ECONOMICS OF SOIL HEALTH MANAGEMENT SYSTEMS ON EIGHT COTTON FARMS IN GEORGIA

U.S. REGENERATIVE COTTON FUND

SOIL HEALTH INSTITUTE

Highlights

- The Soil Health Institute conducted partial budget analyses to provide Georgia farmers with the economic information they need when deciding whether to adopt soil health practices and systems.
- The eight farmers interviewed grew crops on an average of 1,439 acres, using reduced tillage on 68% and cover crops on 64% of those acres.
- No farmers interviewed reported decreased cotton yield from using a soil health management system, and three farmers reported increased yield that averaged 72 lb./acre across the eight farms.
- Based on the information provided by these farmers, it cost an average of $48/acre less to grow cotton using a soil health management system.
- Based on standardized prices, soil health management systems increased net income for these eight farmers by an average of $98/acre for cotton.
- Soil health management systems for other crops in the cotton rotation also increased net income by an average of $60/acre for corn, $89/acre for peanut, and $127/acre for soybean.
- Farmers reported additional benefits of their soil health management system, such as increased resilience to extreme weather and improved access to their fields.
- Current adoption rates in Georgia of conservation tillage (62%) and cover crops (18%) indicate that other Georgia cotton farmers may improve their profitability by adopting soil health management systems.

Introduction

Improving soil health can build drought resilience, reduce wind and water erosion, increase nutrient availability, reduce nutrient losses, and enhance management of some plant diseases. Many soil health management systems (SHMS - 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 SHMS is a business decision that must be economically viable. This project was conducted in Georgia by the Soil Health Institute (SHI) to provide cotton growers with the economic information they need when making that decision.

SHI interviewed eight Georgia farmers who have adopted soil health systems to acquire production information for evaluating their economics based on partial budget analysis (Fig. 1). 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/.

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

Farm Characteristics

The eight cotton farms assessed in this project raised crops on an average of 1,439 acres, cropping cotton, peanut, corn, winter wheat, and soybean. All soybean acreage was double cropped with wheat (Table 1).

Table 1. *Average annual precipitation[1], temperature[1], and crop acres reported for the eight cotton farms.*

Characteristics	Value
Mean Annual Precipitation[1] (inches)	40 to 60
Mean Annual Temperature[1] (°F)	61 to 68
Cotton (acres)	715
Peanut (acres)	300
Corn (acres)	249
Winter Wheat (acres)	169
Soybean (acres)	119
Other Crops (acres)	6
Double Crop (acres)	119
Total Crop Acres	1,439

[1] *PRISM Climate Group 30-Year Normals (1981-2010) (https://prism.oregonstate.edu/normals/).*

The eight farmers interviewed reported that they have adopted strip tillage and other reduced tillage on 68% of their planted land. This compares to 62% adoption of conservation tillage for Georgia and 72% adoption for the U.S. (Fig. 2). Intensive tillage used by the eight farmers was mostly associated with peanut harvest. The eight farmers interviewed also reported using cover crops on 64% of their cropland. This is considerably greater than an average of 18% for Georgia and 5% for the nation (Fig. 2).

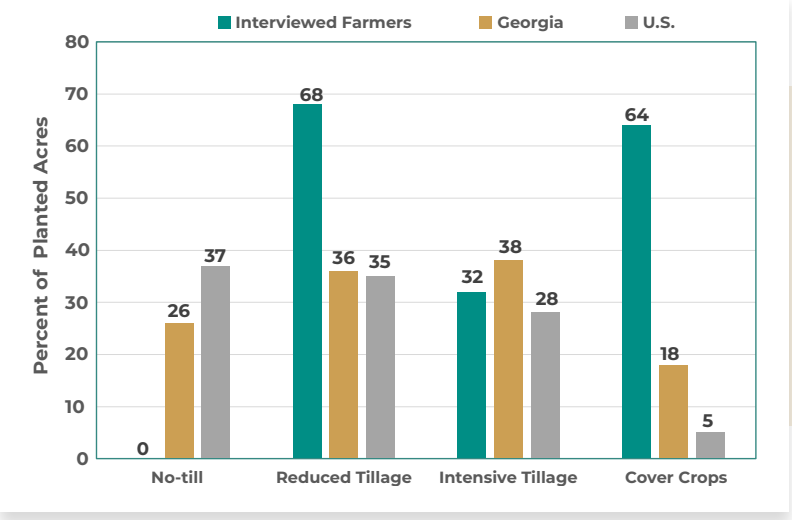


Figure 2. *Percentage of planted acres in no-till, reduced tillage, intensive tillage, and cover crop practices for the eight interviewed farmers in Georgia as compared to cropland adoption of those practices in all of Georgia and the U.S. (2017 U.S. Census of Agriculture, Chapter 1, Table 47).*

The farmers who have been practicing reduced tillage have been doing so for an average of 19 years. The farmers planting cover crops have been doing so for an average of 10 years. Such levels of experience indicate substantial opportunity for learning from these farmers when considering the business case for adopting soil health systems.

Soil types were representative of row crop fields in Georgia and ranged in texture from sandy to clay loam (Table 2). All farms were applying strip tillage practices on cotton acres. One farm practiced reduced tillage for corn and no-till for soybean and wheat. Additionally, one farm practiced no-till for wheat and reduced tillage for crops other than wheat. Six farms planted peanut as a rotation crop with two farms practicing conventional tillage, two farms practicing strip tillage, and two farms practicing other reduced tillage for peanut production. Seven farms planted cover crops consisting of seed mixes having one to six species. One farm allowed winter weeds to grow as a voluntary cover crop before termination in the spring (Table 2). Three of the farms planting cover crops by broadcasting the seed before digging peanut utilized the digging process to incorporate cover crop seeds into the soil. Irrigated acreage ranged from 6% to 95% of cropland acreage (Table 2).

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

Farm	Surface Soil Texture	Tillage Type for SHMS[1]	Cover Crop Species	Percent Irrigated
1	clay loam and sandy loam	strip tillage	wheat	6
2	sandy loam	strip tillage	black oat, annual rye, clover, vetch	95
3	sandy	strip tillage	winter/cereal rye	81
4	sandy loam	strip tillage	legumes, grasses, brassicas	63
5	sandy loam	strip tillage	winter weeds as voluntary cover crop	77
6	sandy loam	strip tillage	wheat	40
7	clay and sandy loam	strip tillage	oat, radish	60
8	sandy loam	strip tillage	winter/cereal rye, vetch, clover, radish, rapeseed, black oat	46

[1] *SHMS is soil health management system.*

Partial Budget Analysis

Partial budgets were calculated to assess changes in cotton expenses and revenue associated with adopting a SHMS. Results were averaged across the eight cotton farms, as presented in Table 3.

Table 3. *Partial budget analysis[1] of adopting a soil health management system for cotton production on eight farms. Expense, revenue, and net farm income units are $/acre (2020 dollars).*

	Cotton	
	Benefits	**Costs**
Expense Category	**Reduced Expense**	**Additional Expense**
Seed	0.00	19.25
Fertilizer & Amendments	22.52	2.90
Pesticides	24.14	6.43
Fuel & Electricity	11.06	2.92
Labor & Services	19.26	7.00
Post-harvest Expenses	0.00	0.00
Equipment Ownership	22.67	13.24
Total Expense Change	**99.65**	**51.74**
	Additional Revenue	**Reduced Revenue**
Yield, lb./acre	71.88	0.00
Price Received[2], $/lb.	0.70	0.70
Revenue Change	**50.32**	**0.00**
	Total Benefits	**Total Costs**
Total Change	149.97	51.74
Change in Net Farm Income	**98.23**	

[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.*

Seven farmers using cover crops reported planting them prior to cotton production. Cover crop seed expenses ranged from $5.50/acre for a one bushel/acre seeding rate of wheat to $40.00/acre for a multi-species mix, with a seven-farm average of $22.00/acre (Table 3). Additional seed expenses averaged $19.25/acre for all farms.

Adopting SHMS can reduce some expenses and increase others. For example, long-term use of SHMS can increase nutrient availability in soils, and indeed, five of these farmers reduced their fertilizer expenses, while also implementing a nutrient management program of soil testing and monitoring. Net fertilizer and amendment expenses were reduced by an average of $18.33/acre ($22.52 minus $2.90 in Table 3).

Reducing tillage and planting cover crops can potentially suppress weeds and lead to changing or eliminating some herbicides. In other situations, herbicides are increased to terminate cover crops or to control weeds that had previously been controlled with tillage. In addition, some of the Georgia farms reported reduced insecticides as a result of cover crops attracting beneficial insects and reduced fungicides due to better crop disease resistance attributable to improved soil health. Consequently, when averaging across all eight farms, we found that pesticide expenses were both reduced by $24.14/acre and increased by $6.43/acre (Table 3).

Adopting no-till and reduced tillage decreases costs for equipment ownership, fuel, labor, and other expenses associated with conventional tillage practices. Reduced expenses in Table 3 for equipment ownership ($22.67/acre) and associated expenses ($11.06/acre and $19.26/acre) totaled $52.99/acre. Examples of additional expenses included equipment ownership, spray applications, and planting cover crops. Additional expenses totaled $23.16/acre (see Table 3).

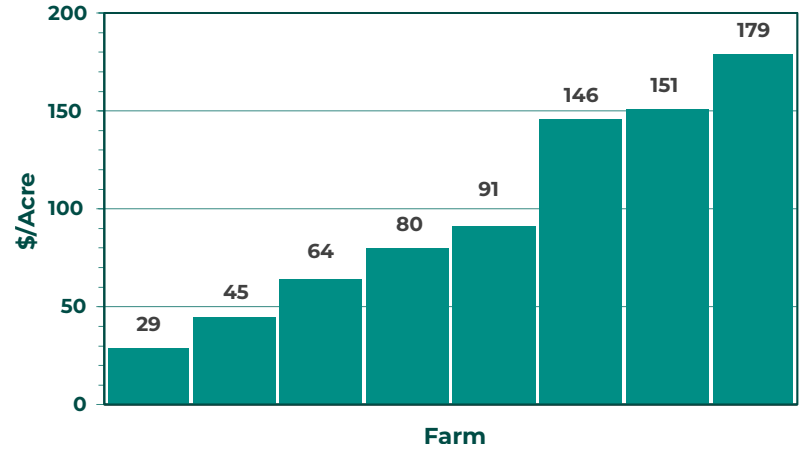
Three farms reported increased cotton yield from adopting SHMS with an eight-farm average increase of 71.88 lb./acre (Table 3). Increased post-harvest expenses associated with hauling, ginning, and other fees were assumed paid by increased value of cottonseed.

Because market prices for crops fluctuate, revenue was calculated by applying a long-term average cotton price, which is explained in the footnote to Table 3. Using those prices, revenue from growing cotton in a SHMS increased by $50.32/acre.

Combining the changes in expenses and revenue showed that a SHMS increased net income for these eight farms by an average of $98.23/acre for cotton (Table 3). Although greater yield contributed substantially to this increase, it cost $47.91/acre less to grow cotton using a SHMS when averaged across all eight farms ($99.65 minus $51.74) (Table 3). Even when yield does not increase, the SHMS was still more profitable because of the reduced expense of growing cotton with a SHMS.

While economic benefits ranged from $29.00 to $179.00 per acre, all farmers reported an increase in net farm income when growing cotton with a SHMS (Fig. 3). The two farms with the greatest net farm income increases ($179.00/acre, $151.00/acre) each had the greatest yield increase of 200.00 lb./acre (Fig. 3). The farm with net farm income increase of $146.00/acre was the other farm with a yield increase (175.00 lb./acre). All other farms had no yield increase, and their net farm income increases were only due to reductions in expenses (Fig. 3).

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



Generally, financial benefits for growing other crops with SHMS were also reported by these eight farmers. Five farmers growing corn reported net farm income to increase from $7.77/acre to $125.21/acre (average $59.72/acre) from adopting SHMS. Four farms growing peanut with a SHMS increased net farm income from $0.42/acre to $298.58/acre (average $88.67/acre). Two farms growing soybean reported net farm income increases that averaged $127.37/acre, and two growing winter wheat reported net farm income to change from a decrease of $3.66/acre to an increase of $4.38/acre (average $0.36/acre) when adopting SHMS. One farm included harvesting silage from cover crops as a component of the SHMS and realized additional net income of $400.00/acre.

Additional Benefits

In addition to reduced equipment ownership expenses per acre in Table 3, there is potential for decreasing total value of equipment owned. Equipment entails long-term capital debt which exposes a farm to financial risk, especially during periods of depressed commodity prices. Fifty percent of the farmers in Table 4 reported decreased value of owned equipment due to adopting SHMS which reduces long-term capital debt and exposure to financial risk. Alternatives to reducing value of equipment owned include retaining equipment to farm additional acreage, upgrading equipment that is associated with SHMS, or retaining tillage equipment for short-term use on newly rented land. In addition to benefits that directly impact profitability, these farmers also reported other benefits from a SHMS, such as increased crop resilience (88%), more timely access to their fields (100%), and improved water quality (100%) (Table 4). Changes in water quality were based on visual differences in water clarity observed by the farmers. In addition to improved water quality, four farmers reported measurements of decreased irrigation water applied due to improved moisture retention and efficiency. Sixty-three percent of the farmers stated that adoption of SHMS improved public perception of agricultural production.

Soil organic matter is naturally low in Georgia and testing for levels is not typically a component of fertility management. Many of these farmers were visually monitoring for observable changes in their soil organic matter levels, and 63% reported that those levels appeared to have increased due to the SHMS (Table 4). Research has shown that higher soil organic matter increases available nutrients and available water holding capacity, which is consistent with reduced fertilizer applications, increased crop resilience, and improved field access observed by these cotton farmers.

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

Benefit	% Responding Yes
Decreased Capital Expense of Equipment	50
Increased Crop Resilience	88
Increased Field Access	100
Improved Water Quality	100
Improved Public Perception of Agriculture	63
Increased Soil Organic Matter	63

Summary

The Soil Health Institute conducted partial budget analyses to provide farmers with the economic information they need when deciding whether to adopt soil health management systems (SHMS). The eight farmers interviewed in Georgia grew crops on an average of 1,439 acres, using reduced tillage on 68% and cover crops on 64% of those acres. Based on information provided by these farmers, it cost an average of $47.91/acre less to grow cotton using a SHMS. Three farmers reported increased cotton yield from using a SHMS. Based on standardized prices, the SHMS increased net income for these eight farmers by an average of $98.23/acre for cotton. Average net farm increases for farmers adopting a SHMS with other crops were $59.72/acre for corn, $88.67/acre for peanut, $127.37/acre for soybean, and $0.36/acre for winter wheat. Farmers also reported additional benefits of their SHMS, such as increased resilience to extreme weather and increased access to their fields. The current adoption rates of combined no-till and reduced tillage (62%) and cover crops (18%) in Georgia indicate that additional cotton farms may improve their profitability by adopting a soil health management system.

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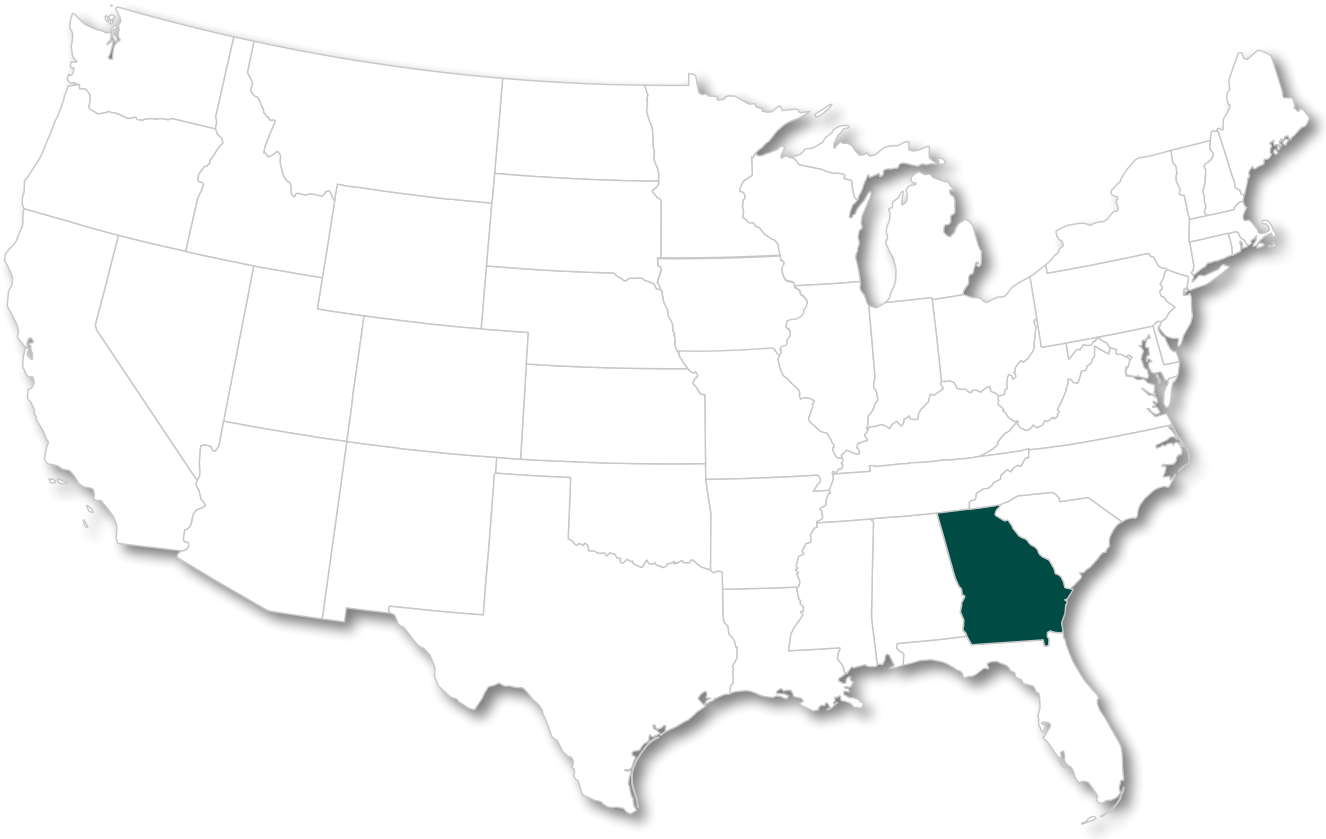

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