An Anthology of Soil Science in North Carolina[1]

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I. Introduction

The course of ***soil science*** in North Carolina was shaped by the nature of the soils in North Carolina.

A. History of soils in North Carolina can be traced to the quartz, feldspar and mica-rich rocks that formed on the supercontinent (Rodinia) one billion years ago.

B. Few mafic and ultramafic rocks formed, and few carbonates were present.

C. North Carolina is almost devoid of sedimentary limestones rich in calcium (Ca) and phosphorus (P).

D. When the collision with Africa ended, about 270 million years ago, the Appalachian mountains were as lofty as any modern mountain chain. Since then they have been eroding and providing the sediment for the Triassic Basins and the Coastal Plain.

E. Soils in North Carolina formed from nutrient-poor rock, much of which was further impoverished during transport, are nutrient-poor soils.

F. Vegetation, however, concentrated what few essential elements that were present into the surface of the soil.

II. What the first European settlers found

A. In 1822, Professor Mitchell described the soils of North Carolina and the first attempts at farming as follows: “The soil of this State is pronounced, by those who have travelled extensively on both Continents, to be of a middling quality. It is of that kind which seems most to demand the employment of science and skill in its cultivation, and to promise that they shall not be employed in vain. Our grounds are neither so fertile that they will produce spontaneously what is necessary to the sustenance and comfort of our citizens, nor so sterile that we have reason to

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abandon them in despair. When our ancestors landed on these shores, they had for ages been covered with a continued forest, the trees of which, as they decayed and fell, had deposited on the earth a rich bed of vegetable matters, which was ready to furnish the most abundant nourishment to any seed that might be committed to the ground. The first settlers, therefore had nothing to do but to select the most promising spots, clear away the timber, and loosen the soil, so that the vegetables to be grown could strike their roots into it. As the fertility which they had at first found was, in the course of a few years, exhausted, it became necessary, either to provide a means of renewing it, or disforest another tract and bring it under cultivation. As it was found that the latter could be done at the least expense of time and labor, it was perfectly natural that the exhausted land should be thrown out, and fresh ground brought under tillage."

B. By 1822, Professor Mitchell described the state of land use in North Carolina as follows: "This process has been going on till most of the tracts whose situation and soil were most favorable to agriculture, have been converted into old fields and in our search after fresh ground to open, we are driven to such inferior ridgeland as our ancestors would have passed by as not worth cultivating. It is useless to complain of the course which our planters have pursued—they have pursued their own interest—and pursued it in the main with discretion and judgement. It were perfectly absurd to expect them to attempt to improve their lands by the application of manures so long as the could obtain, at less expense, the use of that great store of vegetable matter with which nature had for many centuries been covering our country. It is not to be expected that a man will raise a hundred barrels of corn in a way which we may point out to him as the best, at an expense of three hundred dollars, when his past experience informs him that he can produce it in his own way for two hundred."

C. Professor Mitchell then predicts the future and the need for ***soil science*** as follows: "But, in process of time, as this system goes on, the planter will look down from the barren ridges he is tilling, upon the grounds from which his fathers reaped their rich harvest, but which are now desolate and abandoned, and enquire whether he cannot restore to them their ancient fertility, at a less expense than he can cultivate those lands of an inferior quality, with which he is now engaged. Till he is driven by necessity to make this enquiry, we can hardly hope that agriculture will be studied as a science. The planter will not give us a patient hearing when we talk to him about manures."

D. Paul Lilly notes that North Carolina had the greatest acreage of cropland during and just after the Civil War (1865).

III. Post Civil War

And so it was that with peace and reconstruction after the Civil War that the Hatch Act provided federal funding for the study of agriculture. State monies were also channeled to

scientific study of soil. As was true in all southern states, the first priority for Hatch money was for research to improve soil fertility.

A. Commercial fertilizers were known and made available to farmers, but fertilizer products had no quality control and results were not uniform.

B. A cry from the farmers went up to the North Carolina State legislature "Do something about FERTILIZER FRAUD! In North Carolina, as in most other southern states, this demand was answered by employing agricultural chemists to test and evaluate the fertilizer products on the market. The following chain events took place in North Carolina:

1877	Dr. Albert Ledoux is appointed the first Agricultural Chemist, located in Chapel Hill (Fertilizer Analysis).
1880	Dr. Charles W. Dabney, Jr., replaces Dr. Ledoux. Program is moved to Raleigh.
1885	Dabney establishes first experimental farm for fertilizer trials in West Raleigh (now North Carolina State University campus).
1886	Milton Whitney becomes first superintendent of West Raleigh research farm. Whitney began the first pot cultures in candy jars.

C. It is written that when Dr. Dabney made one of his reports revealing that some "fertilizers" were nothing but powdered coal and equally worthless products, the business interests of some of the legislators were implicated and his testimony was challenged by several impassioned testimonials praising the fertilizer value of such products. One legislator was reported to have declared that no thinking man would trust a so-called Doctor in a white coat who spent his time, at taxpayer expense, shuffling around in a foul-smelling laboratory. He then declared that only the crop plants knew good fertilizer from poor fertilizer. Dr. Dabney, being quick of mind, responded that the good man had a point and the legislature should make land available for field testing of fertilizer. Thus the West Raleigh Farm, later to become the NCSU campus, was established.

D. Numerous reports of fertilizer analyses were published during this era. Most reports totaled the chemical value of the P, and sometimes the N and K, contained in various fertilizer products, calculated the dollar value of these elements and revealed where and from whom the fertilizer was purchased and the price charged for the fertilizer. The reports were published in monthly North Carolina Department of Agriculture publications and publications available to the farmers of state. (It is interesting to observe that some of the publications carried a plea to the farmer to "read well and pass on to your neighbor.")

E. One of earliest Experiment Station Bulletins dealt with samples from several phosphate mines on the coastal plain of North Carolina that were being worked for rock phosphate fertilizer. These were the forerunners of our present phosphate

mining in eastern North Carolina. So great was the need for P in the acid, igneous-rock-derived soils of the state that mineral sources, such as the mineral Wavealite, were known to be quarried for fertilizer during the Revolutionary War (1776) near Charleston, South Carolina.

IV. Soil identification and mapping

A. Some soils grew better crops than other soils. This has always been obvious to farmers tilling the land. However, no systematic way had been devised to translate this knowledge in a quantitative fashion to scientists and thus establish a defined entity of soil upon which to conduct scientific research. The quality of crops grown on different kinds of soils differed. In North Carolina, the quality of tobacco was of greatest economic concern. Could scientists identify and locate the best soils for producing the finest tobacco?

1894	Milton Whitney leaves North Carolina to become director of the Division of Agricultural Soils in the U.S. Weather Bureau, USDA.
1895	The Division of Agricultural Soils becomes an independent unit.
1897	The Division of Agricultural Soils is designated the Division of Soils.
1900	The first soil survey *Raleigh to New Bern Area* is published by W. C. Smith, USDA Bureau of Soils, in cooperation with the North Carolina Agricultural Experiment Station and the North Carolina Department of Agriculture. (North Carolina was one of the first six states to start a soil survey.)
1901	Division of Soils is designated the Bureau of Soils, with Milton Whitney as Chief.

B. In *Raleigh to New Bern Area*, 13 types of soils were identified and, in addition, three land types—sandhills, muck, and meadow—were mapped.

C. As a result of this survey, the Upper Coastal Plain Test Farm (now a research station) was established at Rocky Mount in 1902.

V. Soil conservation and improvement

A. By 1900, the land was in bad shape and this was obvious to a more mobile public. The General Education Board, funded by Rockefeller to improve education in the South, determined “They could render no substantial educational service to the South until the farmers of the South could provide themselves with larger incomes. It was necessary to improve Southern agriculture.” Could science change the course of land degradation? They funded farm demonstration work with the supervision of USDA and with Dr. Knapp in charge.

B. In North Carolina several people took up the challenge.

1903	Hugh Hammond Bennett graduates from Chapel Hill. Bennett maps soils in Tennessee, North Carolina, and Virginia.
1907	C. B. Williams is named Director of the North Carolina Agricultural Experiment Station.
1907	County extension work starts in North Carolina.
1914	The Smith-Lever Act establishes cooperative extension work between USDA and North Carolina State College.
1920	First aerial photos by W. B. Cobb and W. A. Davis are used in the soil survey of Tyrrell County.
1921	W. D. Lee is appointed as assistant in soil survey.

C. Soil survey was well established as a tool to organize the complex patterns of soil into units that could receive scientific attention. World War I experience with the airplane demonstrated a view of the land that could speed and increase the ground accuracy of soil identification.

D. The Dust Bowl era of the 1930s brought the problems of the land to the people via their pocketbook and literally dirt on their window sills.

E. Soil chemistry and crop science were coming to understand that total elemental analysis of soil did not predict how crops would respond. New methods of analyzing soil to determine plant-available forms of essential elements had to be developed. Although this breakthrough was taking place in many parts of the world, North Carolina attracted some individuals who were leaders in this effort.

1931	J. F. Lutz joins North Carolina State College as soil physicist and conservationist.
1931	W. H. Rankin joins North Carolina State College for small grain soil fertility research.
1931	Hugh Hammond Bennett becomes head of the Soil Erosion Service, later named Soil Conservation Service and eventually reinvented as the Natural Resources Conservation Service.
1936	E. R. Collins joins North Carolina State College as extension soil fertility specialist-in-charge.
1936	W. W. Woodhouse joins North Carolina State College for pasture and forage soil fertility research.
1938	Adolf Mehlich joins North Carolina State College as a soil chemist.
1941	W. L. Nelson joins North Carolina State College for soil fertility and soil testing research.
1941	R. W. Cummings joins North Carolina State College as Agronomy Head, Director North Carolina Agricultural Experiment Station and soil fertility researcher (later to lead in the establishment of International Research Centers around the world).

1945 J. F. Doggett joins North Carolina State College as extension soil conservationist.
1945 W. G. Woltz joins North Carolina State College for tobacco soil fertility research.
1949 N. T. Coleman joins North Carolina State College as a soil chemist.

F. Many individuals who contributed to soil science in North Carolina have not been identified in this list, and for this I apologize. And, I will not attempt to continue the chronology of individuals beyond 1950 in order not to risk embarrassment by oversights. It would be a fertile area for you to contribute to the Soil Science Society of North Carolina effort during this next year. Get out your pencil or keyboard.

VI. Effect of science on soil stewardship

What has happened on the land as direct, indirect, or coincidental results of the interjection of ***science*** into stewardship of the soil in North Carolina and throughout the nation and world? A complete treatise could fill volumes, and the following are but a few results where I believe ***soil science*** can be credited as a major contributor:

- Decrease in food cost as a percentage of family income in the USA (Figure 1)
- Acreage of US land used to produce domestic food over this century (Figure 2)
- Improvement of yields Iowa and North Carolina comparison for corn 1920–1980 (Figure 3)
- Conservation of the land.

VII. Importance of land to civilization

We are not done yet. We will never be done. Life on earth may have originated in the sea but it is the land—LAND WITH SOIL, not rock land—that supports civilization as we know it. To improve civilization, we need to improve our knowledge of that which supports civilization. Although often unseen as we hide in our soil pits and "foul-smelling" laboratories, we need occasionally to celebrate and take pride in our profession. This next year is one such occasion. Contribute to the celebration. Tell your version of ***soil science*** to the Rotary Club, the local newspaper, your local schools and churches. Like apple pie and motherhood, soil is appreciated and cherished by all people. Instinctively all people know that life depends upon soil. Most people do not understand soil. They need not understand to appreciate and revere. There is no better subject to champion than soil.

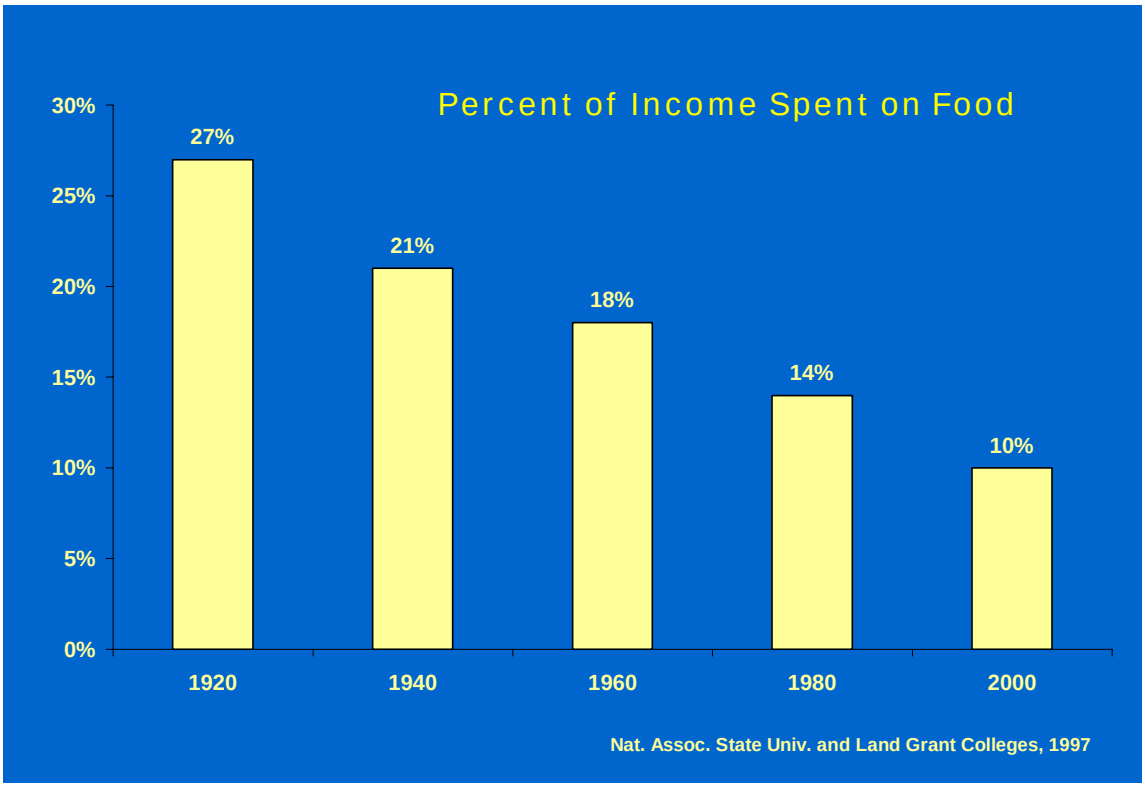

Figure 1. Percent of U.S. income spent on food.

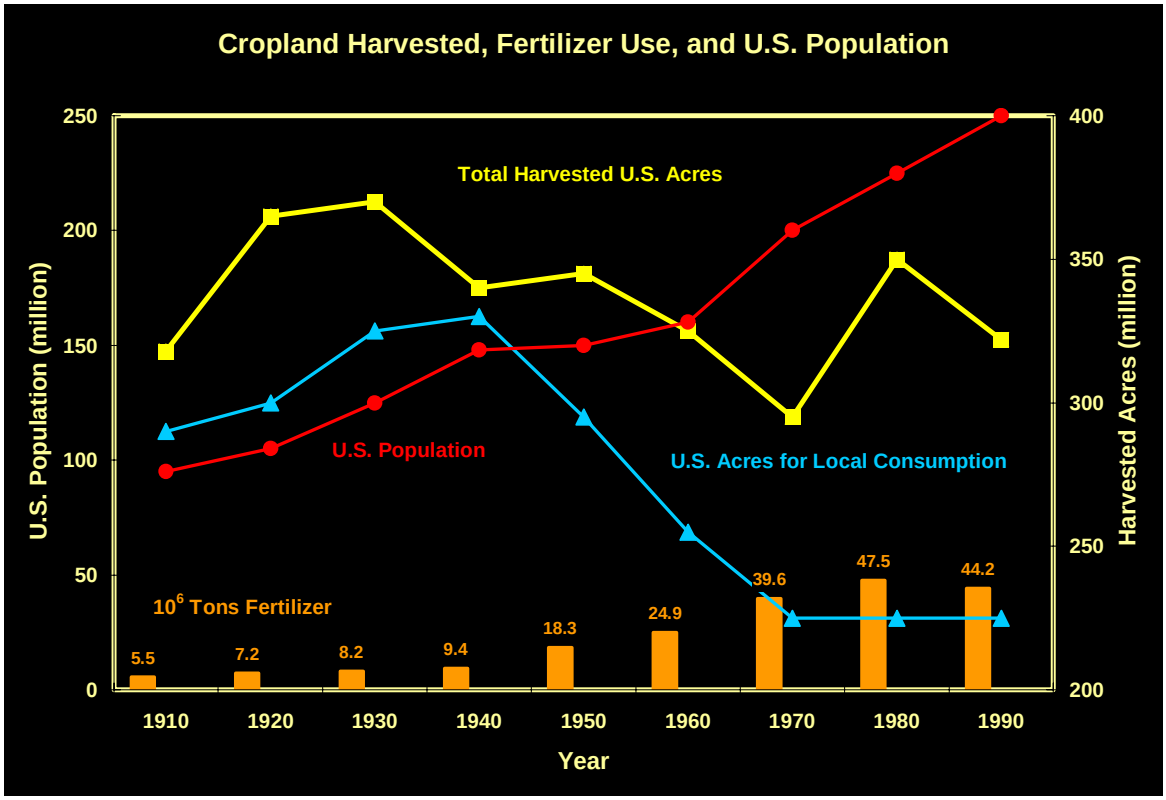

Figure 2. Total U.S. cropland harvested, U.S. cropland harvested for local consumption, fertilizer use, and U.S. population.

	Norfolk Soils (N.C.)		Tama Soils (Iowa)	
Year	1925	1983	1919	1979
Corn Yield (bu/A)	32	110	42	130
Fertilizer Rate (lbs/A)				
N	32–47	120–158	0	150–180
P	3–5	18	0	30–48
K	5–10	67	0	67–99

Figure 3. Historical comparison of average farmer fertilization rates on a naturally fertile and a naturally infertile soil in the United States (original data from soil survey reports and agricultural extension records).