SOIL SURVEY OF NEW HANOVER COUNTY, NORTH CAROLINA.

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DESCRIPTION OF THE AREA.

New Hanover is the southernmost county, except one, on the seacoast of North Carolina. The general shape of the county is that of a triangle, which lies between the Cape Fear River and its northwest branch on the west and the Atlantic Ocean on the east, tapering gradually to a point at its lower extremity. The county contains 122,752 acres, or approximately 192 square miles.

There are no striking contrasts in the topographic features of New Hanover County, but on the contrary there is much sameness

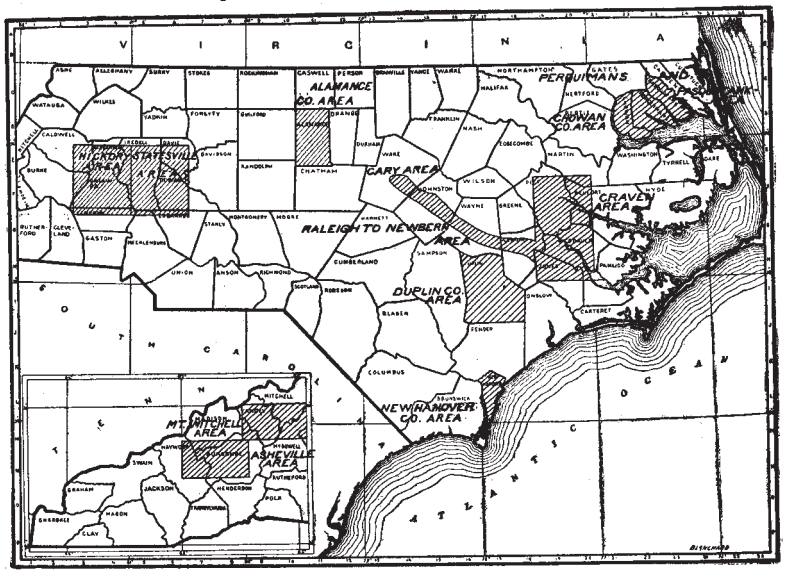

FIG. 7.—Sketch map showing location of the New Hanover County area, North Carolina.

or uniformity throughout, there being no great differences in elevation. Probably no point in the county reaches an elevation of more than 65 or possibly 70 feet.

The main body of the county is bounded by water on three sides, and a ridge is found bordering the water. Commencing near the most northern point, where Island Creek flows into Northeast

Cape Fear River, is a ridge which runs west and then south as far as Smiths Creek, following roughly the direction of the river. South of Wilmington is another ridge, consisting of Sandhill, which borders the Lower Cape Fear River and extends in a gradually narrowing area as far south as Peters Point. Near the lower end of Myrtle Sound this Sandhill ridge is joined by another ridge which borders the sound and extends from this point to a little below Wrightsville. Below Wrightsville there begins a low ridge which in some cases rises gently and in other cases abruptly from the sound to a height of from 10 to 30 feet and extends northeastward to the county line. This ridge slopes gradually, with some slight undulations, to the westward and varies in width from about one-half mile in the beginning to about 2 miles at the county line. This ridge is cut by several streams which flow into the sound.

The north-central part of the county, or that section north and northeast of Wrightsboro lying between the ridge along the river and that along the sound, has a very level topography, and is as yet undeveloped. It consists of very low, flat ridges, lying between broad, level, slightly depressed areas known as "bays" or "swamps", from which several creeks and small streams start and flow either to the river on the north and west or to the sound on the east. As the borders of the county are narrowed by the approach of the river to the ocean the "bays" or "swamps" are not so plentiful and better drainage is afforded. Smiths Creek, flowing into Cape Fear River, and extending some distance inland, assists greatly in the drainage. From Wilmington east to Wrightsville the country is level, with only a few slight undulations, but as a whole this section is well drained. West and northwest of Wilmington is an isolated section of the county, lying between Northwest and Northeast Cape Fear rivers, consisting of high, rolling sand ridges. Througnout the southernmost part of the county there is a general slope eastward toward the sound and ocean. From the lower extremity of Masonboro Sound a broad swampy area extends southward between the ridge of beach sand along the sound and the Sandhill ridge along the river until cut off by the approach of the two elevations.

About 1730 a few of the settlers, who had come originally from Barbadoes and settled at Brunswick, on the opposite side of the Cape Fear River, built their dwellings within the present city limits of Wilmington and established the first permanent settlement within the limits of New Hanover County. This settlement soon grew to be a village, and in 1733 a royal grant was obtained, which gave the colonists the first legal right to their lands. In 1728 the county of New Hanover was formed, and it was not until 1876 that Pender County was formed from its northern portion and New Hanover County was given its present limits. A large majority of the present

population trace their ancestry back to the early settlers, though in and about Wilmington many residents have come direct from the more northern States.

Certain parts of the county are wholly undeveloped, and settlement is forced to wait for drainage and other improvements. Owing to the unproductiveness of the Sandhill section of the county, little attempt has been made to bring it under cultivation and settlement is consequently very sparse. The county is much better developed in the vicinity of Wilmington, especially east and northeast. Along the railroad to Castle Hayne and east to Wrightsville, and thence north along the sound lies the best developed farming section. Many summer homes are built along the sound and various beaches. In this section of the county a prosperous condition is evidenced by good residences, while the north-central portion is practically uninhabited. South of Wilmington there are a few good dwellings, but generally their owners farm some good land which is found in one or two places near the river. To the south and east moderately good houses are confined to a narrow strip of trucking lands (Norfolk fine sand and Norfolk sand) along the edge of the sound. The lower part of the county is inhabited mainly by fishermen, who make a comfortable living, and devote very little attention to agriculture except to supply the wants of the family.

Although cut off from the ocean by sand bars and shallow sounds which prevent the landing of ships, the county has access to this means of transportation through the Cape Fear River. Wilmington, the county seat, is situated near the head of navigation for the larger ships, and is the only port. The Twelfth Census shows this city to be the largest in the State, and it also ranks high among the cotton export cities of the United States. Wilmington and the other smaller shipping points have direct connections over good lines of railroads with New York, Philadelphia, Baltimore, and Washington.

Aside from Wilmington, there are no towns of any importance in the county. Castle Hayne, in the northern part, has about 100 inhabitants. Wrightsville Beach, 9 miles east of Wilmington, is a growing and popular summer resort, and Carolina Beach, 12 miles below, is also deserving of mention. During the summer season these places furnish a good local market for produce of all kinds.

The Wilmington and Weldon branch of the Atlantic Coast Line Railroad extends northward through the county from Wilmington, and furnishes the most important and direct means of transportation of the products of the county to northern markets. The Newbern branch of the same system is little used for truck shipments, being less direct.

Three of the main roads of the county are exceptionally good, two being built of stone and the third principally of shells. Of the

former, one leads north from Wilmington to Castle Hayne, and the other northeast to the Pender-New Hanover line, while the shell road leads to Wrightsville. The other roads of the county are poor, especially in the part of the county south of Wilmington, where the country is usually very sandy. The large two-wheeled cart, which claims an advantage in placing a good portion of the load on the animal's back on a large, saddlelike pad, is used exclusively for hauling. One man is occasionally put in charge of two or three of these carts, the animals being trained to follow, thus reducing the number of drivers required.

The corn grown in the county is all consumed within its borders and more is shipped in. The peanuts are shipped to various parts of the country, many going farther south for seed. The few hogs and cattle find their way into the local market and are not enough to supply the demand. Cowpeas, peanut vines, and crab-grass hay is fed at home, besides which much other hay is shipped in, at high prices. The truck and fruit crops are shipped to New York, Philadelphia, Baltimore, and Washington, and occasionally a car goes to Cincinnati and Chicago.

CLIMATE.

The location of New Hanover County on the immediate seacoast renders its climate mild and pleasant throughout most of the year. The summers are long, but because of the very constant sea breeze the heat is not felt to the extent that it is farther inland. With the exception of brief periods of low temperature the winters are mild. Winds from the northeast occasionally cause the temperature to fall to 15° and sometimes as low as 8° F., but such cold spells are not of long duration. Light snows fall occasionally, but soon melt and disappear. The cold is never severe enough to hinder the growth of winter lettuce and a few other crops when cloth covers are used, thus enabling the grower to market his product very early in the spring.

The appended table, compiled from the Weather Bureau records at Wilmington, shows the average date of the last killing frost in spring to be March 29 and that of the first in the fall November 25. While this indicates a growing season of about eight months, which is about three weeks longer than in the same latitude 200 miles west of Wilmington, yet it will be noticed that killing frosts have occurred as late as April 21 and as early in the fall as November 8. The second table, showing the normal monthly and annual temperature and precipitation, gives the average annual rainfall as 54.37 inches, which is well distributed throughout the year. About 31.02 inches of this falls during the five months from May to September, inclusive, when the evaporation is greatest and moisture is most needed by the growing crops.

Dates of first and last killing frosts.

Year.	Wilmington.		Year.	Wilmington.	
	Last in spring.	First in fall.		Last in spring.	First in fall.
1897	Apr. 21	Nov. 18	1902	Mar. 19	Dec. 9
1898	Apr. 8	Nov. 25	1903	Apr. 5	Nov. 8
1899	Apr. 5	Dec. 7	1904	Mar. 5	Nov. 15
1900	.....	Dec. 12	Average	Mar. 29	Nov. 25
1901	Mar. 17	Nov. 16			

Normal monthly and annual temperature and precipitation.

Month.	Wilmington.		Month.	Wilmington.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F.	In.		°F.	In.
January	46.9	3.94	August	78.2	7.47
February	49.8	3.23	September	73.2	6.42
March	53.9	3.95	October	63.5	3.84
April	61.5	2.96	November	54.6	2.45
May	69.7	4.16	December	48.3	2.98
June	76.7	5.70	Year	63.0	54.37
July	79.7	7.27			

AGRICULTURE.

The earlier attempts at agriculture, which began about 1728, were confined largely to cattle raising, to which the mild climate and abundant pastures were so well adapted, although at the same time a variety of crops was grown. Rice growing was begun at an early date and was a very important industry during the first half of the nineteenth century. After the civil war it became less profitable because of changed labor conditions, but continued to be of much importance until about 1885. Since the development of rice growing in Louisiana and Texas this section can not profitably compete, because machinery can not be used so well in the cultivation and harvesting of the crop, most of the cultivation and harvesting being done by hand. According to the census of 1900 only 11 acres was planted to rice that year.

At the close of the civil war peanuts was the most important as well as the best money crop that could be grown, and good peanut land was then worth $50 an acre. About 1877, however, the price of peanuts dropped to 45 or 50 cents a bushel, and as a result cotton was introduced into this section. Although it was grown more extensively in the adjoining county of Pender, it was profitably produced here and was grown to such extent as to warrant the erection and operation of two cotton gins, one of which was located a

short distance east of Wilmington. The growing of cotton continued only about ten years, when the Spanish peanut was introduced. These ripened at the same time that cotton picking had to be done, which was not the case with the North Carolina peanut previously grown. Since the colored labor preferred to pick the peanuts rather than the cotton and could not be induced to do otherwise, the latter crop was finally abandoned. The 1900 census reports that only 3 acres were planted to cotton during that year, which produced two 300-pound bales of lint.

Taken as a whole, the area under consideration has never attained a high standing as a general farming country. Agriculture has been greatly neglected until very recent years. Lumbering, the production of turpentine and rosin, fishing, and shipping have combined to furnish most of its inhabitants an excellent living and wealth to the more prosperous. The natural conditions have, therefore, made living a comparatively easy matter, and since most of the soils are sandy and large portions of these were formerly thought to be worthless less attention has been given to agriculture than to other lines of development. Since the introduction of truck farming more interest has been taken in this special branch of agriculture, and the condition of the farming classes has been greatly improved. Much land has been cleared, drained, and put under cultivation, yet as compared with its possibilities the county is relatively undeveloped.

The census of 1900 gives a very good illustration of the development of the county, though the conditions have been bettered somewhat since then. There are approximately 128,000 acres of land in the county, of which 50,000 acres were classed as in farms, while only 10,000 acres were classed as in farms improved. One-twelfth of the land in farms improved leaves a very large proportion of the land unimproved and not under cultivation. A little less than two-fifths of the land in the county was classed as in farms, the remainder being held in timber or other tracts or not entered. All the land is now entered, and probably much more would at present be classed as in farms, as well as in farms improved.

There are two systems of agriculture in New Hanover County. One consists of general farming combined with more or less truck growing, and the other of truck growing only. Of the general farm crops of the area, corn covers the largest acreage, after which comes peanuts, cowpeas, oats, and other forage crops in the order named. Peanuts constitute an important money crop.

Some trucking crops were grown about Wilmington for local markets as early as 1875, but the more important development of this industry began in 1885, and it has been steadily increasing since. An encouraging feature is that the markets grow with the increase in

production of the different trucking areas, and since new markets are being constantly opened up and the demands of the old markets increasing there seems to be little danger of overproduction, except an occasional glut in the market on some certain vegetable or during years when, owing to seasonal peculiarities, different sections ship about the same time.

Of the truck crops lettuce is the most important. Potatoes, eggplants, snap and lima beans, cabbage, onions, beets, cucumbers, radishes, early peas, asparagus, watermelons, and cantaloupes are also crops quite generally grown, both for shipment and the local markets. Sweet potatoes, collards, turnips, rutabagas, spinach, okra, cauliflower, Brussels sprouts, salsify, and purslane are grown to a less extent for the home markets. Some strawberries are grown and shipped from the area, but not in such quantities as from some of the other counties in this section of the State. Tomatoes for early market have not been grown extensively, but some trial crops have given very satisfactory results. Returns of $100 an acre have been reported, and there seems to be little doubt that this could be made a profitable crop. Scuppernong grapes do exceptionally well in this locality, and there is a profitable local market for many more than are at present produced.

The most of the farmers are engaged in general farming, while only the larger truck growers confine their attention to trucking. The methods employed in general farming and in truck growing differ greatly even when both are conducted by the same individual. The profits from the former usually do not justify an extensive outlay of money, and the operations are generally conducted on the cheapest plan possible, the methods employed being by no means the best. The tenant system is growing, owing to the existing labor conditions, the tenants usually being colored, and methods under these conditions can scarcely be expected to improve rapidly. These tenants grow small quantities of truck for the local market, usually the crops which require the least skill and attention.

Among those who cultivate their own farms the methods are improving rapidly. The economy and value of growing the legumes as soil renewers and for hay is being realized more and more, and the acreage, especially of cowpeas, is increasing rapidly. Soja and velvet beans, crimson clover, and vetch are grown witn sufficient success to warrant an extended acreage for forage and hay. Cowpeas with sorghum, and vetch with oats, are especially to be recommended for forage crops. If these crops were grown more extensively and fed liberally to farm animals, it would correct one of the greatest faults in the general farm practice and give an added profit in the manure produced. The scarcity of live stock in this connection is to be deplored.

The growing of as many crops as possible during a twelve-month season—for instance, oats sown in the fall, followed in the spring by Spanish peanuts and these by cowpeas—is a matter that should receive more attention. Numerous other combinations, especially with one or more of the truck crops, can be arranged, as well as a definite rotation of crops extending over longer periods. Growing a cover crop on the sandy peanut land for winter protection is also of great importance, since this crop leaves the soil very bare and exposed to shifting by winds and leaching by rains.

The methods in common use in truck growing are more commendable. All the manure it is possible to secure and large quantities of pine needles and other trash are brought together, composted, and used on the land, together with liberal applications of commercial fertilizers. These are of different brands and chemical compositions to suit the different crops, as the experience or fancy of the grower dictates. In the preparation of the soil great care is taken to put it in the best possible physical condition. Some of the most extensive growers have provided elaborate systems of irrigation by sprinkling. These have often been the means of saving a crop not only from drought, but from frost as well.

With the exception possibly of the lack of the most judicious short rotations or the definite planning of a complete succession of crops which fall naturally into a system of double cropping, the frequent failure to provide sufficient manure, because of the expense and difficulty in securing it, and the practice of allowing the land after a certain number of crops to grow up in crab grass and weeds for a time, the methods are sufficiently intensive and are in accordance with the latest and most successful practices in truck growing. Many of the best growers are strongly in favor of the practice of letting the land grow up in grass and weeds in order to "rest" it, but it is believed further experience will show that it is better economy to plant to peas, clover, or vetch.

There is a general scarcity of proficient laborers throughout the county, which is a great hindrance to its development. Near Wilmington this is not so marked, though the laborers demand a good price for their services. Colored laborers are about all that are available, and since the men can usually get good wages about the wharves and at other employment the growers depend principally on the colored women to do their work, securing enough men to do the heavier part of it. The women are paid from $2.50 to $5 a week, while the men are paid from $5 to $7. Within a few miles of Wilmington labor becomes difficult to secure, especially as the sounds are approached. Within 2 or 3 miles of these waters the colored as well as many of the white inhabitants live by clam and oyster fishing, at which they can make more money than by

hiring out as farm laborers. The average price paid a colored laborer in the county is $10 a month by the year, with a small house and garden free. The price of land in some sections has declined somewhat on account of the scarcity of labor.

The average size of the farms in the county is said to be about 150 acres, but there is a tendency with some of the land companies to cut their holdings up into lots of 10 and 20 acres and sell them for small truck farms. Sixty-one per cent of the farms were operated by the owners in 1900, but more land is being rented to tenants each year.

The price of land in the best developed sections has risen greatly during the past few years. The prices vary greatly, ranging from $1 an acre in the southern and a few other parts of the county to $100 an acre for some of the best truck lands a few miles north of Wilmington along the railroad. The average price may be said to range from $15 to $50 an acre. Small tracts of 10 acres are being sold for truck farms at from $30 to $50 an acre. Prices are apt to fluctuate with the success or failure of the trucking industry within the next few years.

Several experiment or demonstration farms are being conducted in the county by some of the more progressive real estate firms as proof to the prospective buyer of what can be grown, and of the profits under good management. Different methods are being tried for the purpose of determining the best and most economical way of growing the more important products of the county. New crops are being tried, and among those which should be watched with interest are alfalfa, clovers, vetches, and other forage crops.

SOILS.

The soils of New Hanover County are typical of those found within the tidewater portion of the Coastal Plain, and consist in general of sands and clays carried down from higher elevations and deposited in the shallow waters of a receding ocean. These soil-forming materials have since been reworked and modified by erosion, winds, stream currents, tides, and various conditions of drainage. As a result of these modifying agencies the soils of the area may be grouped into three well-defined series, the Norfolk, Portsmouth, and Galveston.

The following table gives the name and the actual and relative extent of each of the soil types:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Portsmouth fine sand	24,768	20.2	Galveston clay	5,888	4.8
Norfolk fine sand	21,056	17.2	Galveston fine sand	1,792	1.4
Norfolk sand	19,456	15.9	Galveston sand	1,664	1.3
Sandhill	15,616	12.7	Portsmouth loam	1,344	1.1
Swamp	14,464	11.8	Norfolk sandy loam	1,216	1.0
Norfolk fine sandy loam	9,216	7.5	Total	122,752	.....
Portsmouth fine sandy loam.	6,272	5.1			

The Norfolk series represents a great part of the higher and better drained portions of the interior. The surface soil is accordingly light, and ranges from a medium sand to a fine sandy loam. The subsoils of the various types range from a medium and fine yellow sand to sandy clay. The surface soils in general are light yellow to light gray in color, and apparently contain very small proportions of organic material, the principal constituent being quartz sand. The Norfolk soils occur near the streams, along the salt marshes of the sounds, and in some other positions of sufficient elevation to afford good drainage. The Sandhill type is closely associated with the Norfolk series, representing, however, nonagricultural lands of the most sandy and ridgy nature. The Portsmouth soils occur usually farther inland, occupying low, flat, and poorly drained areas about the heads and along the courses of the smaller streams. These soils are poorly drained, and on account of the wet condition support a rank growth of vegetation, which has accumulated from year to year and become incorporated within the soil, causing it to be very black. Unless ample artificial drainage is supplied these soils are either covered with water or are very wet during a great part of the year. The Galveston series includes the beach sands and the salt marshes between these beaches and the sounds or the mainland.

These soils are all of comparatively recent origin, and in the case of the Galveston sand and Galveston clay are still in the process of building. The geological formation to which the soil material belongs is the Columbia, composed of marine sediments of sands and clays. Beneath this occurs an older consolidated shell marl, which is usually encountered at a depth varying from 8 or 10 feet to several hundred feet below the surface. This marl is formed principally of shells and belongs probably to the Neocene period. Near Castle Hayne, where this rock approaches very near the surface, it was formerly quarried and used for phosphate fertilizer, but its principal use there as well as elsewhere in the county is for road building, for which it is well

adapted. In no case does this rock enter materially into the formation of the soils of the area.

NORFOLK FINE SANDY LOAM.

The soil of the Norfolk fine sandy loam consists of a dark or yellowish gray fine sandy loam 18 inches in depth, with an average of about 12 inches. It has a darker color in slight depressions, where a greater quantity of decayed vegetation is found. Its usually mellow and loamy texture and the large percentage of fine sand which it contains renders it an easy soil to manipulate, one not readily subject to the influence of drought, and at the same time warm and early enough to give good results with truck crops.

The subsoil to a depth of 36 inches is a yellow and somewhat mottled heavy sandy clay, sticky and plastic when wet, and in many respects having the characteristics of a true clay, owing to its massive and close structure. This subsoil serves as an excellent base on which to build up the soil to a high state of productiveness, and besides holds a better water supply nearer the surface than does a subsoil of sand, even though it be of a fine texture. The effects of fertilizers, it is said, are more lasting, and greater yields are constantly obtained, other conditions being equal, than on types with sandy subsoils. Tile drainage would be practicable, and would give good results in this subsoil where the moisture conditions are not satisfactory.

The largest area of this soil type lies around Wrightsville, mostly to the north and west of that place. Another area occurs about 1 mile east of Wilmington on the south side of Smiths Creek. A slightly smaller area occurs west of Castle Hayne, another near Masonboro, and one of similar size west of Wrightsville. The area of greatest importance south of Wilmington occurs in the vicinity of Barnards Creek. Narrow bodies of the type are found in various parts of the county along or near small streams.

The topography of the Norfolk fine sandy loam is quite level to slightly undulating, but in most places the drainage is ample, except in the slight depressions which occasionally occur.

The material from which the Norfolk fine sandy loam is derived is a marine deposit, both the clay content and the fineness of the sand, indicating that it was laid down in quiet water, probably in backwater from the sounds or tide-water streams.

The type is nearly all under cultivation, and is well adapted to a wide range of crops, being especially suited to crops which require the greater part of the growing season for their maturity, as well as those requiring a rather heavy soil. Corn does much better on this than on the more sandy types, but peanuts are not so productive as

on the lighter textured soils. It grows Irish potatoes of a larger size, but of a darker color and poorer selling qualities, than those grown on the Norfolk fine sand, the difference in price often being as much as 50 cents a barrel. The same is true of sweet potatoes, though there is usually no difference in price. Cowpeas give an excellent growth of vines with a light yield of peas. Rye, oats, and vetch do well and afford valuable winter and spring pasture, as well as hay. Lettuce, cabbage, beets, turnips, radishes, onions, spinach, eggplant, cauliflower, collards, and a number of other truck crops do well on this soil. Where the subsoil approaches comparatively near the surface and in the slight depressions where the soil is darker it is one of the best strawberry soils of the area.

Corn yields from 12 to 15 bushels, peanuts from 15 to 25 bushels according to the variety grown, and cowpeas about 12 bushels of peas and from 1¾ to 2 tons of hay per acre. Cotton has been grown at the rate of from one-fourth to three-fourths bale per acre, but this crop is no longer grown. Of the truck and small-fruit crops there is a very wide range in yields, depending upon the more or less generous and judicious use of fertilizers, as well as the cultural methods employed.[a] With most crops, however, the yields are usually somewhat higher on this than on the lighter and more sandy types. The range in price for this type of soil is from $50 to $100 an acre, according to the location as regards shipping and home market facilities. There are a number of areas unfavorably located which can probably be bought for $12 to $20 an acre.

The following table gives the average results of mechanical analyses of samples of the Norfolk fine sandy loam:

Mechanical analyses of Norfolk fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14291, 14293.....	Soil.....	0.3	1.6	1.5	24.3	48.3	16.4	7.4
14292, 14294.....	Subsoil....	.3	1.4	1.1	17.0	44.4	16.1	19.8

[a] A sample of this soil, taken on a farm one-half mile southwest of Castle Hayne, was tested by the paraffin-pot method to ascertain its manurial requirements. The field has good natural drainage, though there existed a system for artificial drainage. About fifty years ago the pine was removed and the field heavily cropped for forty-one years, after which it remained idle for eight years, growing up to grass and weeds. It was next prepared and cropped to peanuts for two years without the addition of fertilizers of any kind.

The results obtained by the tests show that stable manure has an especially beneficial action. Cowpeas also had a marked beneficial effect on the soil, though not so marked as in the case of stable manure. Potash or phosphoric acid, alone or in combination, appear to give but very little increase over the untreated soil. Sodium nitrate, alone or in combination with potassium sulphate or phosphoric acid, gave good results, especially in combination with potassium sulphate.

In these tests wheat plants were used as an indicator and the results are thus strictly applicable only to related crops and to the particular field from which the sample was taken, although it seems probable that they will apply with equal force to other fields on the same soil type that have been subjected to similar treatment.

NORFOLK FINE SAND.

The soil of the Norfolk fine sand to a depth of about 12 inches is a dark-gray to yellowish-brown loamy sand of a fine and very fine texture. In slight depressions it is somewhat darker in color and more loamy. The soil particles are not cohesive and easily separate into a loose mass, yet after rains there is a certain compactness not characteristic of the sand types of coarser texture. Constant cropping does not exhaust the humus content of the soil so rapidly as on the coarser sands, but eventually renders it less productive and of a lighter color. The soil particles being fine and the air space thus relatively smaller, the drying effect of winds is not so great.

The subsoil to a depth of 36 inches or more is a light yellow to gray and occasionally white fine sand, loose and incoherent and not exhibiting the slightly loamy nature of the soil. While not containing silt and clay to any great extent, it is ordinarily retentive of moisture, though permitting a rapid percolation of surface water to lower depths.

The Norfolk fine sand is found quite extensively in the northern half of the county east of the river. East of Wilmington it extends in a large and almost continuous body for several miles. Along the edges of the different sounds it occurs in a low, narrow ridge or elevated and slightly undulating tract which slopes gradually to the westward and broadens to about 2 miles in width toward the north county line. A large area is also found in the vicinity of Castle Hayne, and it is likewise a prominent type along the north side of Smiths Creek. Although level in the central and more inland parts of the county, it is usually well drained, especially along the sounds and river.

This soil was originally a marine deposit carried by ocean waves and slow-moving river currents, and probably to a certain extent sorted and blown by winds after being thus deposited. Near the sounds, with the exception of the higher organic matter content and the color of the subsoil, it closely resembles the Galveston fine sand of the beach.

The Norfolk fine sand is an excellent soil for peanuts and asparagus, and is almost equally as well adapted to cowpeas, early Irish potatoes, sweet potatoes, melons, and a number of other lighter truck crops. Corn is grown to some extent, but the yields are smaller than on the Norfolk fine sandy loam, because of the advantage of the latter in having a clay subsoil. The longleaf pine is the principal tree growth, but near the sounds the loblolly pine was frequently noticed.

The yield of peanuts varies greatly according to the variety grown and attention received. A fair average for North Carolina, Spanish, and Virginia varieties would be 25, 22, and 50 bushels, respectively,

but almost double these yields have been secured. After the third year asparagus will yield from 200 to 250 bunches per acre.

Cowpeas produce from 12 to 18 bushels of peas and from 1½ to 2 tons of hay per acre. The yields of early Irish potatoes and sweet potatoes vary, according to the time of digging, from 90 to 150, and 100 to 550 bushels, respectively, with proper fertilization and cultivation during the growing season.[a] Corn will probably average about 10 bushels, and oats about 15 bushels per acre. Cantaloupes are grown by a few for local market, and good returns are secured. Some bright leaf tobacco of excellent quality has been grown on this type, but owing to unsatisfactory prices the last few years this crop has been discontinued. No definite results with alfalfa have been obtained on any of the soils of the county as yet, but there is reason to believe that with a proper understanding of the cultural requirements of this crop it could be successfully grown on the most of this soil.

The following table gives the average results of mechanical analyses of the Norfolk fine sand:

Mechanical analyses of Norfolk fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13966, 14287.....	Soil.....	0.4	3.8	3.9	50.7	29.1	9.1	2.7
13967, 14288.....	Subsoil.....	.2	4.7	4.0	46.5	31.3	8.5	4.6

NORFOLK SANDY LOAM.

The soil of the Norfolk sandy loam is a dark-gray sand of medium to coarse texture, varying in depth from 14 to 20 inches. The color changes to yellow in the lower depths. The subsoil is a gradation from the yellow sand of the lower portion of the surface soil into a yellow and very sticky sand and sandy clay, the size of the sand particles remaining about the same as in the soil.

The largest area of the type is located about 4 miles north of Wilmington along the northeast branch of the river. A smaller

[a] A sample of this type of soil was selected from a field one-half mile south of Castle Hayne which was cleared of pine growth about fifty years ago, but on which no crop has been grown for the last eight years. The tests show marked benefit from the use of stable manure or a complete fertilizer. Cowpeas gave a good indication, as did nitrate of soda. Lime when used alone gave only a small increase, but when used in connection with other fertilizers it seemed to be very beneficial. Sulphate of potash or acid phosphate when used alone was of little if any benefit, but when used in connection with some other fertilizer it seemed to be slightly beneficial.

In these tests wheat plants were used as an indicator, and the results are held to be applicable only to related crops and to fields having a history similar to that from which the sample was taken.

area was mapped in the northeastern part of the county along Futches Creek.

The surface of the type is slightly rolling, which, together with its general elevation and proximity to streams, insures good surface drainage. Very little of the Norfolk sandy loam is cleared and under cultivation. The location of the most of this soil and its distance from the railroad has probably delayed its development and caused its desirable qualities to be overlooked. Little ditching would be necessary to prepare it for cultivation. It is naturally a very good soil for general farm and truck crops.

The formation of the Norfolk sandy loam is practically the same as that of the other principal soil types of the area, being derived from a coastal deposit which has been more or less changed by subsequent conditions and the accumulation of a small quantity of organic matter in the surface soil. In its higher location the type is well adapted to peanuts, as well as to sweet and Irish potatoes. It possesses much of the warmth and earliness of the Norfolk sand and Norfolk fine sand, and having a higher clay content in the subsoil, is more retentive of moisture than either of the types named. On account of its coarser texture and greater depth to clay it is not as good a soil for all purposes as the Norfolk fine sandy loam, though it ranks above the Norfolk sand. As so little of the type is under cultivation, no data were gathered on the actual yields of various crops.

SANDHILL.

The soil of the least value in New Hanover County is the Sandhill. Very little of it is under cultivation, and then only an occasional small patch on the better phases. The soil is a very loose and incoherent light-gray to white sand of coarse to medium texture, varying from 4 to 12 inches in depth, and averaging probably 8 inches. A large part of the surface is bare of any covering whatever, except accumulations of leaves in slight depressions, while in other cases clusters of moss, and here and there bunches of the native wire grass form the only protection. Below the surface 2 inches there is usually enough organic matter to lend some color, but the bare surface sand is washed clean and presents a white and glaring appearence in the sun, much resembling snow.

The subsoil consists of a loose and open coarse sand, light yellow to clear white in color to a depth of 36 inches, and continues with but little change for several feet below. Silt and clay particles, as well as organic matter, are almost wholly lacking, rendering the type very leachy and incapable of retaining sufficient quantities of moisture. Thus it is seen that the type in its present condition is extremely droughty—more so even than the Norfolk sand, which stands next in this respect.

With the exception of the areas of Swamp, the Sandhill type occupies the entire portion of the county which lies between the Cape Fear and the Northeast Cape Fear rivers. Below Wilmington it extends along tne river in broad, almost unbroken areas, nearly to the southern point of the area.

In the northwestern part of the county the type is uniformly rolling, and ridges from 10 to 30 feet high are of frequent occurrence. Along the southern course of the river, however, the ridges are not so numerous, and while there is a general rolling topography, there are some nearly level areas, but the nature of the soil material is not essentially different from the rolling areas. In these level areas slight depressions occur in which there is a better water supply, and a growth of live oak is usually found about the edges or throughout these places. Small swamps and ponds also occur in some of the deeper depressions. Notwithstanding the general rolling topography, the occurrence of high ridges, and the bareness of the surface, the sand is not blown about by the winds as might be expected, but with the aid of the sun the winds exert a great influence in drying out the soil on the ridges and slight elevations. Loss of moisture from this source must be much greater than on the average Norfolk sand.

The material of the Sandhill has either first been laid down in the shallow edge of the ocean and afterwards piled in ridges and undulations by tide and wave action, or it has been deposited by the rivers along their banks when the general surface of the area occupied a lower position with reference to that of the sea and the streams had not cut to their present depths. The texture of the sand suggests the action of rapid-moving currents, and from the general location of the type it is evident that the river has been a prominent factor in its formation.

The native tree growth is the longleaf pine and the characteristic scrub or turkey oak of the southeast coast. The pine timber has been nearly all removed, but the scrub oak is found on the entire type.

There is little information as to the possibilities of this soil, as it has not been cultivated to any appreciable extent. It is stated, however, that a fair growth of cowpeas can be produced on almost any of it, and that peanuts can also be grown with slightly less success. It is not improbable that the chufa, which is grown extensively for hogs farther south, would do well here. With these crops successfully grown, together with the mast from the scrub oak, hog raising might prove profitable.

Starting with cowpeas and plowing the vines under liberally, the great deficiency in humus could be very largely corrected, and the soil thus improved could better retain moisture. After a few

years it is not improbable that asparagus and possibly early potatoes would do well with proper care and fertilization. While it is possible to bring this loose sand to a much higher state of productiveness than at present, it will never be a good soil for general farming. The expense of manures and fertilizers must necessarily be high and the returns less in proportion than on the other soils of the area.

The following table gives the results of mechanical analyses of this soil:

Mechanical analyses of Sandhill.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14305	Soil	0.5	19.9	29.6	48.0	1.5	0.1	0.5
14306	Subsoil	1.2	21.4	28.2	47.2	1.4	.2	.4

PORTSMOUTH FINE SAND.

The Portsmouth fine sand to an average depth of 10 inches consists of a medium to fine black loamy sand to sandy loam. The subsoil is a dark-brown to black, and in some instances a gray sand, the color varying with the different quantities of organic matter present, as well as with the presence or absence of iron. This sand is usually slightly sticky, and ranges from medium to fine in texture. In some places it is somewhat of the nature of quicksand in its saturated condition throughout the entire depth of the soil profile, while in other areas it assumes the characteristics of a hardpan at from 18 to 30 inches in depth. The latter condition is especially true in the areas of the type lying along the eastern edge of the county, and in many instances extending from 1 to 3 miles back from the sounds, where a compact crust highly impregnated with iron is quite uniformly present at a depth of from 18 to 30 inches. The areas in the more central part of the county are more largely of the former condition.

The largest area of the Portsmouth fine sand lies northeast of Wrightsboro, and it is of frequent occurrence farther to the northeast, bordering the Portsmouth fine sandy loam. An area of about 1 square mile occurs west and southwest of Winter Park, and there are numerous level and slightly depressed areas lying between the low ridge along the sounds and the Sandhill type along the river.

The surface of this type is generally low and flat, and has only a very slight slope where it occurs along small streams. Artificial drainage is always necessary before it can be cultivated, but because of the nature of the subsoil it is often not an easy matter to make this effective, the sand filling the ditches except where hardpan occurs.

This soil is derived from a marine deposit afterwards modified by wet or slightly swampy conditions, due to its flat or somewhat depressed surface.

Only a small proportion of the type has so far been drained and put under cultivation.[a] The principal crop grown is strawberries. These thrive and yield good returns. Onions, cabbage, collards, and a few other truck crops ought to do well where good drainage is established.

The following table gives the average results of mechanical analyses of the Portsmouth fine sand:

Mechanical analyses of Portsmouth fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14297, 14299.....	Soil.....	0.3	3.1	4.5	64.6	11.9	9.2	6.4
14298, 14300.....	Subsoil.....	.3	2.0	3.6	62.5	13.9	10.7	6.8

NORFOLK SAND.

The soil of the Norfolk sand in this area is a gray to yellowish-gray sand of medium texture, the depth of which varies from 7 to 12 inches, the average being about 10 inches. In its virgin state the soil contains some organic matter, but despite this the surface soil is a loose and incoherent mass, the humus content being rapidly exhausted under cultivation unless manures are liberally applied. The soil as a whole is very largely made up of particles of quartz, a difficultly soluble mineral.

The subsoil from 10 to 36 inches or more is a yellow sand of medium texture, in which are found small but varying quantities of silt and clay, but practically no organic matter. Owing to the incoherency and openness of the subsoil the surface water percolates

[a] To ascertain the manurial requirements of this soil, a wire-basket test was made of a sample taken from a field one-half mile east of the stone road and 2½ miles south of Wrightsboro. The field supports at the present time a sod of native wire-grass and a scattering growth of longleaf pine. The natural drainage is very poor and artificial drainage has not been attempted.

The results of the test indicate the greatest benefit from the use of cowpeas with lime. Stable manure applied at the rate of 10 tons per acre is nearly as effective. Lime at the rate of 1 ton per acre also gave a marked increase. Nitrate of soda, alone or in combination with either potash or phosphoric acid or both, gave excellent results. The addition of lime to a complete fertilizer improved the growth of the plants. A mixture of nitrogen and potash appeared to be as beneficial as the complete fertilizer. Phosphoric acid apparently had little effect, whether used alone or in combination. Potash used alone was better than phosphoric acid alone and would seem to be of more value on these sandy soils.

The results obtained were with wheat plants as an indicator.

rapidly to lower depths, and a liberal supply of moisture is not retained within reach of plants for any great length of time after rains have ceased. This in connection with the general character of the overlying soil renders the type subject to the injurious effects of hot weather.

The Norfolk sand is distributed throughout the greater part of the county. It generally occupies the high and somewhat rolling areas bordering the more important streams, or gently rolling areas and low ridges farther inland, probably marking old shore lines. It is the principal soil in the immediate vicinity of Wilmington, and occurs along the Northeast Cape Fear River farther up its course. South of Wilmington the type becomes more rolling and gradually merges into the extensive Sandhill country below. From southeast of Wilmington it extends eastward and thence northeast to the county line in an almost unbroken body. Areas of minor importance occur in the southern part of the county, usually bordering the sound.

With but little exception there is no lack of drainage. The usual position near streams and the elevation of the type, in general, together with the porous nature of both soil and subsoil, afford a means for the rapid escape of water from the surface. In some instances, however, on the lower slopes near the Portsmouth fine sand, the surface is flat and the sand of the subsoil becomes saturated, assuming a compactness which gives it something of the nature of a hardpan. Attempts to drain such areas of the type are very unsatisfactory. This phase occurs along the edge of the area which extends along the road and railroad in the vicinity of Baymead and north of Kirkland. Another such area was encountered at the southeast corner of Wilmington, bordering the small areas of Portsmouth fine sand found there.

Like most of the soils of the county, the Norfolk sand was primarily a marine deposit, being either carried down and deposited by streams or else remaining in almost its original position, marking the shore lines of the ocean. The texture of the sand suggests that it was deposited by fairly rapid currents either of the streams or of the waves and tides.

The Norfolk sand is well adapted to cowpeas, which should be made a very important crop in all attempts to bring this soil under cultivation. Peanuts can be made to give fairly good yields by an occasional application of lime. Some corn is grown, but the yields are low, probably not averaging over 6 to 8 bushels per acre. Lettuce is grown to some extent, but a large quantity of stable manure is necessary to make the crop, and if grown for the fall market, the yield is usually cut short by dry weather, though early spring truck crops do not suffer greatly in this respect. Asparagus does well, and

it is quite probable that most of the type could be used profitably for this crop. Rye, oats, and vetch can be grown for winter and spring pasture. For the growth of any crop the importance of increasing the supply of organic matter can not be too strongly urged.[a] The liberal use of manures and the growing of cowpeas will not only add to the productiveness of the soil, but will to some extent check evaporation and retard the percolation of the water to lower depths, thus enabling the soil to retain a greater supply of moisture within reach of the roots.

The following table gives the average results of mechanical analyses of the Norfolk sand:

Mechanical analyses of Norfolk sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13964, 14283.....	Soil.....	0.9	18.7	20.5	48.8	7.1	2.5	1.4
13965, 14284.....	Subsoil.....	.8	22.4	22.6	44.7	4.6	1.7	2.7

PORTSMOUTH FINE SANDY LOAM.

The Portsmouth fine sandy loam consists of a wet and very mucky fine sandy loam—in some instances almost a true Muck—to a depth of 14 inches or more. Below this the material is either a sandy clay or sticky sand. Both the soil and subsoil vary from jet black to very dark in color, owing to the inclusion of large quantities of decayed vegetable matter.

This soil type occupies the most important "bays" or "bay-galls" and smaller inland swamps of the county. These so-called bays are flat and slightly depressed areas over which a semiswamp condition has existed for a long period. They support a thick growth of bay and gallberry bushes, which vary from 4 to 15 feet in height, together with a rank growth of vines and shrubs which grow in wet and somewhat swampy places. The growth in some areas is so dense as to prevent an investigation of the soil, while in

[a] A sample of this soil was selected for the purpose of determining its manurial requirements. It was taken from a field one-half mile southwest of Baymead. Only one crop has been grown on the land since it was cleared, this being a poor crop of peanuts.

The soil responded in a remarkable manner to all forms of fertilizers which were tried. The largest benefit was obtained by the use of stable manure, but nitrogen as nitrate of soda alone or a combination of this salt with any other fertilizer more than doubled the productive power of the soil. Excellent results were obtained from lime alone, while fairly good results were obtained from either sulphate of potash or from acid phosphate.

In these tests wheat plants were used as an indicator, and the results are not held to be strictly applicable to other and unrelated crops or to any field except that from which the sample was taken, although it seems probable that similar treatments would prove beneficial on all fields of this type under similar conditions.

others more or less open places occur. Above this growth a scattering growth of scrubby pine is usually found. This condition is quite prevalent in the north-central part of the county, where the type was mapped rather extensively, and also in the southern part south of Big Pond. The type occurs likewise along most of the smaller inland streams, but usually in too narrow a strip to separate it from the Portsmouth fine sand or other adjoining types. The inland swamps, such as support a growth of cypress and gum and are covered with water during a good part of the year, are small and infrequent in occurrence, and were included in this type.

The surface of the type is flat, with the exception of tussocks from 1 to 3 feet high formed about the base of clumps of bushes. Water stands to a slight depth during much of the year or is present in sufficient quantities to keep the soil completely saturated.

Like most of the soils of the county, the Portsmouth fine sandy loam owes its origin primarily to marine deposition, the material since being changed by the lack of drainage and the accumulation and decay of large quantities of organic matter.

Practically none of this type is under cultivation, because of its location and the expense necessary in most cases to drain it. Drainage, however, is possible as a rule, but some difficulty will be experienced from the ditches caving in where the subsoil is sandy. If thoroughly drained, and if the vegetable material be given some time to decay more completely, this soil should be one of the most productive of the county. It would be especially adapted to Irish potatoes, onions, strawberries, and possibly celery, and good yields of corn ought to be obtained.

The following table gives the results of mechanical analyses of the Portsmouth fine sandy loam:

Mechanical analyses of Portsmouth fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14301	Soil	0.2	4.9	9.3	43.3	10.0	18.1	14.3
14302	Subsoil	.6	6.3	11.3	43.2	11.1	13.4	14.1

SWAMP.

The soil of the Swamp, to an average depth of 10 inches, is a dark-brown clay, heavy and plastic when wet and containing a large quantity of grass, reeds, roots, and decaying vegetation of various kinds. Often the proportion is so great that the material resembles Muck, but after being drained and cultivated for a few years this tendency disappears very largely and the type becomes distinctly a heavy, plastic clay. The subsoil to a depth of 36 inches is a very wet, soft,

sticky clay, of a bluish-gray tinge. Not infrequently, however, like the soil, it carries roots and other decaying vegetable matter to such an extent as to give it a mucky consistency.

The Swamp is found along the fresh tide-water streams. It has its greatest development north of and including Eagle Island, along the Cape Fear and Northeast Cape Fear rivers. Below Eagle Island the river becomes wider and the Swamp almost entirely disappears on the New Hanover side, where it extends up some of the creeks and smaller streams. The larger proportion of the type is locally known as the "river swamp." While the tides pass up and down the river and cause the water to rise above or on a level with the surface soil, far beyond the limits of this survey, yet the influence of the salt water very seldom reaches Wilmington, except in case of a storm, and then it only causes the river water to become slightly brackish. At Wilmington the average rise and fall of the tide is about 4 feet.

The topography of the Swamp areas is very flat and natural drainage is accordingly poor. The methods of drainage employed consist of building a bank or dike about the area to be drained. In doing this a ditch is made on the inside around the area, which often serves as a main ditch into which other drains 50 to 100 feet apart and parallel to one another are made to empty. At different intervals, wherever the best drainage into the river or creek is afforded, a gate is placed in the dike, so constructed as to permit the water to pass out at low tide, but to close and shut out the water when the tide begins to rise again. Thus at low tide great quantities of water are carried out and prevented from returning till the area is sufficiently drained to admit of plowing and sowing the rice, which has always been the only crop grown on this soil. Later the rice can be flooded or the water drained off again at will, to suit the requirements of the crop. Much of Eagle Island has been drained in this manner and put under cultivation, as well as various other areas farther up the two branches of the river. The type is of comparatively small extent along the streams which enter the various sounds along the eastern edge of the county, being found only at the extreme upper part of the stream course, the remainder of the lowlands in that locality being salt-water marsh.

The Swamp is of alluvial origin, being laid down by overflow and by sedimentation in fresh tidal waters with slow currents or in a comparatively quiet state.

The crop to which this type is best adapted is rice. The variety grown is known in the market as the "Golden seed," a rice of excellent quality, often bringing a slightly higher price than rice from other sections farther south. The Swamp of this section, with its numerous ditches, is not well suited to the use of machinery for cultivating and harvesting the crop, and hence the industry has declined in late years, the farmers here not being able to compete with the

more extensive rice-growing sections where machinery can be used to a better advantage and the crop grown more cheaply.

The crop is sown here from the 1st to the 10th of March and sometimes as late as the 10th of July, but the early sowing is much preferred. After planting, the tide water is permitted to flood the soil and remain for fifteen days, after which the water is allowed to drain off. The crop is worked with hoes after the soil is sufficiently dry and in about twenty days it is flooded again. This process is repeated two or three times, always having the top soil dry when cultivation begins. About the 1st of August the water is admitted and allowed to remain till the crop begins to ripen, after which the water is slowly drawn off as the ripening advances. The crop is then cut by hand.

The yield ranges from 40 to 65 bushels per acre and the selling price from $1 to $1.25 a bushel, although it has been known to drop as low as 62 cents. Owing to low prices in recent years nearly all of the rice lands have been abandoned, but just now more favorable prices are causing some interest to be manifested in this crop. It is probable, however, that it will be many years before rice will be grown as extensively as formerly.

The following table gives the results of mechanical analyses of a sample taken from an area of Swamp which has been reclaimed and used for the growing of rice:

Mechanical analyses of Swamp.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14281	Soil	0.4	1.6	0.5	1.8	1.5	31.6	62.7
14282	Subsoil	.4	1.6	.3	1.3	3.2	35.9	57.4

GALVESTON CLAY.

The part of the county which lies between the mainland and the outlying beaches is occupied by shallow sounds and narrow channels, together with broad expanses of the typical salt marsh known as Galveston clay. The soil is very largely clay, mixed with a high percentage of decayed vegetable matter. There is little difference between the soil and subsoil, except in color, the subsoil being lighter, owing to the less quantity of decayed vegetation.

The only growth upon these areas is a dense covering of marsh grass. This at one time served as pasturage, where easily accessible, but has not been used for this purpose since the enactment of the present stock law. Some of the narrow strips which extend inland along the small streams emptying into the sound were at one

time reclaimed and cultivated to rice. Since rice growing has become less profitable in this section these have been allowed to resume their original salt-marsh condition.

At present no attempt is being made to reclaim any part of the type and, with the exception of the small areas along the streams, this will probably never be practicable and nearly all of the type will remain nonagricultural.

No samples of this type were taken for mechanical analysis.

GALVESTON FINE SAND.

The soil of the Galveston fine sand is a fine sand of a light-gray or white color to the arbitrary depth of 12 inches. It is very loose and incoherent, and is somewhat affected by winds. The subsoil is almost identical with the soil, possibly being of a slightly lighter color and occasionally containing more medium sand. Shell fragments are present in both soil and subsoil.

This type occurs in a narrow ridge or sand bar between the various sounds and the ocean, and attains an elevation of from 10 to 25 feet above low tide. It is of marine origin, being deposited in the shallow edge of the ocean and afterwards washed up by wave and tide action and since modified somewhat by the action of winds. Geologically it is of very recent origin. It is not an agricultural soil, but is merely a beach sand.

The following table gives the results of mechanical analyses of the Galveston fine sand:

Mechanical analyses of Galveston fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*
14279	Soil	Tr.	0.3	1.9	96.4	1.0	0.1	0.3
14280	Subsoil	0.0	.2	2.4	96.3	1.0	Tr.	.0

GALVESTON SAND.

The Galveston sand consists of 3 feet or more of light-gray to white sand of coarse to medium texture, carrying a large quantity of shell fragments. It is of no agricultural value, forming, as it does, the immediate sea beaches in the southern part of the county.

The coarseness of the sand particles prevents the formation of dunes, and the surface is therefore more regular than that of the Galveston fine sand.

The following table shows the results of mechanical analyses of this soil:

Mechanical analyses of Galveston sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14277	Soil	11.5	29.1	17.1	40.8	1.0	0.2	0.1
14278	Subsoil	6.0	25.9	21.1	46.1	.4	.1	.2

PORTSMOUTH LOAM.

The Portsmouth loam consists of a black to dark-brown loam to heavy fine sandy loam 10 inches in depth, underlain by a black to brown or mottled drab plastic clay, or in some instances by a sandy clay, which in turn grades into a clay at lower depths.

The largest area of the type is located about 2½ miles north of Wrightsboro, another of less importance occurs about 2½ miles southeast of Castle Hayne, and another small area a few miles farther to the southeast constitutes the entire extent of the type. It occurs in slightly depressed or flat areas in the uplands.

The topography is flat with occasional gentle slopes. There is a general lack of surface drainage, and the subsoil permits of only a slight percolation of water to lower depths. The subsoil is such, however, as to favor the drainage of the type either by the use of open or tile drains. The soil has been formed by deposition in quiet water, afterwards affected by wet conditions.

No part of the type is at present under cultivation. When cleared and drained it will be an ideal soil for strawberries, corn, cabbage, and onions, and possibly for lettuce.

The following table gives the results of mechanical analyses of the Portsmouth loam:

Mechanical analyses of Portsmouth loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14303	Soil	0.5	3.2	1.3	9.5	43.2	27.0	15.4
14304	Subsoil	.2	1.4	1.2	6.7	41.4	26.9	22.4

DRAINAGE.

The agricultural development of a considerable proportion of New Hanover County depends entirely on drainage. The many "bays" and small swamps, and the broad, flat, or slightly depressed areas are worthless for agricultural purposes in their present condition. The drainage of these areas is more or less difficult. If located far from a

good outlet, the undertaking is usually too costly for the individual farmer. The future of this work will doubtless rest with large companies having an abundance of capital at their disposal, or it will have to be done by cooperation of the farmers. In many instances it will be necessary to clean out and deepen the natural drainage channels. All of these waterways have a thick growth of trees, bushes, etc., along them and in their channels, thus rendering any extensive deepening or widening of the channels very difficult and expensive on account of the roots and stumps which will be encountered.

The method so far in use is the open ditch, which seems to be the most satisfactory. The ditches are cut by hand from 1½ to 3 feet wide, with perpendicular sides, to the depth required. Much annoyance is experienced by the banks or sides caving in, and the expense of cleaning them out is more or less constant throughout the rainy season of the year, this being particularly the case where the subsoil is a loose sand. In many instances digging the top of the ditch wider and leaving the bank with a slight slope to the bottom would doubtless lessen the tendency to cave in. On the whole it seems that tile drains would be very desirable, but the belief is quite prevalent that these would fill up with fine sand. The efficiency of close-fitting tile well laid and with a good fall has not been thoroughly tested here, however.

The subject of drainage by the use of the open ditch has received much attention already, and great progress has been made. Many acres of worthless land have been made valuable, and considering the many square miles of territory yet undrained great development along this line may be expected.

TRUCK GROWING.

New Hanover county lies about half way between the well-known trucking district about Norfolk, Va., to the north, and that about Charleston, S. C., to the south, and together with several neighboring counties west and north constitutes a trucking district or zone which possesses an important advantage in marketing its products. The earlier southern products are usually marketed before those of the central zone begin to move, and the bulk of the central crop is sold before that of the more northern comes in. In this way each section has its regular turn of about 10 days in the market, and in an ordinary season there is little conflict with the other sections mentioned.

The truck crop of greatest importance is lettuce, and more expense in fertilizers and equipment is incurred than in growing any of the others. The plants are grown from the seed and transplanted on a very slight ridge in a cold frame which is provided with a cloth cover

for protection against frosts. These covers are used only on nights when there is danger from this source and are removed during the day to admit the full rays of the sun unless the day be exceptionally cold. The preparation of the soil receives careful attention, and while as much as 100 loads of well-rotted manure is necessary, it is found that the best lettuce can not be grown with this alone. From 500 to 2,000 pounds per acre of high-grade commercial fertilizer is applied when the soil is being prepared, or better, half then and the remainder as a top dressing later between the rows. Some money could be saved by the growers by using home-mixed fertilizers. The following formula has been recommended by the North Carolina Experiment Station[a] for this crop: Acid phosphate, 900 pounds; dried blood, 600 pounds; muriate of potash, 400 pounds. This should be applied at the rate of from 500 to 1,000 pounds per acre. Owing to the large quantity of potash in this mixture it is advised that it be thoroughly incorporated in the soil several days before setting the plants, since it is apt to burn the roots otherwise. If special forcing is desired, a top dressing of sodium nitrate is sometimes given. The most successful growers never use cotton-seed meal, as it is believed to be conducive to rot, which often seriously damages the crop.

About three months are required for lettuce to mature, which permits of two crops being produced each year. The fall crop is set out from the last of August to the middle of September, and is ready for shipment about the last of November or the middle of December. The spring crop is set out in December and is ready for market the last of February or early in March. The spring crop is usually of more importance and brings the best prices. The fall crop is often seriously affected by dry weather, unless provision for irrigation has been made.

More than two or three crops can not be successfully grown on the same land in succession and it is thought better by some to grow only one. Many short rotations or successions of crops might be suggested in connection with this vegetable product. Spring lettuce may be followed by early snap beans and later by collards. About January 15, or a little later, a crop of early Irish potatoes may be planted on the same ground and dug by June 1, which will leave three months for the growing of cowpeas before setting to fall lettuce. Another rotation is spring lettuce, followed by cowpeas for hay, then by a late crop of Irish potatoes, in the spring by sweet potatoes, and in the fall by lettuce. Another excellent rotation is fall lettuce followed by beets, these by cucumbers, and these in turn by a crop of late Irish potatoes, which may be dug in time to permit the ground to be planted in spring lettuce. The frames in which spring lettuce

[a] Bul. 132, North Carolina Expt. Sta.

was grown the year before can be planted in fall lettuce after gathering the crop of cucumbers, the late potatoes being omitted in this case. While most of the older growers of the area believe in growing three and even four crops of lettuce in succession, followed by one or two other crops, and then "turning the land out to rest" for a year or so, yet rotations such as are given above have proved a success in other trucking sections, and it is believed that the growers of this area might well give them a test. Such rotations will prove beneficial to the different crops and will doubtless diminish the damage by rot in the lettuce. The diversity of crops will insure a more certain income and greater returns can be had from a smaller acreage.

In growing lettuce it is advisable to choose the Norfolk fine sandy loam and the well-drained portions of the Portsmouth fine sand and the Portsmouth loam. Good success is also had on the lower slopes of the Norfolk fine sand. On the more elevated areas of this type, as well as on the Norfolk sand, greater expense for fertilizers must be incurred, with much poorer results, and frequent watering is often necessary.

Lettuce is shipped in carloads to northern cities, besides supplying the local demands. The Big Boston variety is grown almost exclusively, the Eastern North Carolina Big Boston lettuce having a high rating in the market. With fairly good market conditions, an expert grower has been known to cut $1,800 worth of lettuce from one acre, which, after deducting freight and expenses for fertilizers, manures, and labor, leaves a handsome profit.

Much of the area is well adapted to the production of asparagus, but as yet there are only a few extensive growers. As the conditions are favorable to the profitable development of asparagus growing throughout the more sandy areas of the county, the methods shown by experience to give the best results should be of interest. Not later than March 15, and preferably earlier in the winter season, crowns produced from seed are set out in rows 5 to 5½ feet apart and 28 inches apart in the rows. The depth of setting should not be more than 6 to 8 inches, in order to secure an early growth of the shoots and to allow them to mature as much as possible above ground, thus producing the green cuttings most sought in the markets. In the preparation of the soil from 800 to 1,000 pounds of fertilizer is usually applied. The best growers use the following mixture: Acid phosphate, 900 pounds; cotton-seed meal, 600 pounds; muriate of potash, 400 pounds, and nitrate of soda, 100 pounds. It is considered very important during the first year to get a good stand and see that every crown is thrifty, hence this period is devoted to careful cultivation and necessary replanting.

During the second year it is best to apply the required fertilizer by growing some heavily fertilized crop or succession of crops between

the rows. Early potatoes, followed by melons for the home market and cowpeas for hay, sown after the melons have started, have proved an excellent combination. During the late fall or early winter of the second year the ridges are laid back from the rows and another application of from 800 to 1,000 pounds of fertilizer per acre is made, together with some well-rotted manure, and the rows bedded back again. This process is repeated each year, but no attempt is made to grow any other crop, except cowpeas for hay, which should be sown about July 30, after the cutting season is over.

The third year yields the first cutting of shoots for market, and if the preceding directions are followed each year good yields will continue for from ten to twelve or even twenty years without resetting. The cuttings are made every other day from March 1 to May 1, about April 15 being the most profitable time to ship from this section. Cuttings later than this are usually for the home markets, and bring from 12 to 15 cents a bunch. Shipments are made in boxes containing 24 bunches each, which sell at from $6 to $12 a box. An acre produces about 240 bunches, and, after deducting the express or freight, usually nets the grower about $100. The Norfolk fine sand throughout almost its entire extent is admirably adapted to this crop, while the greater part of the Norfolk sand is equally as good, and it is not at all improbable that with a little more expense for manures and fertilizers the Sandhill section of the county could be made to yield almost as satisfactory returns.

Asparagus is an admirable crop for shipment, and much more of the sandy soils of the area should be used in its production. The fact that there is very little income for three years, together with the lack of experience and a knowledge of its requirements, doubtless keeps many from making a start with this remunerative crop.

The crop of early Irish potatoes is generally planted about February 15 and occasionally a month earlier. A furrow is thrown back each way and a fertilizer rich in potash is thoroughly mixed with the soil in the furrow. A very successful grower states that the following has proved excellent: Cotton-seed meal, 500 pounds; acid phosphate, 900 pounds; nitrate of soda, 200 pounds, and muriate of potash, 400 pounds. With ordinary cultivation the tubers are ready for market by May 25 to June 1. It is probable that this crop could be produced earlier, as is done in some sections, by planting in December, covering first with a shallow depth of soil, then a heavy coat of manure, and plowing up a heavy furrow from each side. The heat of the manure will sprout the tubers and cause early growth. If the sprouts come through too early a furrow can be plowed on them without damage, and even a second and third. After all danger from frost is passed the ridges are harrowed down to some extent.

A matter of great importance in growing this crop, and one which is practiced to some extent, but should receive more attention, is that of growing from the early crop a second or late crop for seed the following year, as well as for winter use and the home markets. The cultural requirements are about the same as for the early crop, except that a more level cultivation is preferable, owing to the drier season of the year. The seed potatoes are gathered when the early crop is marketed, placed in the shade till somewhat green, then covered with moist leaves and a thin covering of soil, and allowed to sprout. For the planting, which may be done from July 1 to August 15, only the tubers which show thrifty sprouts are used, thus insuring a good stand. After plowing a furrow on the rows after the first killing frost the tubers are often left in the ground till needed for planting the spring crop. The seed thus grown is said by some to be much superior to the northern-grown seed, and besides the grower saves himself a good sum of money. The Norfolk fine sandy loam and some of the other heavier soils give greater yields but of poorer quality than the Norfolk fine sand and Norfolk sand, the difference being generally recognized in market. Early Irish potatoes constitute an important shipping crop. In some years the market drops so low as to make the crop unprofitable, but the price in the beginning of the shipping season usually ranges from $3 to $5 a barrel of 2½ bushels each, from which it gradually declines, the shipments ceasing as soon as the price gets too low for profit.

The minor details of cultivating sweet potatoes can well be omitted, since these are comparatively simple and generally well understood. The plants are set out about May 1. Little fertilizer is used as a rule, only 300 or 400 pounds per acre. The following mixture is suggested by the North Carolina Experiment Station:[a] Acid phosphate, 1,000 pounds; cotton-seed meal, 600 pounds; high-grade sulphate of potash, 400 pounds. Of the ready-mixed fertilizers that containing 7 per cent of phosphoric acid, 5 per cent of nitrogen, and 7 per cent of potash is generally used. The extremely high ridge is not used so much as formerly, and flatter culture gives better success. A late crop is grown for seed and winter use from cuttings taken from the vines and set out in July. Gathering the early crop begins about August 15, and for about ten days the potatoes sell for $1.25 to $1.50 a bushel on the home market, after which the price drops to $1 or as low as 75 cents. A return of $100 an acre is generally easily secured, and where the best methods are employed the profits exceed this.

The Norfolk fine sand is an excellent sweet-potato soil, and the Norfolk fine sandy loam is almost as good. On the former the plants start earlier, and have a more rapid growth during the forepart of the

[a] Bul. 132, North Carolina Expt. Sta.

season, but on the latter, which has a good clay subsoil, and hence a better water and fertilizer holding capacity, the growth is generally forced more during the latter part of the season, and unless the season is wet the crop nearly always matures as early as on the Norfolk fine sand, and the potatoes are usually larger.

Besides the ordinary methods of growing onions from seeds and sets planted in the open, what is known as the "new onion culture" is in common use and is growing in favor. By this method the seed are sown in hotbeds in October, and the plants transplanted into the open field as early in February as the season will permit. A fertilizer rich in potash and well-rotted stable manure are important factors in onion growing. The soils best suited to onion culture are the Portsmouth fine sand and the Portsmouth fine sandy loam, where well drained, and the lower and heavier areas of the Norfolk fine sandy loam.

Two crops of cabbage are produced each season, one early in spring and the other late in the fall. The early crop is of the most importance and is the easiest grown. The seed are sown in well-prepared beds about October 1. During November the plants are set in cold frames containing a rich soil. A cover of cloth or glass is used during nights when the temperature approaches 25° F. The plants are thus made stocky and are kept in good condition, but are not encouraged to make much growth. As early in February as possible the plants are set out in the open, the soil of the field being well manured, and soon after growth begins a top dressing of 100 to 150 pounds of nitrate of soda is usually applied between the rows. Shipping usually begins the last of March and continues as long as the prices justify. The method of growing the late crop is about the same. The seed are sown in July and the transplanting is done in September. No glass covering is necessary, but it is often necessary to use the cloth cover to protect the plants from the sun. The culture of beets is almost identical in every way with that of cabbage.

The eggplant is an important truck crop of the area. The method followed by the larger growers is to plant the seed in a greenhouse, transplant into small pots about March 20, and set the plants in the field about May 1. The most common method, however, is to grow the plants under glass and transplant to the lettuce frames two or three weeks before that crop is cut, thus giving them an early start and getting the protection of the cloth covers. Ordinarily not much fertilizer is used when the crop follows lettuce, but many of the more extensive growers manure heavily and use liberal quantities of high-grade fertilizer as a top dressing, which is applied along the sides of the rows after the plants are well started. Shipping begins about June 20 and continues until

July 25, after which it becomes unprofitable. Shipping is done in baskets, and a paper bag is put around each fruit to preserve its luster. The prices received in the northern markets early in the season range from $2.50 to $3 a basket, but later drop to 75 cents, below which there is no profit. An acre well tended and fertilized will yield about 1,000 baskets.

In addition to following lettuce with eggplant it is good practice to do the same with snap beans, early peas, or beets, the protection of the cloth cover enabling an early start to be had before the lettuce crop is gathered. Radishes can be grown in this way also, but are usually sown in the open as early as it is safe to do so.

In addition to the crops already discussed there are a great many others that are grown, many of them of great importance as money producers. The methods employed are simple and quite generally understood, so that a detailed description is not necessary. Heavy manuring and fertilizing must be resorted to with all crops in order to force the product to an early maturity. The trucking industry is only fairly started in the county, yet the production of manure is by no means equal to the demand, and great quantities are shipped from Baltimore, New York, and other cities at a great expense. Every effort should be made to produce manure within the county, which can be done by growing more forage crops and raising more live stock. The importance of this can not be overestimated.

As a whole the conditions in New Hanover County are doubtless as favorable to an extensive development of the truck-growing industry as in any other part of the seacoast section, which has many advantages by reason of its ideal truck soils and equable climate. As concerns the prospective individual grower, however, it is well to recognize the fact that truck growing is a business in which there are many uncertainties and many different factors affecting one's success, all of which should be carefully considered by a man of moderate means who contemplates engaging in this as his sole occupation. Experience in growing the different crops is often dearly paid for by the beginner, while reverses caused by rot and other plant diseases, or by adverse market conditions, sometimes occur. Large sums must be expended for manures and fertilizers, which becomes a serious proposition in unfavorable years. Yet with all this, those who are able to tide over the unfavorable seasons and who give thought and energy to their business will be able to make a good living on only a few acres, while those who conduct it rightly on a larger scale can expect to make money in the end. Good crops with good market conditions bring almost fabulous returns for each acre cultivated, but that occasionally the crops do not pay expenses is the experience of those who have spent several years in the business.

Freight rates vary from time to time, but for the information of those who contemplate entering the business of truck growing in the South the following table, compiled by the Interstate Commerce Commission, is given:

Statement showing rates on berries, carload, from Wilmington, N. C., to the points named below, via Atlantic Coast Line Railroad.

[Rates in cents per hundred pounds.]

	From Wilmington, N. C., to—				
	Washington, D. C.	Baltimore, Md.	Philadelphia, Pa., New York, N. Y.	Boston, Mass.	Buffalo, N. Y.
Strawberries, in refrigerator cars, per crate of 32 quarts or less, not less than 300 crates per car	50	50	50	80	60
Blackberries, dewberries, and whortleberries, in refrigerator cars, 100 crates, minimum per crate of 32 quarts or less	50	50	50	83	.....
Blackberries, etc., not in refrigerator cars, per bushel package	28	28	28	38	38

Statement showing rates on vegetables, carload, from Wilmington, N. C., to points named below, via Atlantic Coast Line Railroad.

[Rates in cents per hundred pounds.]

	From Wilmington, N. C., to—					
	Washington, D. C.	Baltimore, Md.	Philadelphia, Pa.	New York, N. Y.	Boston, Mass.	Buffalo, N. Y.
Cymling, eggplant, green corn, kale, lettuce, spinach, onions, potatoes, squash, turnips, and vegetables, not otherwise specified (per barrel or barrel crate, standard size)	35	35	45	45	70	62
Same, per bushel box, basket, or crate	19	19	24	24	36	38
Same, per 1½-bushel box, basket, crate, or half barrel	28	28	35	35	54	55
Potatoes and cabbage, bulk, carload, minimum weight 24,000 pounds, per 100 pounds	38	38	41	41	57	.....
Asparagus, per crate of 24 bunches or less	52	52	62	62	87	85
Asparagus, per crate of over 24 bunches, but not over 36 bunches	74	74	82	82	117	115
Tomatoes, per half bushel basket or crate	14	14	17	17	21	.....

SUMMARY.

New Hanover is a seacoast county in the southern part of North Carolina and lies wholly within that physiographic division known as the Coastal Plain. Its topography is flat and its soils are nearly all sandy. The climate is mild and pleasant. Its agricultural development has been very backward, lumbering, the production of turpentine and rosin, fishing, and shipping having occupied the attention of the greater number of the inhabitants until recently. Of the total area of 122,000 acres, 50,000 acres were classed as in farms by the Twelfth Census, and of these 50,000 acres only 10,000 were given as improved.

There are two systems of agriculture in the county. One consists of general farming combined with some trucking and the other of truck growing only. In the line of general farming, the first important "money crop" was rice. This was replaced by the North Carolina peanut, which in turn was abandoned for cotton, and finally cotton was driven out by the small Spanish peanut, which, together with the North Carolina variety, is now the important money crop where general farming is practiced.

About 1885 the trucking industry began to receive attention, and since then the development of this industry has been rapid. The soils and climate are well suited to truck growing, and ample markets exist for all the produce grown. The amount of money invested in this industry in New Hanover County is very large. All the general truck crops are grown, with lettuce and early Irish potatoes as the most important ones. The bulk of the produce is shipped to northern cities.

The soils of the county are typical of the tide-water region of the Coastal Plain. There are two predominating series, the Norfolk and the Portsmouth. The soils of the first-named series are light colored and well drained, while those of the last named are dark colored and poorly drained. In addition to these, there are Swamp and the nonagricultural types, Galveston clay, Galveston sand, Galveston fine sand, and Sandhill.

Of the Norfolk series the Norfolk fine sandy loam is perhaps the best soil for diversified uses. It is the best corn soil in the county, and is a fair soil for sweet and Irish potatoes, the grasses and legumes, and truck crops. It is nearly all under cultivation. The Norfolk fine sand is an excellent soil for peanuts, and is also well adapted to cowpeas, Irish and sweet potatoes, melons, and truck crops. The Norfolk sandy loam is about equal to the Norfolk fine sandy loam for all purposes, but has been little cultivated because of its location at a distance from the railroad. The Norfolk sand is the poorest soil of the series, but possesses qualities of extreme earliness if supplied with sufficient moisture when most needed. It produces fair crops of cowpeas and is fairly good for peanuts, but is a very poor corn soil. It is especially susceptible to drought, and large quantities of organic matter and fertilizers must be added to it before it will produce profitable yields.

The soils of the Portsmouth series, because of lack of drainage, are little cultivated. Practically none of the Portsmouth fine sand is under cultivation, and only small areas of the Portsmouth fine sandy loam have been cleared and planted. If adequate drainage were supplied these types would be valuable farming soils.

The Swamp type and a small proportion of the Galveston clay were at one time valued for the production of rice, but since the abandonment of that crop very little even of the former type is cultivated.

A great deal of valuable land could be brought into cultivation if adequate drainage systems were installed. The work will have to be done on a large scale, and is too much of an undertaking for the individual farmer. It will have to be done either by large companies with abundant capital or by large cooperative enterprises organized by the farmers.

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