# ECONOMICS OF SOIL HEALTH MANAGEMENT SYSTEMS ON FIVE COTTON FARMS

U.S. REGENERATIVE COTTON FUND

SOIL HEALTH INSTITUTE

## Highlights

- The Soil Health Institute conducted this project to provide farmers with the economics information they need when deciding whether to adopt soil health practices and systems.
- The five farmers interviewed in the upland cotton region grew crops on an average of 3,370 acres, using no-till on 93% and cover crops on 79% of those acres.
- Three of the five farmers interviewed reported increased yield from using a soil health management system, and none reported a yield decline.
- Based on the information provided by these farmers, it cost an average of $47.06/acre less to grow cotton using a soil health management system.
- Based on standardized prices, the soil health management system increased net income for these five farmers by an average of $100.66/acre for cotton.
- Farmers increased net income by an average of $97.06/acre for corn, $129.15/acre for soybean, and $49.51/acre for wheat.
- Current adoption rates of no-till (23%) and cover crops (8%) in the five-states (NC, SC, GA, MS, and TX) indicate that other cotton farmers may improve their profitability by adopting soil health management systems.
- Farmers also reported additional benefits of their soil health management system, such as increased resilience to extreme weather and improved access to their fields.
- The Soil Health Institute will conduct additional economic analyses of soil health systems in cotton production through the U.S. Regenerative Cotton Fund.

U.S. REGENERATIVE COTTON FUND
SOIL HEALTH INSTITUTE

## Introduction

Improving soil health can help build drought resilience, increase nutrient availability, suppress diseases, reduce erosion, and reduce nutrient losses. Many soil health management systems (i.e., a suite of soil health practices) also benefit the environment by storing soil organic carbon, reducing greenhouse gas emissions, and improving water quality. However, investing in soil health management systems (SHMS) is also a business decision. This project was conducted by the Soil Health Institute (SHI) to provide farmers with the economic information they need when making that decision.

SHI interviewed farmers who have adopted soil health systems to acquire production information for evaluating their economics based on partial budget analysis. In using this approach, the costs and benefits of a soil health system are compared before and after adoption of that system. A detailed description of the partial budget methodology can be found on the SHI website: https://soilhealthinstitute.org/economics/

A total of five farmers were interviewed across five states (NC, SC, GA, MS, and TX). These states collectively represent approximately 76% of the total cotton produced in the United States (USDA, NASS Crop Production 2021 Summary). The following summarizes the results obtained from five farmers interviewed (Fig. 1).

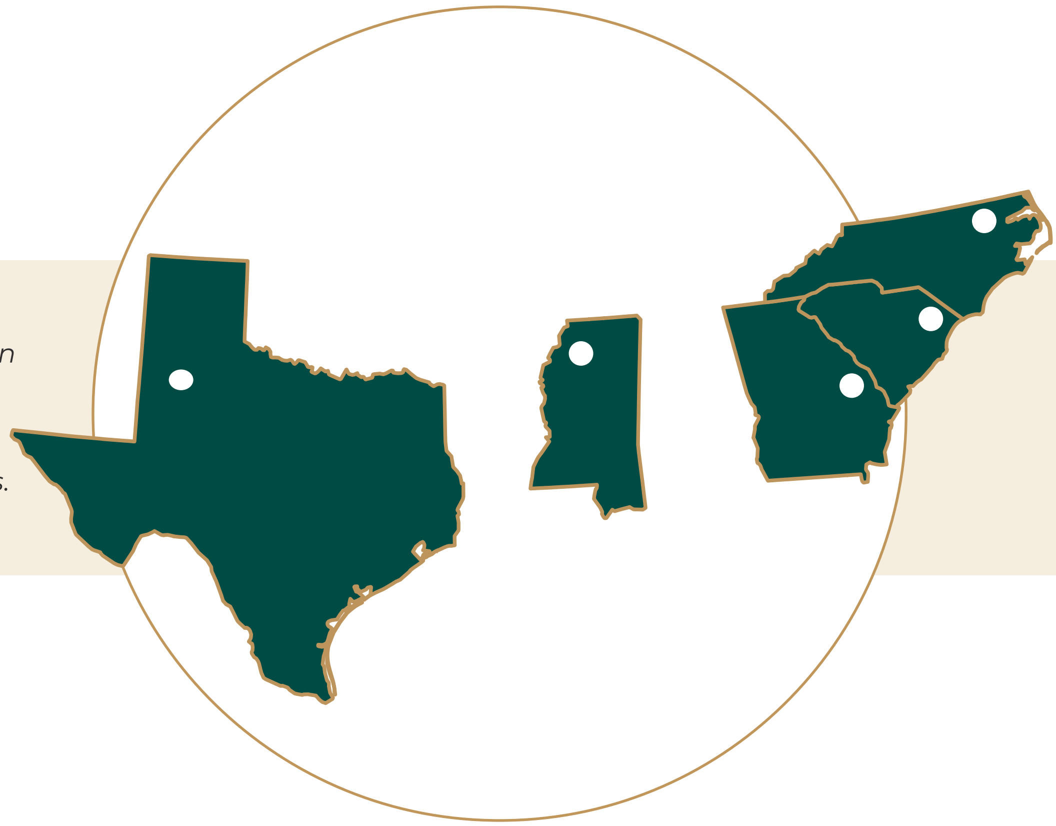


**Figure 1.** *Geographic distribution of the five farms used for economic analysis of soil health management systems.*

U.S. REGENERATIVE COTTON FUND
SOIL HEALTH INSTITUTE

## Farm Characteristics

The five cotton farms assessed in this project raised crops on an average of 3,370 acres, with 1,770 acres of cotton, 630 acres of corn, 560 acres of soybean, 735 acres of wheat (double crop 485 acres), 100 acres of peanut, and 60 acres of pink eye pea. (Table 1).

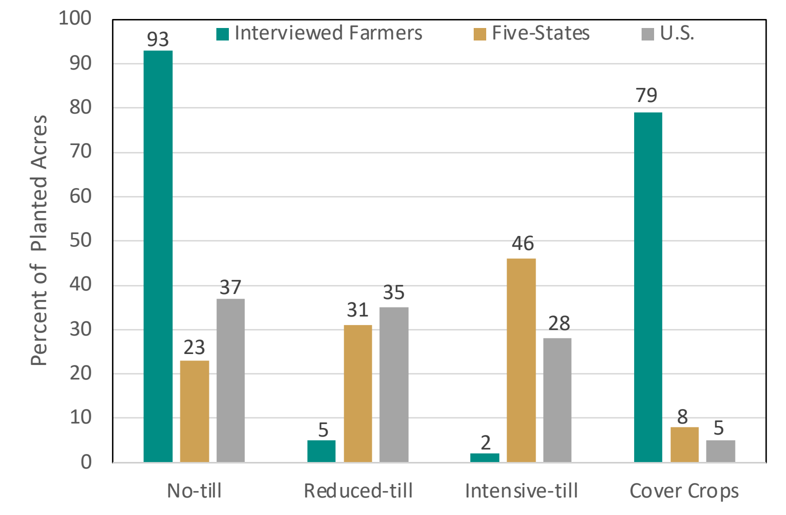
**Table 1.** *Growing conditions and crops for the five cotton farms.*

| Characteristics | Value |
|---|---|
| Range in Average Annual Precipitation (inches)[1] | 19 - 60 |
| Range in Mean Annual Temperature (°F)[1] | 54 - 68 |
| Average Acres in Cotton | 1,770 |
| Average Acres in Corn | 630 |
| Average Acres in Soybean | 560 |
| Average Acres in Wheat | 735 |
| Average Acres in Double Crop Wheat[2] | 485 |
| Average Acres in Peanut | 100 |
| Average Acres in Pink Eye Pea | 60 |
| Average Total Crop Acres | 3,370 |

[1] *PRISM Climate Group 30 Year Normals (1981-2010) (https://prism.oregonstate.edu/normals/).*
[2] *Double crop wheat acres were not added to the total crop acres.*

The five farmers interviewed reported that they have adopted no-till on an average of 93% of their planted land. This is considerably greater than the 23% adoption of no-till for these five states and 37% adoption for the U.S. (Fig. 2). The five farmers interviewed also reported using cover crops on 79% of their cropland, as compared to an average of 8% for the five states and 5% for the nation (Fig. 2).

**Figure 2.** *Percentage of planted acres in no-tillage, reduced tillage, intensive tillage, and cover crop practices for the five interviewed farmers as compared to cropland adoption of those practices in the five states and the U.S. (2017 U.S. Census of Agriculture)*



The farmers we interviewed who have been practicing no-till have been doing so for an average of 8 years with one farmer practicing strip tillage for 40 years, and those growing cover crops have been doing so for approximately 12 years. Such levels of experience indicate substantial opportunity for others to learn from these farmers when considering the business case for adopting soil health systems.

Soils consisted of farms with sandy loam, silt loam, and loam soil textures (Table 2). Four farms were applying no-till with one farm applying strip tillage, and all planted cover crops consisting of multi-seed mixes with three to six species (Table 2). Two farms had no irrigation and one had as much as 90% of acreage irrigated (Table 2).

**Table 2.** *Soil texture, soil health management system tillage practice, cover crop species, and percent of crop acreage irrigated for five cotton farms.*

| State | Soil Texture | Tillage Type for SHMS | Cover Crop Species | Percent Irrigated |
|---|---|---|---|---|
| North Carolina | loam | No-till | winter/cereal rye, hairy vetch, triticale, crimson clover, oats, brassicas | 0 |
| South Carolina | loam | No-till | winter/cereal rye, hairy vetch, winter pea, crimson clover, radish, black oats | 0 |
| Georgia | loam | Strip-till | black oats, annual rye, clover, vetch | 90 |
| Mississippi | sandy loam - silt loam | [1]No-till | winter/cereal rye, winter pea, radish | 35 |
| Texas | sandy loam | No-till | winter/cereal rye, hairy vetch, radish | 35 |

*[1]No-till acreage minimally tilled in selected years to reshape beds for furrow irrigation.*

## Partial Budget Analysis

Partial budgets were calculated to assess changes in cotton expenses and revenue associated with adopting a soil health management system. The results were averaged across the five cotton farms, as presented in Table 3.

**Table 3.** *Partial budget analysis[1] of adopting a soil health management system for cotton production on five farms. Unless shown otherwise, the units are $/acre (2019 dollars).*

| | Cotton | |
|---|---|---|
| | **Benefits** | **Costs** |
| **Expense Category** | **Reduced Expense** | **Additional Expense** |
| Seed | 0.00 | 25.60 |
| Fertilizer & Amendments | 32.33 | 4.69 |
| Pesticides | 21.91 | 10.14 |
| Round Module Covers | 0.00 | 0.67 |
| Fuel & Electricity | 12.52 | 5.58 |
| Labor & Services | 20.28 | 10.96 |
| Post-harvest Expenses | 0.00 | 0.00 |
| Equipment Ownership | 32.15 | 14.49 |
| **Total Expense Change** | **119.19** | **72.13** |
| | **Additional Revenue** | **Reduced Revenue** |
| Yield, lb. | 80.00 | 0.00 |
| Price Received[2], $/lb. | 0.67 | 0.67 |
| **Revenue Change** | **53.60** | **0.00** |
| | **Total Benefits** | **Total Costs** |
| Total Change | 172.79 | 72.13 |
| **Change in Net Farm Income** | **100.66** | |

[1]*Expenses and expected yields based on farmer reported production practices. https://soilhealthinstitute.org/economics/*

[2]*Commodity prices applied to yields based on long-term average prices. S. Irwin, "IFES 2018: The New, New Era of Grain Prices?" Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, January 11, 2019.*

Those farmers using cover crops reported planting them before cotton production. Cover crop seed expenses ranged from $10.00/acre to $40.00/acre, for an average of $23.60/acre. One farm reported an increased seeding rate when planting cotton, raising the average additional seed cost to $25.60/acre. Both reduced expenses and additional expenses often occurred in the same category (Table 3). For example, when adopting a SHMS, a farmer may decrease nitrogen application in one form (e.g., fertilizer), while adding nitrogen in an alternative form (e.g., manure).

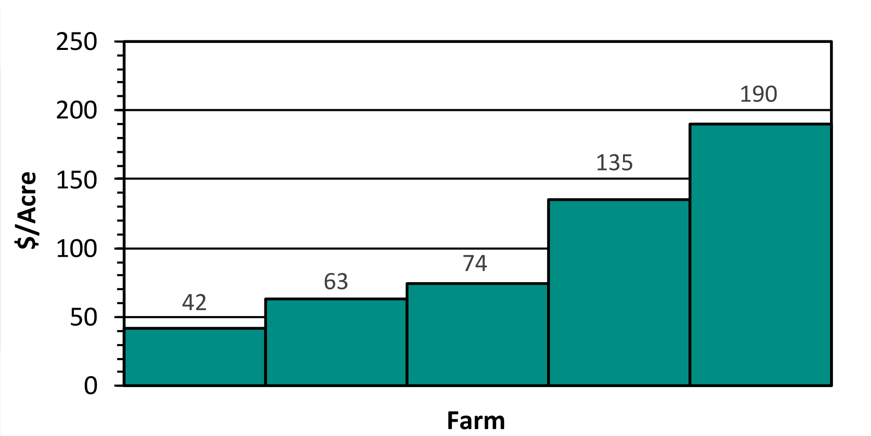
Net fertilizer and amendment expenses were reduced by $27.64/acre (32.33 - 4.69 in Table 3), with farmers implementing nutrient management practices such as grid soil sampling (100%), variable rate fertilizer application (40%), and split application of nitrogen (40%) as part of their overall soil health management system. Pesticide expenses were also $11.77/acre lower with a soil health system (21.91 - 10.14 in Table 3). In total, expenses for producing cotton were $47.06/acre lower (119.19 – 72.13 in Table 3) in a soil health management system when averaged across these five farms.

None of the five farms reported a cotton yield decline from adopting a soil health management system. In fact, three of the five reported increased cotton yield, averaging 80 lb./acre (Table 3). Increased post-harvest expenses associated with hauling, ginning, and other fees were assumed paid by increased value of cottonseed.

Recognizing that market prices fluctuate, we calculated revenue by using a long-term average cotton price, as shown in the footnote to Table 3. Using those prices, revenue from growing cotton in a soil health management system increased by $53.60/acre.

Combining the changes in expenses and revenue showed that the soil health management system increased net income for these five farms by an average of $100.66/acre for cotton (Table 3). Although higher yield contributed substantially to this increase, it was previously shown that total expenses for growing cotton were $47.06/acre lower with a soil health management system. This means that even if yield did not increase, the soil health system was still more profitable on these farms due to the reduced expense of growing cotton by using a soil health management system. The range in net farm income for all five farmers, displayed in Fig. 3, shows that while economic benefits varied for each farmer, all farmers reported a positive benefit for cotton ranging from $42.00/acre to $190.00/acre. The farms with the greatest net farm income increases were those three reporting yield increases due to SHMS.

**Figure 3.** *Change in net farm income for 5 farms after adopting a soil health management system compared to a conventional system, cotton, $/Acre.*




Financial benefits for growing other crops were also reported by these farmers. Those growing corn reported net farm income to increase from $57.10 to $133.39/acre (averaging $97.06/acre), and soybean producers reported net farm income to increase from $62.88 to $195.21/acre (averaging $129.15/acre) when adopting a soil health management system.

Those growing wheat reported net farm income to change by -$4.09 to $103.10/acre (averaging $49.51/acre) when adopting a soil health management system. One farm also harvested cover crops for silage and realized additional net income of $400.00/acre.

## Additional Benefits

All interviewed farmers reported increased crop resilience to extreme weather such as drought and heavy rain (Table 4). In addition to such benefits that directly impact profitability, these farmers also reported other benefits from adopting a soil health system, such as increased access to their fields (four of five) and improved water quality (all five) (Table 4). Changes in water quality were based on visual differences in water clarity observed by the farmers.

Interestingly, many of these farmers were monitoring changes in their soil organic matter levels, and three of five reported that those levels increased by an average of 1.2% due to the soil health management system (Table 4). Research has shown that higher soil organic matter increases available nutrients and available water holding capacity, which is consistent with reduced fertilizer application, increased crop resilience, and improved field access observed by these cotton farmers.

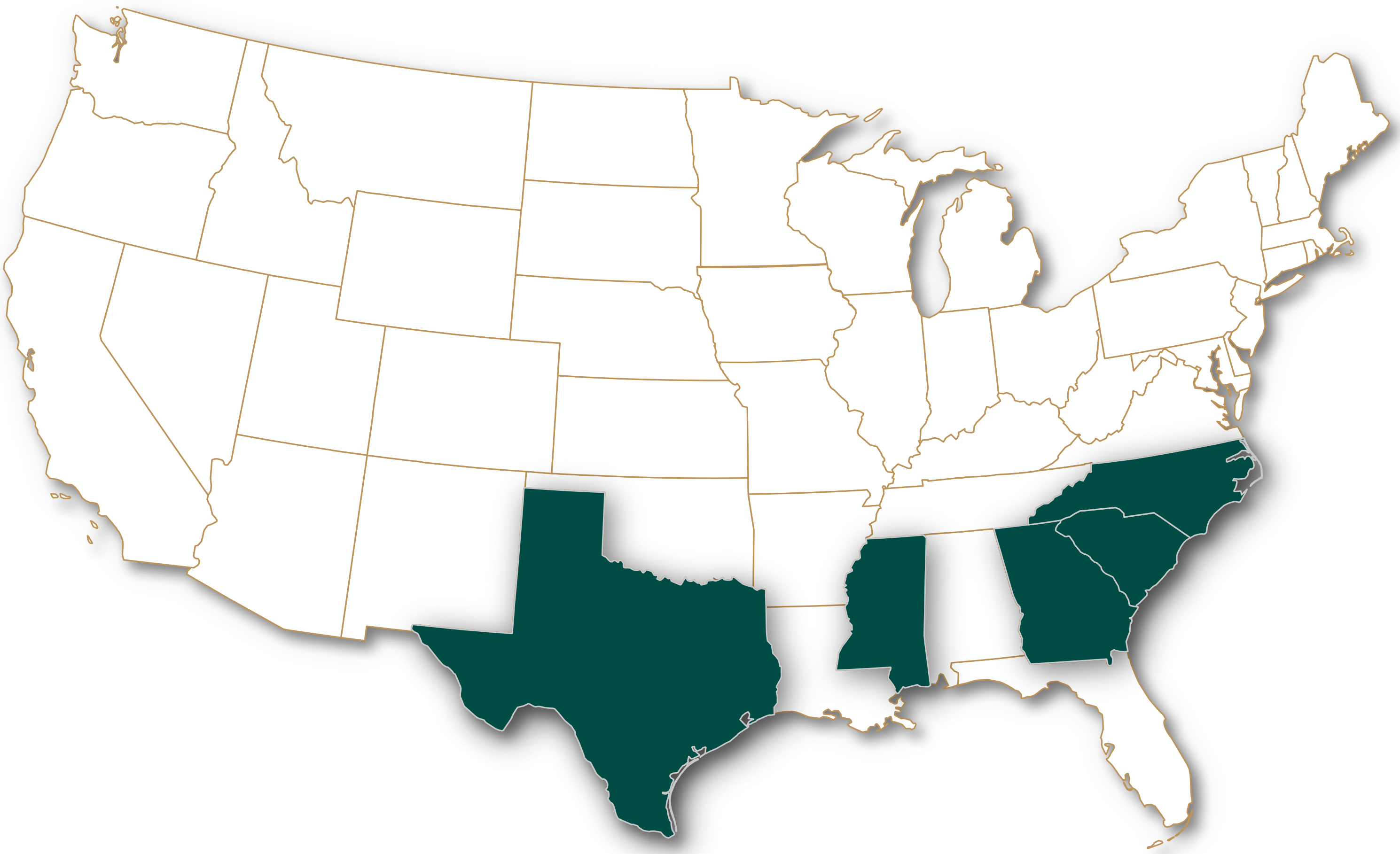
**Table 4.** *Summary of soil health management system benefits reported by 5 cotton farmers.*

| Benefit | % Responding Yes |
|---|---|
| Increased Crop Resiliency | 100 |
| Reduced Fertilizer Expense | 80 |
| Increased Field Access | 80 |
| Improved Water Quality | 100 |
| Increased Soil Organic Matter | 60 |

## Summary

The Soil Health Institute conducted this project to provide farmers with the economics information they need when deciding whether to adopt soil health systems. The five farmers interviewed grew crops on an average of 3,370 acres, using no-till on 93% and cover crops on 79% of those acres. Sixty percent of the farmers interviewed reported increased yield from using a soil health management system, and none reported a yield decline. Based on the information provided by these farmers, it cost an average of $47.06/acre less to grow cotton using a soil health management system. Based on standardized prices, the soil health management system increased net income for these five farmers by an average of $100.66/acre for cotton. Farmers who grew corn increased net income by an average of $97.06/acre, those who grew soybean increased net farm income by $129.15/acre, and those who grew wheat increased net income by an average of $49.51/acre when adopting a soil health management system. The current adoption rates of no-till (23%) and cover crops (8%) in the five-state region indicate that other cotton farmers may improve their profitability by adopting soil health management systems. Farmers also reported additional benefits of their soil health system, such as increased resilience to extreme weather and increased access to their fields. The Soil Health Institute will conduct additional economic analysis of soil health systems in cotton production through the U.S. Regenerative Cotton Fund.

# ECONOMICS OF SOIL HEALTH SYSTEMS ON FIVE COTTON FARMS



OUR MISSION: SAFEGUARD AND ENHANCE THE VITALITY AND PRODUCTIVITY OF SOIL THROUGH SCIENTIFIC RESEARCH AND ADVANCEMENT

U.S. REGENERATIVE COTTON FUND

SOIL HEALTH
INSTITUTE