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Land Use Experience in Callaway County, Missouri

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INTRODUCTION

Farm prosperity in Callaway County has been declining. Evidences of this decline are apparent to the most casual observer. Much of the land in the county is seriously eroded; some of it is probably damaged beyond repair. Hundreds of acres are idle. Only about one-third of the farm homes and buildings appear to be adequate and to be maintained in good repair. Although Callaway County farmers have never been extremely prosperous, old-timers say that the "good old days" at the turn of the century saw much more farm prosperity than has been evident in recent years. Callaway County differs little in these respects from much of northeastern Missouri.

What are the reasons for this decline? To a certain extent, it has been produced by competition on the part of more favorably endowed agricultural areas, by displacement of the horse by mechanical power for city transportation and farm implements, the high prices for grain, and inflated land values which were consequences of World War I, the agricultural depression of the twenties and the great depression of the thirties. More local forces such as the severe droughts of 1934 and 1936 have contributed to the problem of declining prosperity. To a large extent, however, the troubles of Callaway County may be traced even closer to Earth—to the misuse of land. Whether misuse of land is caused by attitudes or by economic pressures may make little difference in its end effects. Agricultural use of land which is not adapted for such use, or the mismanagement of land which is agricultural, usually leads along one road—and it is not the road to increased farm prosperity.

¹The authors wish to acknowledge the assistance of Professor H. H. Krusekopf, Soils Department, Missouri Agricultural Experiment Station, who gave unselfishly of his time and knowledge to assist with the preparation of the discussion of land resources, and to extend their appreciation to officials of the Missouri State and Callaway County Offices of the Agricultural Adjustment Administration for permitting the use of A.A.A. records.

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Recent public agricultural programs and higher prices have offered the means of correcting some of these misuses and abuses of land. Soil conserving practices and conservational land use are being established by many farmers; debt adjustments have been made; and improved credit sources have been opened up.

The present situation, however, is still far from a balanced, well adapted, and prosperous agriculture. Although well-directed national economic policies will go far to improve the situation, the rehabilitation of the local agricultural economy fundamentally depends upon basic adjustments in land use. For the most part, these needed adjustments consist of shifts in sizes and types of farms according to the use-capabilities of the land and the retirement of farms in areas not adapted to agriculture.

This project was initiated to formulate general conclusions regarding adapted types of land uses in Callaway County. The conclusions are significant to other areas in northeastern Missouri which are characterized by similar problems. These conclusions were derived from a method of analysis in which the county was first subdivided into 33 fairly homogeneous land areas. The land of each area was then described in terms of its basic characteristics, agronomic adaptations, and present condition with respect to conservation. Because many of these land areas were similar, they were grouped into eight area groups or classes. Farmers' land-use experience, interpreted mainly from records of the Agricultural Adjustment Administration and a survey of farm buildings, was then appraised for each land area class. Conclusions as to adapted uses of the land in each area class were then drawn by correlating the information regarding the agronomic use capabilities of the land with farmers' experience in using it.

There are several important limitations of this study which the authors recognize. Detailed schedules for selected representative farms would have permitted refinement of the conclusions reached in the study. These, however, were not obtained. Further, the authors recognize that inadequate attention has been given to certain social implications of the conclusions, such as those relating to the number of farms and farmers in the county, the total volume of agricultural products, the character and cost of public services, and the character and extent of public agricultural programs. Most of these questions, however, were outside the scope of the present effort.

GENERAL DESCRIPTION OF AGRICULTURE OF CALLAWAY COUNTY

Location of County

Callaway County, the twelfth largest county in Missouri includes 808 square miles (517,120 acres) in the east-central part of the State just north of the Missouri River (Figure 1). The northern portion of the county lies in Missouri's glacial plains. The southern part includes a portion of the border of the Ozark uplift, while the extreme southern edge of the county takes in a segment of the Missouri River bottom lands. Fulton, the county seat, centrally located in the county, is about 110 miles west of St. Louis, and 155 miles east of Kansas City.

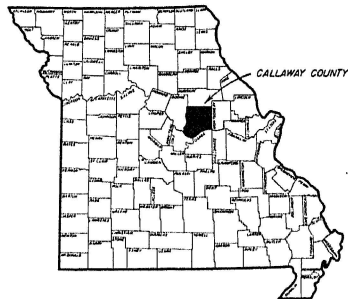


Figure 1.—Location of Callaway county

Importance of Agriculture

Agriculture is by far the most important industry in Callaway County (Figure 2). In 1930 about one-half of the 7,387 persons 10 years old or over who were engaged in gainful occupations were in agriculture. The closest competitor to agriculture from the standpoint of number of persons employed was the services group which occupied about one-sixth of the gainful workers. Most of the employ-

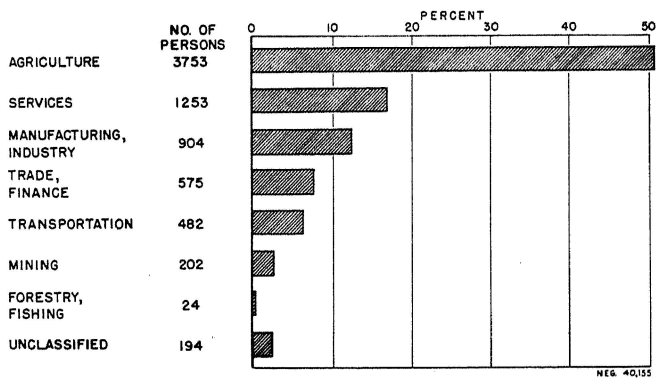


Figure 2.—Percentage distribution of workers by types of employment, Callaway county, 1930

ment in services, manufacturing and industry, trade and finance, and transportation is provided in Fulton, the county seat, and in the rural villages, such as Auxvasse and Mokane. Mining of coal and clay is a

relatively unimportant industry. Very few persons obtained their living from forestry, although much of the southern part of the county is forested. This is undoubtedly attributable to the dual fact that most of the forested land is in farms, and that very little commercial timber remains unfelled.

Agricultural Trends

Most of the land area of Callaway County is in farms. The 1940 Census of Agriculture reports 84.8 per cent of the land area accounted for by farms in 1939. A larger portion of the county formerly was in farms (Table 1). While the trend has not been constant, a decrease of over thirty thousand acres (6.5 per cent) in farm acreage has occurred between 1900 and 1940. The decrease in land in farms has been accompanied by a net decrease of 752 in the total number of farms.

TABLE 1
TRENDS IN NUMBER OF FARMS AND TOTAL ACREAGE IN FARMS,
CALLAWAY COUNTY, 1900 - 1940

Year	Number of farms	Acreage in farms	
		Acres	Percentage of total county area
1900	3585	483,905	93.6
1910	3502	489,240	94.6
1920	3284	476,351	92.1
1925	3015	460,145	89.0
1930	2753	443,272	85.7
1935	3010	475,857	92.0
1940	2833	453,036	84.8

In 1900, the total population of the county was 25,984, but by 1930 there had been a decline of about one-fourth (24.3 per cent) to 19,923. During this same thirty-year period, the rural population (which includes all residents outside of Fulton, the county seat), dropped from 21,101 in 1900 to 13,818 in 1930, a decline of 34.5 per cent.¹ This decline was evident among both farm and nonfarm elements of the rural population. The decrease was partly balanced in the county as a whole by an increase of 1222 in Fulton's enumeration from 4883 in 1900 (19 per cent of the total county population) to 6105 in 1930 (31 per cent of the total county population). In other words, from 1900

¹The figures for rural population were not given in the Census volumes, but were calculated by subtracting the population of Fulton from the total county population.

to 1930 there were two distinct trends in population within the county—a large net emigration of the rural population, and a smaller net immigration to the town of Fulton—resulting in a net loss of population in the county as a whole.

Thus, it is evident that agriculture in Callaway County had been moving from 1900 to 1930 in the general direction of fewer farmers and fewer farms. This direction of movement was fairly regular, but was reversed by the back-to-the-land movement which characterized the early 1930's. Early releases from the 1940 Census of Population show that in that year the total population of the county was 23,094—an increase of 15.9 per cent over 1930. Of this total increase, 2,192 were additions to the population of Fulton. The rural population increased by 7.1 per cent to 14,797, but some or all of this increase may have been rural nonfarm.

Coincident with the decreases in the number of farms, number of farmers and acres in farms, the average size of farms has increased by 18 per cent from 135.0 acres in 1900 to 159.9 acres in 1940. This trend, too, was reversed by the back-to-the-land movement in the early 1930's, but subsequently resumed its former direction.

This increase in the average size of farms is a net increase resulting from forces making for more large farms (260 acres or more) on the

TABLE 2
TRENDS IN NUMBER OF FARMS BY SIZE GROUPS, CALLAWAY COUNTY, 1900-1940

Year	Average size of farms acres	Total number of farms farms	Number of farms by size groups					
			0-19 acres farms	20-99 acres farms	100-174 acres farms	175-259 acres farms	260-499 acres farms	500 acres and over farms
1900	135.0	3585	155	1554	1021	485	310	60
1910	139.7	3502	182	1354	1098	471	334	63
1920	145.1	3284	178	1200	1050	476	316	64
1925	152.6	3015	160	1030	955	472	330	68
1930	161.0	2753	186	814	860	466	354	73
1935	158.1	3010	265	891	889	503	388	74
1940	159.9	2833	255	840	836	442	382	78
Numerical net change 1900-1940	+24.9	-752	+100	-714	-185	-43	+72	+18
Percentage net change 1900-1940	+18%	-21%	+65%	-46%	-18%	-9%	+23%	+30%
Numerical net change 1920-1940	+14.4	-451	+77	-360	-214	-34	+66	+14
Percentage net change 1920-1940	+10%	-14%	+43%	-30%	-20%	-7%	+21%	+22%

one hand, and more very small farms (less than 20 acres) on the other. The middle size groups have, as a consequence, decreased in relative importance (Table 2). In 1900, farms of 20 to 99 acres were by far the most common, but by 1940, the number of these farms had declined 46 per cent. Farms containing 100-174 acres, only two-thirds as prevalent in 1900 as the smaller farms (20-99 acres), decreased 18 per cent in number by 1940. By 1940, farms in these two size groups were equally common, together accounting for about 60 per cent of all farms in the county. Farms of 175-259 acres decreased 9 per cent in number but increased in relative importance. In the meantime, farms in larger size groups have steadily increased in number and relative importance, although they are still relatively few in number. Farms of less than 20 acres have increased by about the same number as these large farms, but to a far greater extent, measured in percentage terms. Most of these very small farms are suburban tracts held as homes and small farms of people who work in Fulton and Jefferson City.

Trends in total acres in farms of various sizes are similar to trends in the number of farms (Table 3), but in some respects the trends in farm acreage are more significant than the trends in numbers of farms. In terms of acreage, for instance, farms of 260 acres or over are of greater importance than farms between 20 and 174 acres although they are only a little over one-fourth as prevalent. Conversely, although farms with less than 20 acres show a great percentage increase in numbers, they still account for less than one per cent of the total area in farms.

The net decrease in acreage in farms represents land that has been allowed to pass out of agricultural use. This land abandonment has not taken place uniformly throughout the county, but has been concentrated in poor land areas. On the other hand, it is apparent that most of the increase in acreage of a very small and very large farms has come through the use of land which was formerly in farms of 20 to 259 acres. Some land has undoubtedly come into farm use since 1900 which was nonfarm land at that time, but there were not enough nonfarm acres in the county in 1900 (33,215 acres) to account for the difference. Thus, farm consolidation and subdivision have been forces of unknown strength in bringing about the trends toward large farms on the one hand, and very small farms on the other, but farm consolidation has been the stronger force. These forces, like land abandonment, are associated with the character of the land.

Livestock farming has been the most important type of farming in Callaway County for many decades. Reference to the early importance of livestock farming is made in one publication² in these terms:

²Krusekopf, H. H., Agee, J. H., and Hall, R. H., *Soil Survey of Callaway County, Missouri*; U. S. Department of Agriculture, Bureau of Soils, in cooperation with University of Missouri Agricultural Experiment Station, published by Government Printing Office, 1919, p. 9.

TABLE 3
TRENDS IN ACRES IN FARMS BY SIZE GROUPS, CALLAWAY COUNTY, 1900-1940

Year	Total acres in farms	Number of acres in farms by size groups					
		0-19	20-19	100-174	175-259	260-499	500 and over
	acres	acres	acres	acres	acres	acres	acres
1900	483,905	(1)	(1)	(1)	(1)	(1)	(1)
1910	489,240	(1)	(1)	(1)	(1)	(1)	(1)
1920	476,351	1,558	74,988	142,994	103,308	105,375	48,128
1925	460,145	1,539	64,291	129,221	99,790	110,858	54,446
1930	443,272	1,681	50,946	117,127	98,876	118,111	56,531
1935	475,857	2,303	54,484	120,981	107,485	131,360	59,244
1940	453,036	(2)	(2)	117,433 ³	89,227 ⁴	130,010	61,468
Net Numerical change	-30,869 ⁵ -23,315	--	--	-25,561 ⁶	-14,081 ⁶	+24,635 ⁶	+13,340 ⁶
Percentage net change	-6.5% ⁵ -4.9%	--	--	-17.9% ⁶	-13.6% ⁶	+23.4% ⁶	+27.8% ⁶

1 Data not available for 1900 and 1910

2 Comparable data not available in 1940 census

3 Data for class interval 100-179 acres as in 1940 census

4 Data for class interval 180-259 acres as in 1940 census

5 Upper figure is net change from 1900-1940; lower figure is net change from 1920-1940

6 Net change from 1920-1940

"This type of agriculture has been practiced since the original settlement of the county. The extensive prairie lands and open woods furnished abundant pasture. Corn, wheat, oats, and tobacco were the principal crops, and were grown in sufficient quantity to supply the home demand. The exports, consisting mostly of tobacco and livestock, were shipped by boat on the Missouri River. With the completion of the Chicago and Alton Railroad through the county in 1871, agricultural development made rapid progress." In 1916, livestock farming was still the most important industry, as may be seen from this statement in the same bulletin: "Callaway County is known throughout Missouri as a livestock region. Combined grain and stock farming is the prevailing type of agriculture. The soil and topographic conditions, and to a lesser extent, the limited transportation facilities, have resulted in making livestock raising the most important industry and all other phases of agriculture are made to conform."⁸ The 1930 Census of Agriculture shows that livestock farming was still the most important type of farming, for 943 (34 per cent) of the 2,753 farms

⁸Idem., p. 9.

enumerated within the county were animal specialty farms. The second and third largest groups were general and self-sufficing farms, which are related types throughout much of the southern margin of the Corn Belt (Table 4).

TABLE 4
FARM TYPES AND AVERAGE SIZES, CALLAWAY COUNTY, 1930

Type of farm	Number	Percentage of total	Average size in acres
Animal specialty	943	34.2	234
General	781	28.4	150
Self-sufficing	319	11.6	95
Poultry	221	8.0	109
Part-time	192	7.0	58
Cash grain	74	2.7	166
Dairy	52	1.9	118
Other	171	6.2	--
Total	2,753	100.0	County Average 161

Although the Census classified seven per cent of the farms as part-time farms, over 12 per cent of all farmers worked off their farms 100 days or more, and four of every 10 (39.1 per cent) received pay for some work off their farms (Figure 3). About one-fifth (19.6 per

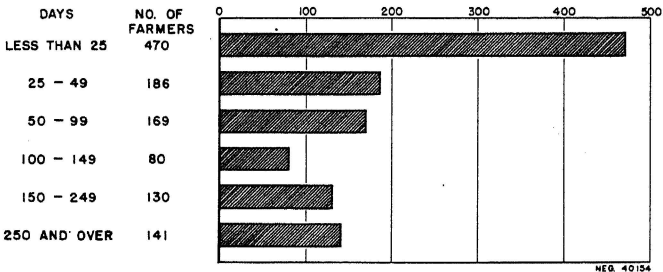


Figure 3.—Number of days Callaway county farmers worked off their farms, 1934

cent) of those farmers who reported days worked off the farm were paid for agricultural labor; most of the others worked at nonagricultural occupations.⁴

⁴United States Census of Agriculture, 1935, *Part-Time Farming in the United States*, United States Department of Commerce, Bureau of the Census, p. 58.

CLIMATE AND LAND; THEIR AGRICULTURAL SIGNIFICANCE

Climate and land together are the most important factors which determine the types of plants which can be produced in any locality. They are, therefore, the most important physical factors influencing the character of agriculture. Climate and land are not independent factors in the determination of crop adaptability. Soils vary greatly in their ability to absorb the shocks of weather variations, or in their capacity to maintain conditions favorable to crop growth despite adverse weather conditions. Generally speaking, good soils have a greater ability to withstand the effects of weather variations than do poor soils. Various climate and land combinations, altered by man as these may be, are agriculturally restrictive in varying degrees, and only those types of agriculture can be permanently successful which are adapted to the natural or physical limitations. It is true that these physical limitations are reflected in the pages of farm account books in economic terms, but this is all the more reason why a basic understanding of climate and land is fundamental to any attempts to adjust land use.

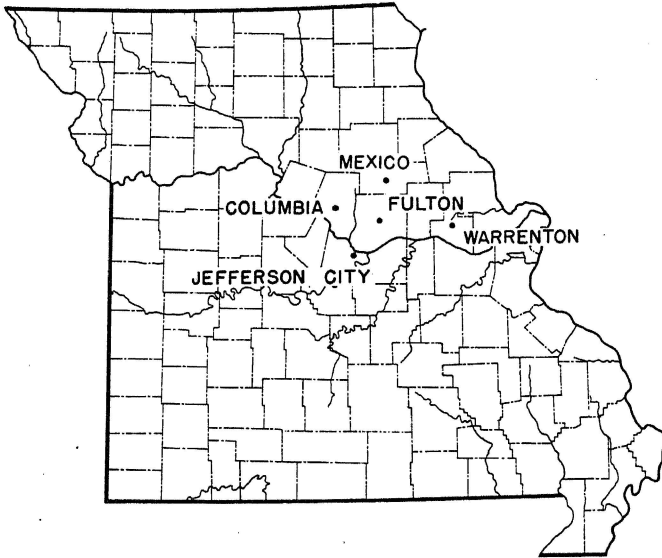
Climate

The climate of the county is continental in type, characterized by abundant precipitation which falls in a distinct seasonal pattern, a wide annual range in temperature from cold winters to hot summers, and a relatively long frost-free period of 150-200 days. Climatic conditions are fairly similar throughout the county, but there are local minor variations such as frost pockets, relatively wet or dry areas, localities in which there are non-typical directions and velocities of winds, and other such differences. The discussion of the climatic conditions given here, however, may be regarded as generally descriptive of the county as a whole.⁵

Average Conditions of Precipitation and Temperature.—The annual march of precipitation varies only minutely between Fulton and four surrounding Weather Bureau Stations—Columbia, Jefferson City, Mexico, and Warrenton (See Figure 4). December, January, and February are the months of least precipitation, each averaging about two inches. Precipitation then increases through March, April, May and sometimes June, to a high of 4 to 5 inches. A sharp drop to about 3 or 3½ inches occurs in July and August. In September a fall high is reached which is generally comparable to the spring high, and precipitation then falls off fairly evenly through October and November to the low precipitation of the winter months (Figure 5).

The range in temperature is greater during the colder months than during the warmer months. The range from the highest to

⁵Records of the United States Weather Bureau at Fulton were started about 1890, and the accurate tabulations which have been kept in the ensuing years provide excellent information on the characteristics of the Callaway County climate. Unfortunately, the Weather Bureau Station at Fulton is the only one in the county; hence, no data exist which indicate local differences.



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Figure 4.—Location of Weather Bureau Stations in and surrounding Callaway county

the lowest recorded temperatures in January at Fulton is about 107°F. , while the range between the highest and lowest recorded temperatures in July, the hottest month, is only about 68°F. July and August are definitely the hottest months, with July having a slight edge over August. December, January and February are distinctly cold winter months, with very little difference in temperature conditions between them (Figure 5).

Precipitation and Temperature History.—During the period 1895-1930, the total annual precipitation, as recorded at the Fulton Station, varied from about 55 inches in 1898 to about 21 inches in 1930 (Figure 6). In 30 of the 41 years for which data are reported, the total annual precipitation was 35 inches or more. It is interesting that 6 of the 11 years in which precipitation was less than 35 inches occurred in the 8-year period 1930-1937, inclusive. The only other similar period of drought was from 1913 to 1920, during which period four years show less than 35 inches, and three years show more than 35 inches.⁶ On the other hand, during the period 1902-1912, inclusive, each year witnessed over 35 inches of precipitation, but in only four of these 11 years did the total precipitation go over 40 inches. From 1921-1929, inclusive, however, precipitation went over the 40-inch mark in 6 of the 8 years for which data are available.

In general, the variability in the mean annual temperature has been between 50°F. and 60°F. at Fulton and surrounding stations

⁶Complete data are not available for the other year, 1916.

AVERAGE MONTHLY CONDITIONS

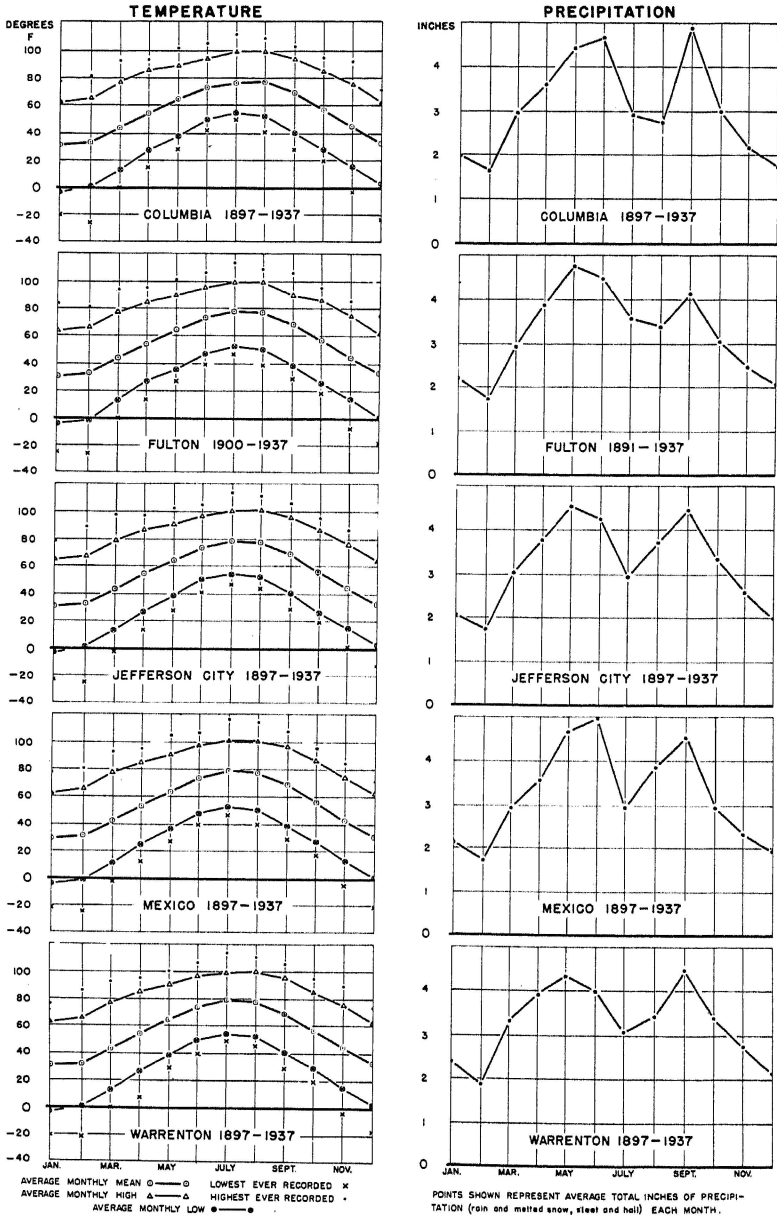


Figure 5.—Average monthly variations in Temperature and Precipitation.

(Figure 6). It is probable that the mean annual temperature is not a very significant figure.

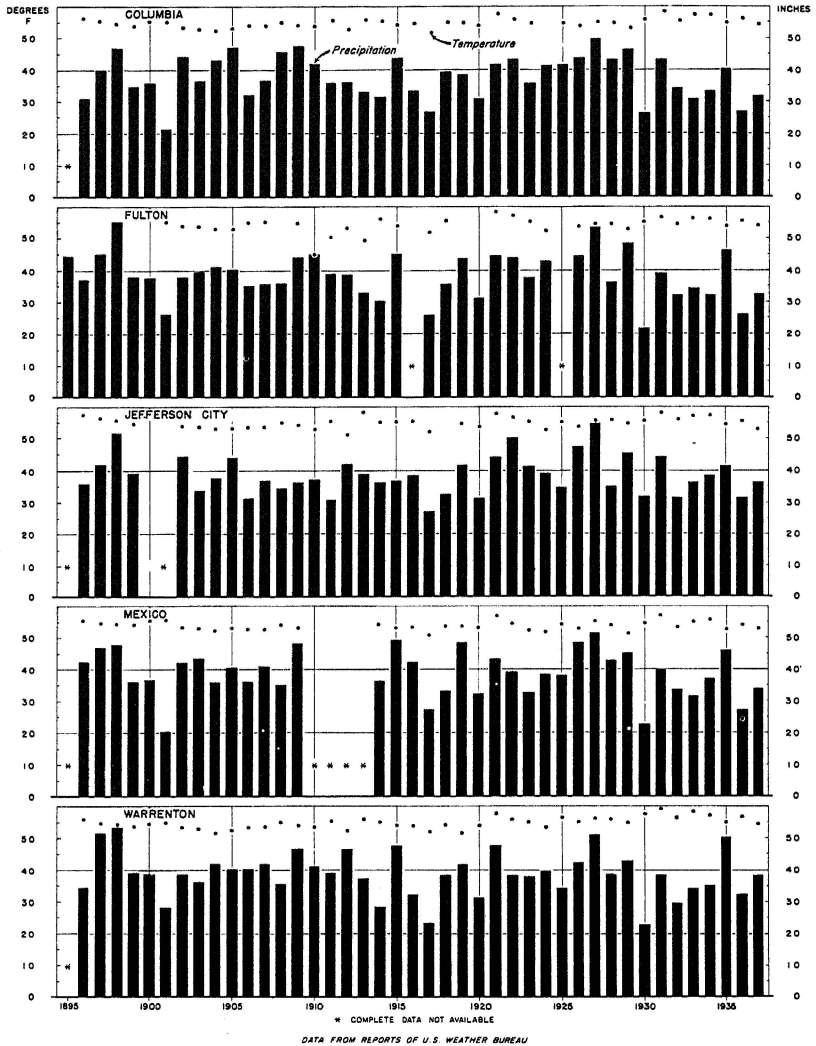


Figure 6.—Average annual temperature and total annual precipitation

There has been much variation in monthly mean temperatures and total monthly precipitation from year to year (Figure 7). The variation has been so great that averages of monthly temperatures and precipitations do not tell much about what can be expected (compare Figures 7 and 5). The extreme variability of precipitation, especially, makes risky any prediction of what is likely to happen in

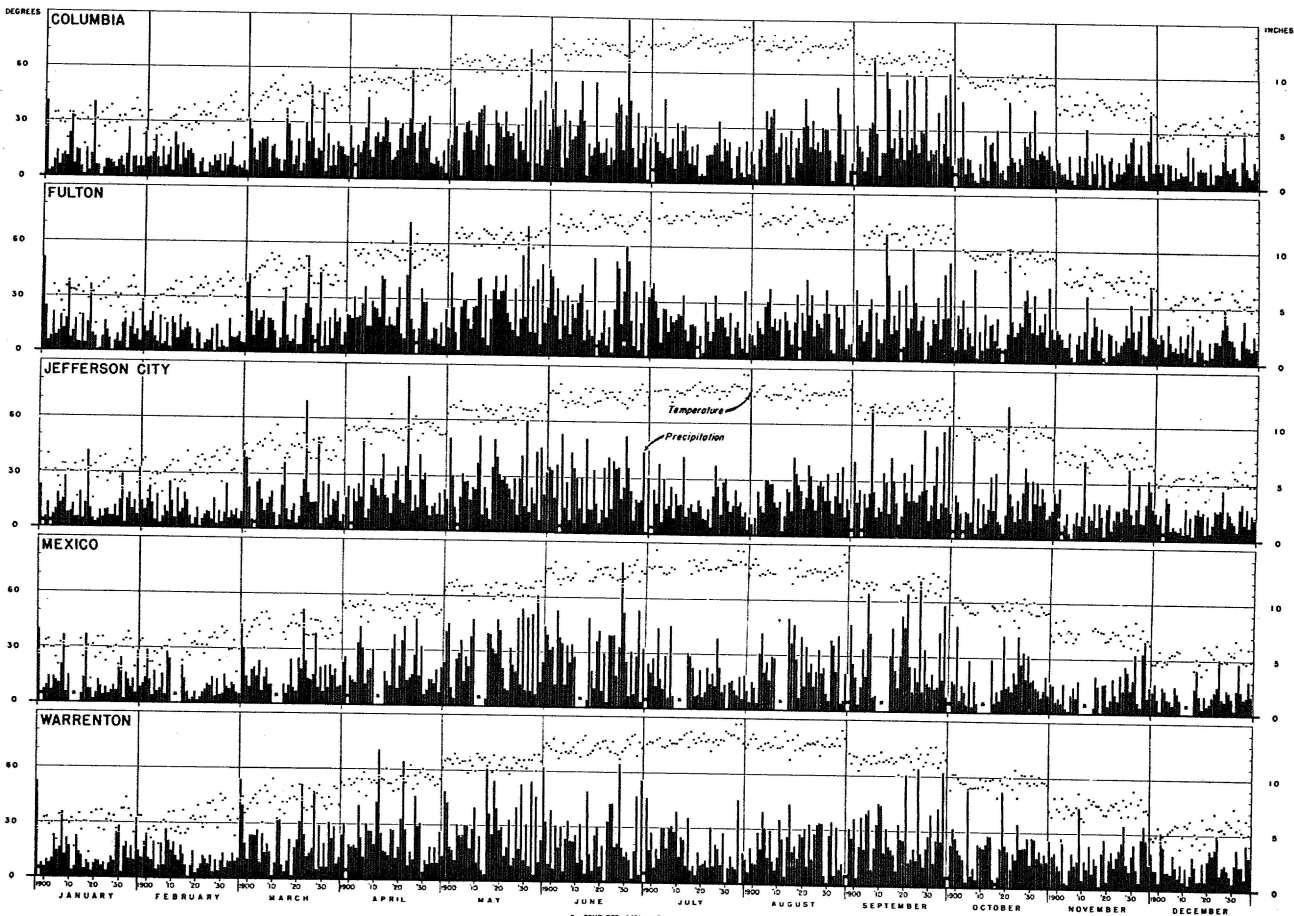


Figure 7.—Comparison of mean temperature and total precipitations for each month from 1897 to 1937

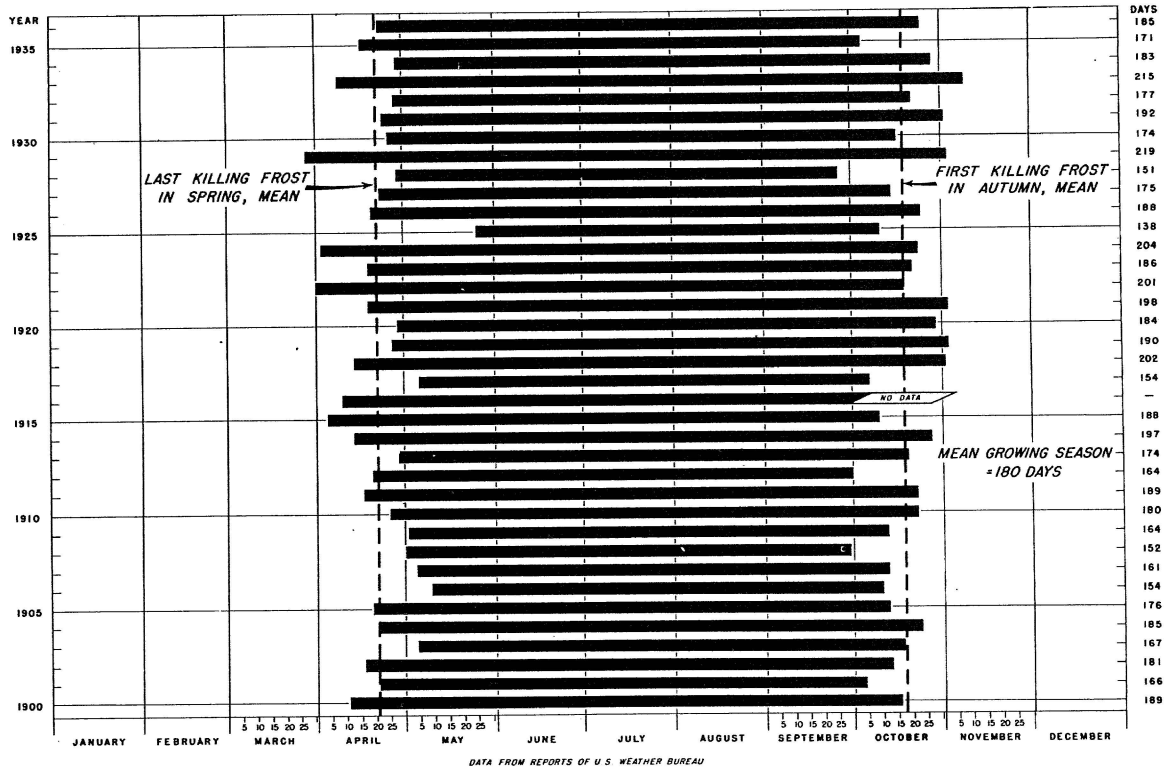


Figure 8.—Length of growing season—Fulton, Callaway county, Missouri, 1900-36

any given year, at least on the basis of present knowledge. It is apparent that the greatest variability occurs in the months of high precipitation.

Frost-Free Period.—The mean number of days between killing frosts is 180 days. The date of the last killing frost has varied from late March to late May, and the first killing frost has occurred as early as late September and as late as early November. April 21 to October 17, however, represent the mean frost dates (Figure 8).

Agricultural Significance of Climate.—The rather long growing season, the usually sufficient precipitation, and the generally moderate winters are factors which contribute to make the climate one in which many crops can be grown. Corn, grain sorghum, winter wheat, barley, oats, alfalfa, soy beans, red and sweet clover, Korean lespedeza, bluegrass, red top, timothy, orchard grass, and other grains, legumes, and grasses are climatically more or less well adapted and are grown throughout the county.

The Callaway County climate is "borderline" for some crops, such as corn, however, and in some years conditions for growth are good, while in others climatic limitations may severely hamper production. Generally speaking, summers which are not intensely hot and which do not have long dry periods are favorable to corn production.⁷ The grain sorghums are relatively better adapted than corn to the usual climate of the county because they are much more resistant to heat and drought. Wheat, barley, and oats are other grain crops which may be said to be relatively well-adapted. Legumes are only fairly well-adapted. Bluegrass, like corn, is likely to be adversely affected by hot, dry periods, but resumes growth with the coming of fall rains. The excellence of bluegrass as a permanent pasture during other seasons of the year makes advisable its inclusion in the farming system, but the use of supplemental pastures is desirable.

Land Resources

The glaciated, northwestern part (approximately 500 square miles) of Callaway County includes flat or nearly flat areas dissected by belts of rolling land which lie along the streams. The native vegetation was prairie, with hardwood trees along the major drainage ways. The soils of the flat upland areas, although developed under prairie vegetation and on generally favorable topography are thoroughly leached and are characterized by a well-developed claypan, mediocre fertility, and a relatively low waterholding capacity. The rolling lands are, in general, less productive because of shallower surface soil and lower content of organic matter.

The unglaciated, southern part (approximately 268 square miles) of Callaway County, almost all of which was originally covered with

⁷The relationship of climate and corn yields is not fully understood. One of the most detailed investigations of this subject is reported by John Kerr Rose in an article entitled, "Corn Yield and Climate in the Corn Belt," published in the *Geographical Review*, XXVI, (1), January 1936.

hardwoods, is characterized by very narrow ridges and valleys, and residual uplands which are limited in usefulness by their low fertility and steep topography. The southern border of this area is, however, hilly with rounded contours, and is covered by loess or windblown soil, erosive and of only medium fertility. The valley soils of the entire unglaciated area are productive.

The Missouri River bottom lands (approximately 33 square miles) lie along the southern edge of the County. The area, with few exceptions, is nearly level, and is subject almost in its entirety to floods from two sources—the Missouri River and the streams which enter the valley from the hills. The native vegetation was hardwoods interspersed with occasional small prairie areas, while willows predominated along the river banks. The soils are all excellent crop soils, and although they vary in texture, they are generally adapted to all crops which are climatically suited.

This broad characterization of the land resources of the county provides only the setting for a more detailed consideration of the land resources. When the soils of Callaway County were surveyed in 1916, 24 soil types and phases were mapped in place and described.⁸ These soil types and phases not only include a wide range of physical characteristics, such as depth of surface soil and topography, but the various areas of any one soil type have been modified dissimilarly by years of use. As a consequence, there are many different kinds of land with many different agronomic adaptations. Some of these kinds of land exist in large bodies covering many square miles in which there are only insignificant variations. Other parts of the county are characterized by patterns of very small bodies of different land types, and the usefulness of these areas is determined by the kind and degree of differences in the agronomic adaptations and by the size of the various component parts of the land type pattern.

Land Areas and Land Area Classes.—For purposes of this study, the county was divided into 33 land areas on the basis of the agronomic adaptations of the various land types (see Figure 9). Some of these areas are fairly uniform in character, while others are composed of patterns of intermixed distinctly different types of land. Moreover, because some areas which are widely separated in the county are essentially like other areas, these 33 areas were placed in 8 groups or classes.⁹ These 8 classes of areas constitute the basis for an analysis of land-use experience in Callaway County. The 8 classes are described below.

Land Area Class 1.—This group of 10 areas includes the flat or nearly flat uplands of the glacial plains. The typical soil of these areas

⁸Krusekopf, H. H., Agee, J. H., and Hall, R. H., *Soil Survey of Callaway County, Missouri*, U. S. Department of Agriculture, Bureau of Soils, in cooperation with University of Missouri Agricultural Experiment Station, published by Government Printing Office, 1919.

⁹See the appendix for a detailed account of the procedure used to delimit and describe land areas and to formulate land area classes.

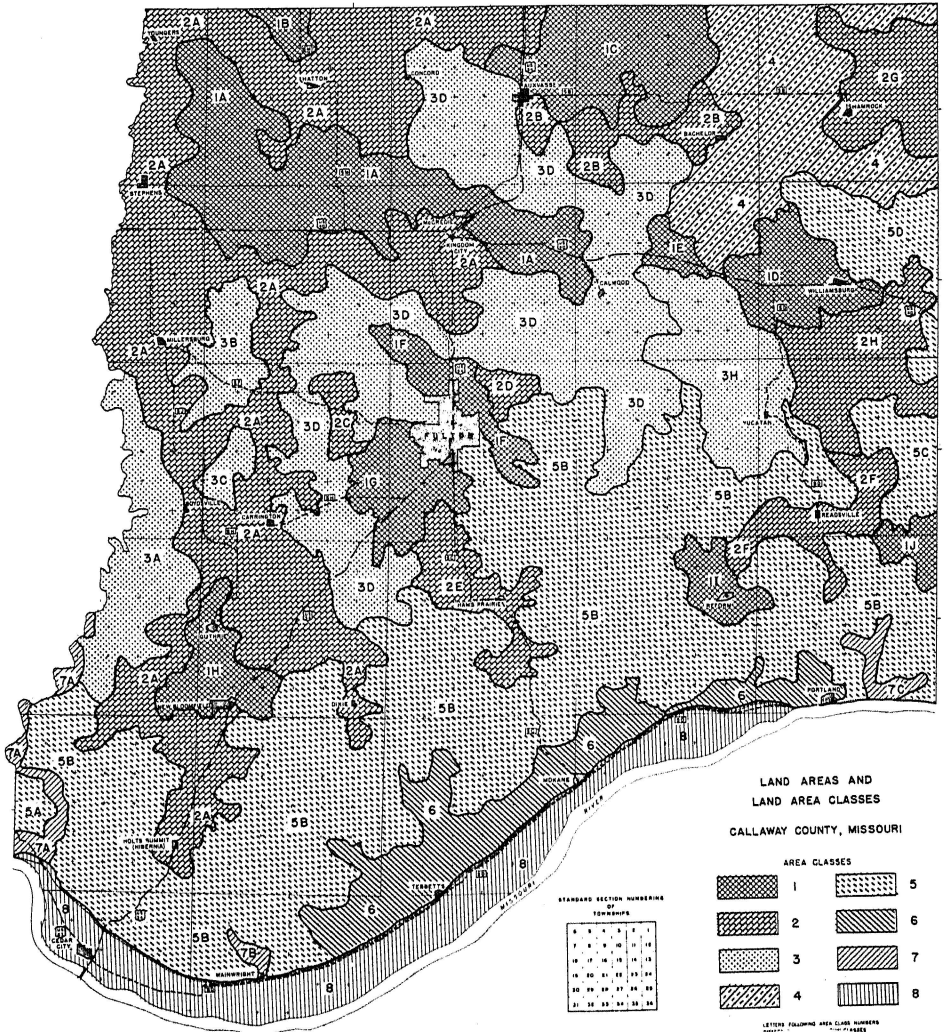


Figure 9.—Land areas and land area classes; Callaway county, Missouri

(Putnam silt loam, level phase) is a flat, prairie soil, characterized by a gray or light-gray, mellow silt loam surface soil 8 to 10 inches deep, and a compact clay subsoil. The flat topography and the tight subsoil together result in very slow internal drainage. The tight subsoil also inhibits the upward movement of groundwater. The soil has been very thoroughly leached, has only medium fertility, and is usually acid in reaction. The characteristic level topography has tended to retard gully erosion, but the soil has been severely sheet eroded. Where the slope is greater than 3 per cent, gully erosion is usually present.

Certain characteristics of the soil—relatively low moisture-holding capacity, low content of organic matter, tight subsoil, medium fertility, and acid reaction—operate together to limit its ability to withstand the effects of weather variations. These characteristics of the soil and certain characteristics of the weather operate together, therefore, to impose important crop production limitations on the land in these areas.

The soil cannot be relied upon to produce good crops of corn with regularity, although corn is one of the most commonly grown crops. Low yields usually follow in the wake of dry periods during July and August, and instances are few in which precipitation occurs in adequate amounts and at frequent enough intervals in these two months to produce reasonably good corn crops.

Grain crops that mature before the July-August low rainfall period, or which are drought-resistant, may be considered relatively well adapted. Wheat, barley, and oats may be listed among the crops which mature before the summer drought, and the grain sorghums, are especially important in view of their drought-resistant qualities. The yields of wheat, barley, and oats fluctuate rather widely depending upon the temperature and precipitation and according to the fertility of individual tracts of land. Sorghum is important as a substitute for corn, but is usually produced for silage rather than for grain. Land which has been known to average not over 20 to 25 bushels of corn per acre has yielded 15 to 20 tons of Atlas sorgo silage per acre, or four to five times as many pounds of digestible nutrients.

These soil and climatic characteristics also impose important limitations upon the production of certain pasture and hay crops. Bluegrass, one of the best and most common grasses in the region, ordinarily makes excellent growth on the better land, but even there becomes dormant during the summer dry period. Bluegrass comes back in the fall, however, and probably finds its most useful place in the agricultural system as permanent pasture used from fall to late spring. Alfalfa is not at all adapted to the land in these areas. Red and sweet clovers and soy beans may be grown successfully if the soil is limed. Korean lespedeza will make a good growth even if the soil is not limed, but both the yield and quality of the crop are improved by liming and fertilizing.

Production of practically all crops and grasses may be increased by the addition of lime and fertilizer. Terracing is usually not necessary; erosion can be controlled by the use of legumes, grasses and small grains.

Cropping systems which lie within the limits of agronomic adaptation would include (1) permanent bluegrass and Korean lespedeza pasture; wheat, barley, or oats double-cropped with Korean lespedeza; and a few acres of Atlas sorgo, and (2) if the land is limed sufficiently to permit the use of red or sweet clover or soy beans, a rotation consisting of one year of corn or grain sorghum, two years of wheat, oats

or barley, and two years of clover or clover and timothy for hay. Soy beans may be substituted for the clover for hay or for the grain sorghum.

Land Area Class 2.—These 8 areas contain most of the undulating to gently rolling parts of the glacial plains section of Callaway County. Although most of the land was originally covered with prairie vegetation, some of it was forested. The prairie soils (dark-colored phase of Putnam silt loam, Shelby loam, Bates silt loam, and Eldon silt loam) differ somewhat from each other, but in general they are deeper, have a much higher content of organic matter, are less acid, and have a greater capacity to respond to management than the soil which was originally forested (Putnam silt loam, rolling phase). The latter soil possesses characteristics very similar to those of the level land in Area Class 1, except that topography is gently rolling, the gray layer underlying the surface soil is less well developed, and the subsoil is not as tight. Erosion has been very active on all land in these areas, and in some places only a few inches of top-soil remain (Figure 10). In general, the better prairie soils have been less damaged by erosion than the soil which was once forested.



Figure 10.—Much of the land in Area Class 2 has been severely damaged or destroyed by erosion.

The agronomic adaptations of the land in these areas vary from permanent pasture to cultivated crops. The better land may be cropped to corn although yields will not average over 20 to 25 bushels per acre, and corn production may cause serious erosion. Wheat, barley and oats and the grain sorghums are well adapted. If the land is cropped, however, it must be protected from erosion

by terracing, strip cropping, or by other measures. Red and sweet clover can be grown on some of the land, but liming is usually necessary. Korean lespedeza can generally be grown without the addition of lime, but does not control erosion as well as bluegrass. If land is to be limed and seeded to permanent pasture it is advisable to try to establish stands of bluegrass.

Valley land in these areas is fertile, but the valleys are very narrow. The most common valley soil in this class (Genessee fine sandy loam) has a dark brown, brown or grayish-brown surface soil which is 10 to 12 inches deep. The subsoil is lighter in color and heavier in texture. The soil lies in the first bottoms, is nearly all subject to overflow, and is only fairly well supplied with lime and organic matter. The natural drainage is good, however, and the soil is easily handled. The valley soils of Area H (Huntington loam and silt loam) are somewhat deeper and more fertile. All of these valley soils have a wide range of crop adaptations, and produce good yields of small grains and clovers. Their most important use-limitations are the small size of the valleys and the hazard of floods. These limitations frequently force the use of the soil for pasture and sometimes even timber. Where areas large enough to permit cropping are available, and where the soil is not regularly flooded, good yields of all grain crops may be expected without the use of amendments.

Land Area Class 3.—There are two main types of upland soil in these five areas. Marion silt loam is found on the flat ridge tops. It is similar in origin and topography to the land described in Area Class 1, but was originally forested. This flat timbered soil is gray and contains iron concretions in the surface soil. It has a very heavy, almost impervious subsoil, low fertility, a strong acid reaction, a low capacity to respond to management, and a low capacity to withstand the effects of weather variations. Generally speaking the soil needs to be limed and fertilized to produce even small yields of grain crops, and is only adapted to such pasture and hay crops as will grow on poor soil. Where satisfactory pasture stands cannot be established, the land may be considered to be adapted only to tree growth.

Lindley silt loam, the most extensive soil in this group of areas, occupies a position on the slopes between the valleys and the flat uplands. The surface soil is about five inches deep where it has not been removed or reduced through erosion. It appears gray or brownish-gray when dry and yellow or brownish-yellow when wet. The subsurface soil, varying from 5 to 10 inches in thickness, is a friable, yellowish-brown silt loam or silty clay loam, but the subsoil itself is a stiff silty clay which is light brown to pale yellow in color. The subsoil is stiffest on the level areas. Because of its glacial origin, the surface soil has loam texture in places, altho a silt loam texture is more common. There are many areas of loam scattered through

the more common silt loam. The soil is everywhere rolling in topography (Figure 11), characterized by typical "choppiness," and in Area H it is hilly. Originally timbered with hardwoods—mostly white oak—the soil is frequently referred to as "white oak land." The problem of keeping cleared land free of brush is a very real one. Being a timbered soil in its virgin state, it has never been well supplied with organic matter. In addition to its low fertility, the soil has a low moisture-holding capacity and, consequently, is droughty. The hilly topography, which contributes to a high degree of run-off, coupled with the shallow surface soil and the low content of organic matter, make the soil a very erosive one. It is generally more severely eroded where the degree of slope is greatest.



Figure 11.—The rolling topography in Land Area Class 3 is an important limitation on its usefulness.

Crop yields do not average high on the upland in these areas. The topography and erosiveness limit all but the more moderately sloping areas to pasture and hay crops. Korean lespedeza is one of the better adapted crops. If limed and fertilized, some of the better land will produce bluegrass, which is more effective in controlling erosion than lespedeza. Where the soil is severely eroded, or the topography is strongly rolling, it is probable that red top pasture, or tree growth, represent the upper limits of agronomic adaptability. The valley lands are similar in character and use adaptations to those in Class 2.

Land Area Class 4.—This area consists of an intricate pattern of small bodies of the same kinds of land which are included in Area Classes 2 and 3, with use adaptations which vary from crops to forest in conformity with differences in the various bodies of land.

Land Area Class 5.—These areas include rough hill country in the southern part of the county. The predominant soil type (Union silt loam) occupies the ridges and more gradual slopes which are not covered by loessial material. The soil is probably derived from the underlying limestone, but glacial and wind-blown materials have evidently entered into its composition. The surface soil consists of from 5 to 7 inches of grayish-brown to gray silt loam. The subsoil is a yellowish-brown silt loam which is moderately friable. The soil becomes very sticky when wet. Most of it was originally timbered, and the content of organic matter is low even under virgin conditions.

Both the character of the soil and the topography impose limitations upon the use-capacities of the land in these areas. The low fertility of the soil is the main problem. It is also highly erosive, and most of the cleared slopes are now severely eroded. Reasonably good yields of small grains and grain sorghums can be produced on the ridge tops and the gentle slopes if the soil is limed, fertilized, and protected from erosion. Corn, however, is not well adapted. Among the pasture and hay crops, alfalfa, soy beans, and red and sweet clover are not well adapted, but red top, timothy, orchard grass and Korean lespedeza will thrive. Lime and fertilizer may be expected to increase yields materially, and on the better land, may permit the establishment of stands of bluegrass. The steep slopes must be kept in grass and trees.

The rough "river-hill" land in these areas is limited in its usefulness to pasture and trees because of its topography and high erosiveness. Also included in these areas is a considerable acreage of rough and stony land which lies along the lower slopes and is adapted only to forest, the present cover.

Valley soils may be divided into first and second bottom soils. The former (Huntington loam and silt loam) are very fertile and have excellent structure. They are adapted to the full range of crops which are climatically adapted. The narrowness of the valleys in which they occur and the frequency of floods decreases their usefulness. The typical second bottom, or terrace soil (Robertsville silt loam) is light colored, low in fertility and has an almost impervious subsoil; it is better adapted to grass than to cultivated crops.

Land Area Class 6.—This area lies just north of the Missouri River and includes the gently rolling parts of the loess-blanketed, "river-hill" country. The surface soil consists of 6 to 12 inches of brown or yellowish-brown silt loam; the upper subsoil is a yellowish brown heavy silt loam. The yellowish-brown heavy silt loam subsoil grades at about two feet into a yellowish-gray compact silt loam which

changes at a still greater depth to a mottled friable silty material. Because of its origin, this soil mantle is very deep, and the loss of several inches of soil does not greatly alter its character. Originally all timbered, the soil contains only a moderate amount of organic matter, and has a good structure, but is highly erosive.

In this area, the more nearly level land can be cropped if adequate erosion control measures are taken. The soil will produce moderate to good yields of the small grains. It is well adapted to grasses and to some of the legumes. Both bluegrass and Korean lespedeza make large and rapid growth. Red clover will give a good yield on limed ground. The soil is also very well adapted to orchards and gardens. Some small valleys are included in this class. The valley soil (Lintonia silt loam) is deep, fertile and adapted to all crops that are climatically suited to this region.

Land Area Class 7.—This group of three areas includes the lower parts of three large creek valleys and the immediately adjacent, low-lying upland in the rough "river-hill" country of southern Callaway County. The valley soil (Lintonia silt loam) is deep and fertile, and is adapted to a wide range of crops. The loessial upland soil (Memphis silt loam) is like the soil in Area Class 6, produces small grains and clovers, but is highly erosive and is usually kept in pasture or hay.

Land Area Class 8.—Very fine sandy loam (Sarpy) and clay (Wabash) soils are of almost equal extent and together comprise slightly over one-half of the land in this area. The former soil is a dark brown or grayish-brown soil varying in texture from very fine sandy loam to fine sandy loam. The coarser textured material is located on low ridges, but away from the river the soil becomes finer and grades into the heavier soils. The surface soil of the very fine sandy loam is about 18 inches deep and changes at that depth to a yellowish-gray or grayish-brown very fine sand which is very deep. The soil is usually found near the river in irregular strips and first bottoms and probably represents old banks of the river. It is one of the most fertile soils in the county, gives excellent yields of practically all crops, including truck crops, which are climatically adapted to this region. Because of its high fertility, excellent structure and high water-holding capacity, this soil also produces high yields of corn except in the most droughty years.

The clay soil is locally known as "gumbo." The surface soil is a black clay loam about 7 to 10 inches deep, and the subsoil is a dark gray, sticky clay. This soil usually occurs near the bluffs, back from the stream front. It is also adapted to the same wide range of crops and gives excellent yields, but requires careful handling and drainage (Figure 12).

There are about equal amounts of (Wabash) silt loam and (Wabash) silty clay loam in the valley. The silty clay loam represents to a certain extent a gradation between the silt loam and clay soils. The silt loam is confined mostly to the higher ground, representing the natural levees

along abandoned stream channels or slashes. The surface soil is a black to very dark brown silt loam which grades at about 12 to 15 inches into the black or dark, drab, heavy silt loam or silty clay subsoil. It is rarely overflowed, is comparatively well drained, and is a very fertile soil which is not overly difficult to handle. The surface soil and subsoil of the silty clay loam grade almost imperceptibly into one another. This soil, which is also very fertile, is more difficult to handle than the silt loam but less difficult than the clay. Its position is usually in the middle of the bottoms in long strips about parallel to the river. It overflows but rarely and has generally good drainage although there are occasional wet spots. Both soils have a wide range of crop adaptability, and produce very high yields.

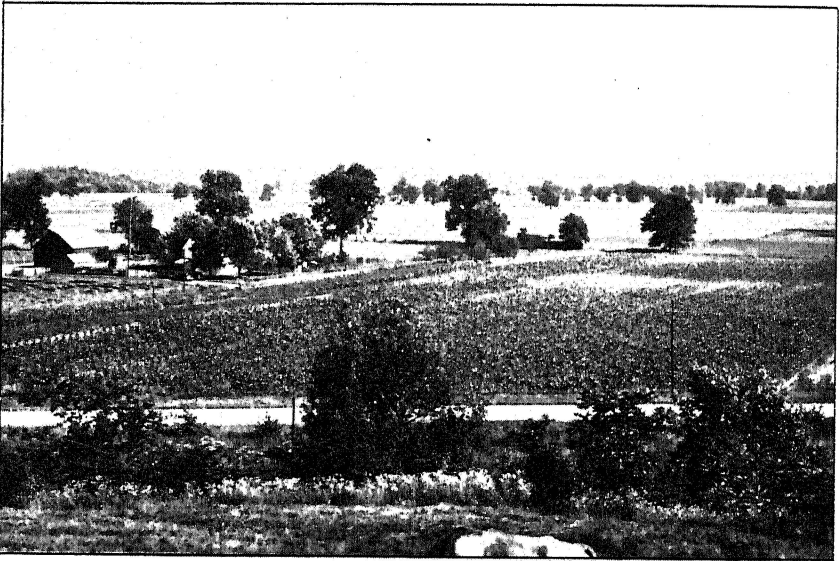


Figure 12.—A general view of the Missouri River bottoms (Area Class 8).

Fine sand (Sarpy) occupies about 10 per cent of the area bordering the river. This type is constantly being overflowed and augmented. It will produce high yields of many kinds of crops in years when floods do not destroy them.

A considerable amount of a slightly different silt loam soil (Lintonia silt loam) is present in the valley as outwash from the "river-hill" land from which it is derived. This soil occurs as alluvial fans at the mouths of the creeks which enter the Missouri Valley from the north. This is one of the most fertile soils in the county. Its depth and fertility make it adapted to many crops, including truck and alfalfa.

No appreciable erosion problem is evident on any of the soils in this land class.

The Census of 1930 reports that 24 farms in the county were artificially drained at that time. It is probable that most of these, if not all, were in the Missouri River bottoms. The 24 farms included 2,149 acres.

DIFFERENCES IN AGRICULTURE, BY LAND AREA CLASSES

Although descriptive statements may be made regarding the general character of the agriculture of Callaway County, it must be recognized that there are important differences between the various parts of the county. Differences in the amount of land in farms, the type of farming, the farm land-use pattern, and farm size are of particular importance in this study.

Land in Farms

The amount of land in farms varies with the character of the land. In the prairie areas of the northern part of the county (Area Classes 1 and 2), practically all of the land is in farms. This is also true of the valley areas (Area Classes 7 and 8). In Area Class 6, some of the land is idle or in nonfarm tracts. The highest proportions of land not in farms are in Area Classes 3, 4 and 5. Even here, most of the land is within the boundaries of farms, but many tracts are timbered and have never been farms, while others were once farms but have since been abandoned.

Type of Farming

Distribution of types of farms throughout the county also varies, one of the important factors determining differences being the variable character of the land resources. Livestock and general farming are the prevailing types of farming in Area Classes 1 and 2. Livestock is probably a more important source of farm income in Area Class 2 than it is in Area Class 1. Beef cattle and hogs are the principal kinds of livestock. However, two Class 1 Areas (Areas F and G), situated adjacent to Fulton are characterized by small dairy farms, which supply the local market. Livestock, general and self-sufficing farms predominate in Area Classes 3, 4, 5, and 6. Beef cattle and sheep are probably the leading types of livestock. Area Class 7, too, is characterized by general farms. Cash grain production is the major type of farming in the Missouri River bottoms (Area Class 8), where the fertile, level land is particularly well suited to wheat, and alfalfa is extensively grown as a cash hay crop.¹⁰

¹⁰These estimates were derived from similar estimates made by the Callaway County Agent for the Department of Agricultural Economics, Missouri College of Agriculture.

Farm Land-Use Pattern

The farm land-use pattern in the various area classes is very closely related to the character of the land, but is also decisively influenced by market advantages as reflected in types of farming. The relationship between land character and land use is evident from a comparison of the proportions of land in grain crops, hay crops and pasture and "other land" in several of the area classes. The average percentage of land in grain crops varies from 6.9 per cent in Area Class 5 to 61.6 per cent in Area Class 8, while the percentage of land in hay crops and pasture varies from 11.3 per cent in Area Class 8 to 64.4 per cent in Area Class 2. "Other land," including woods, idle land, farmsteads, etc., comprises only 12.6 per cent of the land in the livestock and general farming areas of Area Class 1, but 71.8 per cent of the land in Area Class 5 (Table 5). On the other hand, the importance of markets as an influence on land use is evident in the land-use differences between the livestock-general farming areas of Class 1 and the dairy farming areas of the same area class. The dairy areas have much less land in grain crops, more land in hay crops and pasture, and more "other land."

TABLE 5
MAJOR FARM LAND USES ON SAMPLE FARMS,^{1/} BY AREA CLASSES

Area class	No. of sample farms	Grain crops		Hay crops and pasture		Total grain hay and pasture	Other land ^{2/}		Total farm acres
		Acres	Percentage of total farm acres	Acres	Percentage of total farm acres	Percentage of total farm acres	Acres	Percentage of total farm acres	
Areas A, B, C, D, E, H, I, J	38	1930.4	32.3	3285.8	55.1	87.4	753.3	12.6	5,969.5
Areas F and G	14 ^{3/}	182.4	18.0 ^{4/}	652.7	64.4	82.4	177.9	17.6	1,013.0
2-	139	3577.8	19.6	9198.3	50.3	69.9	5506.1	30.1	18,282.2
3-	83	1080.4	12.1	3731.0	41.8	53.9	4122.6	46.1	8,934.0
4-	19	287.0	14.7	982.8	50.3	65.0	684.2	35.0	1,954.0
5-	128	1651.2	6.9	5053.6	21.3	28.2	17088.2	71.8	23,793.0
6-	26	327.0	12.3	894.4	33.7	46.0	1430.6	54.0	2,652.0
7-	4	116.5	20.9	217.6	39.1	60.0	222.9	40.0	557.0
8-	9	648.0	61.6	119.3	11.3	72.9	283.2	27.1	1,052.5

^{1/} See Appendix for a description of the method used in selecting the sample farms used in this analysis.

^{2/} Includes "X land," idle land, orchards, gardens, green manure crops, fallow land and home tobacco patches. "X land" refers to the AAA's designation for "all other land" including woodland, waste land, farmsteads, roads.

^{3/} Includes only those farms (presumably dairy farms) which had Class A or B buildings and which contained less than 100 acres. See page 52 for definitions of buildings classes.

^{4/} Includes 15.0 acres (1.5 percent) devoted to double cropping system (grain plus hay or pasture, same year)

Corn, oats and wheat are the leading grain crops in Area Classes 1, 2, 3, and 4. Timothy, Korean lespedeza and bluegrass are the

principal hay and pasture crops in Area Classes 1 and 2, while timothy and Korean lespedeza are the most important hay and pasture crops in Area Classes 3 and 4. In Area Class 5, corn is by far the leading grain crop, while Korean lespedeza and timothy are the most important hay and pasture crops. In fact, these three crops are the only ones which individually account for as much as one per cent of the total acreage in farms. In Area 6, corn and wheat lead the grain crops, and timothy and Korean lespedeza are again the principal hay and pasture crops. In Area 7, wheat is the leading grain crop, though corn is important and timothy is the principal hay and pasture crop. In the Missouri River bottoms (Area Class 8) wheat is by far the most important crop, occupying almost half of the total acreage. Corn runs a poor second. Alfalfa is extensively grown as a cash hay crop.

Size of Farms

Family-size farms are almost universal throughout the county. In all area classes at least 25 per cent of the farms were between 21 and 100 acres, and over 70 per cent contained no more than 180 acres. In a few area classes the size group 181-260 acres was of considerable importance, but only in Area Classes 1 and 5 were as many as 10 per cent of the farms over 260 acres.

TABLE 6
DISTRIBUTION OF FARMS BY SIZE BY LAND AREA CLASSES

Area class	Total No. of sample farms	Percentage of all sample farms in various size groups				
		21-100	101-180	181-260	261-340	341 and over
Areas A, B, C, D, E, H, I, and J	38	26.3	50.0	13.2	7.9	2.6
1- Areas F and G	22	77.3	13.6	9.1	---	---
2-	139	43.9	41.0	7.9	4.3	2.9
3-	83	61.5	24.1	10.8	2.4	1.2
4-	19	63.1	31.6	5.3	---	---
5-	128	27.3	43.8	16.4	5.5	7.0
6-	26	61.5	26.9	7.7	3.9	---
7-	4	50.0	25.5	25.5	---	---
8-	9	55.6	33.3	11.1	---	---

There is some evidence that farms tend to be smaller on poor land, but this relationship evidently holds true only where the type

of farming remains fairly constant. This may be seen from a comparison of the livestock and general farming areas (A, B, C, D, E, I, and J) of Area Class 1 and Area Classes 2 and 3. The land in Area Class 1 is superior to that in Area Class 2, and a similar relationship exists between Area Class 2 and Area Class 3. The percentage of small farms (size group 21-100 acres) bears a significant inverse relationship to the quality of the land (Table 6).

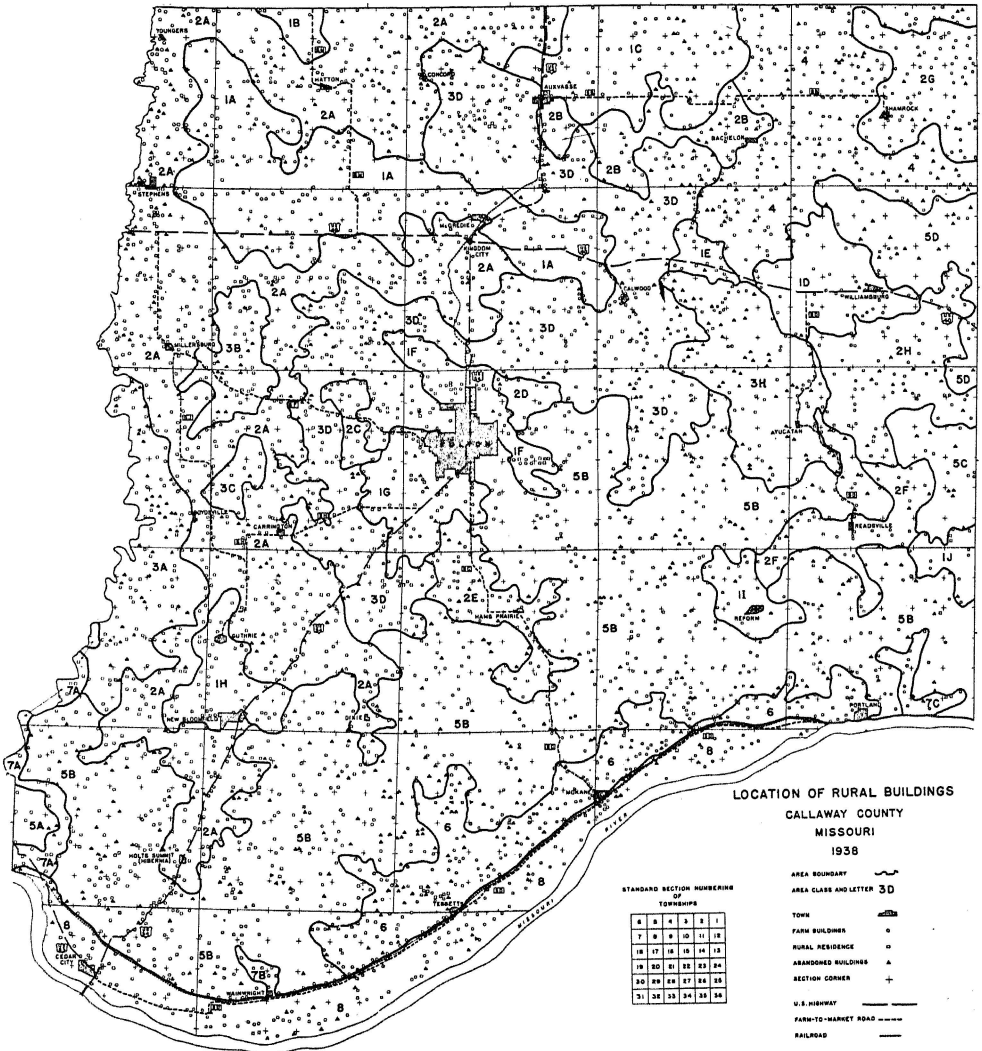


Figure 13.—Location of rural buildings; Callaway county, Missouri

On the other hand, specific local conditions such as type of farming and per cent of land timbered, seem to overshadow the relationship between size of farm and land quality in some areas. This fact is illustrated particularly well by the 10 areas of Area Class 1, all of which contain the same type of land. In spite of this fact, there is a greater difference in the distribution of farm sizes between Areas A, B, C, D, E, H, I, and J, and Areas F and G in Area Class 1 than there is between the first group of areas in Class 1 and Area Classes 2 or 3.

A different type of local situation is presented by Area Class 5. Here the type of farming is also predominately livestock and general farming, as it is in Area Class 1, and while the land is much poorer than in Area Class 1, the farm size distribution is very similar to that in the Class 1 livestock and general farming areas. The relationship between farm size and land quality is apparently obscured in this instance by the fact that large portions of the farms in Area Class 5 are characteristically wooded, while the effective (crop and pasture) acreage may be quite small.

RELATIVE SUCCESS OF FARMING

Evidence of farmers' varying degrees of economic success in using the land resources of Callaway County is found in the records of the Agricultural Adjustment Administration and in a field survey in which number, size and condition of farm buildings were judged as evidences of farm prosperity.¹¹ County records of the Agricultural Adjustment Administration were searched and data relative to size of farm, tenure, idle land, and farm land use were recorded. In the farm buildings survey, towns, villages, farm buildings, both currently used and abandoned, and rural residences were located in place (Figure 13). Farm buildings were classified into five classes as follows (Figures 14 to 18):

- Class A—Buildings which evidenced a high degree of prosperity over a long period of time, and which gave evidence that the farms on which they were located were commercial farms which did a large volume of business.
- Class B—Buildings which evidenced a lower degree of prosperity than the Class A buildings, but which gave evidence that the farms on which they were located did a large enough volume of business to maintain the farm buildings, and provide an acceptable standard of farm living.
- Class C—Buildings which evidenced a lack of or declining prosperity, and which evidenced that the farms on which they were located were unlikely to maintain themselves much longer, or if so, at a very low income level.
- Class D—Buildings which evidenced poverty. The only requirements for this class were that there be evidence of agricultural activity and that the houses be occupied.
- Class E—Abandonments. All abandoned sets of farm buildings and all abandoned rural residences were grouped in this class because there was frequently no way of telling whether the land on which abandoned buildings were found was used as a farm or for residence at the time of the building abandonment. Buildings which had completely disappeared were included in the same class with abandoned buildings still standing, because it was thought that there was no significant reason for distinguishing them.

These two types of experimental evidence were obtained separately, but were related in the analysis of land-use experience in each area class.

¹¹See the Appendix for a detailed account of the procedure used in collecting and analyzing data regarding land-use experience.



Figure 14.—These pictures illustrate farm buildings in Class A.

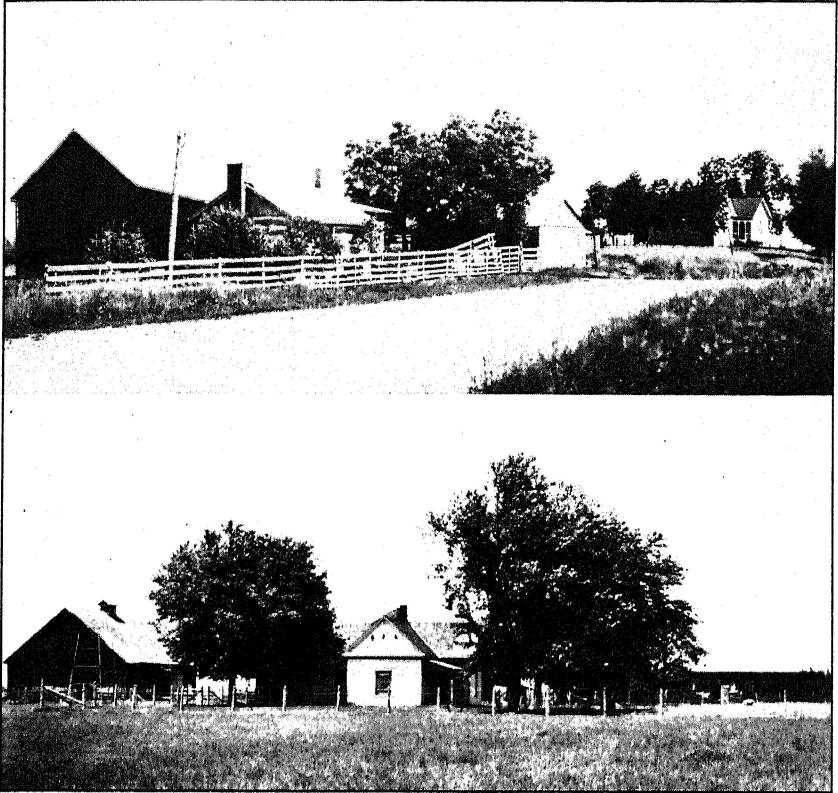


Figure 15.—These pictures illustrate farm buildings in Class B.

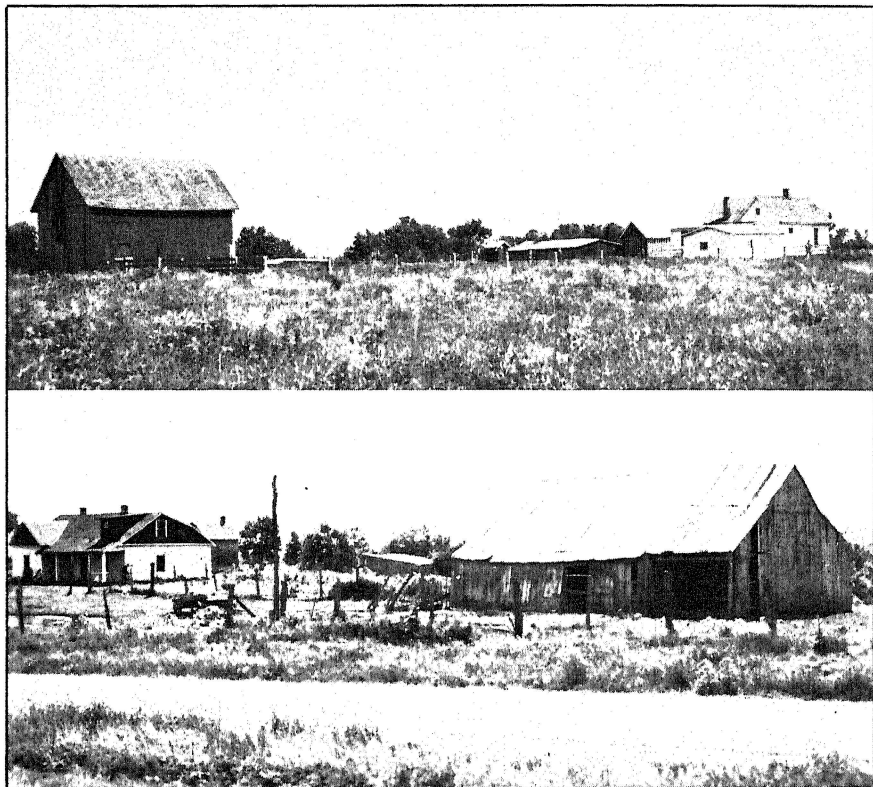


Figure 16.—These pictures illustrate farm buildings in Class C.



Figure 17.—These pictures illustrate farm buildings in Class D.



Figure 18.—This picture illustrates condition of farm buildings in Class E.

Relation of Character of Farm Buildings and Type of Land

In general, farmers have been much more successful on better land than they have on poorer land if their buildings are a dependable indication¹² (Table 7). The level and gently undulating prairie areas

TABLE 7
RELATION OF CHARACTER OF FARM BUILDINGS AND TYPE OF LAND

Area class	No. of sets of farm buildings classified	Percentage distribution of farm building classes						
		Class A	Class B	Classes A and B	Class C	Class D	Classes C and D	Class E
1	474	11.4	55.7	67.1	20.7	1.9	22.6	10.3
2	1064	1.5	37.0	38.5	39.2	5.5	44.7	16.8
3	1029	0.1	6.9	7.0	32.8	26.7	59.5	33.5
4	213	0.0	15.5	15.5	47.9	7.5	55.4	29.1
5	529	0.8	14.3	15.1	38.8	17.9	56.7	28.2
6	232	0.0	20.7	20.7	42.6	16.4	59.0	20.3
7	45	2.2	60.0	62.2	22.2	6.7	28.9	8.9
8	153	6.5	34.7	41.2	35.3	5.9	41.2	17.6
County average	3739	2.3	25.8	28.1	35.4	13.4	48.8	23.1

of the northern part of the county (Area Classes 1 and 2), and the Missouri River bottoms and small tributary valleys in the adjacent river-hills (Area Classes 8 and 7) show substantially higher proportions of Class A and B buildings than may be found on the poorer land of Area Classes 3, 4, 5, and 6. Correspondingly, these poorer land area classes show more Class C, D, and E buildings. Success in the level prairie areas (Area Class 1) evidently has been the greatest in the county. The percentage of all farm buildings which fell in Classes A and B is approximately 1.7 times as great in Area Class 1 as it is in Area Class 2, containing the gently rolling prairie areas. It is significant that in these latter (Class 2) areas, there are very few Class A and Class D buildings; rather, 76.2 per cent of the farm buildings fall in the middle classes B and C. A considerably larger proportion of farm buildings in Area Class 2 have been abandoned than in Area Class 1. The greater economic success of farmers in Area Class 1 is doubtless directly related to the land which is more productive and adapted to a wider range of crops than the gently rolling prairie lands in Area Class 2.

¹²See Appendix.

The small river-hill valleys in the southern part of the county (Area Class 7) evidence considerably greater economic success than the Missouri River bottoms (Area Class 8). In neither area class are there many farm buildings in Class A or Class D; rather the major difference between them lies in the much larger percentage of Class B buildings in Area Class 7. Farm buildings have been abandoned in the Missouri River bottoms to almost twice the relative extent they have in the small, river-hill valleys. Inasmuch as the soils of all of these areas are excellent crop soils of high productivity and a wide range of crop adaptations, farmers' experience in Area Class 7 is reflective of the high soil quality, but the lower degree of success in Area Class 8 must be attributed to factors other than soil, such as losses from floods, the high cost of drainage, or the predominant dependence upon a cash grain type of farming.

Only small proportions of the farms in Area Classes 3, 4, 5 and 6 enjoy economic success, as evidenced by condition of buildings. Practically none of the farm buildings in these areas fall in Class A while over half of the buildings are in Classes C and D and at least a fifth of the buildings in all four of these area classes are abandoned.

Area Class 3 is easily the worst of these four area classes, having the lowest percentage of Class A and B buildings and the highest percentage of Class C, D, and E buildings in the county. Farmers in the other three classes of areas have experienced fairly similar success, although there seems to have been a somewhat greater degree of success in Area Class 6. Farmers' experience in using these land resources seems to be ample proof that those uses which have been experienced are not likely to lead to economic success. There is probably less question about the agricultural adaptability of Area Class 6 than there is about the other kinds of areas. In Area Class 5 there are few Class A or B farms which do not have some valley land. Inasmuch as the valleys in these areas are small, and the number of farms which can obtain access to valley land is extremely limited the almost universal lack of success of upland farms is especially noteworthy. In Area Classes 3 and 4 the low fertility and the narrow range of crop adaptations evidently makes farming an extremely hazardous undertaking.

Relation of Idle Land and Abandoned Buildings to Type of Land

The terms "idle land" and "idle tracts" as used in this study, have reference to tracts of land which were at one time devoted to agricultural uses, but which have not yet reverted to timber. These are still considered "idle land" in the community. Timbered nonfarm tracts are not included. In Callaway County, idle tracts of land are more common in areas containing relatively poor land, than they are in the areas of better land. No idle tracts were found wholly within the valley areas (Area Classes 7 and 8). Idle tracts were infrequent on the flat prairie lands (Area Class 1), but were almost twice as preva-

lent in the gently rolling prairie land areas. The prevalence of idle tracts was about as great in Area Class 6 as in Area Class 2, but was greater in Area Classes 3 and 4 than in Area Class 6. Idle tracts were most common in Area Class 5, which included the roughest lands in the county, even though forested nonfarm tracts were not counted as idle tracts (Table 8).

TABLE 8
RELATIVE PREVALENCE OF IDLE TRACTS

Area class	Index of relative prevalence ^{1/} (0:1 = most prevalent)
1	42:1
2	24:1
3	18:1
4	14:1
5	4:1
6	26:1
7	---
8	---

^{1/} The index of relative prevalence is the ratio of Class A, B, C, and D buildings not on idle tracts to the number of idle tracts. This ratio reflects the relation between the number of farms which have been able to continue operations to the number of farms which are lying idle. Inasmuch as the location of all farm buildings on specific tracts was not ascertained, the number of active farms could not be related to the number of idle tracts, although this would have been a somewhat superior index.

There is a slight tendency for the average acreage per idle tract to be greater in the poorer land areas than it is in the better land areas. In Area Class 5, one of the poor land area classes, the average size of idle tracts is over 100 acres, the only area class in the county where this is true. Evidently farmers did not see their way clear to using some small tracts in areas with reasonably good land, but let more tracts of greater acreage lie idle in poor land areas.

The presence and character of farm buildings on idle tracts is considered significant. Definite evidence was obtained that the presence of farm buildings on idle tracts is associated with *the quality* of the land. There were, as has been pointed out, no idle tracts counted in

the valley areas (Area Classes 7 and 8), while nearly 70 per cent of the idle tracts in the flat prairie areas (Area Class 1) had no buildings (Table 9). At the same time, the poorer, gently rolling prairies (Area Class 2) had no buildings on about half of the idle tracts, and in the definitely poor land areas (Area Classes 3, 4, and 5) only 25 to 38 per cent of the idle tracts were without buildings. Area Class 6 stood between Area Class 2 and the poorer areas as it does in most of the indexes.

TABLE 9
EXISTENCE AND CONDITION OF FARM BUILDINGS ON IDLE TRACTS

Area class	Number of idle tracts ^{1/}	Percent of idle tracts with:				
		No buildings	Class A and B buildings ^{2/}	Class C and D buildings ^{2/}	Class E buildings	Other ^{3/}
1	10	70.0	0.0	20.0	---	10.0
2	37	46.0	2.7	27.0	21.6	2.7
3	55	25.5	3.6	29.1	41.8	---
4	15	33.3	---	40.0	20.0	6.7
5	84	38.1	---	26.2	27.4	8.3
6	7	42.8	---	28.6	14.3	14.3
7	0	---	---	---	---	---
8	0	---	---	---	---	---
Total	208					

- 1/ The idle tracts enumerated include only those reported in the records of the Agricultural Adjustment Administration, and which lay wholly within an area.
 2/ Tracts on which there were Class A, B, C or D farm buildings or rural residences, and upon which there were also Class E (abandoned) buildings were placed in the category of the highest ranking set of buildings on the tract.
 3/ "Other" refers to rural residences or tracts for which it was not possible to determine the buildings class.

Investigation showed that there were very few idle tracts with Class A or B farm buildings. There were, however, significant numbers of idle tracts with Class C and D buildings, and these were most common in the poorer land areas (Area Classes 3, 4, and 5) (Table 9). Thus there is close correlation between 2 distinct sets of evidence of general lack of economic success in those areas where land is relatively poor: idle farms and poor buildings.

Farm failure in the relatively poor areas is further borne out by the percentage of idle tracts which had abandoned farm buildings. Four of every ten idle tracts in Area Class 3 had abandoned buildings (Table 9). Area Classes 2, 4 and 5 had roughly half as many idle tracts with Class E buildings. The relative sparsity of abandoned buildings in Area Class 6 is worthy of attention. It may indicate,

along with a relatively large percentage of Class C and D buildings (Table 7). These farmers do not achieve a very high standard of living in this area, but they do manage to retain a precarious economic foothold.

Further light is shed on farmers' experience with the land of Callaway County by the percentage of the abandoned buildings which are located on idle tracts in the several land area classes. This figure, relatively independent of the total number of abandoned buildings, is important in determining whether farm building abandonment has been accompanied by or caused by farm consolidation, or whether, on the other hand, farm buildings abandonment is more closely associated with land abandonment. In none of the area classes is there a high percentage of the total number of abandoned farm buildings located on idle tracts. On the other hand, to the extent that idle tracts and abandoned farm buildings are related, the degree of association is higher in the poorer land areas (Table 10). In Area Class 5 the per-

TABLE 10
RELATION OF FARM BUILDINGS ABANDONMENT TO IDLE LAND

Area class	Number of Class E buildings	Number of Class E buildings on idle tracts	Percentage of all Class E buildings on idle tracts
1	49	1	2.0
2	179	8	4.5
3	345	26	7.5
4	62	4	6.5
5	149	26	17.4
6	47	1	2.1
7	4	0	--
8	27	0	--
County total	862	66	--

centage of all abandoned farm buildings which are on idle tracts is much higher than in any of the other area classes. These figures appear to indicate that there has been considerable consolidation of tracts throughout the county (although no conclusions can be drawn for the valley areas), indicating that surviving farmers are adjusting their enterprises. It is important to point out that information avail-

able does not permit interpretation as to whether tract consolidation *caused* farm building abandonment or was *consummated* after some farms had been abandoned. This distinction is important, for the two processes probably have different economic significance but might be going on simultaneously in various parts of the county. In further qualification of interpretations which may be made of these data, it is important to recognize that inasmuch as the total abandonment is the culmination of many years of economic experience, it is probable that neither the processes of abandonment nor of tract consolidation have been going on at a very rapid rate.

Relation of Character of Farm Buildings and Farm Size

In Callaway County, farm size has exerted a powerful effect upon farm success, judged by the number, size and condition of farm buildings. This influence of farm size is most effective in areas where the land is definitely adapted to agricultural use. In areas of questionable agricultural adaptations, on the other hand, the influence of farm size on success may still be noticed, but it is relatively ineffective in the face of a greater force—that of poor land quality.

These points are most clearly shown by data for each area class showing the percentage of the sample farms in each size group which have Class A and B buildings (Table 11). In Area Classes 1 and 2, for instance, the percentage of farms which have Class A and B buildings increases significantly with an increase in size of farm. It is important to point out, however, that the size group in which a large

TABLE 11
RELATION OF FARM BUILDINGS CLASSIFICATION AND FARM SIZE BY AREA CLASSES

Area class	Total no. of sample farms	Total no. of sample farms with Class A and B buildings	Percentage of sample farms in each size group which have Class A and B buildings				
			21-100 acres	101-180 acres	181-260 acres	261-340 acres	341 acres and over
Areas A, B, C, D, E, H, I, J	38	29	30.0	94.7	80.0	100.0	100.0
1- Areas F and G	22	19*	82.4	100.0	100.0	---	---
2-	139	66	34.4	50.9	72.7	66.7	100.0
3-	83	15	15.9	15.0	33.3	50.0	---
4-	19	4	25.0	---	100.0	---	---
5-	128	16	5.7	5.4	33.3	14.3	33.3
6-	26	2	6.3	14.3	---	---	---
7-	4	4	100.0	100.0	100.0	---	---
8-	9	5	40.0	66.7	100.0	---	---

*In these two areas, most of the larger farms and those with Class C buildings were evidently livestock or general farms and were located at a greater distance from Fulton than the small dairy farms with Class A and B buildings.

proportion of the farms have Class A and B buildings varies considerably between the area classes. It is also significant that the average size of farm bears a direct relation to the farm buildings classification. In the livestock and general farming areas of Area Class 1, for instance, farms with Class A buildings averaged 228.4 acres, while farms with Class B buildings averaged 164.7 acres and those with Class C buildings averaged 97.2 acres. In the poor land areas, on the other hand, and especially in Area Classes 3 and 5, the influence of farm size on success is apparent, but the proportion of farms which have experienced economic success is small in all size groups. Data obtained in the study showed that in Area Class 5 the total acres of grain, hay and unimproved pasture bore a more significant relation to the buildings description than did total farm acres.

Relation of Character of Farm Buildings and Farm Land Use

With the exception of the Missouri River bottoms, farms with Class A and B buildings tend to use the land more conservationally than do farms with Class C and D buildings, having a smaller percentage of land in grain crops, a higher percentage of land used for hay and pasture, and a lower percentage of "other land" (Table 12). In Area Class 8, however, the farms with Class A and B buildings have a much larger percentage of land in grain crops and considerably less "other land" than do the farms with Class C buildings. Inasmuch as this is the only area class in the county in which erosion is not a problem, this point is particularly significant. Farms with Class A buildings have a somewhat smaller percentage of land in hay and pasture than have farms with Class B and C buildings. In this area class, the greater amount of "other land" on farms with Class A buildings than on farms with Class B buildings is attributable to the greater acreage of truck and garden crops on the former. The much greater amount of "other land" in farms with Class C buildings as compared to those with Class B buildings is due to the much greater amount of idle land on those farms. In Area Class 2, the difference in the proportion of land in grain on farms with Class A and B buildings as compared with farms with Class C and D buildings seems to be of little significance. In Area Classes 4 and 5 the relationships between land use and farm buildings do not follow the pattern common for the other upland areas. Within these area classes, there does not seem to be any consistent relationship.

TABLE 12
RELATION OF FARM BUILDINGS CLASSIFICATION AND FARM LAND USE BY AREA CLASSES^{1/}

Area class	Number of sample farms	Grain crops				Hay and pasture				Other land			
		Class A	Class B	Class C	Class D	Class A	Class B	Class C	Class D	Class A	Class B	Class C	Class D
		pct.	pct.	pct.	pct.	pct.	pct.	pct.	pct.	pct.	pct.	pct.	pct.
1 Areas A, B, C, D, E, H, I, J	38	32.4	30.6	40.0	---	59.8	56.0	45.0	---	7.8	13.4	15.0	---
Areas F and G	22	15.0	20.9	29.4	---	80.3	57.9	49.3	---	4.7	21.2	21.3	---
2	139	20.6	20.3	18.5	18.9	65.0	51.9	48.0	50.0	14.4	27.8	33.5	31.1
3	83	---	11.4	12.9	11.1	---	47.1	42.0	35.6	----	41.5	45.1	53.3
4	19	---	11.0	16.2	11.6	---	38.4	53.6	60.6	---	50.6	30.2	27.8
5	128	---	5.3	7.4	7.7	---	15.5	25.8	19.5	---	79.2	66.8	72.8
6	26	---	12.2	11.6	17.3	---	43.3	32.5	34.9	---	44.5	55.9	47.8
7	4	---	20.9	---	---	---	39.1	---	---	---	40.0	---	---
8	9	72.6	74.9	43.3	---	7.9	12.7	12.7	---	19.5	12.4	44.0	---

^{1/} Data are given in terms of the percentage distribution of land uses on sample farms with buildings in various classes.

CONCLUSIONS

To correct land-use maladjustments it is first necessary to know what land uses are superior to those now prevailing. In very few instances can this answer be framed in simple terms. There are both agronomic and economic considerations.

As the land and the climate in which it is situated determine very largely the kinds of plants that are well adapted, so is the soil affected by kinds of plants that are grown, and the methods of cultivation used to produce them. If the soil is to be conserved and crops are to be grown, attention must be given to the agronomic limitations of land use. Within these limits there may be many or few land-use possibilities. Some soils have a very wide range of possibilities—from many kinds of crops to pasture and forest. Other soils have narrow limits. They are well adapted only to grass or trees.

Usually not all of the plants which a soil will produce are of equal economic interest to farmers. Therefore, farmers are confronted with a problem of use-choice. Judgments as to land uses which are most economical to farmers may be based on analysis of their land-use experience, and on careful consideration of alternative land uses which have not been experienced, but which seem to offer promise. The study of land-use experience is an essential element in the correction of land-use maladjustments, for within the important limits of farmers' knowledge and managerial ability, the size of their farms, the kinds of equipment and amounts of money and credit with which they have to work, and the extent to which they are impelled by custom or habit rather than by economic motives in their use of land, those uses which have been relatively good and relatively bad may be revealed.

But the problem of use choice is very largely one which must be made for each farm individually. No two farms are alike. No two farmers are alike. Consequently the problems of each farm are different. But even so, they are not altogether different, for neighboring farmers who have much the same land, who live in the same climate, and who are confronted with the same problems of prices, market distances, and similar economic considerations, are after all confronted with basically the same problems of land-use choice. It is only in their secondary aspects that the problems of such farmers vary. For this reason, *general conclusions* can be drawn for areas in which farmers' problems of land-use choice are basically the same. Such conclusions drawn on an area basis may be used as a departure point for the solution of individual farm problems.

In approaching the problem of land-use maladjustments on an area basis, conclusions drawn from farmers' experience must be drawn in terms of the *whole range of experience*. In areas in which farming has been attempted, it is rare indeed that all attempts have been successful. Some farmers fail on the best land. Conversely, even though nearly all farmers have failed or have earned only a very meager

living from poor land, a few exceptional or lucky individuals may have succeeded or may succeed in the future. Conclusions formulated to give general guidance to land-use adjustments in areas of fairly homogeneous conditions must be presented in terms of probabilities. Such conclusions should not be criticized for not being specifically applicable to individual farms. They are not so intended.

The conclusions which may be drawn from the data analyzed in this study are here presented by area classes:

Area Class 1.—In the livestock and general farming areas, most farmers evidently have experienced at least moderate economic success. Lack of success must be attributed to factors other than the land, which from an agronomic viewpoint is definitely adapted to agricultural use. The almost universal economic success of farms of 140-180 acres leads to the conclusions that farms of at least that size are desirable in the interest of increased farm prosperity.¹³ Farms as large as 260 acres and more seem to have been more successful. The abandonment of buildings unaccompanied by the abandonment of land indicates that a process of farm consolidation is going on in these areas, and it seems quite likely that small farms are decreasing in number to the advantage of the larger, commercial farms.

Land use on the larger, more successful farms seems to be more conservational than on the smaller farms with Class C buildings. However, there seems to be room for considerable improvement of farm land-use patterns even on the more successful farms. Greater dependence should be placed upon (1) substitutes for corn, such as sorghum (especially Atlas sorgo) and barley, (2) a pasture system based on a balance between permanent and supplemental pastures of bluegrass or Korean lespedeza, and (3) hay crops of legumes, such as soybeans, Korean lespedeza or red clover (if the land is limed) instead of timothy.

The dairy farms in Areas F and G seem to be fairly well adapted as they are now constituted, although some increase in legume pastures and corn substitutes may be desirable. For those farms in these areas which are not dairy or part-time farms the same directions of adjustment as were formulated for farms in Areas, A, B, C, D, E, H, I, and J may be assumed to be approximately correct.

Area Class 2.—Lack of farm success has been more prevalent in these areas than success. There seems little doubt, however, that the soil is adapted to farm use. Success has been fairly common among farms of 180-220 acres or larger, and adjustments in this direction

¹³See Brown R. Rawlings, and O. R. Johnson, Relationship of Productivity of Farm Units and Their Ability to Pay Rent, U. of Mo. Agr. Exp. Sta. Res. Bul. #308. Notice particularly the graph and discussion on page 29 in which it is shown that farm units of approximately 180 acres are necessary to provide a decent family living, pay costs of production and leave a surplus for net rent. The farms from which these conclusions were drawn were selected as representative of typical Putnam silt loam in Callaway County but included more than the level phase represented by Land Area Class 1 in the present study. The acreage indicated as necessary (180) may be higher than would be necessary for farms on the level phase, but it is doubtful whether the calculations would be altered sufficiently to be of any great significance.

are evidently necessary to increase farm prosperity. Abandonment of farm buildings is largely unrelated to land abandonment, evidently strongly associated with a process of farm consolidation. The trend towards larger farms is generally desirable, except that it appears more desirable for undersized units to be enlarged than for large units to be made larger. It is not apparent from the data at hand which of these processes is dominant.

The larger farms with better buildings do not have less cultivated land than the smaller, less prosperous farms, but they do have more land in hay and pasture, and less "X land." Thus they probably use the land more effectively. Apparently most farmers could improve their use of the land through shifts from timothy to Korean lespedeza, and corn to sorgo. Emphasis should be placed on increasing the amount and quality of hay and pasture, with limitation of cropping to those acres which can be so used without significant deterioration. Double-cropping may be particularly well adapted as an aid in preventing the development of feed crop deficiencies through the shifting of land to pasture and hay. Livestock farming is undoubtedly the best adapted type, generally speaking. In these areas especially, however, individual farm sizes and organizations must be tailored to fit the particular bodies of land which they occupy.

Area Class 3.—These areas have contributed heavily to the exodus of farm population from Callaway County land. Successful farmers—even moderately successful farmers—have been few. Certain it is that the types and sizes of farms which have existed are not adequate. In view of the fact that the land is not well adapted to either crops or pasture, and that the problem of keeping cleared land free of brush is serious, basic conditions are unfavorable for the success of any type of agriculture. It is apparent that the data on land-use experience do not provide answers as to what types of land-use are best adapted.

It may be possible, however, that some types or sizes of farms not yet tried can use the land with success. Farms in these areas have been characteristically small. There is some evidence that farms of 220 acres or more have at least a better chance for success than do farms of lesser acreages. Support is added to the view that farm size may have been a great handicap to success by the fact that 54 of the 55 abandoned tracts contained less than 220 acres. Past land use has probably been another handicap to success, for judging by the present extent of soil erosion, farmers have depended too heavily upon cultivated crops. If attempts are made to farm in these areas, units should probably consist of 500-1000 acres with permanent or semi-permanent stands of bluegrass, Korean lespedeza or other adapted legumes, grasses, or mixtures on all land except the few acres suitable for crops and on the extensive acreage better adapted to trees. It is probable, however, that even under these conditions, the chances for farm success must be estimated as very low, and for the vast majority

of farmers, continued activity can only lead to further soil and capital depletion and to farm abandonment.

Two other directions of adjustment deserve consideration. The establishment of publicly or cooperatively operated grazing areas of permanent grass or legume stands to be used by farmers on land in Area Classes 1 or 2 is one possible use. There may be so few farmers who could make a success of large livestock farms in Class 3 Areas, that it would be better to eliminate individual farms and to use Class 3 Areas as supplemental range to augment operations on Class 1 and 2 Areas. It is probable that the success of this type of use would depend upon the interest of farmers in Area Classes 1 and 2, and the possibility of providing those farmers with cheaper pasture than they could obtain on land in Classes 1 and 2.

Another possible direction of adjustment is toward the establishment of forests. Those would be particularly appropriate in Area E, the roughest area. The pattern of small ownership tracts makes it probable that private forestry would be less successful than some type of public control.

Area Class 4.—Although this area is composed of a pattern of land types similar to those found in both Area Classes 2 and 3, the use experience in Class 4 is generally more like that in Area Class 3. The directions of adjustment suggested for Area Class 3 are, therefore, generally applicable to Area Class 4 as well.

Area Class 5.—Land-use experience in Class 5 areas points to the conclusion that the upland in these areas cannot be expected to support an economically stable and reasonably prosperous agriculture, at least under past forms of farm organization. Much land is abandoned or idle, and land and building abandonment are much more closely related than elsewhere, indicating extensive movement of farm population from these areas. The character of the soil and the topography dictate that only those farms which have a sufficient acreage of valley land have a reasonable chance for economic success. The trend in these areas is now and will doubtless continue to be toward additional abandonment of the upland farms.

In view of the agronomic limitations of this land, therefore, and of the unfruitful experience which farmers have had and probably will continue to have, there seems no doubt that land-use adjustments should be directed towards a use based primarily upon forest growth. Because of the pattern of numerous small ownership tracts, the present status of the timbered land and the probable length of time which will pass before sufficient timber of commercial quality is available to make forest operations worthwhile, private forest operations are probably out of the question, unless, indeed, private forestry can be made a more attractive field of investment.¹⁴

¹⁴In this connection, see the following references: Hammar, C. H., "Extending Public Control and Management of Forest Land Without Purchase," *Journal of Forestry*, 37 (1), pp. 3-13. Mussman, A. H. and Hammar, C. H., "Providing Credit for Forest Restoration," *American Forests*, 45; 310-312, 1938. Hammar, C. H. and Mussman, A. H., "Interest and Credit Costs in Forest Restoration," *Journal of Forestry*, 38 (1), pp. 37-43.

Possible directions of land-use adjustment are, therefore, largely confined to the establishment of public forests, parks or wildlife preserves. It is interesting to note that the southern part of Callaway County is included in "Areas Not Reasonably Served by State Parks (Radius of Reasonable Service Assumed at 40 Miles)." The scenic hills of Land Area Class 5 with the present timber stands and the valleys which might be dammed to provide artificial lakes, would offer recreational facilities to the people of nearby towns such as Fulton, Jefferson City, and Columbia. Such valley farms as could continue in existence could remain virtually undisturbed if the areas were used for either forests or parks. Public interest, however, might make it desirable to eliminate even the valley farms, which would be virtually isolated from the remainder of the county unless they were provided with good roads and schools. Such roads and schools for these relatively isolated farms might be costly, and it will doubtless be necessary to determine the probable relative cost of such facilities. Excessive costs would dictate the use for forests of all land in Class 5.

Area Class 6.—Experience in the use of land in Area Class 6 leads to the conclusions that this area will probably continue to be used for farms, even though farmers are not likely to be overly prosperous. Farms have not been prosperous, but, on the other hand, they have not sunk deeply into poverty; Class C buildings are typical. Very little land is abandoned, and although there may have been some farm consolidation, present farms are for the most part quite small. Although the land is well-adapted to the production of hay and pasture and is located next to the best feed-production area in Callaway County (the Missouri River bottoms), the problem of brush control, the low percentage of land which is cultivable, and the present profusion of small farms which is not being reduced very rapidly by abandonment, offer barriers to the development of large livestock farms that may be insurmountable. Dairy and fruit farms, both fairly well adapted to the land and the size of holdings, are not feasible at this time because of the lack of markets.

For these reasons, the most desirable direction of adjustment may be toward more intensively operated small holdings. Such a direction would be more in harmony with present trends, since the area is well-adapted to gardens, orchards and pasture. Small subsistence farms cannot compete with commercial farms on the good land, and they cannot survive on the poorest. Land which is well-adapted to small farms is land of limited adaptability, but fair efficiency such as the land in this class.¹⁵ The place of small holdings in our modern economy has not been adequately explored, but among other possibilities they might serve as (1) farms and homes for farmers who either do not wish to, or for one reason or another cannot successfully, compete in the commercial farm market; (2) temporary

¹⁵See especially: Hammar, Conrad H., "Intensity and Land Rent, An Overlooked Aspect of Rent Theory," *Journal of Farm Economics*, XX, (4), November 1938, pp. 776-791.

farms for displaced but capable farmers; (3) retirement homesteads for either rural or city people; (4) temporary homesteads for city workers during depressions; and (5) farm-homesteads for part-time workers. If the land in Area Class 5 were shifted to forest use, Area Class 6 would provide excellent home sites for the forest workers. The possibilities of small-holdings in general, and in this area in particular, need to be investigated further.

Area Class 7.—Present farms are apparently well adapted. It would doubtless be desirable to place more attention on legumes, such as red clover and lespedeza for hay and pasture on the hills, and on rotations of legumes with grain crops on the valley lands.

Area Class 8.—There is no doubt that this area is adapted to agriculture. There are questions, however, concerning the best-adapted type of agriculture which are not answered by the data presented. At the present time, extreme reliance is placed upon sales of wheat and corn. As in most cash crop areas farmers would likely improve their financial stability by moving toward a more diversified agriculture, but no attempt was made in this study to set up hypothetical farm budgets to determine probable incomes from different types of farms adapted to this area. Many types and sizes of farms are apparently well adapted.

Public Interests in Land-Use Adjustments

Present utilization of resources does not always reflect even the best interests of the individual farmer. When his interests are properly served, the number of cases in which private and public interests are in conflict may be relatively small. In Callaway County it is probable that the directions of adjustment which are most desirable from the farm operator's viewpoint are also the most desirable from the public viewpoint.

At the present time, both land and water resources in Callaway County are being wasted. Unconservational use is almost general. But it is extremely doubtful that this resource waste is really in the interest of the users. Directions of adjustment which have been determined in this study to be desirable from the farmers' standpoint have been predicated upon systems of farming that will conserve the land, and it appears feasible to assume that conservational use of the land will best serve both private and public interests.

There are now considerable differences in the quality of public services provided in the various areas of the county. Little one-room school houses are still the bulwark of the school system, and dirt roads still carry most of the local traffic. In general, schools and roads in the poor land areas of the County are considerably inferior to those in the better land areas.¹⁶ To provide these poor land areas with better

¹⁶Preliminary data collected in Callaway County show this to be true. The questions of the provisions of efficient local government and local public services and the adjustment of land use are related, but a study such as would have been necessary to explore the adequacy of public services and means for correcting the inadequacies would have been an uncalled for digression in this project.

school and road facilities at the present time would undoubtedly mean additional subsidization. Pursuit of the directions of land-use adjustment outlined in this study will likely promote more efficient expenditure of public funds for public services as these poor land areas are withdrawn from farm use.

It is not suggested that adjustments should be undertaken immediately or all at one time. The concept of gradually evolving adjustment is expressed by the term "directions of adjustment." It is assumed, therefore, that public interest in land-use adjustment will be consistent with private interest if movement in the desired direction is accomplished only at a rate that will coincide with the movement of present population to take advantage of better or at least equal economic opportunities elsewhere.

APPENDIX—SOURCES OF DATA AND METHOD OF PROCEDURE

Appraisal of Agricultural Significance of Climate and Land

The climatic analysis available in the 1916 Soils Bulletin was not adequate for the purposes of this study; hence, a more detailed analysis was made. The publications of the United States Weather Bureau were searched to obtain data for approximately 40 years for Fulton (county seat of Callaway County) and four surrounding stations in nearby counties. These data were tabulated and then graphically presented on five charts.

The soil survey map and bulletin of Callaway County¹⁷ were the basic materials used in differentiating the kinds of land. The survey was detailed and the map is published on a scale of one inch to one mile. The soils map showed 24 different soil types and phases, as they were then recognized. Soil surveys of that early date did not always show significant topographic and other physical variations within soil types. In addition, 22 more years of erosion had changed the condition of some of the soil areas since the map was published. For that reason other materials and field observation were used to complement the soil survey.

The topographic sheets available did not cover a very large part of the county and were not used much for the area they did cover. Only two sheets were on a scale of 1:62,500. They were published by the United States Geological Survey as a result of field surveys in 1927, 1928, and 1929. The degree of correlation between topographic and soils maps was so high that interpretation of the soils map gave just as accurate results as a consideration of both maps would have afforded.

¹⁷Krusekopf, H. H., Agee, J. H., and Hall, R. H., Soil Survey of Callaway County, Missouri, U. S. Dept. of Agr., Bur. of Soils, in cooperation with U. of Mo. Agr. Exp. Sta., published by Government Printing Office, 1919.

Aerial photographs were found to be more useful.¹⁸ Permission was obtained from the Agricultural Adjustment Administration for the use of single lens, contact prints (scale 1:20,000) taken in September 1937. The photographs were filed together by flights. A flight is the series of consecutive pictures taken on one trip of the aerial photographer across the county. There is considerable overlap of the flights, and consequently part of the territory shown on the pictures of one flight is also shown on the pictures of each adjacent flight. There may be as many as four complete land survey sections shown on one photograph. More commonly, however, only two complete sections and parts of several other sections are visible. The matching of alternate prints gives a complete and satisfactory picture of the photographed area. Features distinguishable in the photographs included land in timber (of various sizes and densities), cleared land (although cropped, pastured, and abandoned or idle land cannot be clearly distinguished), the extent of gully erosion (but not sheet erosion), topography (by use of a stereoscope), farmsteads and other buildings, roads, streams, and many other landscape features. The comparison of the soils map with the aerial photographs was most easily accomplished by working from one corner of the county, and following consecutive groups of two flight lines across the county. The soils map and the aerial photographs were studied section by section. The interpretation of the photographs was greatly facilitated by the use of a stereoscope, and numerous prints were studied through the scope to give the observer a good idea of the land surface features. In cases where there were significant differences in topography or erosion in different areas of a given soil type, lines were drawn to differentiate between the various types of land. Notes in regard to topography, cover, and erosion were taken from the aerial photographs for each kind of land.

Unpublished materials of the Soils Department were used to supplement the knowledge gained from the soil survey, topographic sheets, and the aerial photographs.

The statements as to the agronomic use-capacities of the various types of land were based upon the soils bulletin, supplemented by current knowledge and opinion of staff members of the Soils Department who have had long experience with the soils found in the county. Consideration was given to the fact that the soil survey report was over 20 years old, and that the use-capacities of certain soils had changed considerably during that time.

The land areas delimited in this study were of three kinds so far as composition was concerned. In those cases where a given land type covered an area large enough to contain several farms, and there were neither any adjacent or associated land types with the same agronomic use-capacities, nor any associated land types with different

¹⁸See Ahrens, T. P., "The Utilization of Aerial Photographs in Mapping and Studying Land Features," Land Use Planning Publication #6, Land Utilization Division, Resettlement Administration, Washington, D. C., October 1936, 27 pp.

use-capacities, the given land type was set off by itself as an area. In those cases, however, where two land types with insignificant differences in use-capacities were adjacent or associated, they were included in the same area. In still other cases, where different land types with dissimilar use-capacities were intimately intermingled in a pattern (land-type association), and the areas of these land types were so small that farms typically included several or all of them, the entire area of the land-type association was separated out as a definite area.

Any one of the three kinds of areas was thought to be large enough to be "economically significant" if it contained several farms. The question of size was considered to be one of judgment, and no attempts were made to lay down arbitrary sizes in terms of acreage or number of farms as a basis for decision.

The areas which had been delimited in the manner described above were then grouped according to the similarities of their agronomic use-capacities. These groups or classes were *not* defined beforehand, and then used as pigeon-holes in which to place the various land areas. Rather, the classes were formed by the grouping of the similar areas. The definitions of the classes were formed by the characterization of the areas. No attempt was made to grade the classes; instead, attention has been focused on absolute rather than relative use-capacity.

Analysis of Land-use Experience

There are several sources of evidence that may be used in the appraisal of land-use experience. Although farm survey records are probably the most reliable source of experiential evidence in agricultural areas, they are very expensive and none were gathered in this investigation.

Various short-cut methods have been devised to indicate farm success or failure where farm survey records are not available. One of the best known of these devices is the farm buildings classification developed at Cornell University.¹⁹ The work carried out at Cornell University by Dr. A. B. Lewis and others in establishing the validity of the farm buildings classification as a criterion on economic success in long established agricultural areas was drawn upon heavily by the authors in this phase of the study. Preliminary investigations did not reveal the presence of any unusual factors, such as important sources of outside income, extensive construction and reconditioning of farm buildings by holders of farm real estate for purposes of attracting buyers, and other factors, which would tend to nullify the validity of the farm buildings index. Hence, there did not appear to be any necessity for establishing the exact relationship between farm

¹⁹Lewis, A. B., "Methods Used in An Economic Study of Land Utilization in Tompkins County, New York," and in other similar studies in New York, Memoir 160, N. Y. (Cornell) Agr. Exp. Sta., April 1934, p. 18. See also, Haggerty, J. J., and Meyers, A. M., Jr., "Materials and Techniques of Modern Land Classification," paper presented at National Conference on Land Classification, 1940, Mo. Agr. Exp. Sta. Bul. 421, pp. 117-118.

income and the number, size, and condition of farm buildings in Callaway County.

The farm buildings classification, inspired by the Cornell work but different in some respects, was one of two main sources of information. The classification was made in the following manner: A soils map was cut into small pieces, pasted on an 8½" x 10" cardboard, and used as field sheets. All roads and trails were then driven or walked, and pencil checks of different colors were used to classify in place all the sets of buildings which could be located. Farmsteads which were in existence at the time the soil survey was made were, for the most part, very accurately located. Farmsteads which had been erected since the soils map was prepared were located as accurately as possible. Rural residences were noted; towns and villages were circled. The buildings were classified visually according to the degree to which they evidenced farm prosperity. Five classes were used.²⁰ Number, size, and condition of buildings were considered the main evidences of prosperity, although other evidences, such as the kind and condition of the fences and equipment, were considered if they could be definitely related to a farmstead. The buildings represented probably 95 per cent of the basis of judgment. When there was a noticeable difference in the prosperity of a farm as judged by the house or by other farm buildings, the farm buildings other than the house were given predominant weight. It should be realized that the classification, being entirely subjective, was not designed to give exact evaluations, but rather to give some indication of the relative prosperity of different land areas as it might be indicated by the percentage distribution of the various buildings classes.

After the work had been completed, the information on the field sheets was transferred in the office to a whole soils map which was mounted on one-half inch thick insulation board. The edges of the board and the mounted map were bound, and the buildings classification was shown by means of colored map tacks inserted at the appropriate places.

There is no doubt that in many areas the evidences of prosperity which one can observe by looking at a farmstead and other farm buildings bear a close relation to past farm income. There are, however, so many factors (such as tenancy, equity, nationality, degree to which past income represents liquidation of soil capital, gains or losses from other activities than farming, and other factors) which influence income and the evidences of farm prosperity, that any results obtained by such a survey must be carefully interpreted in light of the local conditions existing in the surveyed territory. Inasmuch as there do not appear to be any influences which alter the significance of the buildings classification in Callaway County, it is thought that the index is serviceable as used in this study.

²⁰See page 52 for definitions of the classes.

ship tract could be combined. The following system was used as a guide to completing the cards under the various situations encountered:

- (1)—For tracts on which only one operator was shown:
 - (a)—If the operator was also the owner, one card was completed for the entire tract, showing the operated acres as the same as the owned acres.
 - (b)—If the operator was a cash tenant, one card was completed for the entire tract, showing the operated acres as the same as the owned acres.
 - (c)—If the operator was a crop-share tenant and lived on the tract, one card was completed for the entire tract showing the operated acres as the same as the owned acres. Determination of whether or not an operator lived on a tract was made on the basis of these factors:
 - (i) —Whether or not a house could be seen on the photograph.
 - (ii) —Whether or not there were any milk cows on the tract in 1938 (Section II—bottom of front of form 217).
 - (iii)—Knowledge of AAA clerks, some of whom usually knew most of the farmers and approximately where they lived.
 - (d)—If the operator was a crop-share tenant and *did not live* on the tract, two cards were completed each showing the legal description and acreage of the ownership tract with one card showing the land operated by the operator, and one card showing as idle the land not shown to be operated.
- (2)—For tracts on which more than one operator was shown:
 - (a)—If an operator lived on the tract, the X and Y land and all fields operated by that operator were shown on one card. Other cards were made for fields operated by each of the other operators.
 - (b)—If no operator lived on the tract, the X and Y land and any other fields not specifically assigned to any operator were shown on one card which was marked "Not Operated." Other cards were made for each of the other operators showing X and Y land and fields as they were specifically shown to be operated by them. In cases where the Y land was specifically assigned to an operator, but the X land was not, the X land was assigned to the operator who operated the Y land.

Each farm shown on any photograph is numbered. This number and the number of the photograph on which the farm is shown, appear in the upper right-hand corner of Form 217 for that farm. As the Form 217 for each farm was withdrawn from the file, the photograph (or photographs in some cases) on which the farm was shown, was obtained also. When the farm was located on the photo the legal description was checked. Since many of these were incomplete or in error on the forms 217, the correct legal description and acreages were determined from the photo and written on the data card. The farm photo number was written in; for instance farm #5 on photo #430 was written 5-430. The other items were completed in order.

After the cards were completed, they were sorted alphabetically by the last name of the operator. Names were then matched, and all cards relating to any given operator were clipped together. Cards for idle tracts were placed in a separate group, as were cards for tracts on which information had been refused (a small number).

The cards were then sorted as to whether operators were full-owners, part-owners, or tenants. To eliminate as much as possible the influence of tenancy on land use, the cards for part-owner-operators and tenants were put aside. The cards relating to owner-operated farms were then sorted to divide owner-operators into two groups: (1) those who did not rent any land, and (2) those who did rent parts of their farms. The latter group was also put aside. Working then only with operators who owned all the land they operated and operated all the land they owned, the cards were sorted by aerial photographs, and related by the legal description of the tracts to the map. The number(s) of the area(s) in which the tract(s) fell and the classification of any buildings on the tract or tracts were then noted at the

appropriate places on the card. Cards were then sorted by areas and all cards for farms which did not fall completely within any one land class were laid aside. Thus the cards remaining applied to farms lying wholly within one land area class and on which the operator owned all the land he operated, and operated all the land he owned. Some of these were laid aside for various reasons. *The remainder constituted the sample used and referred to in the analysis of land-use experience in the various land area classes.* The distribution of farms with Class A, B, C, and D buildings was practically the same for the sample as for all farms in nearly all area classes.

Cards for idle tracts were then related to the map by legal description and the area number and buildings classification were noted. Again, all cards relating to tracts which lay in more than one land area class were laid aside; the others were used in the analysis.

Various data from the United States Census and the Missouri Crop Reporting Service were used to give background for more detailed facts or for observations. Such data included population history, crop and livestock history, size and number of farms history, etc.