

**UNITED STATES DEPARTMENT OF AGRICULTURE**

**Soil Survey**  
of  
**Caroline County, Maryland**

By

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and

**S. R. BACON**

United States Department of Agriculture



**Bureau of Chemistry and Soils**

In cooperation with the Maryland Geological Survey  
and the Maryland Agricultural Experiment Station

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## SOIL SURVEY

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# SOIL SURVEY OF CAROLINE COUNTY, MARYLAND

By H. B. WINANT, Maryland Agricultural Experiment Station, in Charge, and S. R. BACON, United States Department of Agriculture

## COUNTY SURVEYED

Caroline County includes an area of 319 square miles, or 204,160 acres. It occupies a central position, in a north-south direction, among the Eastern Shore counties of Maryland. It is bordered on the east by the State of Delaware, on the south by Dorchester County, Md., and on the west and northwest, respectively, by Talbot and Queen Annes Counties, Md. (Fig. 1.)

The general surface features of Caroline County comprise level, undulating, and gently rolling areas, with short steep slopes bordering some of the larger streams. The principal areas of undulating and gently rolling relief are developed in the central and, particularly, in the southwestern parts of the county. The steeper slopes and more rolling areas border Choptank River, some of the marshlands, and in some places Tuckahoe Creek and Marshyhope Creek. The larger and more continuous level, flat, and undulating areas are developed along the eastern border of the county, in the vicinity of American Corners, and in the northern end of the county north of Goldsboro.

The general slope of the land is toward the south and southwest, and the natural drainage is into Choptank River and Tuckahoe and Marshyhope Creeks. The larger streams in places have reached base level, and their flow is sluggish. The channels of the smaller streams increase in depth gradually from merely shallow drainage ways near their sources to comparatively deep valleys which widen as they approach the rivers. Some of these small streams are still cutting deeper channels. The escarpments from the rivers and streams rise from a few feet to more than 30 feet above the stream levels.

The central and southwestern parts of the county are dominantly well drained, although here and there a level area of poorly drained land occurs. The northern end, the eastern side, and the southeastern part of the county are not everywhere well drained, as many of the level flat areas or slight depressions have not been invaded by streams and are wet for a long time during the winter, necessitating open ditches to effect drainage. The areas of tidal marsh are permanently wet, and areas of meadow are alternately wet and dry. A large proportion of the more level land in Caroline County would be much more poorly drained were it not for the excellent underdrainage afforded by the sandy material beneath the subsoil.

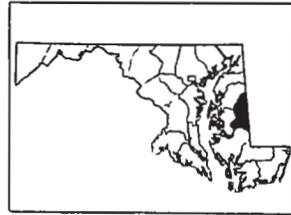


FIGURE 1—Sketch map showing location of Caroline County, Md.

Along a few of the streams, sufficient water power to operate grist-mills is developed. Good drinking water is obtained at a depth ranging from 20 to 35 feet below the surface of the ground.

The average elevation of the county is between 40 and 60 feet above sea level, with a minimum elevation of about 5 feet near Choptank and a maximum elevation of 75 feet 1 mile southwest of Templeville. The elevation <sup>1</sup> at Denton is 42 feet above sea level; at Federalsburg, 11 feet; at Ridgely, 70 feet; at Preston, 47 feet; at Greensboro, 41 feet; at Goldsboro, 64 feet; and at Hillsboro, 49 feet.

Owing to uncertainty regarding the validity of titles as a result of the undetermined boundary line between Maryland and Delaware, the boundaries of Caroline County were not settled until about 1760, although explorations had been made years previously along Choptank River and Tuckahoe Creek. The county was organized in 1773, when the cession of the main territory by Dorchester County and of Tuckahoe Neck by Queen Annes County allowed its formation. The original settlers were largely of English descent, mainly religious refugees, many Quakers being attracted from Virginia and New England by the toleration act of 1649. Most of the early settlements were established along the banks of the navigable streams which were the main arteries of communication.

The population is still largely of English descent, although many negroes, in addition to the white population, now reside in the county. The 1930 Federal census <sup>2</sup> reports the population of Caroline County as 17,387, all of which is classed as rural. This shows a slight decrease since 1920. Denton, the county seat, has a population of 1,604. The populations of other incorporated places are as follows: Federalsburg, 1,369; Greensboro, 760; Ridgely, 703; Goldsboro, 211; Marydel, 211; Preston, 315; and Hillsboro, 200. According to the same census, 76.3 per cent of the population is native white, 21.1 per cent negro, and 2.6 per cent foreign-born white. The density of population is 54.5 persons a square mile.

Although water transportation was largely instrumental in effecting the settlement of Caroline County, at present no steamboat lines give regular freight and passenger service, but Choptank River is used by oil tank steamers and sailing vessels for the transportation of heavy freight as far as Denton. Rail transportation is provided by a branch line of the Pennsylvania Railroad across the northwestern part of the county, the Maryland & Delaware Coast Railway across the central part, a branch of the Pennsylvania across the southeastern corner, and the Baltimore & Eastern Railroad across the southwestern corner. Railroad transportation of both freight and passengers seems to be declining in volume as a result of competition by motor trucks and motor busses, and most of the freight and passenger traffic now moves by way of the improved roads.

In 1929 the county had 112 miles of State highway, of which 67 miles were concrete and 25 miles macadam, connecting all the principal towns. Although the heaviest traffic in the summer is probably over United States route 213, which is part of the highway from Claiborne to Ocean City and other points on the southern part of

<sup>1</sup> GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U S Geol Survey Bul. 274, (FOURTH EDITION) 1,072 p. 1906

<sup>2</sup> Soil survey reports are dated as of the year in which the field work was completed. Later census figures are given whenever possible.

the Eastern Shore, probably most of the farm produce is transported over the highways that run in the direction of New York and Philadelphia. Although no data are available giving the relative tonnage of farm products transported by road and by railroad, it is fairly certain that the larger part of such freight is being moved over the State highways, as the railroad companies themselves frequently ship by motor truck to avoid the expense and delay of reloading. This is especially advantageous for such perishable products as strawberries. When the volume of commerce with New York and Philadelphia is considered, it is difficult to exaggerate the importance of good roads to the prosperity of Caroline County.

The numerous small towns throughout the county are well supplied with telephones, churches, and schools. Large high schools with modern equipment are at Denton, Federalsburg, Ridgely, Greensboro, and Preston, and a smaller high school is at Henderson. School attendance is facilitated by special bus lines which are supported at public expense.

Caroline County is essentially rural with respect to its industry, most of the factory products either originating on the farm or being intended for farm use. A fertilizer factory is at Greensboro, and fruit-crate factories are at Federalsburg and Ridgely. Flour mills are located at Federalsburg, Denton, Greensboro, and other points, some communities having more than one. The most widely developed industry in the county is the canning of vegetables. Practically every community has at least one canning establishment, and most of the larger towns have two. In 1925 there were 47 canneries in Caroline County which ranked second in Maryland in this respect. All the canneries can tomatoes, and some can peas, sweet corn, Lima beans, snap beans, and other vegetables. Milk cooling plants are at Ridgely and Goldsboro, and a large condensary is located at Greensboro. This plant has a maximum capacity for handling about 200,000 pounds of milk daily.

Although the county contains numerous deposits of sand and gravel, which may be used for concrete construction, such deposits are used only locally, where conveniently located, for road improvement.

Deposits of bog iron ore occur at different places in the county, from which about a century ago attempts were made to manufacture iron but without commercial success. A bloomery was erected on Marshyhope Creek a mile south of Smithville. In 1840 iron was produced from bog ore at a forge on the east bank of Marshyhope Creek just above Federalsburg, but the iron obtained was too brittle.

### CLIMATE

Because Caroline County is situated between the Atlantic Ocean and Chesapeake Bay its climate is oceanic in character, and the range between winter and summer temperatures is comparatively slight. The distribution of rainfall throughout the growing season is very uniform, and the snowfall is light. The records of the United States Weather Bureau station at Denton show that the average date of the last killing frost is April 14 and of the first is October 22, giving an average frost-free season of 190 days. Frost has been recorded

at the Denton station as late as May 12 and as early as September 23. The records of the station at Ridgely show but little difference from those of the Denton station. The proximity of Caroline County to both the ocean and the bay, and the extensive areas of light-textured soils favor orcharding, viticulture, and the production of early vegetables and small fruits, especially strawberries. Rye is commonly grown as a winter cover crop, and crimson clover is also grown to some extent for the the same purpose. Spinach can be grown during the winter. Cultivation of the ground can be carried on for about 10 months of the year, as the soil does not freeze much before January and thaws before the end of March.

Table 1, compiled from the records of the Denton station, gives the more important climatic data for the county.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Denton, Md.

[Elevation, 42 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1914)	Total amount for the wettest year (1919)	Snow, average depth
	°F	°F	°F.	Inches	Inches	Inches	Inches
December.....	35.7	70	-4	3.20	4.78	3.28	4.5
January.....	34.2	74	-17	2.98	4.72	3.26	6.0
February.....	33.5	73	-14	2.95	2.11	2.56	5.9
Winter.....	34.5	74	-17	9.13	11.59	9.10	16.4
March.....	43.8	91	1	3.48	1.94	3.09	3.4
April.....	52.9	97	21	3.26	2.81	4.22	.6
May.....	63.7	98	30	3.74	2.09	6.30	.0
Spring.....	53.3	98	1	10.48	6.84	13.61	4.0
June.....	71.2	101	41	3.89	2.30	2.69	.0
July.....	76.2	105	47	4.38	3.23	9.05	.0
August.....	74.3	105	42	4.68	4.56	12.99	.0
Summer.....	73.9	105	41	12.95	10.09	24.73	.0
September.....	68.8	95	32	2.98	.83	2.74	0
October.....	57.4	88	23	3.18	1.28	3.55	.0
November.....	45.7	80	15	2.61	2.00	3.68	.6
Fall.....	57.1	95	15	8.77	4.11	9.97	5
Year.....	54.7	105	17	41.33	32.63	57.41	20.9

### AGRICULTURAL HISTORY AND STATISTICS

Although staple crops have been grown since Caroline County was first settled, during the colonial period tobacco also was universally grown and was used as currency in payment of wages, debts, and taxes. Failure to accept this medium of payment rendered a debt legally void. Continued and injudicious cropping, however, resulted in such soil impoverishment that tobacco growing became unprofitable, and this crop is not grown at present.

About the middle of the nineteenth century peaches became an important crop, and during the picking season the capacity of numerous steamboat lines was taxed in handling the crop. A disease,

peach yellows, however, ruined this industry. The peach crop in 1889 amounted to 163,078 bushels, but in 1899 the crop had dwindled to 683 bushels. The crop has increased to some extent in recent years. The most popular early varieties grown at present are Carman, Hiley, and Belle, and Elberta is the late variety most commonly grown.

Since 1900, apples have exceeded peaches in production. The principal apple varieties are Stayman Winesap, Winesap, and Grimes Golden. Pears are produced to some extent, mainly on roadside trees. There are several important commercial vineyards in the county, in which Concord is the leading variety of grape. Nuts and small fruits are produced to a small extent. Strawberries are the most important fruit crop, and Federalsburg is the principal strawberry market. Howard 17 (Premier) is the leading variety of strawberry.

The production of tomatoes for canning started about 1872 and in 1907 Caroline County is reported to have produced 10 per cent of the total tomato pack of the United States. In the 6-year period, from 1922 to 1927, inclusive, Caroline County ranked first among the Maryland counties in the acreage planted to tomatoes. Its failure to retain the rank held in 1910 seems to be owing less to a decline in actual production within the county than to an increased production elsewhere. At present the Marglobe variety of tomato, owing to its resistance to *Fusarium* wilt, seems to be very popular, although the Baltimore varieties are also grown extensively on the heavier soils. Other canning crops grown are peas, Lima beans, and snap beans. Peppers, sweetpotatoes, potatoes, and various other vegetables are grown, and asparagus culture seems to be increasing. Owing largely to its high rust-resisting ability, Martha Washington is the leading variety of asparagus. A rather large acreage is devoted to the production of cucumbers and cantaloupes. Among the market-grown crops, cantaloupes rank next to tomatoes in importance. The leading varieties are Hearts of Gold, Pearl Pink Meat, and Pollock 1025. White Spine cucumbers are very generally grown.

Corn and wheat are still the main grain crops, and soybeans are rapidly increasing in importance. Crimson clover is less commonly grown than formerly, owing to its susceptibility to leaf spot disease, and it is being replaced by sweetclover or by a combination of rye and vetch.

During the early period of agriculture in Caroline County, livestock were scarce and livestock products were not readily marketable; but the value of livestock raising as a means of soil improvement was soon recognized, and it became the custom among landlords to take no share of the small numbers of livestock produced by the tenant. With the growth of cities and the improvement in transportation systems, the demand for milk and butter increased and dairying became profitable. Dairying gives a quick return on labor investment, and its profits are more certain than for cultivated crops. Hence an increase in dairying has resulted, even on lands that are not primarily adapted to that industry.

Table 2 gives data for various farm crops grown in Caroline County in stated years.

TABLE 2.—*Acres and production of selected crops in Caroline County, Md., in stated years*

Crop	1879		1889		1899	
	Acres	Bushels	Acres	Bushels	Acres	Bushels
Corn.....	30,590	512,930	21,364	373,055	26,306	672,520
Wheat.....	18,336	187,581	19,617	280,437	24,509	331,480
Potatoes.....		16,468	293	22,461		27,371
Sweetpotatoes.....	444	30,571	273	22,636	321	32,780
Hay, total.....	1,601	Tons 1,492	4,799	Tons 6,076	8,396	Tons 8,778
Clover alone.....					2,378	2,933
Apples.....		Trees		Trees		Trees
Peaches.....		Bushels		Bushels		Bushels
			42,397	25,599	68,559	63,604
			670,828	163,078	628,384	683
Grapes.....		Vines		Pounds		Pounds
					4,137	13,100
Strawberries.....		Acres		Quarts		Quarts
					1,269	2,826,410

Crop	1909		1919		1929	
	Acres	Bushels	Acres	Bushels	Acres	Bushels
Corn.....	30,199	855,313	28,421	581,134	21,562	516,261
Wheat.....	24,201	264,161	28,893	335,333	24,648	424,843
Potatoes.....	704	73,403	571	36,775	444	40,663
Sweetpotatoes.....	680	91,586	562	52,783	211	22,939
Hay, total.....	7,617	Tons 9,806	11,305	Tons 14,034	8,384	Tons 10,337
Timothy and clover, mixed.....	2,520	3,135	5,177	6,693	3,381	4,365
Clover alone.....	3,665	4,863	2,095	2,694	1,099	1,375
Alfalfa.....	38	70	474	1,060	804	1,371
Annual legumes.....			1,170	1,292	2,747	2,936
Apples.....		Trees		Trees		Trees
Peaches.....		Bushels		Bushels		Bushels
Pears.....						
	46,310	15,723	68,006	38,661	53,182	20,128
	175,339	515	26,323	12,434	12,411	8,094
	28,593	4,070	12,579	10,740	4,648	3,570
Grapes.....		Vines		Pounds		Pounds
	2,455	24,925	11,474	91,115	20,267	88,628
Strawberries.....		Acres		Quarts		Quarts
	1,482	2,727,654	821	959,962	646	1,189,001

The canning industry is, and has been for many years, an important source of revenue to the farmers in Caroline County. Tomatoes, sweet corn, peas, and snap beans are the principal vegetables canned. In 1929, 5,388 acres were devoted to tomatoes, 2,215 acres to sweet corn, 2,827 acres to garden peas, and 621 acres to snap beans. Among the market-garden crops grown, other than the vegetables mentioned, are asparagus, Lima beans, cantaloupes, cucumbers, peppers, and watermelons.

On April 1, 1930, the total number of cattle on the farms of Caroline County was 9,473; of horses, 3,530; of mules, 2,015; of sheep, 2,369; of goats, 64; of swine, 5,483; and of chickens, 228,289

Livestock raising, that is, the production of draft animals, sheep, and hogs, is practiced more generally on the heavier soils of the county, especially in the vicinity of Tuckahoe Neck.

Dairying appears to be a growing industry in Caroline County, for in spite of the fact that much of the soil is too light for the best adaptation to crops essential to milk production, most farmers desire

some assurance of a steady income. A few beef cattle are raised, but the raising and fattening of beef cattle is of small importance compared with dairying.

Poultry raising is a rather extensive industry in Caroline County, and the value of poultry and poultry products has materially increased within the last decade. In 1926, 21 hatcheries were located in Caroline County, with a total capacity of 611,340 eggs. In the same year 56,000 cases of eggs, with a total value of \$585,000, and 1,200 tons of poultry, with a total value of \$600,000, were shipped. In 1928 the number of chickens hatched was between 2,000,000 and 2,500,000. A single hatchery at Ridgely has a total capacity of 100,000 eggs, and several hatcheries are near Denton. Numerous poultry farms are in the sandy land along the east bank of Choptank River. Turkey raising is carried on rather generally and several farms specialize in turkey raising, but no data on turkeys appear in the census reports for Caroline County.

Table 3 gives the value of agricultural products in Caroline County, Md., in 1929.

TABLE 3—Value of agricultural products in Caroline County, Md., in 1929

Crop	Value	Livestock and products	Value
Cereals.....	\$961,099	Domestic animals.....	\$1,551,681
Other grains and seeds.....	37,007	Dairy products.....	458,209
Hay and forage.....	185,736	Wool.....	2,639
Vegetables (including potatoes and sweetpotatoes).....	893,181	Poultry.....	713,709
Fruits and nuts.....	184,153	Eggs.....	563,981
Farm garden vegetables (for home use only).....	67,731	Honey.....	1,462
Total.....	2,328,907	Total.....	3,291,661
		Total agricultural products.....	5,620,568

During recent years the value of cereal crops has decreased and that of animal products has increased. The acre yield of most crops has increased, which would indicate more efficient agricultural practices. It is probably due mainly to the withdrawal of marginal or unproductive land and to the use of a more intensive system on the remaining agricultural land. The production of alfalfa and annual legumes tends to raise the average yield of hay crops. Agricultural leaders in Caroline County observe a recent change in agricultural practices, notably an increase in the dairy industry.

There are several greenhouses in the county, where trees, plants, vines, flower and vegetable seeds, and bulbs are grown for sale.

Federalsburg is an important strawberry market. At some places, as near Ridgely, canning companies grow on their own land the crops they can and in so doing follow a special rotation and use factory labor for planting, harvesting, and cultivating their crops.

A State experimental farm, which has been in operation since 1916, is located at Ridgely. It is devoted primarily to the production of crops which are of economic importance in Caroline and adjacent counties.

An intensive type of agriculture is fostered by a combination of such factors as light-textured soils and easy access to markets, owing to good roads and to the comparatively short distances to Philadelphia and New York. This market factor, in conjunction with the

favorable texture of the soils and climate, apparently is responsible for the extensive truck-crop industry. Consequently, there is a tendency for farms to decrease in size. This trend is accentuated by the fact that a small farm, owing to the smaller initial cash payment involved, is more easily sold than a large farm and because small farms require less labor. In 1890 the average size of farms was 121 acres. Since then there has been a steady decrease in size, the present average being 87.2 acres. More than 80 per cent of the farms range from 10 to 174 acres in size and more than 50 per cent from 20 to 99 acres.

According to the census data, there has been a gradual increase in farm ownership since 1880, from 60.7 per cent in that year to 64.7 per cent in 1930. This tendency has been noted by men acquainted with rural affairs in Caroline County and is in harmony with the dominant economic factors. The farms are becoming smaller because the development of an intensive type of agriculture demands increased labor which results in a decrease in the area of the farm unit. The only counter tendency to be noted is when a company absorbs several farms and manages them as a group of units, but such a system is too expensive to become general under present conditions and is restricted to a few localities where fertile soils are most extensive.

In 1930, of the 651 tenants, 13.1 per cent were designated as cash tenants and 9.1 per cent as croppers, most of the others being share tenants.

According to the share system of rental now customary in Maryland, the landlord furnishes all the lime, all the fertilizer except half the amount that is used for wheat, and one-half of the seed. The tenant furnishes labor, horses, and farm implements, and receives all the milk and livestock products, and one-half of the crops.

Most farms are equipped with walking or riding plows, disk plows, spike and spring toothed harrows, mowers, grain drills, and corn planters. Many of the larger farms have grain binders, manure spreaders, rollers, cultipackers, gang plows, and tractors. Silos are common on farms where dairying is practiced. On account of the prevailing gently rolling or undulating surface relief occupied by soils that are naturally fairly well drained, tractors can be operated over large areas. Combined harvesters and headers were in operation on a number of wheat fields in 1929. Some farmers engaged in the production of truck crops use transplanting machinery to reduce the cost of man labor.

Owing to the abandonment of many farms and to a shortage of labor on many that are being operated, the buildings generally are in need of repairs.

The expenditure for fertilizers and lime for the entire county in 1929 amounted to \$210,280, only a small percentage of which was spent on lime.

The general growing of truck crops requires a relatively large supply of human labor compared to animal labor, particularly in planting and harvesting operations. On the ordinary farm much of the labor is furnished by the family, although on some farms additional help may be required for the harvesting of wheat, fruits, and vegetables. According to the census report for 1930, cash wages paid for labor in 1929 amounted to \$267,990 on 42.5 per cent of the farms in the county.

## SOILS AND CROPS

Caroline County borders the State of Delaware and lies about midway, from north to south, of the Eastern Shore of Maryland. It contains 204,160 acres, 82.1 per cent of which is farm land. According to the census, about one-half of the land of this county is under cultivation, a large acreage is in pasture, and a rather large acreage is devoted to the production of apples, peaches, and other fruits. Much of the land is in a high state of productivity as attested by the prosperous appearance of the farm improvements. The unused land consists principally of poorly drained areas, particularly in the northern end of the county, and the sandy pine barrens along the eastern bank of Marshyhope Creek and to less extent along Choptank River. Some of the poorly drained areas are devoted to pasture or support a growth of hardwood trees, and most of the unused land of the more sandy areas supports a second growth of pine. Only a small amount of merchantable timber remains in the county.

Caroline County contains a great variety of soils. Perhaps 60 per cent of the soils are no heavier in texture than sandy loam, and this condition has resulted in the development of a diversified agriculture, including staple crops accompanied by a wide variety of truck crops. The soils have had a direct bearing on the agricultural development, as many of the farmers can not compete in the production of staple crops, in dairying, and in livestock raising with their neighbors in adjoining counties, where the heavier soils predominate, but can excel them in growing truck crops and crops for canning purposes.

The largest acreage is devoted to corn which is grown on practically every soil type and is used mainly for feeding work animals and hogs and for meal. Most of the wheat is grown on the heavier types of soil. After supplying the home needs with flour, some of the wheat is sold for cash.

Tame or cultivated grasses, timothy and clover mixed, clover, alfalfa, and annual legumes occupy a large acreage. These crops are grown primarily for use on the farm as feed for work animals and dairy cows.

In addition to the staple crops a large acreage is devoted to tomatoes, potatoes, sweetpotatoes, peas for canning, cantaloupes, snap beans, sweet corn, asparagus, cucumbers, watermelons, strawberries, a large number of apple, peach, and pear trees, and grapevines.

All of the truck and canning crops, together with the dairy and poultry products, constitute the principal cash income of the farmers of Caroline County. The sale of dairy and poultry products throughout the year and the sale of truck crops through the late spring and summer, furnish the farmers the necessary cash for their operations.

The farmers have worked out a system of agriculture that apparently fits in exceptionally well with the soils and the climate of this region. Of course the markets have been an important factor in the kind of crops that have been and are grown. Considering the soil, climate, markets, and transportation facilities, the farmers are free to grow a wide variety of such crops as are the most profitable and find a ready sale for cash. The excellent appearance of the farms throughout the county indicates that the operators are of a high class.

In Caroline County a direct relationship exists, in many cases, between the agriculture and the various soil types. The agricultural

soils of the county naturally fall into three main groups as follows: The brown well-drained soils, the light-gray poorly drained soils, and the black poorly drained soils. In addition, two miscellaneous soils, meadow and tidal marsh, are mapped.

In the following pages of this report the soils of Caroline County are described in detail, and their agricultural importance is discussed; their distribution is shown on the accompanying soil map; and Table 4 gives their acreage and proportionate extent in the county.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Caroline County, Md*

Type of soil	Acre	Per cent	Type of soil	Acre	Per cent
Sassafras sandy loam.....	38,784	19 0	Elkton sandy loam.....	7,424	3 6
Sassafras sandy loam, deep phase...	384	2	Elkton silt loam.....	3,684	1 8
Sassafras loam.....	27,200	13 3	Plummer loamy sand.....	2,804	1 1
Sassafras silt loam.....	768	4	Portsmouth loam.....	7,872	3 9
Sassafras loamy sand.....	41,216	20 2	Portsmouth sandy loam.....	7,424	3 6
Sassafras sand.....	19,136	9 4	Meadow.....	10,304	5 0
Keyport loam.....	5,120	2 5	Tidal marsh.....	4,416	2 2
Keyport sandy loam.....	5,760	2 8			
Keyport loamy sand.....	5,832	4			
Elkton loam.....	21,632	10 6	Total.....	204,160	-----

#### BROWN WELL-DRAINED SOILS

The group of brown well-drained soils includes all the soils of the Sassafras and Keyport series. These soils dominate the agriculture of the county and produce some of the most profitable cash crops as well as the greater part of the staple crops; in fact these soils are the choice agricultural lands of the Eastern Shore of Maryland, Delaware, and New Jersey.

They occur in large areas in the southwestern and central parts of the county and are distributed to some extent throughout the rest of the county. They have an almost level, undulating, or gently rolling surface relief which is favorable for the use of improved machinery. The farms on these soils show evidence of the prosperity of the farmers, and good houses and barns are seen nearly everywhere.

Perhaps one of the main reasons for such a wide diversification of crops in Caroline County is because a large proportion of the soils are sandy loam or loamy sand in texture. These soils are admirably suited to the production of truck crops but are not so well suited to growing staple crops, dairying, and livestock raising as are the heavier types of soil predominating in some of the adjoining counties.

These soils are naturally well drained both on the surface and in the subsoils, and even under the subsoils of the heavier types a loose sandy stratum effects good drainage throughout the soil mass. They warm up early in the spring and allow early planting of seed.

The soils of this group range in color from uniformly brown to light brown or grayish brown in the surface layers, and from reddish brown to yellowish brown in the subsoils. They range in texture from sand to silt loam, the dominant types being sandy loam and loamy sand. The surface soils are friable and mellow and the subsoils, which range from sand or sandy clay to clay loam, are also friable.

The subsoils are retentive of soil moisture and of plant food. All of these soils are easy to cultivate, and a good mellow condition can usually be produced and maintained by proper tillage. Hand tools can be used advantageously in most of them. Where the land has been in grass over a long period or has been well manured, the surface soils contain a large amount of organic matter.

The physical properties of these soils are such that they respond quickly to manures and fertilizers and the effects of manures or of turning under green-manure crops is very lasting, especially on the soils which have a sandy clay or clay subsoil. The heavier types are naturally productive, and the more sandy types respond readily to fertilizer.

Chess or cheat is a common weed in grainfields and Bermuda grass in cultivated fields. Grasslike sedges grow in some poorly drained fields. Broom sedge, which is one of the true grasses, is common in abandoned fields. Goldenrod commonly grows on poorly drained land. Poverty grass, wild oatgrass, rush grass, skeleton grass (*Gymnopogon* sp.), silvery hairgrass, and sand burs grow on sandy land. Indian grass occurs commonly in moderately wet or uncultivated dry fields. Grasses suitable for hay grow in wet places.

Nearly all the area of Sassafras sandy loam, Sassafras loam, and Sassafras silt loam is cultivated, and the remainder is forested to loblolly pine and a second growth of pin oak, white oak, and Spanish oak, together with some sweetgum, poplar, birch, maple, beech, dogwood, and hickory, and in places an undergrowth of sassafras bushes and myrtle, the sassafras bushes growing rapidly on the abandoned loamy sand areas. The main crops on the Sassafras soils are corn, wheat, and hay, and the secondary crops include a wide variety of truck crops.

The Keyport soils occupy an intermediate position between the well-drained Sassafras soils on the one side and the poorly drained Elkton soils on the other. Generally speaking, the Keyport soils are not so desirable for general-farming purposes, and particularly for truck crops, as the Sassafras soils. They are not quite so well drained as the Sassafras soils but are much better drained than the Elkton or Plummer soils, and consequently they are more closely related agriculturally to the Sassafras soils than to the Elkton soils.

**Sassafras sandy loam.**—Sassafras sandy loam is one of the extensive and important soil types of Caroline County. It occurs in rather large areas in all parts and is well developed east of Ridgely, in the vicinity of Greensboro, around Hobbs, and in the southern part of the county west of Federalsburg. It is a soil on which staple crops and a large variety of truck crops are successfully grown. It is a general-purpose soil and one that is easy to cultivate under a wide range of moisture conditions. For dairying and livestock production Sassafras sandy loam is not quite so good as Sassafras loam, but it is a better soil for the production of truck and canning crops, which are important in Caroline County.

The surface soil in cultivated fields is grayish-brown or light-brown mellow and friable loamy sand or light sandy loam to a depth of about 6 or 8 inches. It is easily maintained in good tilth. Below this is brownish-yellow or light-brown sandy loam extending to a depth ranging from 12 to 20 inches. The subsoil, to a depth ranging from 28

to 34 inches, is yellowish-brown or reddish-brown friable and crumbly clay loam or light clay. The subsoil is sufficiently heavy to retain moisture and plant food and at the same time affords excellent drainage. It grades below into yellowish-brown or brownish-yellow loamy sand or sand, which in places contains some gravel.

The greater part of Sassafras sandy loam is under cultivation. The leading crops are corn, wheat, tomatoes, potatoes, strawberries, peas, beans, and cantaloupes. Wheat yields from 15 to 20 bushels an acre with an acre application of 400 pounds of a 2-8-5<sup>3</sup> fertilizer. Corn yields range from 20 to 40 bushels an acre, the larger yields being obtained where heavy applications of manure or commercial fertilizer have been made. Tomatoes rank next to corn and wheat in acreage, and the yields are satisfactory. Garden vegetables do exceptionally well.

**Sassafras sandy loam, deep phase.**—The deep phase of Sassafras sandy loam occurs in a few small areas scattered throughout areas of Sassafras sandy loam and Sassafras sand. It differs mainly from the typical sandy loam in that the sandy clay subsoil begins at a depth of about 20 or 24 inches below the surface, consequently this layer is thin over the sandy material of the substratum. In most places the surface soil is lighter in color and also lighter in texture than that of the typical sandy loam and is more nearly a loamy sand.

Approximately 70 per cent of this deep soil is under cultivation. In general the same crops are grown as on the typical sandy loam, although tomatoes and potatoes are grown to less extent, and cantaloupes, strawberries, and truck crops more extensively. The land receives about the same fertilization and cultural treatment as the typical sandy loam but yields are slightly lower, especially of wheat, corn, and hay. This soil is best used for early truck crops, sweet-potatoes, melons, and peaches.

**Sassafras loam.**—Sassafras loam is an extensive and important soil in Caroline County and one of the best general-purpose soils in this region. It is especially suited to the production of the staple crops, and good yields of tomatoes and late truck crops are obtained. The largest areas of this soil occur in the west-central part of the county. Some of the more continuous areas are south of Hillsboro, north of Ridgely, northeast of Denton, and southeast of Andertown.

The surface soil of Sassafras loam is grayish-brown or light-brown mellow and friable loam to a depth ranging from 6 to 12 inches. The subsoil, to a depth of 30 or 34 inches, is reddish-brown or yellowish-brown friable and crumbly sandy clay or clay loam, which allows good drainage and aeration and at the same time holds moisture well. Below the subsoil is the characteristic sandy and gravelly material which affords excellent underdrainage.

Sassafras loam is used largely for dairying, and most of the soil that is not in pasture is used for the production of corn, wheat, clover, and tomatoes. Approximately 95 per cent of this soil is under cultivation. Corn yields from 30 to 65 bushels an acre, wheat from 18 to 35 bushels, and grass from 1½ to 2½ tons of hay. Fair yields of strawberries, cantaloupes, asparagus, and buckwheat are obtained.

**Sassafras silt loam.**—Sassafras silt loam differs essentially from Sassafras loam in that both the surface soil and subsoil are more

<sup>3</sup> Percentages, respectively, of nitrogen, phosphoric acid, and potash.

silty in texture, that is, they have a smooth floury feel, and in some places both the surface soil and subsoil materials are slightly lighter brown than the corresponding layers of Sassafras loam. This soil occurs in small areas, the largest of which are in the southwestern corner of the county west of Preston.

Some of the best dairy farms in the county are on Sassafras silt loam. It is excellent pasture land and produces high yields of corn, wheat, hay, and tomatoes. Because of its favorable surface relief and good drainage it lends itself admirably to tractor farming. It is well suited to livestock production. Practically all of this soil, with the exception of a few wood lots, is under cultivation.

**Sassafras loamy sand.**—Sassafras loamy sand consists of grayish-brown or light-brown loamy sand to a depth ranging from 8 to 12 inches. This material grades into brown or slightly reddish brown loamy sand which continues to a depth of about 20 inches, where it is underlain by light reddish-brown sandy loam or loamy sand, which extends to a depth of 28 or 30 inches. In most places below this depth the color becomes brownish yellow and the material is loamy sand or sand.

Sassafras loamy sand is the most extensive soil in Caroline County. Its greatest development is in the southern end. It occurs in large areas north of Preston, around Fowling Creek, in the vicinity of Andersontown, and east and north of Denton. The surface relief of this soil is more rolling than that of Sassafras sandy loam but is generally smoother than that of the hummocky Sassafras sand. The land is exceptionally well drained, and, at the same time, the loamy character of the lower part of the subsoil is such as to afford fairly good moisture-holding capacity.

Although general farming is carried on rather extensively on this soil, it is especially adapted to the growing of watermelons, cantaloupes, sweetpotatoes, tomatoes, and other truck crops. The yields of staple crops, such as corn, wheat, and hay, are much less than on the heavier Sassafras soils. Sassafras loamy sand is inherently lower in fertility than the loam or sandy loam, and a much smaller proportion of this soil is under cultivation than of the sandy loam. It is used to some extent for poultry raising. Sassafras loamy sand, in point of productivity and crop yields, ranks between Sassafras sandy loam and Sassafras sand. It is very easy to till and responds readily to fertilization.

**Sassafras sand.**—Sassafras sand is developed in large continuous areas along Choptank River, beginning at the Delaware State line and extending through Greensboro and Denton to the southern tip of the county. Areas are east and northeast of Federalsburg along Marshyhope Creek. The latter region is locally known as the "pine barrens" because extensive areas of this sand are forested mainly to scrub pine (*Pinus virginiana*). Under present economic conditions it is not profitable to farm this land, except in patches for special crops or in conjunction with some of the more productive soils.

Sassafras sand is brown, slightly reddish brown, or yellowish-brown sand of uniform color to a depth ranging from 3 to 5 feet, at which depth the color becomes slightly lighter, or brownish yellow. Where green-manure crops have been turned under the surface soil is slightly loamy, the loaminess being caused by the organic matter rather than by the silt or clay content. Most of the sand is incoherent, that is,

it is very loose, porous, and extremely leachy, so that crops suffer from excessive or from insufficient moisture. In order to produce crops on this soil it is necessary to apply large quantities of fertilizer or to make heavy applications of manure. When this is done, early truck crops and corn can be produced. In a few places sweetpotatoes, cantaloupes, and watermelons do well if moisture conditions are favorable. Such areas can be used for poultry raising. The best use for Sassafras sand under present conditions is for reforestation.

**Keyport loam.**—Keyport loam occurs in small areas, mainly in the northern and southern ends of the county. The surface soil is light-brown or brownish-gray loam to a depth of about 8 inches. Below this is pale-yellow or grayish-yellow loam continuing to a depth of about 18 or 20 inches. Below this, and extending to a depth ranging from 32 to 36 inches, is mottled gray, yellowish-brown, or brownish-yellow friable clay or heavy sandy clay, underlain by gray or mottled gray and yellow loamy sand.

Probably about 50 or 60 per cent of Keyport loam is under cultivation. It is a good general-purpose soil, and wheat, corn, and hay are the principal crops. In places it is used for growing tomatoes, beans, peas, and potatoes. The yields of all crops are slightly smaller than those on Sassafras loam.

**Keyport sandy loam.**—Keyport sandy loam differs from Keyport loam in that it is more sandy both in the surface soil and in the subsoil. The surface soil resembles that of Sassafras sandy loam in color, but the mottled subsoil and poor drainage cause this soil to be markedly different from Sassafras sandy loam. This is one of the small and unimportant soil types scattered throughout the county. In crop adaptation it is not essentially different from Keyport loam, but the sandy character of the surface soil renders it of slightly lower fertility than the loam, and acre yields of the staple crops are slightly smaller. The sandy character of the surface soil renders it easy to cultivate, and a good tilth can be obtained.

**Keyport loamy sand.**—Keyport loamy sand occurs in small areas in the northern end of the county, southwest and west of Henderson. The surface soil is grayish-brown loamy sand or sand to a depth of 8 or 10 inches. Below this is a pale-yellow or grayish-yellow loamy sand, containing streaks and splotches of grayish white and yellowish red, which extends to a depth of 30 or 40 inches. In most places at a depth ranging from about 20 to 30 inches the soil contains sufficient fine material to give it a loamy character.

Keyport loamy sand is naturally low in fertility by reason of its sandy texture. The sandy texture, however, is advantageous in regard to drainage conditions, and the soil warms up fairly early in the spring. This soil is too light generally for the production of the staple crops, but it can be used advantageously for the production of truck crops.

#### LIGHT-GRAY POORLY DRAINED SOILS

The second group, or the light-gray poorly drained soils, may be termed the Elkton group, and it includes all the soils of the Elkton and Plummer series mapped in Caroline County. Conditions in Caroline County are dissimilar to those of some of the neighboring counties, as none of these soils is developed in very large areas such as occur in Talbot County. These soils occupy no distinct geographic position

but are scattered very irregularly but generally among the Sassafras, Keyport, and Portsmouth soils. Their surface relief is distinctive in that these soils invariably occur on the flat areas, in small shallow depressions, and near the heads of streams where associated with the Sassafras soils. Where these soils are associated with the Portsmouth soils, they usually occupy a higher position than the Portsmouth soils, and because of this position the water table is lowered and better drainage is established. All the Elkton and Plummer soils are naturally poorly drained owing to their flat surface relief and, in the Elkton soils, to the heavy subsoils. Artificial drainage is necessary to reclaim these soils for agricultural purposes. This can best be accomplished by means of open ditches, the walls of which stand up well in the heavy clay subsoils, especially in the Elkton soils. In the Plummer soils the ditches fill by material caving from the walls and are not so effective as ditches in the Elkton soils.

The soils of this group are light colored, ranging from almost white to light gray. They are dominantly silty or heavy in texture and have a tendency to clod or run together. The subsoils of the Elkton soils are composed of tough heavy plastic clay and heavy sandy clay, more or less mottled. The surface soils contain only a small amount of organic matter, except in a few places in the wooded areas where there is a thin covering of leaf mold. All these soils are acid and require from 1,000 to 3,000 pounds of lime an acre to correct the acidity. The loams and silt loams are not so easy to cultivate as the Sassafras sandy loams and sands, and they must be plowed and cultivated under proper moisture conditions, otherwise the soil will break up into lumps, and if too wet the silt loams have a tendency to run together and compact. These soils require stronger work animals and heavier machinery than the lighter-textured soils. A more liberal supply of manure and any form of organic matter will improve their physical condition.

The percentage of these soils under cultivation is much less than that of the brown well-drained soils, and a large percentage of them is wooded or used for summer pasture. The principal trees are second-growth white oak, southern red (Spanish) oak, and pin oak, also maple, some sweetgum, black gum, loblolly pine, and holly, with an undergrowth of myrtle and huckleberry.

Elkton loam and Elkton silt loam are fairly well suited to such crops as corn, wheat, and hay. They do not produce tomatoes, beans, potatoes, and other truck crops so well as the Sassafras soils. On farms which do not include any of the Sassafras soils, the Elkton soils can be used for all purposes. The production of truck crops on the Elkton soils is, therefore, due to the necessity for a cash crop rather than to the adaptability of these soils for truck crops. In Caroline and Dorchester Counties a large quantity of wheat, hay, and corn are produced, and good yields are obtained when the soil is limed, manured, and properly cultivated.

The Elkton soils in many places are locally known as "white-oak land," and in a few places Elkton silt loam is known as "pipe-clay land." Most of the merchantable timber on these soils has been cut.

**Elkton loam.**—In cultivated fields, the surface soil of Elkton loam, to a depth ranging from 6 to 10 inches, is gray or light-gray loam, underlain by light-gray heavy loam extending to a depth ranging

from 14 to 20 inches. The typical subsoil is plastic heavy sandy clay or tough clay, light gray in color and mottled with orange, brownish yellow, or rust brown. In most places, below a depth ranging from 28 to 36 inches, light-gray sticky sand, light sandy loam, or gravelly sandy material is reached. Elkton loam is scattered throughout all parts of the county. Some of the largest areas are in the vicinity of American Corners, east of Andersonstown, west of Denton, and west of Henderson.

Elkton loam occupies a fairly large acreage in the county and is one of the main agricultural soils in the production of staple crops. It is a good soil for general farming and in this region is well adapted for growing hay, wheat, corn, soybeans, and tomatoes. About 40 or 50 per cent of the soil is cultivated or in pasture. Wheat and corn occupy the largest acreage, although a large acreage is devoted to the production of canning crops.

**Elkton sandy loam.**—Elkton sandy loam is one of the less extensive soils of the county and occurs in scattered areas throughout the southern and northern parts. Some of the largest areas are in the extreme southern part southeast of Federalsburg. This soil usually occurs near the heads of streams or where the surface relief is dominantly flat, in many places occurring adjacent to meadow. It also occurs locally in poorly drained spots in the slight depressions within large sandy areas.

The surface soil is gray or dark-gray sandy loam to a depth of 6 or 8 inches. It grades into light-gray sandy loam which continues to a depth of 15 or 20 inches. The subsoil is gray plastic sandy clay or heavy sandy loam mottled with yellow or rust-brown stains. In most places, below a depth of 30 inches, the substratum of gray sticky sand is saturated with water. Included with this soil are small spots consisting of rather light textured sand or loamy sand which extends to a depth of 3 feet or deeper.

The principal crops are corn, hay, tomatoes, strawberries, and soybeans. The acre yields of these crops are not quite so large as those obtained on Elkton loam.

**Elkton silt loam.**—Elkton silt loam occupies low flat areas and is scattered throughout the northern, eastern, and southern parts of the county. Some of the largest areas are near the Delaware State line, north and south of Willoughby School, and in the southwestern corner south of Bethlehem. Only a small percentage of Elkton silt loam is under cultivation at present, some of it is in pasture, and the remainder is forested.

Elkton silt loam consists of light-gray or grayish-white silt loam to a depth of 6 or 8 inches. This layer is underlain by light-gray or bluish-gray slightly plastic silty clay or clay loam, mottled with gray and rust brown. Like other Elkton soils this soil, at a depth of about 30 inches, is underlain by light-gray sticky sand or sandy loam. The surface soil, when dry, has a floury feel and appearance. It has a tendency to run together and clod. When drained and limed the land produces good yields of wheat and grass and is well suited to the production of timothy. Because of its heavy texture and tendency to run together and clod and also on account of poor drainage, it is a less desirable soil for agricultural purposes than

Elkton loam or Elkton sandy loam. The tilth and productivity of this soil can be improved by the addition of organic matter.

**Plummer loamy sand.**—Plummer loamy sand is one of the inextensive and unimportant soil types in Caroline County, occurring in only a few small scattered areas. Most of it is poorly drained and surrounds the heads of small streams or occurs in flat areas or slight depressions. Included in mapping are both loamy sand and sand areas. In color and drainage conditions this soil closely resembles the Elkton soils. The sandy character of the subsoil is such that ditch walls do not stand up so well as in the Elkton soils.

Because of its light texture, poor drainage, and low content of organic matter, Plummer loamy sand is of low productivity. Only small fields of it are cultivated, but some of it is in pasture and wood lots. Its best use is for pasture and for forestry.

#### BLACK POORLY DRAINED SOILS

The third group, or the black poorly drained soils, includes the soils of the Portsmouth series and two miscellaneous classifications of material—meadow and tidal marsh. Most of the Portsmouth soils occur in the northern end of the county, and small areas are developed in the southeastern corner. Tidal marsh occurs in the southwestern part, and meadow is distributed over all parts.

The Portsmouth soils are black in their natural wet condition, owing to the high content of organic matter. These soils have remained in a swampy or semiswampy condition for a long time, vegetation has flourished, and the vegetable remains have accumulated in the surface soil to a depth of several inches. These soils occupy flat, level, or slightly depressed areas where natural drainage has not been established. The black color of these soils, resembling the prairie soils of the West, frequently misleads farmers in respect to their fertility. Only a very small percentage of these soils in Caroline County is under cultivation. The cultivated areas have been artificially drained by means of large open ditches.

The main agricultural use of these soils is the production of strawberries and certain truck crops, in addition to corn and potatoes.

The Portsmouth soils are naturally sour, or acid, and require a large amount of lime to correct their acidity. When drained, reclaimed, and limed these soils will produce good yields of corn and hay and furnish good pasture for cattle. The soils are loamy in character, being mellow and friable, and are easy to cultivate. On account of their low, flat position, water will stand on the surface longer than on the better-drained soils, and owing to the high content of organic matter they hold moisture very well, although they can not be cultivated so soon after rains as the Sassafras or Keyport soils. Over the greater part of the Portsmouth soils the merchantable timber of the original forest growth has been cut and the remaining growth consists of black gum, sweetgum, red maple, pin oak, willow oak, and some holly, bay-bushes, and smilax.

**Portsmouth loam.**—Portsmouth loam is one of the extensive and important soils in the northern end of the county. It occurs in the vicinity of Henderson, northwest of Goldsboro, and west of Mount Zion.

The surface soil, to a depth ranging from about 10 to 24 inches, consists of black loam which is high in organic matter and in some places has a soft mucky feel. The subsoil is light-gray or bluish-gray, mottled more or less with rust brown, heavy sandy loam or a sandy clay or a light-gray clay which extends to a depth ranging from about 30 to 36 inches, where it grades into light-gray compact sticky sandy loam or loamy sand. Probably not more than 35 per cent of the area of Portsmouth loam has been cleared and cultivated. The soil, where well drained, is suited to the production of strawberries, buckwheat, and corn, and yields of these crops are satisfactory.

**Portsmouth sandy loam.**—The surface soil of Portsmouth sandy loam is very dark gray or black medium sandy loam of high organic-matter content, ranging in depth from 6 to 16 inches. It is underlain by light sandy loam or loamy sand, which extends to a depth of about 20 or 24 inches, where it grades into grayish-white or bluish-gray sandy loam or light sandy clay. In most places at a depth of about 30 or 36 inches the texture becomes lighter, and loamy sand or sticky sand is reached. This sandy substratum is everywhere saturated, except during extremely dry spells or where the land is thoroughly drained.

This soil occurs in rather large areas in the extreme northern end of the county and in smaller areas in the southeastern corner. It is well developed northwest of Goldsboro, north of Henderson, and near the Queen Annes County line. Areas of this soil are almost entirely lacking in natural drainage, but all of them can be reclaimed by open ditches and canals, the walls of which stand up very well. However, in some places the loose sandy material slides in and the ditches become partly filled.

The forested areas support a growth of sweetgum, black gum, beech, maple, and scattered pine, with a dense undergrowth of huckleberry, gall berry, and other bushes. Probably not more than one-third of this soil has been cleared and cultivated. When thoroughly drained, limed, and fertilized, excellent yields of strawberries, corn, dewberries, and, in a few places, cantaloupes are successfully grown. Buckwheat and oats do fairly well, also onions and celery.

**Meadow.**—Meadow occurs along the rivers and streams throughout the county. Most of the strips range in width from 100 to 400 feet. During the winter and early spring, water stands on this land part of the time, but during the summer and fall months most of the areas are dry. The surface soil and subsoil vary greatly in texture, color, and structure. Small areas of muck were included with meadow at the boundary of Queen Annes County along the State road leading from Goldsboro to Ingleside. The soil materials composing meadow have been washed from the uplands and deposited by the streams. Some of the areas would be fairly easy to reclaim by straightening and deepening the stream channels. When thoroughly drained, most of this land would return good yields of corn and hay, but at present most of it is used for summer pasture for cattle. In addition to alder, the forest growth includes oak, pine, black gum, and sweetgum. Myrtle bushes and briars comprise the undergrowth. The best use of meadow is for pasture and forestry.

**Tidal marsh.**—Tidal marsh includes areas of both brackish and fresh water marsh developed along Choptank River, the largest bodies being in the southwestern corner of the county. It lies near sea level and is subject to inundation by fresh water during high tides. The soil material in most areas is dark-gray or brownish-gray slimy oozy loam or silt loam. The surface part to a depth of several inches in most places contains many roots of marsh grass and much partly decomposed organic matter. At a depth ranging from 12 to 20 inches the material grades into gray rather heavy clay loam containing some rust-brown mottlings. In places the surface material is underlain by sand or sand and gravel.

Tidal marsh supports a rank growth of marsh grasses, numerous sedges, some ironweed, cow lily, arrowhead, water hemp, and wild rice which has an economic value as it furnishes food for ducks. Tidal marsh has no agricultural value except scant grazing for cattle.

#### RECOMMENDATIONS FOR THE IMPROVEMENT AND MANAGEMENT OF CAROLINE COUNTY SOILS<sup>4</sup>

The University of Maryland Agricultural Experiment Station has conducted experiments in Caroline County over a period of 16 years on the soil classed as Sassafras loam. The crop rotation used consists of tomatoes, corn, wheat, and hay supplemented with various fertilizer treatments, with and without lime. The fertilizers have been applied to the tomato and wheat crops and the lime, at the rate of 2 tons an acre, was applied only once during the 16-year period.

Results of these experiments indicate that phosphorus is the most important requirement of this soil, with manure or organic matter next in importance. Responses were also obtained from the use of nitrogen, but indications are that the same results could be obtained with less nitrogen, if the organic-matter content is raised and phosphorus is supplied in liberal amounts. Potash alone does not produce any material benefit, but it is valuable when used with phosphorus, organic matter, and nitrogen. The application of 2 tons of ground limestone an acre proved too heavy. It was particularly harmful to tomatoes, of no benefit to wheat, of some value to corn, and of decided value to grass. The effect of the lime is still apparent after a period of 16 years. Raw rock phosphate seems to be as good a carrier of phosphorus as superphosphate when twice as much rock phosphate as superphosphate is applied.

The phosphorus content of Sassafras loam is normally low. The 2-ton application of lime decreased the availability of the normally deficient available phosphorus, which resulted in decreased crop yields, hence, the marked response to phosphate fertilizers. The manure supplies nitrogen and also organic matter which improves the physical condition of the soil. The improvement of the physical condition of the soil has doubtless increased yields as much as, if not more than, the nitrogen contained in the manure. This is demonstrated by the fact that manure, at the rate of 10 tons an acre, has given higher

<sup>4</sup> METZGER, J. E., and WHITE, A. VARIETY TESTS OF FIELD CROPS AT RIDGELY. Md Agr Expt. Sta Bul 281, p 203-214, illus 1926. Also unpublished data from Ridgely substation.

yields than a nitrogenous fertilizer alone or a 3-8-10 fertilizer applied at the rate of 450 pounds an acre. Although the 2-ton application of lime has generally resulted in lowered yields, it is not to be inferred that the use of lime is harmful, but these results should serve as a warning against the use of lime in excessive amounts. Soils should be tested for lime at stated intervals and lime applied when necessary. Rather frequent light applications of lime are better than less frequent heavy applications.

In the event that manure is not plentiful, provision should be made in the rotation for green-manure crops, preferably legumes, to keep the soil supplied with organic matter. The analysis of the fertilizer and the rate of its application will depend on the crop rotation and the previous management of the soil, but in all cases the fertilizer used should be high in phosphorus.

The other soil types of the Sassafras series in the county, also Keyport loam, are similar in many respects to Sassafras loam, consequently, the management of these soils is similar to that of Sassafras loam. However, as the texture, or the size of the soil particles, becomes coarser, it is more difficult to maintain the organic-matter content, so that it is more necessary to provide green-manure crops in the rotation to be turned under for the maintenance of organic matter. Usually, it is not necessary to change the analysis of the fertilizer mixture, but it may be necessary to increase the rate of application on the coarser-textured soils.

The other soils occurring in the county are members of the Keyport, Elkton, Portsmouth, and Plummer series. With the exception of Elkton silt loam, which occupies a small area, all the types of the series named are comparatively coarse textured, and, as a consequence, should be managed similarly to soils of the Sassafras series. Chemical analyses show that the soil types in this group are low in phosphorus, and observations and experiments over a period of several years have shown that it is necessary to supply phosphorus and organic matter in liberal quantities. Best results from the use of nitrogen have been obtained by using it as a supplement to phosphorus and organic matter. Potash alone does not seem to be profitable, but it is beneficial when used in conjunction with nitrogen, phosphorus, and organic matter. Some variation from this practice has proved beneficial with the Portsmouth soils. In addition to the coarse texture of these soils, they contain a rather large amount of organic matter, much of which is inactive. This makes it necessary to supply larger amounts of nitrogen and potash than are normally used on soils of the other series of this group, and it is advisable to supply active organic matter. Active organic matter consists of green crops or manure that will readily decompose, whereas inactive organic matter is that which requires several years to become incorporated in the soil. Lime is beneficial in most places but should not be used in excessive amounts.

Three distinct types of cropping systems are prevalent in Caroline County, depending on canning-crop production, dairying, and general farming. On many farms a combination of the three is practiced.

The production of winter wheat and corn is practiced on nearly all farms.

The rotation problem on the farms devoted exclusively to truck crops is more difficult than on farms devoted to either dairying or general farming. Experiments and demonstrations indicate that growers who use either a 2 or 3 year rotation, with a legume green-manure crop plowed under for each cultivated crop, are best meeting the fertility and organic-matter problem.

For the developing dairy industry, it would be best to use a special alfalfa, corn, and barley rotation on a part of the farm, and a corn, wheat, hay (two years) rotation on the remainder of the crop land. This plan has the special merit of producing each year an adequate supply of roughage of high feeding value and also to increase the acreage available for summer pasture.

Where canning crops, such as tomatoes and sweet corn, are introduced on the general farms they should replace a part of the corn acreage. The cultivated area should not exceed one-third of the total crop land unless special means of maintaining the fertility are adopted.

The kind and amount of fertilizer to use is determined by local conditions. Both truck and dairy farming are practiced in the county, which makes it necessary to vary the fertilizer practice because of differences in crops and soils. Where truck crops are grown, a higher analysis fertilizer is used and the rate of application is also much higher. In the dairy sections, the amount of nitrogen is usually reduced and the rate of application is usually diminished. In either type of farming, the fertilizer used should be high in phosphorus, and each crop should be fertilized. Crop rotations should be planned to include green crops to be turned under as a means of supplying organic matter to the soil. In some places the natural drainage is not adequate because of stiff subsoils or because of low pocketlike areas which do not allow proper drainage, and artificial drainage of such areas would be very beneficial. This is especially true of the soils of the Elkton, Portsmouth, and Plummer series. The method of improving the drainage is determined by the location and other local factors.

Most of the fertilizers are bought ready mixed, although some farmers mix equal parts of kainite and superphosphate and use the mixture as a substitute for ready-mixed fertilizers. One farmer made an application of this mixture to sweet corn at the rate of 300 pounds an acre, another applied 600 pounds an acre to tomatoes, and a third applied 400 pounds an acre to wheat.

The general practice is to apply fertilizers without regard to soil variations except by altering the rate of application. In an area where the soils are so extremely variable any other arrangement would be impractical. Table 5 shows the fertilizers used on different farms in Caroline County, for different crops, together with the rates of application. This table contains only fertilizer mixtures that are in more or less common use in the county. No fertilizer recommendations are given in the table as any such suggestions involve the maintenance of soil fertility which is also dependent on crop rotation.

TABLE 5—Fertilizer practices on farms in Caroline County, Md.

Crop	Acre appli- cation of fertilizer	Fertilizer mixture	Remarks
	<i>Pounds</i>		
Wheat.....	300- 400	2- 8- 5	} These three mixtures lead all others in tonnage sales
Do.....	300- 400	1- 9- 4	
Do.....	300- 400	0-12- 5	
Field corn.....	200	0-12- 5	} Usually 5 tons of manure is applied without commercial fertilizer. Many farmers use no fertilizer on sweet corn but apply about 10 tons of stable manure to sod to be turned under.
Sweet corn.....	300- 400	2- 8- 5	
Do.....	400	134-10- 3	} Contains fish scrap.
Cantaloupes.....	400-1,000	2- 8- 5	
Do.....	400-1,000	4- 8- 4	} There is no set practice for fertilizing cantaloupes, but usually, in addition to the commercial fertilizer, from 8 to 12 tons of stable manure an acre are applied to the hills
Do.....	500-1,000	5- 8- 5	
Do.....	500-1,000	3- 8- 8	
Do.....	500-1,000	2- 8-10	
Do.....	500-1,000	7- 6- 5	
Cucumbers.....	500	5- 8- 5	} Applied in row at planting time. Applied later as a top-dressing
Do.....	500	3- 8- 8	
Canning peas.....	400- 600	2- 8- 5	} Bone meal is applied by many growers at a rate of 500 or 600 pounds an acre as a top-dressing the first year, and some apply nitrate of soda as a top-dressing the second year. Most farmers apply fertilizers both the first and second years
Do.....	400- 600	7- 6- 5	
Do.....	400- 600	4- 8- 4	
Do.....	400-1,000	5- 8- 5	
Strawberries.....	400-1,000	3- 8- 8	} Sometimes supplemented with chicken manure.
Do.....	400-1,000	2- 8-10	
Do.....	400-1,000	7- 6- 5	
Do.....	400-1,000	2- 8- 5	
Tomatoes.....	500- 600	5- 8- 5	} A common practice is to apply a fertilizer low in nitrogen and to supplement it with 8 or 10 tons of stable manure
Do.....	500- 600	3- 8- 8	
Do.....	500- 600	2- 8-10	
Do.....	500- 600	7- 6- 5	
Do.....	500- 600	7- 6- 5	

The consensus of opinion among farm owners and tenants in Caroline County is that lime is not used in sufficient amounts. In spite of a general agreement between farm owners and operators as to the beneficial effects of lime, the system of land tenure established by custom charges the cost of lime to the landlord but prevents him from participating in its profits, for lime is most used in the production of hay crops which are generally fed to livestock to be marketed, and all livestock products belong to the tenant. Another factor tending to discourage the use of lime is the growth of truck crops, many of which, especially strawberries and potatoes, are not generally in special need of lime.

Tests to determine the amount of lime required to obtain neutrality were made by the modified Comber method on 146 samples of approximately air-dry soils. The results obtained are given in Table 6.

TABLE 6—Lime requirement of different soils in Caroline County, Md

Soil type	Samples tested	Average lime require- ment per acre
	<i>Number</i>	<i>Pounds</i>
Sassafras loamy sand and Sassafras sandy loam.....	43	826
Sassafras silt loam and Sassafras loam.....	20	1,021
Keyport sandy loam.....	8	1,313
Keyport silt loam.....	15	1,466
Elkton sandy loam.....	6	1,500
Elkton silt loam and Elkton loam.....	24	3,021
Portsmouth sandy loam.....	10	2,700
Portsmouth loam.....	20	3,300

Determinations of pH values were also made with a colorimetric field outfit, but, although they could be made more rapidly, the method was discarded because the change in color made variations in intensity of color difficult to detect; because an excess of reagent affected the accuracy of the reaction; and because it was easier to interpret the results of the Comber test to the farmer as texture and buffering substances influenced this reaction less than they did the pH determination.

It is evident, according to the data in Table 6, that all soils heavier or more poorly drained than Elkton sandy loam are badly in need of lime, but less than 50 per cent of such soils are cultivated. These soils in many places, perhaps, never have been limed and most of them require drainage even more than liming. The lime requirements of the better-drained soils do not seem to be too high for the satisfactory growth of general farm crops. In one place a splendid crop of soybeans was growing on Keyport loamy sand which had a lime requirement of 3,000 pounds an acre and a pH value, according to the colorimetric method, of 6. It seems to be the custom on many farms to apply lime every fifth or sixth year.

#### SOILS AND THEIR INTERPRETATION

Caroline County lies in the coastal plain and is slightly north of the geographical center of the Eastern Shore peninsula, which includes several counties of Maryland, Delaware, and Virginia. It is in the brown forest soils belt. These soils, although belonging to the podzol group, are not true podzols.

The soils of Caroline County have developed under a forest cover of pine intermixed with hardwoods, and conditions have not favored the accumulation of a large amount of organic matter in the soils. In some of the forested areas there is a slight accumulation of vegetable mold, leaves, twigs, and grass roots on the surface, but, as a general rule, organic matter is not mixed with the soil to a great depth. The organic content, therefore, of all the soils of Caroline County is low, except in the Portsmouth soils, and these soils have remained under semiswampy conditions which favored a heavy growth of vegetation.

The soils of the county are developed on two distinct geological formations or classes of material—the Wicomico formation, which covers the central, southwestern, and many other parts of the county and the Talbot formation. These formations consist of unconsolidated beds of clay, loam, and sand, or sand and gravel. These materials grade one into the other both vertically and horizontally, but the coarse materials predominate at the base of the formation and the finer deposits are largely developed toward the top. The Wicomico formation contains more sand than the Talbot formation. It covers more of the county, lies at a higher elevation, is much better drained, and is more dissected than the Talbot formation. The Talbot formation wraps itself about and is intermixed with the Wicomico. It is very little eroded and presents very much the constructional form as the material was laid down by the sea. On the Talbot formation, aeration, oxidation, and drainage are much less developed than on the Wicomico formation, and as a result heavier soils are developed.

The following two main groups of soils occur in Caroline County: (1) The well-drained and mature soils, and (2) the imperfectly drained or young soils. The first group includes those soils having a normally developed profile, and their present characteristics, both physical and chemical, are due to the effects of climate rather than to the geologic or soil-forming materials from which they were derived. These soils have been identified as members of the Sassafras series and express the normal characteristics of the climate and the natural processes of weathering. They are characterized by an eluviated A horizon and an illuviated B horizon. The B horizon is the seat of deposition of material carried from above by the downward percolation of rain water; consequently it contains a higher percentage of fine material than the layers above. It constitutes a reservoir of soil moisture for the soil as a whole and usually it contains a higher percentage of potash than the surface soil. It is the horizon in which the weathering is most nearly complete, that is, it is uniform in color and consistence throughout.

The Sassafras series in Caroline County includes the sandy loam, sandy loam, deep phase, loam, silt loam, loamy sand, and sand. A profile description of Sassafras sandy loam as observed in an area of virgin soil 2 miles east of Williston represents the normally developed profile of the Sassafras soils and is as follows: Horizon A<sub>1</sub>, from 0 to 1 inch, dark-brown leaf mold with a small amount of mineral matter; horizon A<sub>2</sub>, from 1 to 16 inches, light brownish-yellow mellow and friable sandy loam which is uniform in color; horizon B, from 16 to 30 inches, reddish-brown sandy clay which is friable and crumbles into a mellow granular mass having no definite structure and is uniform in color throughout; and horizon C, from 30 to 40 inches, brownish-yellow sand which is only slightly compact.

Following is a profile description of Sassafras loam as observed in an area of virgin soil, four-fifths of a mile northeast of Hillsboro: Horizon A<sub>1</sub>, from 0 to 1 inch, dark-gray loam containing a large amount of organic matter; horizon A<sub>2</sub>, from 1 to 10 inches, light brownish-yellow loam which is mellow and friable; horizon B<sub>1</sub>, from 10 to 13 inches, yellowish-brown clay loam which is friable and crumbly; horizon B<sub>2</sub>, from 13 to 35 inches, light reddish-brown clay which is friable and crumbly and breaks into irregularly shaped lumps that readily crush into a fine granular mass, the color of the soil particles being uniform on the outside and inside; and horizon C, from 35 to 45 inches, brownish-yellow sandy clay material mottled with light gray.

Occupying a position between the Sassafras and Elkton soils is an intermediate grade of material as regards color, drainage, and consistence in the B horizon. These conditions give rise to soils that have been grouped in the Keyport series. The soil profile is somewhat similar to that of the Sassafras soils to the bottom of horizon A which comprises the surface and the subsurface layers. Horizon B, or the true subsoil, shows evidence of incomplete oxidation in its mottled gray, yellow, and brown color. It is heavier in texture, is tough, and in many respects resembles the subsoil of the Elkton soils. The mottled condition of the lower subsoil layer is not owing entirely to imperfect drainage, but in part to the fact that oxidation has not yet extended below a depth ranging from 12 to 18 inches. Below the typical subsoil is the light-textured loose material of horizon C, or the parent material.

Following is a profile description of Keyport loam as observed in an area of virgin soil,  $2\frac{1}{4}$  miles northwest of Greensboro: Horizon A<sub>1</sub>, from 0 to 2 inches, gray loam carrying much organic matter and having a very shallow covering of brown leaf mold; horizon A<sub>2</sub>, from 2 to 10 inches, yellow mellow and friable loam; horizon B, from 10 to 32 inches, mottled light-gray and brownish-yellow fine sandy clay that breaks into irregular lumps and crushes easily, some of the lumps having a gray coating and a red interior; and horizon C, from 32 to 50 inches, light-gray sand mottled with brownish yellow.

In a few places, generally in the northern part of the county where the water table is abnormally high, some soil resembling Norfolk was mapped as Keyport. With Keyport loam is grouped Keyport silt loam, which occurs mainly in a few small isolated areas in the southwestern part of the county and in the southern part of Tuckahoe Neck.

The Elkton soils, occupying flat areas of low elevation and poor drainage, indicate that their profile development has been retarded or influenced by excessive moisture. In areas where surface drainage is imperfect and the soil has been subjected for long periods to the influence of excessive moisture and imperfect internal drainage during parts of the year and to conditions of deficient moisture during periods of dry weather, that is, to alternating wet and dry conditions, the surface soil is gray or nearly white. In a few forested areas some vegetable matter has accumulated on the surface. The main subsoil layer, or horizon B, consists of heavier material, mottled gray, yellow, and brown. This layer varies in thickness and in structure, but in most places, at a depth ranging from 28 to 34 inches, it is underlain by material which is lighter in color and much more friable. The mottled color of the entire profile bears evidence of incomplete oxidation.

Following is a profile description of Elkton loam, as observed in a broom-sedge field, 2 miles southwest of Preston: Horizon A, from 0 to 6 inches, gray fairly friable loam containing fine grass roots. Horizon B<sub>1</sub>, from 6 to 14 inches, light-gray loam faintly mottled with brownish yellow and carrying much silt and fine sand. Horizon B<sub>2</sub>, from 14 to 28 inches, rather heavy and slightly plastic light-gray clay mottled with rust brown and yellow and carrying a little fine sand. The mottling is not uniform, but here and there are chunks of gray and blotches or streaks of brownish yellow. The material has no definite breakage lines. Horizon C, from 28 to 38 inches, light-gray sand with a few small brownish-yellow sandy clay lumps.

The Plummer series is represented in Caroline County by one type, Plummer loamy sand, which has a light-colored poorly drained surface soil and a light-gray, mottled with yellow or rust brown, sand or light sandy clay subsoil.

The soils of the Portsmouth series have black surface layers highly charged with organic matter. The subsoils are sandy clay or clay of a light-gray color mottled with yellow or rust brown, or in places are uniformly light-gray clay. They are the most poorly drained and poorly aerated soils of the county. Portsmouth sandy loam and Portsmouth loam are mapped.

Iron concretions occur in the Sassafras soils at different scattered localities, and gravel occurs here and there, especially in the vicinity of Andersontown. Along Choptank River between Greensboro and Goldsboro are several small areas of brown fine sand.

Southwest of Hollingsworth Crossroads, south of Smithville, and east of Tanyard are spots of poorly drained soils in which an organic hardpan layer is developed. Locally this overlies a hardpan of bog iron ore.

In addition to the definite soil types two classifications of material, meadow and tidal marsh are mapped. The term meadow is applied to the variable-textured poorly drained soils occurring in the first bottoms along the small streams. Tidal marsh, which is permanently wet, is developed along the rivers and at the mouths of some of the larger creeks.

#### SUMMARY

Caroline County, included among the Eastern Shore counties of Maryland, has perhaps the most diversified agriculture of any county in the State. In 1907, Caroline County is reported to have produced 10 per cent of the total tomato crop of the United States. This county is well located as regards transportation facilities and particularly in regard to the markets of Philadelphia and New York. Good roads connect the county with these large and important markets. The greater part of the county has a level, undulating, or gently rolling surface relief and is naturally well drained. The surface relief, together with the favorable physical characteristics of the soils, is such as to allow the use of modern machinery. The climate is equable and one in which a wide variety of crops can be successfully grown.

Two general classes of soil occur in Caroline County, the well-drained soils and the poorly drained soils. The well-drained group includes Sassafras sandy loam, Sassafras sandy loam, deep phase, Sassafras loam, Sassafras silt loam, Sassafras loamy sand, Keyport loam, Keyport sandy loam, and Keyport loamy sand. These soils range in texture from loose sand to floury mellow silt loam. Sassafras loam, Sassafras silt loam, part of Sassafras sandy loam, Keyport loam, and Keyport sandy loam are the main soils for the production of staple crops, such as wheat, corn, hay, and also tomatoes. These are some of the best soils in the State of Maryland for the production of these crops, as well as for dairy farming. Sassafras sandy loam and Sassafras loamy sand are used to less extent for general farm crops but are especially suited to the production of truck crops and canning crops.

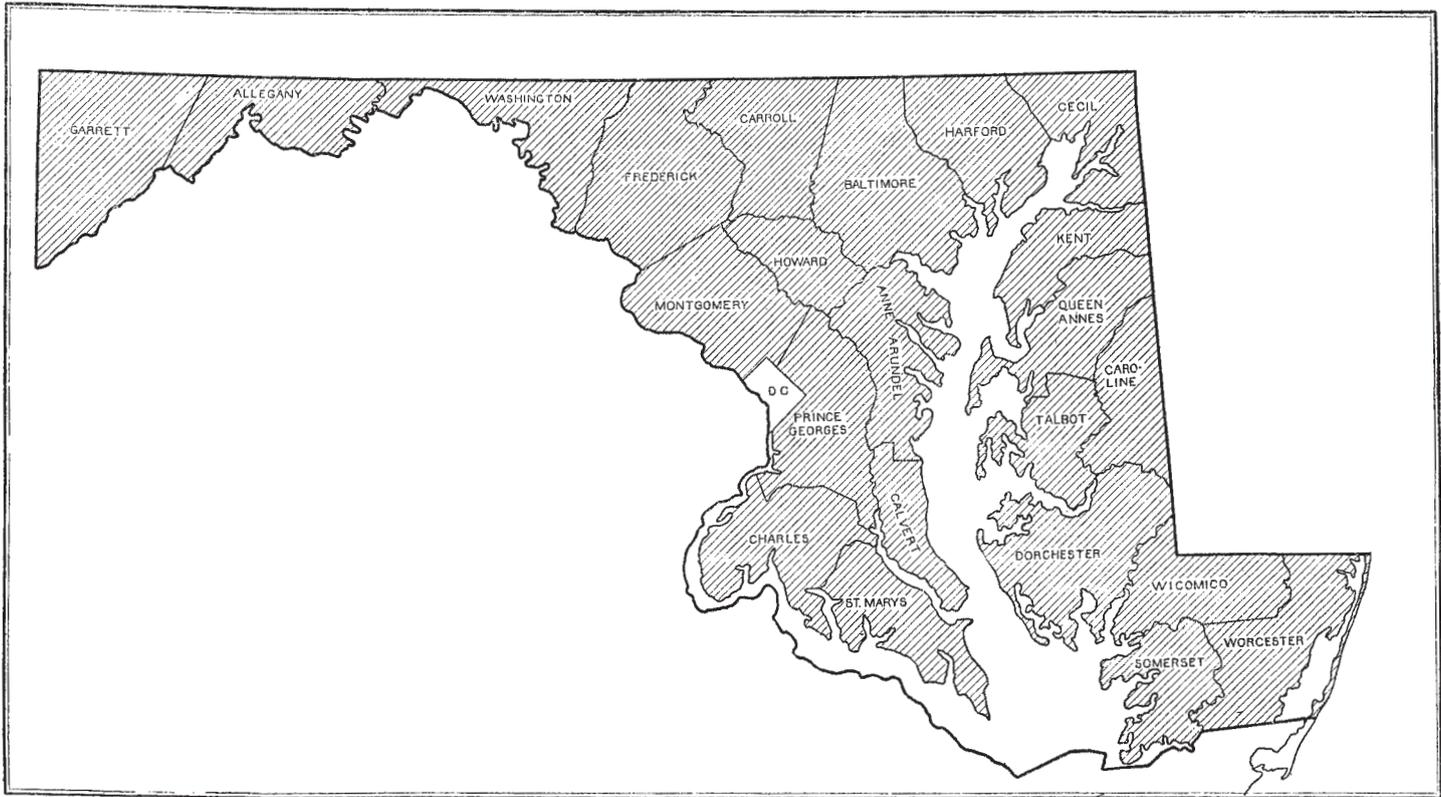
The poorly drained soils of the Elkton and Portsmouth series have, over large areas, been drained and reclaimed for agricultural use and are now used for the production of suitable crops. In some places, however, these soils are used for tomatoes and for truck crops because the farmers do not own any, or very little, of the Sassafras soils. These soils also furnish grazing for cattle and supply the farms with fence posts, firewood, and a small amount of soft timber.

Caroline County, because of its wide range in soils and their adaptability to a great diversity of crops, has a well-balanced type of agriculture, and if some crops fail others are likely to be successful and profitable.

Caroline County offers inducements to persons interested in dairying or livestock production and to those desiring to grow truck crops, canning crops, berries, and fruits. Some of the soil in the county is as good as any soil occurring on the Eastern Shore of Maryland

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Areas surveyed in Maryland, shown by shading

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