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UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey
of
Furnas County, Nebraska

By

L. A. BROWN
Nebraska Soil Survey, in Charge
and
S. R. BACON
United States Department of Agriculture

Bureau of Chemistry and Soils

In cooperation with the
University of Nebraska State Soil Survey
Department of the Conservation and Survey Division

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SOIL SURVEY OF FURNAS COUNTY, NEBRASKA

By L. A. BROWN, Nebraska Soil Survey, in Charge, and S. R. BACON, United States Department of Agriculture

COUNTY SURVEYED

Furnas County is in southern Nebraska, adjoining Norton County, Kans. (fig. 1). Beaver City, near the central part, is 215 miles southwest of Lincoln. The county is rectangular, its approximate dimensions being 30 miles east and west and 24 miles north and south. Its total area is 716 square miles, or 458,240 acres.

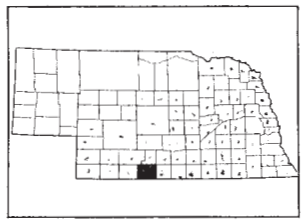

FIGURE 1.—Sketch map showing location of Furnas County, Nebr.

The county is part of a broad, gently eastward sloping, loess-mantled plain, the surface of which has been dissected by the valleys of Republican River, Beaver and Sappa Creeks, and the numerous large and small tributaries of these streams. About 40 percent of the county is occupied by remnants of the old plain, which have escaped destructive erosion, and the remainder consists of valley slopes and alluvial strips along the drainage ways. Most of the old plain remnants occur as long, narrow, nearly level, or gently undulating divides having a general north and south direction. The broadest divides are north of Republican River in the eastern part of the county, where a few of them are about 1 mile wide, but elsewhere throughout the uplands the plainlike remnants consist chiefly of tonguelike divides, in few places more than one half mile wide.

The larger stream valleys, which cross the county in a general east-west direction, are intrenched from 100 to 250 feet below the general level of the old plain remnants. They are, in general, bordered by long rather gradual slopes to the uplands, on the north side of the streams, and by steep, in many places precipitous, slopes on the south side.

The smaller stream valleys are from 20 to 25 feet deep. They are narrow and steep-sided near their heads but become deeper and broader downstream. They are very numerous and over rather large areas have produced a sharply rolling or hilly surface relief. On many of the steeper slopes soil slipping is common and has resulted in the formation of a series of contourlike shelves known as catsteps.

The alluvial lands occupy about one fifth of the area of the county. They include terraces and flood plains along the larger streams and occur as continuous strips ranging from one eighth to 2½ miles in width along Republican River and Beaver, Sappa, Medicine, and Muddy Creeks. Narrower strips lie along many of the tributaries to these streams.

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The terraces occupy about two thirds of the alluvial lands, occurring as almost continuous strips along all the larger stream valleys. They lie at several levels, depending on the depth to which the streams had cut prior to deposition of the alluvial sediments, and they range from 8 to 50 feet above the present stream channels. None of the terraces is subject to overflow from the streams. The surface of the terraces is nearly level except where intrenched by shallow, steep-sided drainage ways issuing from the uplands. The transition between the different terrace levels and to the flood plains is marked in most places by a short steep slope.

The flood plains, or first bottoms, occupy the lowest land in Furnas County, lying only a few feet above the normal flow of the streams. The largest developments are along Republican River, where the width of the flood plain ranges from one half to more than 1 mile. Narrower continuous or broken strips lie along most of the larger streams.

The average altitude of Furnas County is about 2,250 feet above sea level, ranging from approximately 2,035 feet at the point where Sappa Creek crosses the eastern boundary to about 2,500 feet on the uplands northwest of Wilsonville. The elevations of the larger towns, all of which are in the valleys, are as follows: Wilsonville, 2,298 feet; Cambridge, 2,261 feet; Arapahoe, 2,173 feet; Beaver City, 2,147 feet; and Oxford, 2,077 feet.[1]

Drainage in Furnas County, with the exception of a small area in the extreme southeastern corner which drains southward to Prairie Dog Creek in Kansas, is effected by Republican River, Beaver and Sappa Creeks, and tributaries of these streams. The three master streams are roughly parallel and flow in a general easterly direction. Aside from a few depressions on the terraces and locally throughout the first bottoms, the county is well drained.

All the streams in Furnas County have steep gradients and are actively deepening their channels. Water power is developed on Republican River at Arapahoe. Most of the smaller drainage ways are widening their valleys in their lower courses and are extending their channels through headward erosion into the loessial uplands.

Well water of good quality is obtained over most of the county. However, dry wells and those in which the water supply is insufficient or alkaline occur wherever the Pierre shale formation is exposed or lies near the surface of the ground, as on the valley slopes along Republican River and locally on the uplands south of that stream. Most of the well water throughout the uplands is obtained from Tertiary sands and gravels which overlie the Pierre formation, and the wells range in depth from 100 to more than 250 feet, with an average depth of about 150 feet. The water in the wells is medium hard but otherwise is of good quality. The wells on the alluvial lands range from 10 to 50 feet in depth, depending on the thickness of the alluvial deposits. The water is abundant in most places, but it differs in quality, the wells nearest the base of the valley slopes usually containing more highly mineralized water than those nearer the middle of the valleys. Springs occur in several localities but are not an important source of water supply. They

[1] GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U.S. Geol. Survey Bul. 274, ed. 4, 1,072 p. 1906.

are most numerous on the southern Republican Valley slopes. Seepage springs occur along Sappa and Beaver Creeks.

Forest, consisting of native broad-leaved trees—chiefly willow, ash, elm, boxelder, and cottonwood—occupies narrow belts along most of the larger drainage ways. The trees are not of merchantable size but are of value for firewood and posts.

The first permanent settler in Furnas County located in Republican Valley in 1870, and within the next few years settlement spread rapidly throughout the valleys and later onto the uplands, until most of the county was included in homesteads. The early settlers were of many nationalities, although most of them were American born. The county was organized with its present boundaries in 1873.

The population of the county in 1880 was 6,407, and by 1930 it had increased to 12,140. It is all classed as rural, there being no towns of more than 2,500 inhabitants. The average density is 16.8 persons a square mile. The population is rather evenly distributed, although it is somewhat denser in the valleys than in the uplands. The largest towns are Beaver City, Arapahoe, Cambridge, Oxford, which is partly in Harlan County, and Wilsonville. Beaver City, the county seat, about 7 miles southeast of the center of the county, is an important distributing point for the southern part. All the larger towns are located along railroads and furnish local markets for farm implements, supplies, and produce.

Transportation facilities are good. The main line of the Chicago, Burlington & Quincy Railroad follows Republican Valley, and a branch of the same system follows Beaver Creek Valley. All parts of the county are within 11 miles of a shipping point.

The public-road system is well developed. State and Federal highways cross the county in several directions, and most of them are surfaced with gravel. Other roads are of earth construction and are kept in good repair. All roads, except parts of the highways and roads in the rougher sections, follow land lines. Cement bridges and culverts are common, even on the minor roads.

Rural mail delivery routes serve most sections, telephones are in common use, and the public-school system is highly developed.

CLIMATE

The climate of Furnas County is continental and is characterized by wide differences between winter and summer temperatures, but it is well suited to the production of grain and hay crops and to the raising of livestock. The spring weather is usually cool, with considerable rain, which favors rapid growth of winter wheat and spring-planted small grains. The summers are long, with warm days and nights, conditions especially favorable to corn production. The autumns are mild, with occasional periods of rainy weather, but they afford the farmer ample time to prepare and seed his land for winter wheat and to harvest the corn crop.

Topographical differences are not sufficient to cause appreciable differences in climate. Table 1, compiled from records of the Weather Bureau station at Beaver City near the central part of the county, gives the normal monthly, seasonal, and annual temperature and precipitation.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Beaver City, Furnas County, Nebr.*

[Elevation, 2,147 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1883)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	29.3	71	−20	0.69	0.39	1.72	3.5
January	28.1	75	−25	.28	.19	.70	2.2
February	29.8	77	−35	.60	.07	1.25	5.3
Winter	29.1	77	−35	1.57	.65	3.67	11.0
March	40.1	92	−7	.96	.00	.50	4.4
April	52.2	100	11	2.28	.25	5.19	1.2
May	62.0	109	22	2.94	2.62	3.87	.3
Spring	51.4	109	−7	6.18	2.87	9.56	5.9
June	71.8	108	35	3.43	1.66	6.94	.0
July	77.0	113	41	3.53	1.53	5.50	.0
August	75.7	112	40	2.92	2.81	4.86	.0
Summer	74.8	113	35	9.88	6.00	17.30	.0
September	67.4	108	26	1.84	1.58	2.75	.0
October	54.5	101	6	1.31	.12	6.42	.9
November	40.5	85	−10	.72	.08	.00	1.4
Fall	54.1	108	−10	3.87	1.78	9.17	2.3
Year	52.4	113	−35	21.50	11.30	39.70	19.2

The precipitation varies greatly from year to year. In the 20-year period, 1895–1914, it was less than 85 percent of the mean annual precipitation about one fourth of the years. About 75 percent of the mean annual precipitation falls from April to September, inclusive, or during the principal part of the growing season. A large percentage of the precipitation is in the form of torrential rains which cause rather rapid erosion and materially increase the loss of moisture through surface run-off. Droughts, although rare during May and June, sometimes occur in the latter part of July and August. However, crops seldom suffer from lack of moisture to a great extent when properly tended, as the soil has a high moisture-retaining capacity.

The average length of the frost-free season is 155 days, from May 3 to October 6. The date of the latest recorded killing frost is May 27, and of the earliest is September 15. During the years from 1895 to 1914 there were five times in which killing frosts occurred 10 or more days earlier than the average date in the fall and five times in which they were 10 or more days later in the spring. The annual snowfall ranges from a few inches to several feet, averaging 19.2 inches. Most of the snow falls from December to March, inclusive.

From November to March northwest winds prevail, and during the rest of the year the prevailing winds are from the southwest. Strong winds are common, but tornadoes are rare.

AGRICULTURE

Prior to the entry of the white man, Furnas County was covered with a luxuriant growth of prairie grasses, with marginal strips of tree growth along the larger streams. The first permanent settlement was made in Republican Valley in 1870, after which settlement spread rapidly throughout the alluvial lands and gradually extended into the uplands, and by 1890 most of the desirable land had been taken up under the homestead and preemption laws.

Corn was the main crop grown during the first few years and, together with beef and game, composed most of the food of the early settlers. As conditions became more stable, wheat, oats, barley, rye, and garden vegetables were introduced, and by 1900 most of the prairie sod on areas topographically suited to cultivation had been broken for crop production. Some trees still remain along the larger streams.

Early agricultural development was slow. The farmers were not familiar with local climatic conditions and soil requirements, and farming methods were crude and wasteful. Much of the seed had been brought from the more humid Eastern States, and the resulting crops were poorly adapted to the region. Farm implements were crude and the seed bed was usually poorly prepared. A series of dry years, culminating in the disastrous droughts of 1893 and 1894, greatly checked agricultural development. The farmers learned new methods from their own experiences and from farmers in more eastern counties.

Corn has been the leading cultivated crop since the earliest history of the county, with the exception of a few years during and immediately after the World War, when a larger acreage was devoted to wheat than to corn. In 1929 corn occupied nearly three times the acreage devoted to wheat.

Table 2, compiled from the Federal census reports, gives the acreage and production of the important crops and shows the general trend of agriculture during the last 50 years.

TABLE 2.—*Acreage and yield of crops in Furnas County, Nebr., in stated years*

Crop	1879		1889		1899	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	8,994	236,495	65,598	1,854,040	127,435	2,094,620
Wheat	7,047	64,619	15,822	152,062	47,691	277,050
Oats	882	18,634	11,731	166,915	5,844	68,330
Rye	950	11,077	2,157	22,204	2,761	22,380
Barley	794	10,323	194	2,716	1,226	11,570
Potatoes		14,896	1,107	74,222	862	49,040
		Tons		*Tons*		*Tons*
All hay	5,815	8,010	19,194	23,804	25,960	38,326
Clover					10	20
Alfalfa					11,122	23,814
Millet and other tame grasses					2,617	3,244
Wild, salt, or prairie grasses					11,459	10,505
Grains cut green					752	743
Coarse forage					5,332	9,900
		Pounds		*Pounds*		*Pounds*
Broomcorn		16,150	944	332,870	458	77,420
	Trees	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*
Apples			1,426	563	12,959	664
Peaches and nectarines			19	2	22,050	18

TABLE 2.—*Acreage and yield of crops in Furnas County, Nebr., in stated years*—Continued

Crop	1909		1919		1929	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	115,661	711,404	86,999	2,338,153	151,107	3,339,230
Wheat	71,403	818,208	108,098	1,540,773	60,479	785,775
Oats	9,829	175,767	2,578	59,552	2,603	129,623
Rye	632	6,042	1,238	14,740	354	5,884
Barley	1,262	17,201	8,876	171,867	7,637	195,594
Potatoes	958	52,253	322	9,964	396	28,863
		Tons		*Tons*		*Tons*
All hay	33,397	54,161	21,838	36,409	20,154	31,403
Clover	8	32	72	87	1,551	1,635
Alfalfa	16,934	35,485	10,845	24,029	8,625	20,941
Millet and other tame grasses	5,552	8,296	1,851	3,116	3,269	4,675
Wild, salt, or prairie grasses	10,749	10,198	8,330	8,011	6,589	3,960
Grains cut green	151	145	667	986	80	145
Silage crops			1,716	10,358		
Coarse forage	11,480	18,303	26,218	59,226	[1] 10,145	[1] 17,086
	Trees	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*
Apples	9,216	4,223	5,092	8,714	2,569	4,055
Peaches and nectarines	23,775	101	3,105	1,126	1,230	517
Plums and prunes	4,969	437	944	416	930	555
Cherries	8,094	997	3,072	1,433	1,958	1,045

[1] Grain sorghums: In addition corn from 3,043 acres was cut for fodder, but no production figures are given.

Table 3 gives the number and value of domestic animals and poultry on farms in the last 20 years.

TABLE 3.—*Number and value of domestic animals on farms and ranges in Furnas County, Nebr., in 1910, 1920, and 1930*

Kind of animal	1910		1920		1930	
	Number	Value	Number	Value	Number	Value
Horses	13,409	$1,360,074	12,081	$787,074	8,706	$401,327
Mules	1,727	191,315	2,049	198,861	1,630	101,668
All cattle	26,190	615,417	32,972	1,566,856	32,481	1,582,019
Beef cattle			21,262	1,040,503		
Dairy cattle			11,710	526,353		
Sheep	2,305	10,016	12,309	115,024	3,762	22,735
Goats	7	22	96	440	73	385
Swine	31,656	269,886	29,529	637,447	66,566	608,135
Poultry	132,715	62,400	159,027	143,945	158,118	205,979

Approximately 60 percent of the land is used for cultivated crops, 33 percent is in range and pasture land, and about 2 percent is in woodland. The remainder is occupied by building sites or is included in stream channels.

The value of all field and orchard crops, vegetables, and farm gardens in Furnas County was $3,680,428 in 1929. The value of all livestock, including poultry, on hand April 1, 1930, was $2,838,963. Dairy products, excluding those consumed on the farms, were produced to the value of $300,658 in 1929, and poultry and eggs produced were valued at $465,798.

Corn, winter wheat, sorghum forage, alfalfa, barley, and wild hay are the leading grain, forage, and hay crops. Table 4, compiled from the 1929 Nebraska agricultural statistics, shows the average

acre yields of these crops during the period 1916–25, inclusive, and the acre yield, with approximate percentage of the cultivated area devoted to each crop in 1929.

TABLE 4.—*Average acre yield of selected crops, 1916–25, and average acre yield and percentage of land occupied by each crop in 1929*

Crop	Average acre yield, 1916–25, inclusive	Average acre yield, 1929	Cultivated land occupied by each crop, 1929
	Bushels	*Bushels*	*Percent*
Corn	20.60	23.0	62.0
Winter wheat	11.90	14.0	22.0
Barley	20.00	30.0	3.2
	Tons	*Tons*	
Sorghum forage	2.50	2.6	3.5
Alfalfa	2.96	3.0	3.5
Wild hay	1.00	.9	[1] 2.9

[1] Percentage of uncultivated land.

The minor crops include sweetclover, oats, millet hay, sudan-grass hay, rye, potatoes, and garden vegetables, which rank in acreage during most years in about the order named. Federal census statistics show that 96.2 percent of the county was in farms in 1930 and that 63.8 percent of the farm land was improved, improved land including crop land and plowable pasture. Most of the farms range in size from 100 to 500 acres. The average size in 1930 was 286.7 acres. According to the 1930 census, of the 1,549 farms in the county, 701 were operated by tenants, of whom 50 were cash tenants, and most of the remainder were operated by owners. Under the share-rental system the owner usually receives one third of the grain delivered at the nearest elevator and from 50 cents to $2 an acre for pasture land. The better farms in the valleys are usually rented for two thirds of the grain delivered. All seed, labor, and machinery are furnished by the tenant. When alfalfa land is rented on the share basis, the owner receives one half of the hay stacked in the field. When land is rented for cash, the owner receives from $2.50 to $5.50 an acre, including pasture land. The acre rental depends on location, improvements, and general productivity of the individual farm. Most of the land rented for cash is in the valleys.

The farms, as a rule, are well improved, practically all of them are equipped with modern labor-saving machinery, and a large percentage have pressure water systems. On most farms, the buildings are painted and kept in good repair. The farms are fenced and cross-fenced, mainly with barbed wire on wooden posts, but some fields are fenced with woven wire, especially in the valleys where most of the hogs are raised. Four-horse and 6-horse teams perform most of the farm work, although the light-type all-purpose tractor is used with a proportional decrease in the number of horses.

According to the Nebraska agricultural statistics, there were 39 combines, 91 grain threshers, 329 gas engines, 294 tractors, 129 trucks, and 1,344 automobiles on the farms in 1929. Other farm equipment is adequate. Sheltering facilities for machinery are only fair.

Farm laborers are usually plentiful, except during the small-grain harvest season, when good help is often scarce. Wages up to 1929 ranged from $30 to $50 a month with board and lodging. Day labor during the harvest season commanded from $3 to $4. Wheat was harvested for $3 to $5 an acre, depending on the amount of labor required. When a combine is used the cost is usually less than when the crop is harvested with a header and thresher. The grain was threshed for 7 or 8 cents a bushel. Corn shuckers received from 6 to 8 cents a bushel. A few mechanical corn pickers are in use.

The agricultural industries of Furnas County are closely related to the utilization of the crops. Most of the land farmed is used for the production of feed crops, which include corn, alfalfa, sorghum and cane forage, oats, barley, and sweetclover. The uncultivated areas are practically all used for native pasture or hay. The greater part of the cultivated crops is fed to livestock on the farm where grown or on farms situated within the county. The returns derived from the sale of livestock and livestock products are the main sources of income on most farms, and the raising and winter fattening of cattle are the most important branches of the livestock industry. Most of the herds of cattle are composed of grade animals headed by a pure-bred bull. The quality of the beef cattle is in general very good. The principal breeds are Hereford and Shorthorn. Many of the cattle are raised locally, but a few farmers ship in cattle for summer grazing, and numerous feeders annually purchase animals for winter fattening. The animals are fed corn and alfalfa from 60 to 90 days and are then shipped to the Omaha or Kansas City markets.

Hog raising is almost as important as cattle raising. Each farmer in the valleys and many on the uplands raise from 25 to 60 hogs a year, and a few have herds of several hundred. Most of the hogs are raised on corn and alfalfa or sweetclover, although young pigs usually receive some oats or barley. Some hogs are raised in connection with the feeding of beef cattle. The hogs are all of good breeding, and there are numerous pure-bred herds in the county. Spotted Poland China, Duroc-Jersey, and Chester White are the leading breeds. Practically all hogs are fattened on the farm where raised, and most of them are sold in Omaha. Hog raisers use sanitary methods, and conditions are favorable for this form of livestock enterprise, especially in the valleys of the larger streams where corn and alfalfa are abundant.

Dairy products are an important source of income on many farms. Only a few farms are devoted exclusively to the dairy industry, but most farmers keep a few milk cows, mainly of mixed beef and dairy breeding, and sell their surplus products to local cream buyers. Cream routes are established in some parts of the county, and much of the cream is collected by the purchaser. Pure-bred dairy herds, chiefly Holstein-Friesians, are on a few farms in the vicinity of the larger towns. The abundance of corn and alfalfa, especially in the larger valleys, favors the extension of the dairy industry.

Chicken raising is a rather important source of income on many farms. Demand for poultry products is slowly increasing, and the poultry industry is receiving more attention than in previous years.

Most farms have from 50 to 75 chickens, and, on many, flocks of several hundred are maintained. The principal breeds are Plymouth Rock, Leghorn, Rhode Island Red, and Buff Orpington. Poultry products are either sold or exchanged for farm supplies in local towns.

Only a few sheep are raised, but several thousand sheep are annually shipped in and fattened on corn, alfalfa, and sweetclover.

Horse raising is confined chiefly to the breeding of work mares. Percheron blood predominates in most of the horses. Pure-bred stallions are kept on a few farms. Owing to the increased use of tractors, horse raising is not profitable.

SOILS AND CROPS

Furnas County, as heretofore stated, is part of a broad, gently eastward sloping, loess-mantled plain, the surface of which has been modified by the valleys of Republican River, Beaver and Sappa Creeks, and their numerous large and small tributaries, the valleys of many of which are canyonlike, especially in their upper courses.

According to the 1930 census, 59.2 percent of the land is under cultivation. The remainder consists chiefly of areas of sharp divides and steep slopes carved in the loessial mantle by the numerous drainage ways but also includes small areas of swampy land in the larger valleys, of forest along the larger streams, and numerous canyon-floor areas which, although nearly level, are too narrow and inaccessible to be profitably farmed. These areas are used for native pasture and hay, in connection with the raising of beef cattle, which is an important industry in Furnas County.

The cultivated land occurs in nearly all parts of the county, including the uplands, terraces, and bottom lands. It ranges from nearly level to strongly rolling and in a few places throughout the uplands is hilly. Probably 90 percent of it is well suited to tractor farming. It is used for all the crops commonly grown in the region, chief among which are corn, wheat, sorghum forage, alfalfa, and barley, ranking in acreage in the order named. Rye, clover, oats, potatoes, and other grain, forage, and truck crops are also grown but are of minor importance. The county has no mining or manufacturing industries, and grain, hay, and livestock are the chief sources of revenue.

Excluding alfalfa, the total area occupied by each of the crops is greatest in the uplands, where the cultivated areas are most extensive; and the acreage of corn, which is needed as feed for livestock, exceeds that of any other crop in all parts of the county.

The cultivated soils, on account of their slightly larger acreage and greater producing powers, will be discussed in the first part of this section and the uncultivated soils in the latter part.

The cultivated soils of Furnas County are rather uniform, being characterized, as a whole, by dark-colored topsoils well supplied with organic plant food and by fine-textured, friable, and lighter-colored subsoils with a high lime content. They are easily tilled, have good moisture-absorbing powers, and are able to release their moisture freely to the growing crops. A few of the terrace soils have slightly lighter colored topsoils than is usual, and some of the soils in the

bottom lands have extremely sandy subsoils, but these deficiencies are counteracted in many places by unusually favorable moisture conditions, and the cultivated soils as a whole are well adapted to the crops commonly grown.

The chief factor influencing crop yields and soil and crop adaptations on the cultivated soils in Furnas County is soil moisture. The county is in a region of rather low annual precipitation—21.5 inches—only about 16 inches of which falls during the growing season. Obviously, the more elevated soils do not receive the equivalent of 16 inches precipitation during this season, as part of the moisture is lost as run-off to lower-lying soils.

The slight differences in the soil moisture produce marked differences in crop yields and in soil and crop adaptations. Corn, which requires an abundance of moisture throughout the growing season, yields higher on the terrace soils than on the upland soils, on account of a more favorable moisture supply, and the highest yields are obtained on the bottom-land soils. Small grains, in most years, also do better on the terrace soils than on the upland soils, but, as these crops mature early in the growing season, they seldom require all the available moisture in the soils, and differences in their yields on the uplands and terraces are less pronounced than those of corn. Small grains are not well adapted to the bottom-land soils because the excessive moisture often produces rank stalk growth at the expense of the grain. Alfalfa produces the highest yields on the bottom-land soils, where it can obtain an abundance of moisture for rank vegetal growth. All forage crops do better on the terraces than on the uplands and yield highest on the moist bottom-land soils. These differences in crop yields and adaptabilities have influenced the proportional acreage devoted to each crop on the cultivated soils of the uplands, terraces, and bottom lands as shown in table 5, the data for which were obtained during the progress of the Furnas County soil survey.

TABLE 5.—*Approximate percentages of cultivated land devoted to crops on the soils of the uplands, terraces, and bottom lands in Furnas County, Nebr.*

Crop	Upland	Terrace	Bottom land	Crop	Upland	Terrace	Bottom land
	Percent	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*
Corn	70	80	85	Alfalfa	1	4	8
Wheat	20	10	1	Barley	2	2	1
Sorghum forage	5	1	1	Minor crops	2	3	4

Obviously the cultivated soils of Furnas County, on the basis of their moisture supply, which is determined largely by their topographic position and which has been shown to strongly influence crop yields and soil and crop adaptations, may be divided into three broad groups, as follows: Cultivated upland soils which receive moisture from precipitation alone; cultivated terrace soils which receive moisture from precipitation supplemented by run-off from the uplands; and cultivated bottom-land soils which receive precipitation and run-off from both terraces and uplands, in addition to seepage from the water table which occurs within a few feet of the surface.

In the following pages of this report the soils of Furnas County are described in detail, and their agricultural relationships are discussed; their location and distribution in the county are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 6.

TABLE 6.—*Acreage and proportionate extent of soils mapped in Furnas County, Nebr.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Holdrege silt loam	167,360	36.5	Sarpy very fine sandy loam	5,760	1.2
Hall silt loam	38,336	8.4	Sarpy fine sandy loam	6,976	1.5
Hall silt loam, high-terrace phase	11,776	2.6	Sarpy loamy sand	2,112	.4
Hall very fine sandy loam	1,856	.4	Cass very fine sandy loam	2,816	.6
Bridgeport very fine sandy loam	7,744	1.7	Cass fine sandy loam	1,280	.3
Bridgeport silt loam	3,520	.8	Colby silt loam	186,368	40.7
Bridgeport fine sandy loam	768	.2	Nuckolls silt loam, eroded phase	512	.1
Judson silt loam	1,664	.3	Butler silty clay loam	256	.1
Lamoure silt loam	16,960	3.7	Rough stony land	320	.1
Lamoure silty clay loam	1,856	.4			
			Total	458,240	

CULTIVATED UPLAND SOILS

This group includes the largest area of cultivated soils, occupying 36.5 percent of the total area of the county. These soils occur in all parts of the county but are most extensive in the northeastern part where the loess plain has been least modified by erosion. Elsewhere the soils of this group occur as long, generally narrow, flat-topped divides between canyonlike drainage ways. The group is represented chiefly by one soil type, Holdrege silt loam. A few small areas of Colby silt loam are also cultivated, but as most of the Colby soil is used for pasture land it will be described with the uncultivated soils.

Holdrege silt loam.—Holdrege silt loam, owing to its high producing powers when adequately supplied with moisture, and to its large extent, good drainage, and favorable surface relief, is the most important soil in Furnas County. The surface soil, which ranges from 8 to 16 inches in thickness, is very dark grayish-brown mellow silt loam. The dark color is the result of an abundance of well-decayed vegetable material which constitutes about 3 percent by weight of the 6-inch surface layer. This material is an important factor in producing the soft mellow character so desirable for tillage, and it has strong absorbing powers for moisture and heat. It retains moisture well and is the chief source of nitrogen, an essential plant food. The subsoil, which extends to a depth of about 4 feet, is friable silt loam, brown or grayish brown in the upper part, where it has been stained by organic matter washed from the surface soil, and light gray or almost white in the lower part. Lime is abundant below a depth of 26 or 30 inches, occurring chiefly in finely divided form thoroughly mixed with the silt. The subsoil is highly retentive of moisture. Beneath the subsoil is light yellowish-brown floury silt having a high lime content. It is the formation from which the soil has weathered, is known geologically as loess, and is exposed in all the deeper road and stream cuts.

Holdrege silt loam, although remarkably uniform in its characteristics throughout the area of its occurrence in Furnas County, presents a few variations. On the broader and more nearly level divides in the northeastern part of the county, the upper part of the subsoil is a little denser than usual, the topsoil is a trifle thicker, and lime in the subsoil lies at a slightly greater depth. These characteristics, however, are scarcely noticeable, except through close observation, and the slightly increased thickness of the topsoil is the only feature which noticeably influences the agricultural value of the soil. The characteristics are largely the result of unusually slow surface drainage which has allowed more of the precipitation to enter the soil, thereby promoting vegetal growth, the translocation of the finer surface soil particles into the subsoil, and deeper leaching of the entire soil. In the more rolling areas, especially in the vicinity of the Colby soils where the surface relief has allowed more rapid run-off, erosion has somewhat thinned the topsoil and lime lies a little nearer the surface of the ground than is typical.

Holdrege silt loam is sufficiently porous throughout to allow good aeration, easy root penetration, and free upward and downward movement of soil moisture. Lime, although not abundant in the topsoil, is present in sufficient quantities to prevent excessive leaching of the decayed vegetal material and other plant foods and to prevent the soil from becoming sour or acid. The lime is plentiful in the subsoil and is within easy reach of crop roots.

Obviously, Holdrege silt loam is an ideal soil for general farming. However, it occurs in the uplands where soil moisture depends entirely on the precipitation, and this is not sufficient in all years for maximum yields of crops requiring moisture in large quantities during the entire growing season. In unusually wet seasons, such as occurred in 1930, crop yields, particularly those of corn, are about twice as large as are those obtained during years of normal precipitation, and in unusually dry years corn yields, especially, are very low. However, the great demand for corn as a feed for livestock necessitates using the soil chiefly for this crop.

Sweetclover and sorgo cane, which to some extent are able to adapt themselves to variations in the moisture supply, generally do well except in the driest years. Alfalfa, provided a good stand is obtained, gives moderate returns for 3 or 4 years because it is able to obtain moisture from great depths, but when the deep subsoil moisture is exhausted alfalfa yields decline, as the crop is unable to make good growth in this region on the moisture supplied by precipitation alone, hence alfalfa is of minor importance on Holdrege silt loam. Yields of wheat differ from year to year less than those of other crops, because wheat matures early in the summer, usually before the moisture stored in the soil during the winter and spring is exhausted. Oats, barley, and other early maturing crops also yield rather consistently. The soil, therefore, is naturally better suited to small grains than to corn and forage crops, and because wheat is the chief cash crop in this county a large proportion of the soil is used for this crop. Oats and barley are used only as a step in the rotation between corn and wheat and are of little importance on any of the soils in Furnas County.

In normal years the average acre yield of corn is about 18 bushels, of wheat about 11 bushels, of oats about 22 bushels, and of barley about 24 bushels. Alfalfa, during the first 3- or 4-year cropping period, yields about 1.5 tons of hay an acre a season in normal years; sweetclover in such years yields about 1.8 tons of hay; and sorgo cane about 2½ tons of forage.

Table 7 shows the results of mechanical analyses of samples of the surface soil, subsurface soil, and several layers of the subsoil of Holdrege silt loam.

TABLE 7.—*Mechanical analyses of Holdrege silt loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
377614	Surface soil, 0 to ½ inch	0.1	0.1	0.1	0.2	18.6	59.0	21.9
377615	Subsurface soil, ½ to 2 inches	.0	.2	.1	.3	16.0	61.6	21.7
377616	Subsoil, 2 to 16 inches	.0	.1	.1	.1	12.2	55.4	32.1
377617	Subsoil, 16 to 26 inches	.0	.1	.1	.1	14.2	49.5	35.9
377618	Subsoil, 26 to 40 inches	.0	.1	.1	.1	12.6	61.5	25.6
377619	Subsoil, 40 to 55 inches	.1	.1	.1	.2	13.6	62.0	24.0
377620	Subsoil, 55 to 84 inches	.0	.1	.1	.1	17.5	58.4	23.8

CULTIVATED TERRACE SOILS

Practically all the area occupied by the soils of the terrace group, which comprises 14.4 percent of the total area of the county, is under cultivation. This group includes 7 soils, namely, Hall silt loam with a high-terrace phase, Hall very fine sandy loam, Bridgeport silt loam, Bridgeport very fine sandy loam, Bridgeport fine sandy loam, and Judson silt loam. These soils occur in rather continuous strips, ranging from ⅛ to 2½ miles in width, along all the larger drainage ways, but they are most extensive along Republican River. They have nearly level or gently undulating surfaces, lie from 8 to 50 feet above the stream channels, and are all well drained.

The Hall soils of the terraces are similar in their principal characteristics to Holdrege silt loam. The Bridgeport soils have slightly lighter colored topsoils, and Judson silt loam has a deeper and in most places a darker topsoil. The topsoils of some of the terrace soils are also a little more sandy than the topsoil of Holdrege silt loam. Moreover, nearly all the soils on the terraces are underlain, at a depth ranging from 2 to 7 feet, by older buried soils that were evidently formed prior to the deposition of the sediments from which the present soils have developed. However, these differences, especially in a region as far west as Furnas County, are of little importance in determining crop yields and soil and crop adaptations. The chief factor in determining these properties is the moisture supply in the soils which is naturally greater on the terraces, where precipitation is supplemented by some run-off from higher levels, than it is on the uplands. The terrace soils, therefore, are more productive of all crops than is Holdrege silt loam.

Throughout most of the terrace soils the moisture supply is more nearly ideal for all crops common to the region than it is in the soils of the uplands or bottom lands. Especially is this true on the

lower terraces which, although well drained, receive more moisture in the form of run-off than the higher terrace soils and in addition have comparatively high water tables.

Hall silt loam.—Hall silt loam, together with its high-terrace phase, occupies nearly 80 percent of the terrace lands in Furnas County. It is extensively developed along all the major streams, but the largest areas are along Republican River and Sappa and Beaver Creeks. Most of this land lies from 8 to 25 feet above the stream channels. The surface relief ranges from nearly level to very gently undulating. The soil is well drained and where typically developed is very similar in all characteristics to Holdrege silt loam, differing from that soil only in topographic position. As mapped in this county, however, it includes more variations than does Holdrege silt loam. The most important variation is on the lower terraces in Sappa Creek Valley and in the eastern part of Beaver Creek Valley, where the topsoil ranges from 20 to 36 inches in thickness, this unusual thickness being apparently due to deposition of dark-colored soil material on an older topsoil. On similar terrace levels in the western part of the county the topsoil has been made slightly lighter in color and coarser in texture than usual by stream-deposited sediments. It is dark grayish brown in color and in places approaches very fine sandy loam in texture. In numerous places throughout this soil two Hall silt loams are developed, one above the other. The upper soil in few places exceeds 30 inches in thickness. It has a dark topsoil and in most places is characterized by a light-colored subsoil. The lower soil is similar to Holdrege silt loam in character and thickness. Locally, however, the upper soil has only a topsoil resting directly on the corresponding layer of the lower soil, making its topsoil much thicker than that of Holdrege silt loam. In a few small areas accumulations of alkali salts have caused the soil to puddle and the subsoil to become rather compact.

About 80 percent of Hall silt loam is used for corn. In seasons of normal precipitation yields of this crop range from 20 to 30 percent higher than on Holdrege silt loam and in dry years are often more than twice as high. Wheat occupies about 10 percent of the land, being grown chiefly on the higher terraces, where it yields from 10 to 15 percent more than on the Holdrege soil in normal years. The average acre yield of alfalfa is about 3 tons on the lower terraces and about 2 tons on the higher ones. This crop occupies about 4 percent of Hall silt loam. The remainder of the soil is used for sorgo cane, barley, potatoes, sweetclover, and other minor crops, all of which yield from 10 to 30 percent higher than on the uplands.

Hall silt loam, high-terrace phase.—The high-terrace phase of Hall silt loam, as the name implies, occupies the higher terraces. It does not differ in any striking soil features from typical Hall silt loam and is almost identical in its characteristics with Holdrege silt loam. The largest developments are along Sappa and Beaver Creeks, adjacent to the uplands. Soil of this phase is also developed locally along Republican River.

The surface relief is nearly level or very gently undulating. The soil lies from 30 to 50 feet above the stream channels and from 5 to 35 feet above the lower-lying Hall soils. Its moisture supply is naturally supplemented by some run-off from the uplands but not so much

as on the lower terraces, and, although the soil is suited to all crops commonly grown on Holdrege and Hall silt loams, its topographic position makes it transitional in productivity between these soils, especially for crops requiring an abundant and prolonged moisture supply.

Soil of the high-terrace phase produces slightly higher yields of all crops than Holdrege silt loam and is equal to the lower terrace soils for wheat production, but it does not produce quite such high yields of corn and alfalfa as the lower-lying soils. Alfalfa does not produce much better on the high terraces than on the uplands, because the water table is beneath the reach of alfalfa roots.

Hall very fine sandy loam.—Hall very fine sandy loam is similar to Hall silt loam and Holdrege silt loam in all soil characteristics except that it contains a little more very fine sand in its surface layer than does the corresponding layer of those soils. It occurs mainly in narrow strips along a few creeks entering Republican River from the north and occupies less than 3 square miles in Furnas County. Farming practices and crop yields are practically the same as on Hall silt loam, but, owing to the narrowness of the Hall very fine sandy loam areas, a smaller percentage of this soil is farmed than of Hall silt loam.

Bridgeport very fine sandy loam.—Bridgeport very fine sandy loam has developed from light-colored sediments, some of which were deposited by the streams when their channels were near the present terrace levels and some of which have washed or rolled down from nearby soils. It occurs on the same terrace levels as Hall silt loam, but it occupies only 12 percent of the terrace lands. The largest developments are in the vicinity of Edison and east of Holbrook. The surface relief ranges from nearly level to gently sloping, the more sloping areas being near the base of upland slopes, where sediments from higher-lying soils have accumulated.

The outstanding characteristic of this soil is its light color and uniform character to a depth below 4 feet. The material is largely grayish-brown friable very fine sandy loam. The 6- or 8-inch surface layer is, in general, considerably darker than the remainder of the soil, in many places being dark grayish brown, owing to a comparatively large content of organic material, but the surface soil is not well supplied with organic material and is nowhere so dark as the surface layers in the Hall soils. In most places lime occurs within a depth of 3 feet, and in places it is abundant within a few inches of the surface of the ground.

This soil is rather uniform throughout the areas of its occurrence, but it presents a few variations. It varies slightly in texture, especially near the margins of the areas, in some places containing an unusually high proportion of either silt or fine sand, depending on the character of the adjacent soils, and undoubtedly numerous small areas of Bridgeport silt loam or fine sandy loam are included on the accompanying soil map. Locally, in Beaver Creek and Republican River Valleys, the soil is underlain at a depth ranging from 1 to 3 feet by a buried dark-colored soil resembling Hall silt loam. These variations, however, are of such small extent and local importance that they are not shown on the soil map.

Owing to its lower organic-matter content, Bridgeport very fine sandy loam does not absorb and hold such large amounts of moisture as the Hall soils. It also has a little lower nitrogen supply than those soils. These deficiencies, although reflected in slightly lower crop yields than are obtained on the darker terrace soils, are not sufficiently pronounced to greatly reduce the agricultural value of the land. Most farmers consider Bridgeport very fine sandy loam as only slightly inferior to Hall silt loam for general farming, and it is considered superior to Holdrege silt loam because of its more favorable position for the accumulation of moisture.

Corn is grown on about 80 percent of the area occupied by Bridgeport very fine sandy loam and yields about 20 bushels an acre in normal years. Wheat occupies about 10 percent of the land, with an average yield of about 12 bushels an acre, and alfalfa, with a yield of about 3 tons of hay an acre, is grown on approximately 4 percent. The remaining land, practically all of which is cultivated, is used for minor crops, including sweetclover, sorgo, millet, barley, and potatoes, all of which yield about 5 percent higher than on Holdrege silt loam and 4 or 5 percent lower than on the Hall soils.

Bridgeport silt loam.—Bridgeport silt loam is identical with Bridgeport very fine sandy loam, except that it contains a slightly higher percentage of silt throughout. This higher content of silt is scarcely noticeable. It does not seem to cause any difference between these soils in crop yields or adaptability, and both soils are regarded with equal favor by the farmers. Bridgeport silt loam occurs chiefly in Beaver Creek Valley, where it occupies several small areas. One of the largest developments, comprising about 240 acres, is east of Beaver City.

The soil occupies the same terrace levels as Hall silt loam and Bridgeport very fine sandy loam and is used for the same crops in about the same proportional acreages as those soils. The land is well drained, and practically all of it is under cultivation.

Bridgeport fine sandy loam.—Bridgeport fine sandy loam occupies several small areas, chiefly in the Republican River Valley south and east of Cambridge. The largest body comprises about 160 acres.

This soil, although similar in its characteristics to Bridgeport very fine sandy loam, has a noticeably higher sand content and a lower organic-matter content than that soil. It does not produce quite such high yields as the finer-textured terrace soils, especially of wheat, which requires a rather firm seed bed. Therefore this crop occupies a comparatively small proportion of the soil. All other crops occupy about the same proportional acreages as on Bridgeport silt loam and Bridgeport very fine sandy loam, except sorgo, which is grown on a slightly larger proportional acreage of Bridgeport fine sandy loam than it is on the finer-textured Hall and Bridgeport soils.

Judson silt loam.—Judson silt loam occurs only in a few small bodies scattered through the larger valleys. Most of it occurs as narrow elongated strips bordering the lower slopes to the uplands. It occupies only 2.6 square miles in Furnas County.

The most striking characteristic of Judson silt loam is its uniformity to a depth exceeding 4 feet. It consists of very dark grayish-brown mellow silt loam which is rich in well-decayed plant re-

mains and which continues with little change throughout the entire soil. It is rather low in lime but is not deficient in this material. Its lower lime content and dark color differentiate it from the Bridgeport soils. The lower part of the soil is also less limy and darker than the corresponding part of the Hall soils.

This soil has developed over a mixture of fine sediments which were washed or rolled down from nearby higher-lying soils and deposited in the valleys. Its dark color is owing to the high organic-matter content of the original sediments which were derived largely from the dark-colored surface layers of upland soils.

Judson silt loam is well drained, has good tilth, and is used for all crops commonly grown in the region. Practically all the land is under cultivation, and it is as productive as any of the terrace soils, but it occupies only a small part of the farms on which it occurs and is of little agricultural importance.

CULTIVATED BOTTOM-LAND SOILS

The soils of this group occupy the lower positions along the larger drainage ways, where they have developed over sediments deposited by the streams during periods of high water. The sediments are of rather recent origin compared to those from which the terrace soils have developed, and they have not been so greatly altered by weathering. Their character, therefore, is the dominant factor in determining the character of the bottom-land soils. The sediments deposited by the local upland streams flowing through areas of loess are naturally uniform and silty, whereas those deposited by more deeply intrenched streams, which have cut through the loessial mantle into an underlying sandy strata, are coarser. The mixing and reassorting of the fine and coarse particles have given rise to a complete assortment of sediments, especially in the bottom lands along Republican River, where the sediments came not only from the surrounding uplands but also from a variety of sources to the west. The bottom lands, therefore, although comparatively inextensive in Furnas County, are occupied by a greater variety of soils than occur on the uplands or terraces. They include 2 Lamoure, 2 Cass, and 3 Sarpy soils.

The Lamoure soils have developed from the finer, more silty sediments, and the Cass and Sarpy soils from the coarser-textured sandy and gravelly deposits. The sediments from which the Lamoure and Cass soils developed have been in their present positions long enough to have accumulated considerable organic matter in their upper parts, and these soils have dark-colored surface soils. The Sarpy soils, however, have developed from comparatively recently deposited sands and gravels, and they are light colored throughout.

Nearly all the bottom-land soils are subject to occasional overflow from the streams during periods of high water, and numerous small areas are poorly drained, but overflow water disappears rapidly from all except the lower-lying areas when the streams subside, and the bottom-land soils as a whole are well drained. About 75 percent of the area occupied by these soils is under cultivation, and the remainder, including poorly drained areas and those supporting native forest, is used for hay and pasture land.

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The bottom-land soils are naturally better supplied with moisture than soils on the uplands and terraces, because the precipitation received by them is supplemented by run-off from higher land and by seepage from the stream channels. The water table, which lies at slight depths in the bottom lands, is also the source of an abundant moisture supply within easy reach of deep-rooted crops. The run-off from the higher land carries considerable organic matter and other plant foods to the lower areas, making the bottom-land soils highly productive, especially of crops requiring an abundance of moisture. Even the light-colored and sandy Sarpy soils produce excellent yields of corn and alfalfa, and the Cass and Lamoure soils are the strongest corn and alfalfa soils in the county. In fact, the cultivated bottom-land soils as a whole produce higher yields of all crops, except wheat and oats, than the upland and terrace soils. Wheat is seldom planted in the bottom lands, because the abundant moisture causes this crop to produce long weak stems which break during windy weather. Excessive moisture also results in small yields of late-maturing wheat. Oats yield fairly well in the bottom lands, provided short stiff-stemmed varieties are grown, but even this crop has a tendency to grow rank at the expense of the grain and is of minor importance on these soils. Although the cultivated bottom-land soils as a whole are highly productive, they differ somewhat in their producing powers, crop adaptabilities, and tillage properties.

Lamoure silt loam.—Lamoure silt loam is the most extensive bottom-land soil in the county, occupying practically all the flood plain along Sappa Creek, most of that along Beaver Creek, and a large part of the bottom land along Republican River. Its surface relief is nearly level or very gently undulating. The soil lies only a few feet above normal flow of the streams, and, although not well drained, only about 20 percent of it remains too wet for farming operations.

The surface soil, to a depth of about 6 inches, is very dark grayish-brown heavy silt loam which is underlain by a 12-inch layer of almost black silty clay loam. These layers contain an abundance of well-decayed vegetable material, which accounts for their dark color. Beneath the topsoil is light grayish-brown friable very fine sandy loam or silt loam, with a high lime content. This layer contains numerous rust-brown and gray spots and splotches, which indicate poor drainage.

This soil, although fairly uniform throughout the areas of its occurrence in Furnas County, varies somewhat in different localities. In the Republican River Valley south of Cambridge the surface soil over a small area is much lighter than typical, and the soil has many of the characteristics of Laurel silt loam which is developed in counties to the west. In a few places the subsoil contains more and coarser sand than usual, and locally spots occur containing alkali in sufficient quantities to injure crops, but as these variations are not sufficiently extensive to noticeably alter the agricultural value of the soil, they are not shown on the soil map.

Lamoure silt loam is probably the most productive corn soil in the county, and about 85 percent of the cultivated area is used for this crop. Corn yields ranging from 60 to 75 bushels an acre are not un-

common, and the average acre yield over a period of years is between 50 and 55 bushels. Alfalfa also does well and is grown on about 10 percent of the cultivated land, yielding about 3 tons of hay an acre each season. In seasons of unusually high precipitation the corn and alfalfa yields may be somewhat reduced on account of excessive moisture. Lamoure silt loam cannot be cultivated under so wide a range of moisture conditions as soils containing more sand in their surface layers, but with reasonable care good tilth is easily maintained.

Lamoure silty clay loam.—Lamoure silty clay loam is similar to Lamoure silt loam, except that it contains much more clay in its topsoil and is therefore more difficult to handle. It is the heaviest soil in the county and is locally known as "gumbo land."

This soil occupies less than 3 square miles in Furnas County. It occurs chiefly in the western part of Republican Valley as small bodies within other soil areas. Its high clay content makes it extremely difficult to handle except under the most favorable moisture conditions. If plowed when wet, clods are formed, which require subsequent wetting and drying or freezing and thawing before favorable tilth is restored. When the soil is dry, it checks and cracks badly, exposing crop roots to drought, and it is almost impenetrable to cultivating tools. Only about 40 percent of the land is under cultivation. The narrow range of moisture conditions under which it can be advantageously tilled causes most farmers to use it for pasture and hay land.

Corn occupies about 90 percent of the cultivated area, and the remainder is used chiefly for alfalfa and sweetclover. In favorable years these crops yield even higher than on Lamoure silt loam because the soil is naturally very strong and fertile. Crop yields are greatly reduced in wet years by excessive moisture and in dry years by drought.

Sarpy very fine sandy loam.—Sarpy very fine sandy loam occupies only 9 square miles in Furnas County, chiefly along Republican River, Medicine Creek, and Beaver Creek, where it occurs as narrow elongated strips near or adjacent to the stream channels. The surface relief is nearly level or very gently undulating. This soil lies only 4 or 5 feet above the normal level of the streams, and, although subject to overflow during periods of high water, only about 20 percent of the land remains too wet for cultivation after the streams subside.

Sarpy very fine sandy loam has developed from recently deposited sandy and gravelly sediments which have not lain long enough to have accumulated much organic material. The surface layer, to a depth of 8 or 10 inches, consists of grayish-brown friable very fine sandy loam. This is underlain to a depth exceeding 4 feet by gray or almost white sand. In the upper part of the subsoil the sand is in most places very fine and is mixed with considerable silt, but it becomes coarser with depth and in some places grades into a mixture of coarse sand and gravel below a depth of 3 feet. The soil is more or less limy throughout.

The principal variation in this soil is in the texture of the material in its surface and subsoil layers. In some places the surface soil contains unusually large quantities of silt, in others fine and medium

grades of sand are unusually abundant. Locally the silt content is practically negligible. The chief subsoil variation is in areas in which the material is practically free from the coarser grades of sand, and the soil throughout has a very fine sandy loam texture. Scattered throughout the soil are small spots in which alkali is sufficiently abundant to injure crops. However, the variations mentioned are so patchy and of such local importance that they are not shown separately on the soil map.

About 80 percent of Sarpy very fine sandy loam is under cultivation, and the remainder is used for pasture and hay land. About 60 percent of the cultivated land is devoted to corn, about 30 percent to alfalfa, and the remainder to minor hay and feed crops and garden truck.

The soil is low in organic matter and therefore in nitrogen, as is indicated by its light color. It requires fertilization for optimum yields of all crops except alfalfa and sweetclover, which derive their nitrogen supplies from the air. Alfalfa yields about 3½ tons an acre each season in normal years. Sweetclover, although well adapted to this soil, is seldom grown on it because alfalfa is preferred for feeding purposes. Corn on areas which have received liberal applications of barnyard manure yields about 50 bushels an acre and on unfertilized land from 20 to 30 bushels an acre. Truck crops, chiefly watermelons and potatoes, are grown for home consumption and for sale in the local markets. The soil warms up early in the spring, and, provided it receives sufficient manure, produces good yields of truck crops.

Sarpy fine sandy loam.—Sarpy fine sandy loam resembles Sarpy very fine sandy loam except that it has a slightly coarser textured surface layer than that soil. It occupies a total area of 10.9 square miles, occurring in small bodies, chiefly in the Republican River bottom lands near Arapahoe. About 60 percent of the land is under cultivation.

Sarpy fine sandy loam is used for the same crops, in about the same acreage ratios, as Sarpy very fine sandy loam, and crop yields are about the same on the two soils. More or less barnyard manure is used in growing all crops except alfalfa. The soil is very stable even during prolonged periods of dry, windy weather. The uncultivated parts of this soil, most of which are included in poorly drained areas or forest, are used for pasture or hay land.

Sarpy loamy sand.—Sarpy loamy sand occurs in a few small bodies scattered throughout the bottom lands, chiefly along Republican River. It consists of gray incoherent fine or medium sand, the topmost few inches of which contain sufficient silt, clay, and organic matter to give the material a loamy texture but not enough to prevent the sand from drifting during prolonged dry, windy weather. Coarse sand and gravel occur in many places below a depth ranging from 2 to 3 feet, and below a depth of 18 inches the sand is very limy.

This soil occurs adjacent to, and only 2 or 3 feet above, the stream channels and is subject to rather frequent overflow. Its surface relief is less level than that of the finer-textured and more coherent bottom-land soils, and over small areas the wind has whipped the

loose sand into low mounds and ridges, giving the soil a decidedly hummocky appearance. Such areas are almost devoid of vegetation.

Owing to its rather unstable character and its proximity to the river, only about half of Sarpy loamy sand is used for crops, and the remainder is in native pasture or woodland. Corn and alfalfa are the chief crops on the cultivated areas, and potatoes, watermelons, cantaloups, and other truck and garden crops are grown for home consumption or for sale in the local towns. This soil is about as productive as Sarpy very fine sandy loam, provided it receives an abundance of manure and care is taken to prevent soil drifting.

Cass very fine sandy loam.—Cass very fine sandy loam occurs in several small areas, most of which are in the Republican River bottom lands near Arapahoe. A few bodies are in the Beaver Creek bottom lands.

This soil has developed over sandy deposits similar to those underlying the Sarpy soils, but which have accumulated an abundance of well-decayed vegetable material in their surface layers. The topsoil, which is 8 or 10 inches thick, consists of very dark grayish-brown or almost black mellow very fine sandy loam. This material gives way rather abruptly to a grayish-brown incoherent mixture of fine sand and medium sand, which becomes gradually coarser in texture with depth and in some places below a depth ranging from 3 to 4 feet contains considerable fine gravel. In most places the soil throughout contains sufficient lime to effervesce when dilute hydrochloric acid is applied.

The principal variation in this soil is toward a silt loam, and several small bodies of Cass silt loam are included with it on the soil map.

Most of Cass very fine sandy loam is above the lower flood levels of the streams and is well drained. Practically all the land is under cultivation. Corn is grown on about 70 percent of it, alfalfa on about 20 percent, and minor grain, forage, tame-hay, and truck crops on the remainder.

This soil equals any of the Lamoure soils in yields of corn, and it produces slightly higher yields of alfalfa than Lamoure silt loam. However, owing to its small extent, it is of little agricultural importance in Furnas County.

Cass fine sandy loam.—Cass fine sandy loam resembles Cass very fine sandy loam in all respects except its slightly coarser textured topsoil. It occupies only a small total area in Furnas County and occurs chiefly in the Republican River bottom lands east of Arapahoe. The land is well drained and is practically all under cultivation. The same crops are grown, in about the same acreage ratios, as on Cass very fine sandy loam, and yields compare favorably with those on Lamoure silt loam.

UNCULTIVATED SOILS

The soils classed as uncultivated soils occupy about 45 percent of the land in the county. They are not used to an appreciable extent for the production of grain, tame-hay, or forage crops. Scattered patches of them, occurring chiefly around the edges or in the corners

of corn or sorgo fields, may be cropped occasionally, but the total cultivated acreage is practically negligible.

According to the 1929 Nebraska agricultural statistics, about 97 percent of the uncultivated land in the county is in virgin pasture and is used chiefly for grazing beef cattle. The remainder is native-hay land. The grazing areas occur chiefly in the rougher parts of the uplands where the surface relief is unsuited to the use of hay-making machinery.

More than 95 percent of the uncultivated soil area in the county is occupied by Colby silt loam. This soil, together with an eroded phase of Nuckolls silt loam, occupies the more eroded parts of the uplands. Butler silty clay loam occurs locally in shallow and poorly drained basins on the terraces. The rest of the uncultivated soil area includes rough stony land and the more poorly drained parts of the different bottom-land soils.

Colby silt loam.—Colby silt loam is the most extensive soil in Furnas County, occupying 40.7 percent of the total area. It has been formed from light-gray limy and floury silt similar to that underlying Holdrege silt loam, but which has been subjected to such severe erosion that it has not accumulated much organic material in its surface soil. The soil as a whole lies considerably below remnants of the old loess plain, on which the Holdrege soil is developed. It is characterized by steep slopes and sharp divides. It occurs in all parts of the uplands, wherever drainage has carved the gray loess into a rugged surface relief. In the more eroded sections, soil slipping is common, and many of the steeper slopes present a succession of short vertical exposures, locally known as catsteps. The topsoil, which in few places is more than 6 or 7 inches thick, is loose friable silt loam, ranging in color from dark grayish brown to ash gray, depending on the severity of erosion to which the soil has been subjected. The 3- or 4-inch surface layer is commonly much darker than the rest of the topsoil, owing to the presence of small amounts of organic matter. The subsoil is light-gray or yellowish-gray floury silt which grades at a depth of about 20 inches into very light gray or almost white parent loess. The subsoil and in many places the topsoil are very limy, the lime being in finely divided form and evenly distributed throughout the soil mass. The soil is simply gray loess, the surface layer of which has been slightly darkened by organic matter. Much of it was probably originally Holdrege silt loam, but it has lost most of its organic constituents through erosion. In areas where erosion has been especially severe, all organic materials have been removed as fast as formed and the parent loessial formation is exposed in many places.

Colby silt loam as a whole is unfavorable to cultivation, but it supports a good growth of nutritious grasses, including grama, buffalo, June, and little bluestem and, owing to its large extent, is the leading pasture and hay soil in the county. Hay is cut chiefly on the more gradual slopes and on narrow canyon floors. The native grasses will support about 40 head of cattle on 160 acres during the summer grazing season, May to October inclusive, or when cut for hay will yield about one third ton to the acre. Some corn, wheat, and sorgo are grown on areas least subject to erosion, but the yields

are much lower than those obtained on Holdrege silt loam. Probably less than 4 percent of this soil is under cultivation.

The grazing of beef cattle is the chief industry on this soil, especially in the rougher sections. The animals are pastured during the summer and fed hay in the winter until they are 2 or 3 years old, when most of them are either shipped as feeders to Kansas City or sold to local feeders for fattening. Some ranches include both grazing and grain land, and on these the cattle are usually fattened before they are sold.

Nuckolls silt loam, eroded phase.—The eroded phase of Nuckolls silt loam occupies less than 1 square mile in Furnas County. It has developed from a reddish-brown loesslike material which underlies the gray loess of the uplands and is exposed locally in the more severely eroded sections, mainly in the deeper canyons. Although this soil occurs in numerous bodies, none of them exceeds 80 acres. In most of them the topsoil is dark grayish-brown friable silt loam 4 or 5 inches thick. Below this layer the color gradually becomes lighter with depth, and reddish-brown material becomes more and more pronounced until, at a depth of about 30 inches beneath the surface of the ground, the pale reddish-brown limy and somewhat sandy parent loess occurs. The subsoil and in many places the topsoil are very limy. Many of the bodies classed with this soil on the soil map are simply exposures of the reddish-brown loess, and they have not developed soil characteristics.

The eroded phase of Nuckolls silt loam is topographically unsuited to the use of any farm machinery and is all included in pasture land. It supports the same species of grasses as grow on Colby silt loam and has about the same grazing value as that soil, but, owing to its small extent, it is of little importance, even for grazing.

Butler silty clay loam.—Butler silty clay loam occupies less than 300 acres in Furnas County. It occurs in a few shallow basinlike depressions on terraces, chiefly in Spring Green precinct, the largest development, comprising about 90 acres, occurring in section 30 of this precinct. The depressions have no surface outlets and are naturally poorly drained. Water accumulates in them after heavy rains and remains on the surface of the ground for several weeks.

The surface soil in the basins is an almost black heavy silty clay loam averaging about 6 inches thick. It is underlain by a lighter-colored, in places nearly white, layer about 3 inches thick. The next lower layer is almost black dense clay which continues to an average depth of 30 inches. The lower part of the subsoil is light colored, friable, and very limy.

The thickness of the different soil layers differs somewhat in the different basins and even within different parts of the same basin. In many places the light-colored subsurface layer is poorly developed. Locally it is absent, and the dark topsoil rests directly on the almost black dense clay of the subsoil. However, the soil as a whole is very uniform throughout the areas of its occurrence.

Because of its poor drainage, Butler silty clay loam is not farmed. It is doubtful that it could be profitably farmed even if it were artificially drained, because the dense claypanlike layer in the subsoil prevents free movement of soil moisture and greatly resists root

penetration. Some hay of rather poor quality is cut in the basins, but the greater part of the soil is regarded as waste land.

Rough stony land.—A few small areas of rough stony land occur in places where the main drainage ways dissecting the upland have cut into and exposed the underlying rock. The soil developed over these exposures is thin, and patches of bare rock are exposed where the soil has been removed by erosion. The soil is in general very fine sandy loam or silt loam, and it has a high lime content. Drainage is naturally excessive, on account of the slope and the porous sandy substratum. The grass growth is scanty, owing to the low moisture supply. The land is used only for pasture, and it is of very little value, even for this purpose.

Poorly drained bottom-land soils.—The characteristics and utilization of the cultivated parts of all the bottom-land soils in Furnas County have been set forth. Each of these soils includes small areas that are too wet for cultivated crops, but the soil in the wet areas does not seem to differ noticeably from that in the better-drained areas.

Practically all the area occupied by the poorly drained parts of the bottom-land soils supports a rank growth of water-loving grasses, rushes, and sedges, and the land is used chiefly for hay production. The hay is much coarser than that obtained on the Colby soil of the uplands, and it has a lower feeding value. However, the land produces two or three times as much hay to the acre as the upland soil, and this tends in a measure to offset the inferior quality of the hay. The grasses on those parts of the poorly drained bottom lands which are not used for hay production will support a cow or horse on each acre during the summer grazing season.

AGRICULTURAL METHODS AND MANAGEMENT

Agricultural methods and management in Furnas County are similar to those practiced throughout southwestern Nebraska and northwestern Kansas. Corn is planted between the first and middle of May. Practically all the corn on the upland and most of that on the alluvial land is listed, as this method requires no seed-bed preparation beyond that furnished by the lister. Corn planted in this manner is considered by most farmers to be more drought resistant than that planted with a drill. The corn crop is cultivated three or four times during the season, 2-row cultivators being commonly used. The last cultivation is usually given early in July, after which the crop is "laid by" and receives no further attention until harvest.

Corn matures in September or early in October, depending on the season. The greater part of the crop is husked from the standing stalks, after which cattle and horses are pastured in the fields during the winter. On many farms part of the corn is cut for winter roughage, and some farmers annually fence off a few acres of uncut corn to fatten hogs and cattle, thereby saving part of the expense of husking.

The chief varieties of corn are Reid Yellow Dent, Iowa Silvermine, and Calico. Careful seed selection is not generally practiced, and much seed corn is shipped in, although this is not advisable, as such seed usually yields less than a good type of well-adapted local seed.

Some farmers have grown corn successively on the same ground for many years with but slightly lowered yields. However, the rotation in general use on the uplands consists of 2 years of corn followed by 1 of wheat. On the alluvial lands the rotation in common use is 3 or 4 years of corn followed by 1 of small grain and 3 or 4 of alfalfa.

Seed-corn treatments have not proved beneficial under Nebraska soil and climatic conditions and are not generally practiced. Corn smut is carried over from year to year in the field and not in the seed, which makes such treatment ineffective as a control measure for this disease.

Practically all the wheat grown is of the winter varieties, chiefly Kanred, Turkey, and Nebraska no. 60, the last-named variety being a strain of Turkey. Nebraska no. 60 and Kanred are the most popular. The land to be used for wheat is usually plowed and harrowed during late summer, and the seed is planted with a press drill late in September. Some seed is drilled in between the corn rows early in the fall. The crop usually makes a good growth before killing frosts occur. It remains dormant during the winter, resumes growth in the spring, and usually matures early in July. Most of the crop is headed and threshed from the stack or harvested with combines, but a few farmers still prefer binding the wheat and threshing from the shock. Some farmers, especially in the southeastern part of the county, grow winter wheat on the same soil many years in succession.

The wheat yield is sometimes reduced by stinking smut which distorts the kernels, stunts their normal growth, and gives the grain an offensive odor. This form of smut may be controlled by mixing the seed before planting with copper carbonate powder at the rate of 2 ounces of the powder to a bushel of grain.[2]

Barley is of minor importance, although the production of this crop is increasing as it rightly should. Barley ranks next to corn, measured in terms of feed produced to the acre. The development of high-yielding smooth-bearded varieties of barley, such as Comfort and Glabron, has removed the disagreeable task of handling the rough-bearded varieties, which made barley unpopular in the past. Beardless varieties have not yielded nearly so well as bearded varieties and are not recommended by State agronomists.

Early seeding of barley during late March or early April at the rate of 2 bushels an acre has given the best average results. Most of the barley grown is fed on the farms. Feeding tests show that coarsely ground barley is 90 percent as good as corn in a fattening ration. Barley is a good substitute for corn, and a reasonable acreage will insure feed for livestock if unfavorable weather should materially reduce the yield of corn. Barley is equal, if not superior to, oats as a nurse crop, and it is used with alfalfa or clover seedings.

Oats are not considered a very profitable crop and are not grown extensively. However, the crop is desirable for feed and is of value in a crop rotation between corn and wheat. Oats are seldom planted on the same land 2 years in succession. They are sown and harvested in the same manner as wheat, but the land is prepared and the grain is planted in the spring instead of in the fall. All the crop is usually

[2] NEBRASKA UNIVERSITY, AGRICULTURAL COLLEGE EXTENSION SERVICE, DEPARTMENTS OF AGRONOMY AND PLANT PATHOLOGY. CEREAL SMUTS AND THEIR CONTROL. Nebr. Agr. Col. Ext. Circ. 126, 8 p., illus. 1925.

consumed on the farm where produced. Kherson is probably the chief variety grown as it yields well, is early maturing, and has a short stiff stem which reduces the danger of lodging. Nebraska no. 21 is also an important variety and is being grown more extensively each year as it has the better qualities of the Kherson, from which it was selected as a pure strain, and in addition produces somewhat higher yields. Seed selection is not carefully practiced.

Smut sometimes lowers oat yields during prolonged periods of rainy or cloudy weather. The injury from this source, however, can be controlled by killing the smut spores on the seed before planting. This may be done by sprinkling the seed, after the grain has been fanned, with a solution containing 1 pint of formaldehyde to 35 gallons of water.[3]

Rye is not an important crop. Winter rye is grown for the grain and to some extent for hay and pasture. The land for rye is prepared in the same manner as that for winter wheat. The seed is planted with a press drill early in the fall. The crop is usually cut with a binder and shocked or stacked for threshing in July. The grain is fed locally to hogs. Rosen rye is the chief variety.

Alfalfa is the leading hay crop. The varieties grown are among the most hardy obtainable, including Common, Grimm, and Cossack, all of which are resistant to winter-killing. The seed is usually sown in April or early May, that sown at the earlier date generally giving the best results. Fall seeding is not recommended for western Nebraska conditions. Thorough seed-bed preparation is important in obtaining a stand. Early plowing, followed by sufficient disking, harrowing, and possibly rolling to control weed growth and to compact the soil, is desirable in most places. The best results are obtained by planting the seed after the first heavy rain in the spring. The standard seeding rate is 15 pounds of good seed to the acre, and pure certified seed should be used. Planting with a press drill is nearly always more successful than broadcasting the seed. Drilled seed should not be planted deeper than 1 inch. When the seed is broadcast, it is usually covered with a harrow.

A stand of alfalfa is usually allowed to remain as long as it yields profitably, generally 3 or 4 years on the upland and from 4 to 8 years on alluvial land. The crop is rarely frozen out. It is usually cut three times during the summer, and occasionally a fourth cutting is obtained. Nearly 9,000 acres, most of which was alluvial soil, were devoted to alfalfa in Furnas County in 1929. The common practice is to stack the hay in the field and haul it to the feed lot as needed. Most of it is fed to cattle and hogs. Many farmers run hogs in the alfalfa field during the summer, but cattle are seldom allowed to graze for long periods on green alfalfa, on account of the danger of bloating.

Sweetclover, although still of minor importance, is being grown more extensively each year, especially throughout the uplands. The plant is a biennial and dies at the end of the second season, after producing seed. It is used chiefly for pasture and to some extent for hay and seed. When hay is desired the crop is usually cut during the first year, before the growth becomes coarse and weedy. In the

[3] See footnote 2, p. 25.

second year, the crop may be allowed to mature and reseed itself, or it may be cut with a binder and threshed for seed. The permanence of a sweetclover stand depends entirely on its ability to reseed, and most farmers take care during the second year not to graze so closely as to prevent the maturity of enough of the crop to reseed the land.[4] Seeding during two consecutive years at the start is recommended to provide for annual reseeding and also for continuous early and late pasture. The most common time of seeding is in early spring, either in late March or early April. The seed bed is prepared in a similar manner to that used for alfalfa. Planting the seed with a press drill generally insures a more uniform stand than broadcasting and covering with a harrow. From 15 to 20 pounds of unhulled seed are usually used when seeding broadcast or 12 pounds when a press drill is used.

Sweetclover has an unusually wide adaptation. It thrives on both comparatively wet and dry soils and on soils of either light or heavy texture. It is very valuable for soil improvement. Most farmers consider it more satisfactory for this purpose than alfalfa, especially on the upland, and it is adapted to shorter rotations than is alfalfa. The roots are large and vigorous, and they decay rapidly at the end of the second year of growth. The crop not only adds organic matter to the soil, but, in common with other legumes, it has the power of fixing atmospheric nitrogen in the nodules on its roots. It is a good soil binder and is especially valuable on the steeper slopes where erosion is severe.

Wild hay is cut from the bottom lands, where drainage is insufficient for the production of cultivated crops or tame hay, and from the level canyon floors of the uplands. The greater part of that cut in the bottom lands consists of water-loving grasses and sedges, and it is rather coarse in texture, but most of that cut on the canyon floors is of excellent quality. Most of the hay is either stacked in the fields or stored in the barns for winter feeding, and a small quantity is baled.

Sorgo is the chief forage crop. It is grown on nearly every farm in the county, except on the alluvial lands, where alfalfa is more profitable. The yield of sorgo ranges from 1 to 5 tons an acre, the average yield in 1929 being 2.6 tons. Sorgo belongs to a group of plants that become temporarily dormant during dry periods, and it is very drought resistant as well as extremely productive. The best quality of feed is produced if the crop is cut when the earliest heads begin to mature. Most of it is fed with corn and oats, and its feed value compares favorably with any of the wild hays. Black Amber, Sumac, and Early Orange are the most common varieties grown.

No commercial fertilizer is used. A rather large quantity of barnyard manure is produced, but in general little care is taken to preserve it. On most farms manure is piled outdoors, where much of its value is lost by leaching. The manure is hauled in the fall or spring and is generally spread on the more sandy bottom-land soils. The crop usually grown after manuring is wheat, corn, or some truck crop. On tenant farms little care is taken to apply the manure

[4] STEWART, P. H., and GROSS, D. L. SWEETCLOVER IN NEBRASKA. Nebr. Agr. Col. Ext. Circ. 122, 15 p., illus. 1923.

where it is most needed, and the greater part is spread on the land nearest the barnyard.

Many farms throughout the county include fields which have been continuously used for grain crops and have received no fertilizer of any kind since the virgin sod was broken. Samples of the first and second 6-inch soil layers were obtained from several of these fields and were analyzed for nitrogen which is one of the most important plant foods and which decreases rapidly when the soil is used for grain crops unless care is taken to preserve it. Similar samples from nearby, in most places adjoining, virgin fields having comparable surface relief and drainage were also obtained and analyzed for nitrogen, in order that comparisons might be made of the total nitrogen content of the soils in the cultivated and uncultivated fields. All samples were taken in representative areas of the more important and extensive soils. The results of the analyses are shown in table 8.

TABLE 8.—*Nitrogen content of samples of the first and second 6-inch layers of virgin and of cultivated soil of representative soils in Furnas County, Nebr., and percentage of loss of nitrogen in the topmost foot of the cultivated soil*

Group	Soil type	Condition of soil	Nitrogen content			Nitrogen loss through cultivation	
			0–6 inches	6–12 inches	0–12 inches	0–6 inches	0–12 inches
			Percent	*Percent*	*Percent*	*Percent*	*Percent*
1	Holdrege silt loam	Cultivated 35 years	0.143	0.126	0.135	25.5	21.1
	Do	Virgin	.192	.149	.171		
2	Do	Cultivated more than 25 years.	.109	.109	.109	42.0	33.1
	Do	Virgin	.188	.123	.156		
3	Do.[1]	Cultivated 30 years	.107	.090	.099	40.2	33.1
	Do.[1]	Cultivated 20 years	.113	.097	.105	36.8	29.0
	Do.[1]	Cultivated 5 years	.156	.099	.128	13.0	13.5
	Do.[1]	Virgin	.179	.117	.148		
4	Colby silt loam [2]	Cultivated more than 25 years.	.042	.038	.040	71.6	67.5
	Do	Virgin	.148	.097	.123		
5	Hall silt loam	Cultivated more than 25 years.	.145	.097	.121	19.0	22.0
	Do	Virgin	.179	.130	.155		
6	Do	Cultivated 40 years	.103	.103	.103	41.1	31.0
	Do	Virgin	.175	.122	.149		
7	Bridgeport very fine sandy loam.	Cultivated more than 20 years.	.106	.052	.079	16.6	29.4
	Do	Virgin	.127	.096	.112		
8	Cass fine sandy loam	Cultivated 25 years	.086	.070	.078	35.8	30.5
	Do	Virgin	.134	.090	.112		

[1] Data furnished by agronomy department, University of Nebraska, from unpublished records of J. C. Russel and G. M. Bahrt.

[2] Samples taken from severely eroded fields.

SOILS AND THEIR INTERPRETATION

The soils of Furnas County as a whole have developed from highly calcareous geological formations and under climatic conditions favoring fairly rapid vegetal growth and decay. All of them, except in eroded sections or on recently deposited alluvial sediments, have received enough decomposed organic material from the decaying grass roots to make their topsoils dark. The topsoils also have a

mealy and open but not granular structure. The rainfall of about 21.5 inches per annum has been sufficient, especially in those parts of the county where the soils have lain for the longest periods undisturbed by erosion, to leach the readily soluble salts (mostly lime carbonate), from the surface soil and upper part of the subsoil. These salts have accumulated in the lower part of the subsoils, forming a layer of highest lime content, commonly known as the lime zone. In the rougher parts of the county, however, less water enters the ground and the soils are not so deeply leached, lime occurring in many places at or near the surface of the ground, depending on the severity of erosion.

In addition to the characteristics mentioned, the older soils of the county have developed layers, or horizons, parallel to the surface of the ground, occurring in definite order from top to bottom and differing from one another in one or more important characteristics, such as color, texture, structure, chemical composition, or compaction. These layers, as well as all other characteristics mentioned, are the result of soil development and, as a rule, are most pronounced in those areas where the soils have been subjected to a minimum of erosion and where they have lain exposed to undisturbed weathering for the longest periods.

Holdrege silt loam is the leading soil throughout the more nearly level parts of the uplands. It has developed from light-gray friable limy silt, known by geologists as Peorian loess, under conditions especially favorable for the development of the normal regional profile. A typical profile of this soil in its virgin condition, as observed on a fairly wide divide in the northeastern part of the county, has a topsoil consisting of three fairly well defined layers. The upper one is loose mulchlike dark grayish-brown silt loam 1 inch thick. The second is 1½ inches thick, is slightly darker than the layer above, and has a poorly developed laminated or platy structure. The third, or lower, layer has a mealy open but not granular structure. It consists of small fragile clusters of soil particles and extends to a depth of 16 inches. The clusters, or aggregates, are slightly larger in the lower part of the layer, but do not exceed one sixteenth inch in diameter. The three layers are friable and are composed largely of silt particles and organic matter. The lower part of the third layer contains a little more clay than the rest of the topsoil.

The content, distribution, and stage of decomposition of the organic matter differs somewhat in the different layers. In the mulchlike layer the organic constituents are not thoroughly decomposed, although they are abundant and uniformly distributed.

The second, or laminated, layer contains the largest quantity of thoroughly decomposed organic material and has a slightly darker color than the layer above, being dark grayish brown or very dark grayish brown. Its color remains constant when the soil material is crushed, indicating that the organic matter is thoroughly mixed with the mineral soil particles.

The decomposition of organic remains is complete in the third layer, but the organic material is not sufficiently abundant to thoroughly permeate the soil mass and is deposited as a film or coating on the surfaces of the soil clusters, or aggregates. The film is thick-

est in the upper part of the layer, causing a natural exposure of that part to appear as dark as the layer above. However, when the aggregates are crushed they are lighter in color than material similarly treated from the laminated layer. The organic film decreases in thickness with depth, and the lower part of the layer is dark grayish brown or, when crushed, is grayish brown.

The subsoil of Holdrege silt loam is composed of two layers. The upper layer, immediately below the dark surface soil, extends to a depth of 26 inches. It consists of grayish-brown fine-textured material which breaks into more or less cubical clods from one half inch to 2 inches in diameter. The material has no well-defined structure but is slightly more coherent than the material above and below, and it is friable throughout. It contains numerous borings and some insect casts, most of which are either lighter or darker than the general color of the layer in which they occur, depending on whether the material composing them was derived from overlying or underlying layers.

Carbonates have been leached from the surface soil and upper subsoil layer but have accumulated in the next lower, or second, subsoil layer, forming a layer of higher lime content than occurs in any other part of the soil. This layer is commonly known as the lime zone and extends to a depth of 40 inches. It is light grayish-brown friable structureless silt containing a few borings of slightly darker color than the remainder of the material. The carbonates are most abundant in the upper part of the zone where they occur both in finely divided form thoroughly mixed with the soil particles, also as soft and hard visible segregations. Visible lime decreases with depth, and the layer merges at a depth of about 55 inches below the surface of the ground with raw parent loess which, although highly calcareous, contains little visible lime. The organic matter so abundant in the upper soil layers decreases rapidly with depth, practically disappearing a few inches beneath the zone of maximum compaction.

Associated with Holdrege silt loam throughout the uplands is Colby silt loam which has also developed from Peorian loess but under conditions unfavorable for the development of a regional profile. The surface relief of Colby silt loam ranges from strongly rolling to rough and broken, and surface run-off is rapid. Smaller quantities of moisture enter the soil than in areas of Holdrege silt loam, and the rapid run-off removes the surface soil almost as fast as it forms. The soil is simply Holdrege silt loam, the surface layer of which has been greatly thinned or entirely removed by erosion. Most of it has from 3 to 8 inches of dark-colored topsoil which rests directly on the parent loessial formation. In many places, especially on the steeper canyon sides, the raw loess is exposed.

A typical profile of this soil, observed near the center of the county, has a dark grayish-brown friable and mealy topsoil 5 inches thick. It is similar in character to the third layer of Holdrege silt loam but is slightly lighter in color. Beneath this layer the material to a depth of 18 inches is light-gray floury silt which has been subjected to weathering barely long enough to have been leached of its carbonates. The next lower layer, which continues to a depth of about 3 feet, is similar in color, texture, and structure to the one above but

contains more lime than any other layer in the soil profile, the lime occurring as white coatings and soft segregations and in finely divided invisible form. This layer rests on raw Peorian loess similar to that underlying Holdrege silt loam.

In the deeper stream valleys, erosion has removed the gray Peorian loess in places, exposing the underlying formations to weathering. The uppermost of these is reddish-brown limy and silty material, known by Nebraska geologists as Loveland loess which is thought to be older and more oxidized than the overlying gray loess. In a few places exposures of this material have weathered into a soil similar in its characteristics to Colby silt loam but having a decidedly red cast. In such places the soil is classed as an eroded phase of Nuckolls silt loam.

The Hall, Bridgeport, and Judson soils occupy well-drained terraces or benches in the larger stream valleys. The Hall soils have developed from silty sediments deposited by the streams when flowing at higher levels. They have lain in their present positions long enough to have accumulated an abundance of dark organic material and to have developed definite layers, or horizons, resembling both in character and number those in the more nearly level but well-drained parts of the uplands. In fact, the Hall soils may be regarded as terrace equivalents of the Holdrege soils.

The Bridgeport and Judson soils are of more recent origin than the Hall soils, and their character depends largely on the character of the materials from which they have developed.

Scattered throughout the more nearly level parts of the terrace lands are a few small shallow depressions, locally known as buffalo wallows, or lagoons, which are occupied by the Butler soils. Water accumulates in these depressions after rains and often remains on the surface of the ground for several weeks. Downward percolation of water is excessive, and its results are pronounced. The topsoils are friable or only slightly compact and are about 9 inches thick. They are in general structureless. The basic color of the upper two thirds or three fourths is almost black, but in many places the material is sprinkled with light-gray or almost white floury silt, from which the organic matter has been leached. The color of the lower part of the topsoil depends on the amount of leaching to which the material has been subjected and may range from almost black to white. Where unusually light in color it contains some black hard and almost round ferruginous concretions about one eighth inch in diameter. The upper part of the subsoil, which is about 2 feet thick, is a true claypan, being composed of almost black, dense structureless clay. The lower part, which constitutes the lime zone, is about 12 inches thick. It consists of light-colored silt loam containing more lime than occurs in any layer above or below. The lime zone rests on unweathered or only slightly weathered Peorian loess at a depth of about 4 feet. The loess is limy, but the carbonate is less abundant than in the layer above.

Table 9 gives the pH value; hygroscopic coefficient; and organic-matter, volatile-matter, and lime content, by soil layers, of a representative sample of each of the more important and extensive soils in Furnas County.

TABLE 9.—*pH value; hygroscopic coefficient; organic-matter, lime, and volatile-matter content, by soil layers, of selected soils in Furnas County, Nebr.*

Soil type	Depth	pH [1]	Hygroscopic coefficient	Organic matter [2]	$CaCO_3$ [3]	Volatile matter
	Inches			*Percent*	*Percent*	*Percent*
Holdrege silt loam	0– ½	6.5	8.8	6.2	(5)	7.4
	½– 2	6.6	8.4	4.5	(5)	7.1
	2–16	6.8	9.8	2.6	0.00	5.1
	16–26	7.2	12.3	.3	.00	3.6
	26–40	8.0	9.9	(4)	5.95	3.2
	40–55	8.0	9.3	(4)	5.05	3.1
	55–84+	7.9	8.7	(4)	1.45	2.6
Colby silt loam	0– 6	7.7	12.2	2.5	2.66	4.8
	6–18	7.7	10.6	.8	4.75	3.7
	18–36	7.7	9.7	(4)	4.23	3.1
	36–60+	8.1	8.5	(4)	2.54	2.2
Hall silt loam	0– ½	6.6	7.7	4.0	(5)	7.1
	½– 1½	6.8	7.3	3.7	(5)	6.1
	1½– 5	7.2	8.3	2.9	(5)	4.9
	5–18	7.3	10.0	1.9	.00	4.3
	18–30	7.8	11.6	.7	.00	3.4
	30–45	8.2	9.9	(4)	2.64	3.0
	45–74+	8.3	9.4	(4)	4.35	2.5
Bridgeport very fine sandy loam	0–10	8.3	5.1	1.8	.02	2.5
	10–35	8.3	5.7	.5	2.32	2.2
	35–48+	8.4	4.8	(4)	1.82	1.7
Lamoure silt loam	0– 5	7.7	12.6	3.8	.40	6.5
	5–18	7.9	12.3	3.1	.25	5.5
	18–37	8.3	9.1	(5)	1.86	3.6
	37–48+	8.6	8.6	(5)	2.38	3.2
Sarpy very fine sandy loam	0– 4	7.7	6.0	2.3	(5)	4.0
	4–20	8.6	3.8	1.3	(5)	2.3
	20–30	8.9	2.8	(5)	(5)	.7
	30–48+	9.0	3.5	(5)	(5)	1.1
Cass very fine sandy loam	0– 6	8.5	8.8	3.1	(5)	6.4
	6–18	8.6	5.8	1.0	(5)	2.7
	18–48	8.7	3.3	(5)	(5)	1.0

[1] Average of results obtained with quinhydrone electrode and colorimetric methods.
[2] Determined by oxidation with 30 percent H_2O_2.
[3] Calculated from inorganic CO_2.
[4] Less than 0.25 percent.
[5] Not determined.

SUMMARY

Furnas County is in southern Nebraska, adjoining Kansas. It is rectangular and comprises 716 square miles or 458,240 acres.

The county is in the loess region of Nebraska. About 40 percent of the land surface, including about half of the uplands, is occupied by nearly level remnants of an old constructional loess-mantled plain which once covered most of southern and eastern Nebraska. About 42 percent, including the rest of the uplands, has been more or less eroded and ranges from strongly rolling to extremely rough and broken. The remainder of the county is occupied by nearly level alluvial lands which occur as continuous strips of various widths along all the larger streams.

Furnas County has an average elevation of about 2,250 feet above sea level. The land slopes gradually downward toward the east.

Drainage is effected through Republican River, Beaver and Sappa Creeks, and their numerous tributaries. The three large streams are roughly parallel and flow in a general easterly direction. The county is well drained, except locally on the alluvial lands.

The first permanent settlement in the area now included in Furnas County was made on Republican River in 1870, and the county was organized in 1873. Most of the early settlers came from the East

Central States. According to the 1930 Federal census report, the population is 12,140, all of which is classed as rural.

Transportation facilities are good, and no point is more than 11 miles from a railroad. All parts of the county are supplied with rural mail delivery, telephones are in common use, and the public-school system is highly developed.

The climate is suited to the production of hay and grain and to raising livestock. The mean annual temperature is 52.4° F., and the mean annual precipitation is 21.5 inches. The average frost-free season is 155 days, which is sufficient for the maturing of all crops common to the region.

Furnas County is essentially agricultural. Grain and hay growing and livestock raising are the chief occupations. According to the Nebraska agricultural statistics for 1929, corn, wheat, sorgo, alfalfa, barley, and wild hay are the leading crops.

Systematic crop rotation is not practiced. No commercial fertilizer is used, but barnyard manure is applied on a few small areas in the bottom lands.

Farm improvements are generally good. Most farms are equipped with modern labor-saving machinery, and many tractors are used in performing the heavier farm work.

Farm laborers are usually plentiful except during grain harvest. Wages before 1929 ranged from $30 to $50 a month with board and lodging.

Holdrege silt loam is an extensive and the most important agricultural soil in the county. It covers all the nearly level or gently rolling parts of the uplands. The land is well drained, easy to cultivate, and in years of heavy rainfall ranks among the most productive upland soils in Nebraska. It is well suited to all crops climatically adapted to the region.

The Hall and Bridgeport soils occupy terrace or bench positions. They are more productive than Holdrege silt loam, but owing to their smaller extent, rank next to that soil in agricultural importance. Their unusually high productivity is owing to their location, which is more favorable for the accumulation of moisture than that of the upland soils.

The Lamoure, Cass, and Sarpy soils occupy narrow strips on the flood plains. These soils have developed on alluvial sediments recently deposited by the streams during periods of high water. The Lamoure soils are the strongest corn soils in the county, but they are not sufficiently extensive to be of much agricultural importance.

Colby silt loam is the most extensive soil, but as a whole it is not suited to cultivation because of its unfavorable surface relief. It occupies the more severely eroded parts of the upland and ranges from hilly to extremely rough and broken. Most of it is used for grazing beef cattle. Some hay is cut on the more gradual slopes and on the numerous canyon floors.

Nuckolls silt loam, eroded phase, occupies small scattered patches wherever erosion has entirely removed the gray upland loess and exposed the underlying reddish-brown loesslike formation to weathering. It is all included in pasture land.

○

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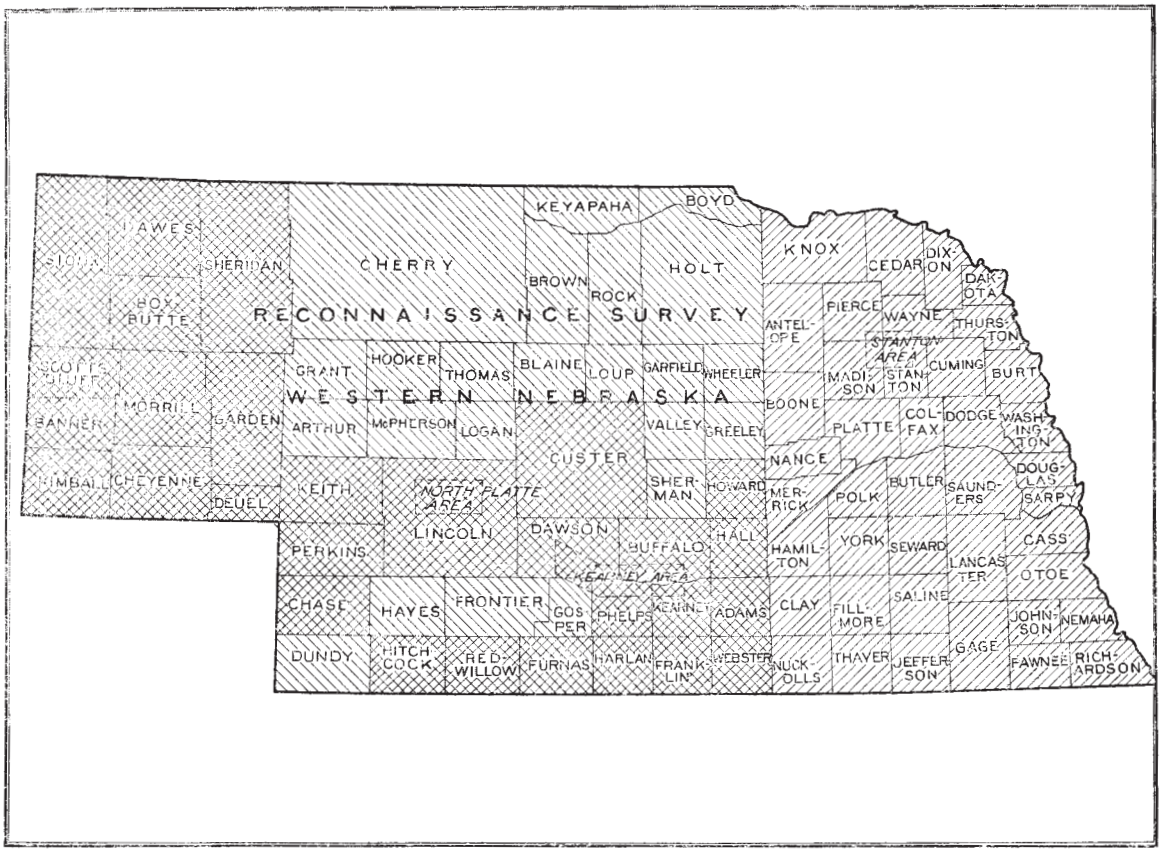
There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than two hundred and fifty copies shall be for the use of each Senator from the State and not more than one thousand copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in Nebraska, shown by shading.

Detailed surveys shown by northeast-southwest hatching; reconnaissance surveys shown by northwest-southeast hatching; **crosshatching indicates areas covered in both ways.**

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