 246 : 366	: 2.2 : 2.7 : .5
Dakota	: 1313 : 1174	: 1.0 : 1.7 : .7
Dodge	: 924 : 883	: 1.8 : 2.7 : .9
Douglas	: 1004 : 1210	: 1.5 : 1.8 : .3
Faribault	: 1715 : 1834	: 1.1 : 1.1 : .
Fillmore	: 1693 : 1639	: 1.3 : 1.7 : .4
Freeborn	: 1346 : 1441	: 2.1 : 2.4 : .3
Goodhue	: 1669 : 1559	: 1.5 : 2.2 : .7
Grant	: 1087 : 1267	: .7 : .9 : .2
Hennepin	: 1139 : 1128	: 2.1 : 2.7 : .6
Houston	: 822 : 834	: 1.8 : 1.6 : -.2
Hubbard	: 254 : 402	: 1.0 : 1.6 : .6
Isanti	: 750 : 933	: 1.4 : 1.9 : .5
Itasca	: 61 : 183	: 2.8 : 2.7 : -.1
Jackson	: 1612 : 1734	: 1.0 : .8 : -.2
Kanabec	: 197 : 439	: 2.8 : 3.4 : .6
Kandiyohi	: 1628 : 1753	: 1.0 : 1.4 : .4
Kittson	: 1242 : 1574	: .5 : .6 : .1
Koochiching	: 23 : 97	: 2.0 : 2.3 : .3
Lac Qui Parle	: 1891 : 1778	: .5 : .8 : .3
Lake	: 10 : 19	: 3.3 : 3.2 : .6
LeSueur	: 861 : 967	: 1.6 : 1.6 : .
Lincoln	: 1009 : 1211	: 1.0 : .9 : -.1
Lyon	: 1492 : 1497	: .8 : .7 : -.1
McLeod	: 1059 : 1165	: 1.9 : 2.6 : .5
Mahnomen	: 95 : 422	: 1.3 : 1.0 : -.3
Marshall	: 1567 : 2206	: .9 : .8 : -.1

TABLE IV. (continued)

County	: Acres of crops, :		: Dairy Cows per 100 :		: Increase* of Dairy Cows:	
	: weighted :		: Acres of crops, :			: per 100 acres of crop, :
	: 1910 :	: 1920 :	: weighted :	: 1920 :		
Martin	: 1721	: 1914	: 1.0	: .8	: -.2	
Meeker	: 1261	: 1322	: 1.5	: 2.2	: .7	
Mille Lacs	: 273	: 473	: 3.0	: 4.0	: 1.0	
Morrison	: 926	: 1248	: 1.9	: 2.6	: .7	
Mower	: 1635	: 1548	: 1.1	: 1.6	: .5	
Murray	: 1533	: 1701	: .8	: .7	: -.1	
Nicollet	: 951	: 1001	: 1.2	: 1.6	: .4	
Nobles	: 1780	: 1948	: .8	: .8	: :	
Norman	: 1393	: 1965	: .9	: .8	: -.1	
Olmstead	: 1406	: 1345	: 1.3	: 1.8	: .5	
Otter Tail	: 2740	: 3423	: 1.3	: 1.7	: .4	
Pennington	: 611	: 755	: 1.4	: 1.4	: :	
Pine	: 316	: 741	: 3.3	: 3.2	: -.1	
Pipestone	: 1109	: 1156	: .7	: 1.1	: .4	
Polk	: 2784	: 3717	: .9	: .8	: -.1	
Pope	: 1216	: 1383	: 1.0	: 1.1	: .1	
Ramsey	: 236	: 200	: 2.5	: 3.1	: .6	
Red Lake	: 337	: 636	: 1.4	: 1.3	: -.1	
Redwood	: 1909	: 1905	: .8	: 1.1	: .3	
Renville	: 2273	: 2338	: .8	: .9	: .1	
Rice	: 1062	: 1024	: 2.0	: 3.0	: 1.0	
Rock	: 1348	: 1406	: .7	: .5	: -.2	
Roseau	: 573	: 825	: 1.5	: 1.4	: -.1	
St. Louis	: 194	: 481	: 3.4	: 3.1	: -.3	
Scott	: 644	: 659	: 2.0	: 2.5	: .5	
Sherburne	: 692	: 809	: 1.0	: 1.6	: .6	
Sibley	: 1204	: 1376	: 1.4	: 1.8	: .4	
Stearns	: 2217	: 2541	: 1.6	: 2.1	: .5	
Steele	: 979	: 911	: 2.1	: 3.0	: .9	
Stevens	: 1137	: 1302	: .6	: .7	: .1	
Swift	: 1513	: 1879	: .7	: .7	: :	
Todd	: 968	: 1356	: 2.1	: 2.7	: .6	
Traverse	: 1269	: 1397	: .4	: .5	: .1	
Wabasha	: 1099	: 1041	: 1.1	: 1.4	: .3	
Wadena	: 359	: 585	: 1.9	: 2.0	: .1	
Waseca	: 970	: 949	: 1.4	: 2.0	: .6	
Washington	: 797	: 800	: 1.4	: 2.1	: .7	
Watsonwan	: 985	: 1034	: 1.2	: 1.4	: .2	
Wilking	: 1337	: 1777	: .4	: .3	: -.1	
Winona	: 1150	: 1104	: 1.5	: 2.1	: .6	
Wright	: 1184	: 1366	: 2.4	: 3.0	: .6	
Yellow Med.	: 1740	: 1619	: .7	: .9	: .2	

* A minus (-) sign denotes a decrease.

Table IV gives the number of dairy cows per 100 acres of crops, weighted, for 1910, the number of dairy cows per 100 acres of crops, weighted, for 1920, and the increase or decrease, of dairy cows per 100 acres of crops, weighted, from 1910 to 1920 for the counties of the state.

The increase in the importance of dairying, as shown by Figure 5, is most marked in II, the Twin City area. The increase extends beyond this, and includes, with minor exceptions, the South East area (IV), Sandy Potato Area (V), South Central Area (VI) and the southern portion of the North East Cut-Over Area (I) and the North Central Cut-Over Area (III). This is largely the deciduous forest area of the state and the extreme southern edge of the pine region.⁽¹⁾

The two outstanding exceptions in this region are Houston County in the extreme south east corner of the South East Area, which shows a decrease in dairy cows per 100 acres of crops, weighted, and LeSueur County in the South Central Area, bordering on the Minnesota River, which shows no relative change during the period. Next to these, Freeborn and Wabasha Counties show smaller relative increases than the rest of the counties in the region. Houston County shows an actual decrease in the number of dairy cows with a slight increase in the weighted crop acres. LeSueur County shows a 14 per cent increase in the number of dairy cows and about the same rate of increase in the weighted crop acres, which means that the ratio of cows to weighted crop acres remains the same for the two periods. Wabasha County shows a slight reduction in weighted crop acres in 1920 over 1910 with an increase in the number of dairy cows, while Freeborn shows an increase in both. The relative increase of these two is the same for the ten year period.

(1) Indicated by Map in Minnesota Geological Survey Bul. 14, page 20.

Cook and Lake Counties in the extreme north eastern part of the state show a considerable increase in cows per 100 acres of crops, weighted. The number of cows and crop acres for these counties are so small that not much reliance can be placed upon them. It indicates, however, that the rate of increase in dairy cows has been considerably greater than the rate of increase in crops. Hubbard in the North Central Cut-Over Area (III), shows a much greater increase than the adjoining counties. It has increased its dairy cows 164 per cent while its crop acres only 58 per cent. Otter Tail, Todd, Morrison, Mille Lacs, Kanabec and Crow Wing Counties all show crop acre increases but a relatively much greater increase in the number of dairy cows. Pipestone county in the SouthWest Area (VIII) stands out as an exception in increased dairy importance, while all the adjoining counties show decreases. Pipestone County has a 69 per cent increase in the number of dairy cows, while the adjoining counties show decreases, or not much change. In crop acres, Pipestone County shows only a 4 per cent increase. This makes the strong showing for the dairy increase. However, Figures 2 and 3 indicate that Pipestone, Murray and Nobles Counties are about equally important in gallons of milk and value of dairy products compared with the weighted crop acres. One may reasonably infer from this, that in making the enumeration in Pipestone County, cattle which should have been classed as beef were counted as dairy.

The counties bordering on the Minnesota River to the south, namely Lac Qui Parle, Yellow Medicine, Redwood, Brown, Blue Earth and Watonwan all show dairying more important in 1920 than in 1910. All these counties have an actual reduction in weighted crop acres, except Brown and Watonwan, which have a slight increase. Increase in the number of dairy cows is found in all of them.

In general, the least relative increase in dairying has been in the North East Cut-Over Area (I), North Central Cut-Over Area (III), Western Spring Wheat Area (VII) and the South West Area (VIII) with the exceptions mentioned above. In the main, the most pronounced increase has been in the Twin City Area (II) and the areas adjoining it. Other changes accompanying the changes in dairying for the period of 1910 to 1920 will be discussed in the following chapter.

CHAPTER IV.OTHER CHANGES ACCOMPANYING CHANGES IN DAIRYING.

In discussing other changes accompanying changes in dairying from 1910 to 1920, land in farms, improved land in farms, size of farms and agricultural tendencies in general, will be considered. The specific farm enterprises will be grouped as competing enterprises, complementary enterprises and independent enterprises and discussed separately.

AGRICULTURE - IN GENERAL.

Land in Farms. - The entire area north of the Twin Cities shows an increase in land in farms between 1910 and 1920. The cut-over counties, and the north two-thirds of the spring wheat region have the greatest increases, which could be expected. The area between the Twin Cities and the Cut-Over area and extending about that width east and west across the state, has increased the land in farms, but to a less extent. The counties in the south east part of the state, comprising approximately the area south and east of the Twin Cities show slight decreases. Houston County is an exception, having had a small increase. Small increases have also been made in the counties of the south west area, except in Lincoln in the northwest corner and Faribault in the southeast corner, which show minor decreases. In general, the rest of the state shows little change. Slight increases or decreases are found among the rest of the counties but with no regularity, and are not any greater than could be expected as errors in enumeration.

Improved Land in Farms. - The areas that show increases in total land in farms from 1910 to 1920, also show increases in improved land in farms.

The areas having decreased in total acres have also decreased in improved acres. Where the total acreage remained about constant for the period, the improved acres in farms show the same tendency. The percentage increase, however, is greater for the improved land than the total land in farms in the newer regions of the state. This is especially true in the cut-over counties and the north two-thirds of the western spring wheat region.

Number of Farms. - All counties of the state, except seven, show increases in the number of farms from 1910 to 1920. The exceptions are Cook and Lake Counties in the northeast part of the state, Pennington County in the northwest part of the state, Ramsey County, where St. Paul is located, and Olmstead, Mower and Fillmore Counties in the southeastern part of the state. Ramsey County shows a decrease of nearly 8 per cent. This is probably due to the expansion of the city. The decreases in the other six counties are only a few farms each. The cut-over region of the state shows the greatest increase in number of farms, ranging as high as 75 to 100 per cent in some of the newer counties. The increase for the rest of the state is fairly uniform, with the southeastern part of the state showing the least change. The number of farms in the state as a whole increased from 156,137 in 1910 to 178,478 in 1920, or 17 per cent.

Size of Farms. - As a measure of size of farms, both total acres per farm and improved acres per farm may be used. These have both decreased for the state as a whole, from 1910 to 1920. In 1910 the average size farm of the state was 177 acres, while in 1920 it was 169 acres, or a decrease of 5 per cent. This decrease is fairly uniform over the state, except for nine counties in the northern part of the Western Spring Wheat Area, and Lake, Kanabec, Beltrami and Crow Wing Counties in the Cut-Over region. The south half of western Minnesota shows a slightly greater decrease in size of farm

than the rest of the state.

The improved land in farms has decreased from 126 acres in 1910 to 120 acres per farm in 1920, or 5 per cent. The north half of the state, however, comprising the cut-over region and the western wheat area north of the southern border of Otter Tail County, shows an increase in improved land in farms. Hubbard and Kittson Counties show exceptions, having had decreases. The counties in the southern half of Minnesota have fewer acres of improved land in farms in 1920 than they had in 1910, except Carver, Wright, Isanti, Anoka, Stearns, Nicollet and LeSueur counties, which have all increased. The southern half of the western part of the state, which showed greatest reduction in total acres per farm, also show greatest reduction in improved acres per farm from 1910 to 1920.

COMPETING ENTERPRISES.

The farm enterprises are grouped as competing, complementary and independent. Some of the enterprises of the farm may as well be placed in one group as the other, but they are considered in the groups into which they would most logically fall. The competing farm enterprises are the beef industry and the hog industry.

Beef Industry. - The south one-half of the Spring Wheat Area (VII), the South West Area (VIII), the South Central Area (VI) and the South East Area (IV) show beef increases from 1910 to 1920. These areas can best be located by referring to Figure 4, page 22. Only five of these counties, Lyon, Murray, Rock, Jackson and Martin show decreases in dairy cows for the period. In the rest of the counties in the areas referred to the beef industry and dairying have been developed together. Dakota County, on the north border of the South East Area, however, shows a reduction in beef cattle. The greatest development in beef production has been in the southwestern

part of the state. Where dairying has had its greatest development, beef has actually decreased. In a few of the cut-over counties the number of beef animals remain about constant, and a few increases have occurred, but the numbers are so small, and changes so slight that not much stress can be placed upon it. In general, the north one-half of the state, together with the Sandy Potato Area and the Twin City Area show actual reductions in beef production.

Hog Industry. - In considering the hog industry, it must be kept in mind that it adjusts itself to changing conditions more quickly than the beef or dairy industries. Hogs are bred and made to produce offspring in a year, while cattle require about two years. Cows will produce one calf a year, while hogs will farrow from 4 to 8, or more pigs in a litter, and often two litters a year. In 1909, which furnished the data for the 1910 census report, the hog prices were about normal.

Hog prices advanced rapidly in 1917 and 1918, remaining high the greater part of 1919. The 1919 pig crop was produced before the prices came down, so whatever reaction followed the latter part of the year did not affect the 1919 crop, which is the basis for 1920 census data. Consequently, this may show the 1920 hog population to be somewhat larger than if the temporary stimulus of high prices had not been present.

The difference in the time of the year for taking the two censuses will, on the other hand, tend to show relatively more hogs in 1910 than in 1920. More hogs are born between January 1st and April 15th than are slaughtered or sold during that time. Therefore, the 1910 census, taken as of April 15th, shows more hogs than if the enumeration had been made as of January 1st, when the 1920 census was taken. This assumption is verified by the Bureau of Crop Estimate figures⁽¹⁾ which give the total hogs in the United States on January 1st,

(1) U.S.D.A. Year book - 1910.

1910 to be 1,003,000, compared with 1,520,257 shown by census enumeration. Since the stimulus of high prices, and the difference in the time of taking the two censuses, tend to influence the data in opposite directions, the comparability of the figures should not be greatly affected.

The increase in the number of hogs from 1910 to 1920 has been general over the state. In 1910 there were a total of 1,520,257 hogs, and in 1920 2,380,862, an increase of 56 per cent. All counties of the state show increases except Houston, Steele and Winona which have slight decreases. Changes in hog production has not followed beef production changes definitely. The cut-over region which developed along dairy lines from 1910 to 1920 has increased its hogs about 80 per cent during the period. The western wheat area has increased in hogs about 87 per cent for the period. In the south half of the state, however, the greatest hog increases have been in the western part, where beef has increased the most. The increase in the South Western Area was about 79 per cent. The smallest increase was around the Twin Cities, and in the southeastern part of the state. The Twin City Area shows an increase of 21 per cent and the South Eastern area an increase of 28 per cent. These are the areas designated, respectively, as II and IV in Figure 4.

COMPLEMENTARY ENTERPRISES.

The important enterprises in the state grouped as complementary to dairying are, hay and forage, corn and oats. They are all feed crops. For dairy purposes, corn for silage and other forage is more important than corn as grain. Oats is used considerable as a cash crop, but also furnishes some of the dairy feed, consequently is grouped with the complementary crops.

Hay and Forage. - All hay and forage is grouped together for comparison. This involves some error, in that the various hay and forage crops yield differently. Timothy hay may yield from one to two tons to the acre,

while corn silage yields from eight to ten tons. However, there is 90 per cent of dry matter in timothy hay and about 22 per cent dry matter in corn silage,⁽¹⁾ the yield per acre, on the dry matter basis, would be about twice as great for corn silage as for timothy hay, and not instead of five or six times as great when compared on the tonnage basis. Since the value per ton is not uniform, and since all other crop analysis will be made on the acreage basis, the acreage of hay and forage will also be used for comparison. The 1910 and 1920 censuses use different terminologies for some of the forages, but if they were correctly reported by the farmers they should not show any discrepancies.⁽²⁾ Greater error in enumeration is apt to be made in hay and forage than in other crops. This is particularly true of wild hay, since the acreage is frequently a matter of estimate, while with seeded crops some sort of measure of acreage is used.

Hay and forage shows a general increase over the state from 1910 to 1920. The only counties that have decreased the hay acreage during the period are Rock and Nobles Counties in the southwestern corner of the state and Marshall and Pennington counties in the northwestern part. The dairy areas have increased the hay and forage acreage more than the beef acres. It is also true that the increase in acreage of hay and forage was greater in the northern dairy region, where the forage was largely hay, than in the dairy regions further south, where silage constituted a considerable portion of the hay and forage acreage. Data on silage is not available for 1910, so no comparison can be made on that basis. The southeastern part of the state has a greater increase than the southwestern. The south half of Minnesota

(1) Feeds and Feeding, Henry.

(2) The class called "coarse forage" in 1910 was subdivided into "annual legumes cut for hay, silage crops, corn cut for forage, kafir, sorghum, etc., for forage and root crops for forage" in 1920.

has increased less than the rest. The fact that corn forage and corn silage constitutes a greater portion of the total hay and forage acreage than in the north half of the state accounts in a measure for this difference.

Oats. - In general, the east one-half of the state from the edge of the cut-over region to the southern border, produced about the same oat acreage in 1920 as in 1910. The cut-over region shows about a 75 per cent increase in acres of oats. The Spring Wheat Area and the South West Area have increased the oat acreage about 21 per cent during the period.

Corn. - The important corn acreage increase from 1910 to 1920 has been in the part of the state south, west, and southwest of the Twin Cities. The region immediately around the Twin Cities, and including the Sandy Potato Area to the north, show little change. The region between a line drawn east and west on the southern border of the cut-over district and one drawn parallel to it at Duluth, shows an increase of about 15 per cent, but the acreage in the territory is very small. The part of the state north of Duluth shows a small increase, but corn here is an insignificant crop. The part of the state south of the cut-over region, omitting the Sandy Potato Area, the counties around the Twin Cities, and the part of the state south and east of the Twin Cities shows the greatest corn increase, of about 20 per cent. Of this territory, the southwestern area, and the south one-third of the Western Spring Wheat Area, shows the largest increase, of about 26 per cent. The district south and east of the Twin Cities has decreased its corn acreage about nine per cent from 1910 to 1920. In general, the regions increasing the oat acreage also increased the corn acreage, except in the more recent developed regions of the north. There, oats is used as a grain crop while corn is too uncertain.

INDEPENDENT ENTERPRISES.

The beef and hog industries have been considered as enterprises competing with dairying, and hay, corn and oats as complementary enterprises. Since wheat, barley, rye, flaxseed and potatoes cannot logically be grouped under either of these, they will be classed as independent enterprises.

Wheat. - The Western Wheat Area is the principal wheat growing region of Minnesota. The area as a whole raised 26 per cent more acres of wheat in 1920 than in 1910. The south one-third of the area, however, show little change. The north two-thirds of the area has had a 53 per cent increase from 1910 to 1920. Wheat in the cut-over region has increased 21 per cent. The Sandy Potato Area shows a 17 per cent increase, while the Twin City Area remains about unchanged. The district south and east of the Twin Cities does not have a large wheat acreage, but had a 155 per cent increase from 1910 to 1920. The rest of the state, comprising the South Central Area, the South West Area and the south one-third of the Spring Wheat Area has had a decrease of about 6 per cent in wheat acreage. The greatest reduction in this region was in the South West Area, with a 16 per cent decrease. In general, the areas increasing in corn, decreased in wheat, except in the newly developed counties in the northern part of the state, which show increases in all crops.

Rye. - Rye production is distributed over Minnesota but is not a large crop. However, it has increased 144 per cent in the state from 1910 to 1920. The greatest increase is in the cut-over region, the Western Wheat Area and the South West Area, where the increase has exceeded 150 per cent. Rye is more important than wheat in the Sandy Potato Area. It increased 82 per cent from 1910 to 1920, when it had a larger acreage than oats in this area. The smallest increase has been in the southeastern part of the state.

In the extreme southeast corner of the state practically no rye is grown.

Barley. - A 47 per cent decrease in the barley acreage of the state has taken place from 1910 to 1920. The old important barley area in southeastern Minnesota decreased 63 per cent. A less important barley district in the southwestern area decreased 81 per cent. A 32 per cent reduction is shown in the Western Spring Wheat Area, the counties farthest south in the area having the greatest decrease. The Sandy Potato Area has a 37 per cent decrease, the Twin City Area 66 per cent decrease, and the South Central Area a 51 per cent decrease. The only barley increase in the state is in some of the newly developed counties in the northern part of the state. However, the acreage is small.

Flaxseed. - The flaxseed is produced mostly in the western part of Minnesota. A very small acreage is grown in the rest of the state. A 28 per cent decrease occurred from 1910 to 1920. No flax growing areas are being developing in Minnesota.

Potatoes. - The acreage of potatoes increased 48 per cent from 1910 to 1920. Potatoes are grown on practically all farms for home consumption. In 1910 the commercial potato districts of the state were around the Twin Cities and extending north to the cut-over region, and a second area in the Red River Valley, centering in Clay County. In 1920 the Sandy Potato Area and the area around the Twin Cities remained about the same in acreage while the Red River Valley district had expanded greatly. The counties of Polk, Norman, Clay and Becker, which are the most important Red River Valley counties for potatoes, increased its acreage 141 per cent from 1910 to 1920. Potato production is developing thruout the northern half of the state, and is becoming an important source of income in the newer settled regions of Minnesota. About a 30 per cent increase is also shown in the southwestern

part of the state, but the acreage grown is relatively small. The southeastern part of the state shows practically no change.

The changes in the geography of the dairy industry of the state from 1910 to 1920 was discussed in Chapter III.

The present chapter contains an explanation of what changes have occurred to agriculture in general, and to the important farm enterprises during the period. Chapter V. will be devoted to an analysis of the causes for the changes of location, and extent of dairying in Minnesota.

ANALYSIS OF THE CAUSES FOR THE CHANGES OF LOCATION AND EXTENT OF DAIRYING
IN MINNESOTA 1910 to 1920.

The changes in the location and extent of dairying in Minnesota, compared with weighted crop acres are shown on the map in Figure 5, page 30, and discussed in Chapter III. The present chapter will be devoted to an analysis of the causes for these changes. Frequent reference will be made to the dairy areas of the state, designated in Figure 4, page 21, for the purpose of directing attention to definite regions of the state more specifically. To preface this discussion, a brief description of the physical features of Minnesota, particularly the topography and the changes in population in the state will be given, as it may be possible to show a relationship between these and dairying.

Physical Features of Minnesota. - The Minnesota Geological Survey⁽¹⁾ says, "Minnesota presents more variety in surface features than most of the north central states, yet a great part of its surface is level or only gently undulating. The flattest portion falls largely in the northwest quarter, and was once the bed of the glacial Lake Agassiz, a lake held in on the north, in central Canada, by the great ice sheet. The roughest portion is in the northeastern quarter. This part is composed largely of volcanic formations and iron-bearing rocks which, though glaciated, were not buried beneath the glacial deposits. In the southeastern part of the state deep erosion valleys along the Mississippi and its tributaries present bold rock bluffs 300 to 600 feet high. The interior and southern parts of the state have features due almost entirely to the work of the great ice sheets, which at successive times, and from different directions, overspread Minnesota. The glacial deposits com-

(1) Minnesota Geological Survey, Bul. No. 14, page 5.

prise an intricate system of moraines with undulating to hilly surface, associated with which are level outwash plains of sand and gravel, and gently undulating intermorainic till plains."

The Minnesota Geological Survey also states that throughout much of Minnesota, except the northwest, southwest, and southeast corners, small lakes are a common feature. The areas in which rock is so exposed as to render the land untillable are largely in the northeastern quarter of the state, or along valleys in the southeast quarter. The northwest quarter has very little bare rock. The southwest quarter of the state has some rock outcroppings. There are a few small areas of granite knobs along the Minnesota valley from Big Stone Lake down to New Ulm.

The condition of the soil depends to some degree upon the character of the vegetation which has covered it. In prairie districts there is a more uniform exposure to weathering agencies than in forested districts and consequently a more uniform soil is developed on a given deposit. The forests occur only on protected slopes in much of southern Minnesota and are absent from such slopes in much of the western part of the state. In the central and northeastern parts they cover plains or uplands as well as valley slopes. The muskegs, which have a scanty forest growth, are developed chiefly in the northern half of the state and within the forested area.⁽¹⁾ According to a map by Warren Upham and Frederic K. Butters showing the distribution of forest and prairie in Minnesota⁽²⁾, the coniferous forest region corresponds quite closely with the Cut-Over Areas (I and III in Figure 4). The deciduous forest region comprises the Sandy Potato Area (V), the Twin City Area (II), the South Central Area (VI) and the South East Area (IV), except for Freeborn, Mower and Dodge counties, and portions of the counties adjoining.

(1) Minnesota Geological Survey, Bul. No. 14, page 7-19.

(2) " " " " " " " " figure 3, page 20.

Effects of Changes in Population. - The population of the United States increased from 91,972,266 in 1910 to 105,708,771 in 1920, or 15 per cent. Minnesota increased its population from 2,075,708 in 1910 to 2,387,125 in 1920 which was also a 15 per cent increase. The improved land in farms in the state increased about 9 per cent, which was largely confined to the north half of the state. The farmers of Minnesota produce largely the staple foods for its own people, as well as portion of the food for the rest of the people in the United States and for export purposes.

Since an increased population requires an added amount of food, and since expansion in area where crops are grown has not kept pace with the increase in population, it means that more intensive farming has become necessary in order to produce the additional food required. There has been a marked increase in live stock production in Minnesota from 1910 to 1920. It is reasonable to assume that the type of farming in a community is the type for which that community is best suited. Logically, when more intensive farming becomes advantageous, the different communities will increase the product or products which best suit their conditions. It is well to keep this in mind in considering the causes for the changes of location and extent of dairying in Minnesota from 1910 to 1920.

It must also be remembered that the study is not based on the actual increases in dairying, but on the increase in the number of dairy cows compared with the weighted crop acres from 1910 to 1920.

Analysing the Causes for the Changes. - Figure 5, page 30, shows the most pronounced increase in dairying from 1910 to 1920 in the Twin City Area (II) and the areas adjoining it. It includes, in the main, the Sandy Potato Area (V), the South Central Area (VI), the South East Area (IV), the southern border of the North East Cut-Over Area (I) and the southern border of the

North Central Cut-Over Area (III). The degree of increase is quite uniform. A few counties show exceptions, and these will be discussed separately. This entire region corresponds quite closely with the deciduous forest area of the state and includes the south border of the coniferous forest area. The region is dotted with small lakes, is rather rolling, and was originally wooded. This makes the fields less regular, smaller and not so convenient to work. It makes more desirable conditions for land in pasture than in the more level prairie section in the western part of the state.

The demand for dairy products by the Twin Cities is largely responsible for the great increase in the area tributary. The population of Minneapolis and St. Paul, not including the smaller towns and villages nearby, increased from 516,152 in 1910 to 615,280 in 1920, or 19 per cent. The market milk and milk and cream for ice cream purposes must come from a limited radius.⁽¹⁾ The Sandy Potato Area is not particularly favorable for pasture but the increase may be accounted for by its nearness to the cities. Isanti and Benton counties sell less market milk than the counties nearer the cities, and show a small increase in dairying. The southern part of Mille Lacs County would in all probability show results similar to Benton and Isanti Counties if data for that portion was available separately.

The southern portion of the pine area (which has a mixed growth of pine and deciduous trees) developed earlier than the rest of the pine region. The small acreage of improved land per farm, plenty of pasture and reasonable proximity to market makes the region suited for dairying.

The South Central Area (VI) borders the Twin City Area (II). It has about the same natural advantages for dairying as nearer the cities, but the greater distance from market may account for the smaller increase.

(1) Twin City Milk Producers get all of its supply within a radius of forty miles.

The farms are also larger farther out from the more dense dairy region. Le Sueur County is an exception among the counties in that region. Figures 1, 2, and 3 show that LeSueur, Nicollet and Sibley counties were equally important in dairying in 1920. LeSueur County increased its dairy cows 20 per cent, Nicollet County increased 48 per cent and Sibley increased 40 per cent from 1910 to 1920. Statistics also show that LeSueur County increased its beef cows 107 per cent, Nicollet County increased 8 per cent and Sibley County 3 per cent from 1910 to 1920. LeSueur County had fewer gallons of milk per cow in 1910 than Nicollet and Sibley Counties. This seems to indicate that some of the beef cows in 1910 were classed as dairy cows, which makes the increase in dairying from 1910 to 1920 appear less than for Nicollet and Sibley Counties. The changes in the wheat acreage in LeSueur County is different than the adjoining counties. LeSueur County increased the wheat acreage five per cent from 1910 to 1920 while Nicollet County decreased 21 per cent and Sibley County decreased 21 per cent. The variation in the changes in wheat acreage from 1910 to 1920 makes LeSueur County show relatively less increase in dairying during the period. The U. S. Census reports 65,710 acres of wheat grown in 1919. The State Department of Agriculture (1) reports 53,682 acres sown in 1920. Either LeSueur County raised a large wheat acreage in 1919 and reduced it considerably in 1920, or else some error has crept into the census figures of 1919. The other counties used in this comparison show a somewhat smaller wheat acreage sown in 1920, as reported by the State Department of Agriculture, than the acreage grown in 1919 as reported by the U. S. Census, but none show as great a difference as LeSueur County. The increase in the wheat acreage from 1910 to 1920 and the discrepancy in the figures on dairy cows for 1910 accounts for the ratio between dairy cows and weighted crop.

(1) Farm Census and Other Agr. Statistics for 1920, Bul. No. 14, page 6.

acres remaining the same in LeSueur County while showing an increase in Nicollet and Sibley Counties.

It is interesting to note the important increases in dairying in Rice, Steele and Dodge Counties. Rice County is furnishing market milk for the Twin Cities, as was shown in Chapter III. Martin J. Anderson⁽¹⁾ in a study made for a thesis prepared under the direction of Prof. E. V. Robinson of the University of Minnesota, found a relationship existing between immigration and the localization of butter and cheese production. He says, "Wherever the Danes have settled, we find the largest production of butter, and wherever the Swiss have settled, we find cheese production localized". Steele and Freeborn Counties have a large number of Danish immigrants, a large part of which engage in dairying or butter manufacturing. The cheese industry is largely localized in Dodge and Goodhue Counties. Cheese production has spread to the adjoining counties of Olmstead, Rice and Mower. Cheese is also produced in Blue Earth and Watonwan counties in the southern area. Anderson shows that Swiss immigrants have largely settled in these counties. The high percentage increase in Winona County may be partly accounted for by the City of Winona being located within its border. Altho the population of the city has increased only three per cent from 1910 to 1920, the number of dairy cows have increased 35 per cent. The former barley area in the southeastern part of the state has been greatly reduced, evidently due to the enactment of the National Prohibition law. Most of the land represented by the reduced barley acreage has gone into hay and forage. Wabasha County has more improved land than Winona County and has increased the wheat and rye acreage, while increasing the hay and pasture acreage about the same as Winona County. It has increased its beef, hogs and corn more than Winona County.

(1) Minnesota Dairy and Food Dept. Bul. No. 52, page 18.

Houston County shows an actual decrease in dairying compared with weighted crop acres. It has decreased in dairy cows and hogs but increased in beef cattle and total crop acres. It has only 53 per cent of its farm land improved which should, according to the tendency in other counties be favorable to dairying. Figures 1, 2, and 3 show the importance in dairying in Houston County similar to the other counties in the district for 1920. Houston County shows dairying more important in 1910 in relation to crop acres than the adjoining counties. The 1910 census shows that Fillmore County had 48 per cent more cows than Houston County, but had 71 per cent more gallons of milk for the same period. This seems to indicate that some cows which should have been classed as beef in 1910 were classed as milk cows, which makes the increase in dairying to appear less than it would had fewer cows been reported as dairy in 1910 .

The North East Cut*Over Area (I) and North Central Cut-Over Area (III), except for the southern border already considered, is the newly developed section of Minnesota. This region has developed considerable along dairy lines, but proportionately more in crop production. Considerable emphasis has been placed on potatoes, as larger return per acre can be expected from them than from grain crops. Where farmers have only a comparatively small acreage improved, an intensive crop such as potatoes together with the grain crops gives a means of utilizing their own labor and the labor of their families to best advantage.

The production of crops must precede production of live stock. Hay and feed must be produced for winter feeding. Consequently in a region just developing, the increase in crops will tend to be as great, or greater than the increase in live stock. The relatively great importance of the dairy industry in Cook and Lake Counties, as shown in Figure 5, may be accounted for

by the smaller amount of farming country there, and the location of Two Harbors near the border of the counties. An increase of a few animals makes it appear very important.

The importance of Crow Wing County is evidently due to the southern part being in the earlier settled region which may be considered an extension of the important dairy regions of Mille Lacs and Morrison Counties. Hubbard County has increased its dairy cows over 200 per cent, and the weighted crop acres 58 per cent. Figures 1, 2 and 3 show that in 1920 Hubbard and the adjoining counties were about equally important in dairying in 1920. The difference is found in the statistics of 1910. Hubbard County had 1.0 dairy cow per 100 crop acres, weighted, in 1910, while Wadena County to the south had 1.9, Cass County on the east had 2.5 and Becker County on the west had 1.4 cow per 100 acres of crop, weighted. Checking dairy cows with gallons of milk produced in 1910 does not indicate any error of enumeration in 1910, as is supposed for Houston and LeSueur Counties. Statistics show there were only a small number of either dairy or beef cattle in Hubbard County in 1910. The most logical explanation seems to be that in the development of that region it proceeded from the prairies to the west and from the south, northward, and that Hubbard County was a newer country in 1910 than Wadena and Becker Counties, and ~~at~~ that in 1910, emphasized crops more than live stock. A prairie region will increase its crops much more rapidly than a forest region will. A forest must first be cleared of its timber before it can be put into crops, while a prairie country can be broke without this additional work. This would account for the relatively great increase in dairying in Hubbard County from 1910 to 1920.

The western spring wheat area (VII) is a prairie region, extending eastward into the edge of the forest region. It is an area of large farms, where wheat production has been emphasized because of its adaptability to the

region and the extensive type of farming. The wheat acreage increased 26 per cent from 1910 to 1920. The part of the Red River Valley in Minnesota is within this area. Dairying actually increased 40 per cent from 1910 to 1920 and weighted crop acres about the same. Otter Tail, Grant, Douglas, Lac Qui Parle and Yellow Medicine Counties show the greatest increased compared with crops. Otter Tail County is dotted with lakes, has considerable rolling land, partly covered with deciduous forest, which makes it more suitable for dairying than extensive crop production, due to the smaller, irregular fields. Douglas County has a topography similar to Otter Tail County. The southern part of the Spring Wheat Area merges into the corn, hog and beef area to the south of it. The number of dairy cows has increased in all these counties, but the larger farms, the level country and warmer climate make corn production, combined with beef and hogs, more important.

It is interesting to note that the counties of Swift, Chippewa and Renville on the north side of the Minnesota River show relative less increase in dairying than Lac Qui Parle, Yellow Medicine, Redwood and Watonwan Counties on the south side of the river.

Renville, Chippewa and Swift Counties have carried on extensive drainage projects while the counties on the south side of the river have drained considerable less.⁽¹⁾ Back from the Minnesota River is a rather low country, continuing to the north edge of Renville, Chippewa and Swift Counties and including the southwestern corner of Kandiyohi County. The drained land became suited for corn, and with it came beef cattle and hogs to feed the corn to. The land before it was drained was used considerable for farming purposes in 1910 but not suited for corn production, which accounts for

(1) Information furnished by F. J. Brown and W. E. Morris, Asst. County Agent Leaders for Minnesota.

these counties failing to show a very great increase in improved acres in farms. The wheat area moved from south, northward, and corn followed in its place. Wheat had partly been replaced by corn in the counties farther south by 1910, while the counties to the north changed later. This seems a reasonable explanation, as in 1920 all these counties were equally important in dairying when compared with weighted crop acres, as shown by Figures 1, 2, and 3. Only a narrow strip of land along the river on either side is rough. The land away from the river about one-half to two miles is level prairie. There are more rivers and streams entering the Minnesota River on the south side than on the north side. Since the table land on the south side of the river is higher, the rivers are cut deeper than on the north side. The larger numbers of rivers and streams and the higher banks give Brown, Redwood and Yellow Medicine Counties more rough land than Renville, Chippewa and Swift Counties. This makes the counties bordering the Minnesota River on the south more suited to dairying than the counties on the north side of the river. It was stated in Chapter III. that animals that should have been classed as beef in Pipestone County in 1920 were evidently classed as dairy because Figures 2 and 3, basing the comparison on gallons of milk and value of dairy products, do not correspond with Figure 1 showing dairy cows per 100 acres of crops, weighted for Pipestone County.

Conclusion. - In conclusion, this study shows that the regions near the larger consuming centers become important in dairying for the purpose of supplying market milk and milk for ice cream purposes. Outside of this area the most important factor is the topography of the country. Rough, wooded regions, having numerous lakes tend to dairying because of the irregularity of the fields and the inconvenience of producing crops on a large scale. Pasture and hay and forage is necessary for dairying to develop. The growing

population of the country requires the production of more food. Since the area for expansion is limited, more intensive agriculture must be followed. The various communities will increase the farm enterprises for which they seem best suited. There has been a tendency all over the state to increase in production of live stock from 1910 to 1920. The more intensive nature of the dairy industry has encouraged it on the smaller farms. The proximity to market and the character of the immigrants settling in a community are factors in determining the type of agriculture. Studying the importance of the dairy industry, and its change, on the basis of weighted crop acres seems to be a satisfactory method.

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