# ECONOMICS OF SOIL HEALTH MANAGEMENT SYSTEMS ON EIGHT COTTON FARMS IN THE TEXAS SOUTHERN GREAT PLAINS

U.S. REGENERATIVE COTTON FUND

SOIL HEALTH INSTITUTE

## Highlights

- The Soil Health Institute conducted this project to provide Texas Southern Great Plains 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 4,752 acres, using no-till on 63%, reduced tillage on 37%, and cover crops on 84% of those acres.
- All farmers interviewed reported increased cotton yield that averaged 134 lb./acre from using a soil health management system.
- Based on the information provided by these farmers, it cost an average of $63/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 cotton farmers by an average of $157/acre for cotton.
- Farmers adopting soil health management systems for other crops also increased net income by an average of $73/acre for grain sorghum and $130/acre for corn.
- All eight cotton farmers increased net farm income with a soil health management system, whether with high input or low input practices (e.g., irrigated or non-irrigated).
- Farmers reported additional benefits of their soil health management system such as increased resilience to extreme weather and improved access to their fields.
- Farmers reported fewer trips with sand fighters (implements used to control wind erosion) after adopting soil health management systems.
- Current adoption rates in Texas of no-till (15%), reduced tillage (31%), and cover crops (6%) indicate that other Texas Southern Great Plains 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 study of cotton production in the Texas Southern Great Plains was conducted by the Soil Health Institute (SHI) to provide farmers with the economic information they need when making that decision.

SHI interviewed eight farmers who have adopted soil health systems in the Texas Southern Great Plains 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 4,752 acres, with 3,119 acres of cotton, 544 acres of winter wheat, 494 acres of grain sorghum, 269 acres of corn, and 63 acres of other various crops. An average of 263 acres/year was fallow (Table 1).

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

| Characteristics | Value |
|---|---|
| Mean Annual Precipitation[1] (inches) | 16 - 24 |
| Mean Annual Temperature[1] (°F) | 57 - 64 |
| Cotton (acres) | 3,119 |
| Winter Wheat (acres) | 544 |
| Grain Sorghum (acres) | 494 |
| Corn (acres) | 269 |
| Other Crops (acres) | 63 |
| Fallow (acres) | 263 |
| Total Crop Acres | 4,752 |

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

The eight farmers interviewed reported that they have adopted conservation tillage practices (100%) with no-till on an average of 63% and reduced tillage on 37% of their planted land. This is considerably greater than the 46% adoption of conservation tillage for Texas and 72% adoption for the U.S. (Fig. 2). The eight farmers interviewed also reported using cover crops on 84% of their cropland, as compared to an average of 6% for Texas and 5% for the nation (Fig. 2).

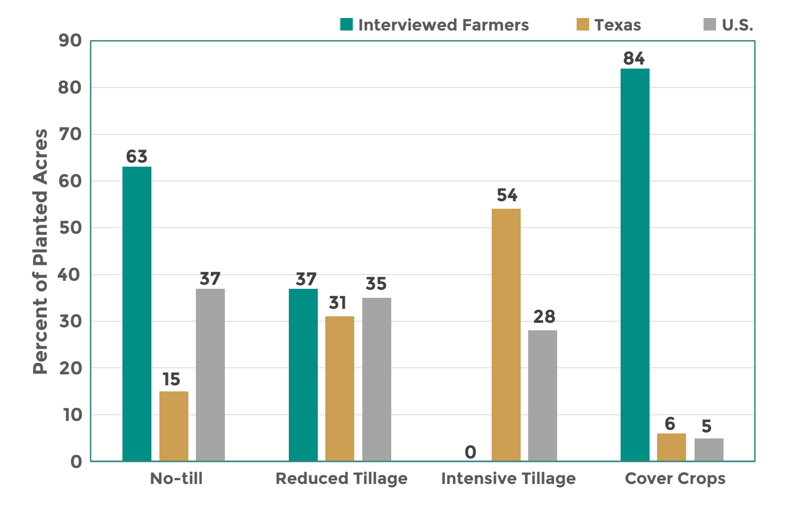


**Figure 2.** *Percentage of planted acres in no-tillage, reduced tillage, intensive tillage, and cover crop practices for the eight interviewed farmers in the Texas Southern Great Plains as compared to cropland adoption of those practices in all of Texas and the U.S. (2017 U.S. Census of Agriculture,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

The farmers who have been practicing no-till have been doing so for an average of 11 years, while those practicing reduced tillage have been doing so for an average of 8 years. The farmers planting cover crops have also been doing so for an average of 8 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.

Soil types were representative of row crop fields in the Texas Southern Great Plains and ranged in texture from sandy loam to clay loam (Table 2). Four farms were applying no-till, and two farms were applying reduced tillage practices. Two farms had separate acreages with no-till and reduced tillage applications. Seven farms planted cover crops consisting of seed mixes having one to three species (Table 2).

Using cover crops in the Texas Southern Great Plains entails annual considerations for planting due to inconsistent precipitation resulting in limited soil moisture. Of the seven farmers planting cover crops (representing 84% of planted acreage (Fig. 2)), six reported planting cover crops on 100% of crop acreage and one reported cover crops on 50% of crop acreage. These percentages are for typical years with adequate soil moisture. In years with inadequate soil moisture, farmers reported that cover crops were not planted, and the SHMS applied was no-till or reduced tillage without cover crops.

One farm had no irrigation, while 13-64% of cropland was irrigated on the remaining seven farms (Table 2). These irrigated percentages reflect the maximum crop acreage with installed irrigation capability. In severely dry production years, farmers reported that irrigated acreage may be reduced to efficiently use the limited available water on only a portion of the acreage capable of receiving irrigation.

**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 | no-till | none | 13 |
| 2 | clay loam and sandy loam | no-till | winter/cereal rye | 21 |
| 3 | fine sandy loam | reduced till | winter/cereal rye, wheat, oats | 0 |
| 4 | clay loam and sandy loam | no-till | winter/cereal rye | 49 |
| 5 | sandy loam | no-till; reduced till for organic cotton | winter/cereal rye, hairy vetch, radish | 35 |
| 6 | clay loam | no-till; rented land begins as reduced till | winter/cereal rye, wheat | 64 |
| 7 | clay loam and sandy loam | no-till | winter/cereal rye, radish | 60 |
| 8 | clay loam and sandy loam | reduced till | wheat | 50 |

[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 soil health management system. The 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 | 11.63 | 9.00 |
| Fertilizer & Amendments | 20.33 | 2.00 |
| Pesticides | 12.69 | 12.86 |
| Round Module Covers | 0.00 | 1.51 |
| Fuel & Electricity | 15.22 | 2.86 |
| Labor & Services | 21.69 | 8.97 |
| Post-harvest Expenses | 0.00 | 0.00 |
| Equipment Ownership | 35.34 | 16.22 |
| **Total Expense Change** | **116.90** | **53.42** |
| | **Additional Revenue** | **Reduced Revenue** |
| Yield, lb. | 134.00 | 0.00 |
| Price Received[2], $/lb. | 0.70 | 0.70 |
| **Revenue Change** | **93.80** | **0.00** |
| | **Total Benefits** | **Total Costs** |
| Total Change | 210.70 | 53.42 |
| **Change in Net Farm Income** | **157.28** | |

[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.*

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Seven farmers using cover crops reported planting them before cotton production. Cover crop seed expenses ranged from $2.00/acre for a low seeding rate of wheat to $20.00/acre with an average of $10.29/acre. Additional seed expenses averaged $9.00/acre for all farms in Table 3. Two farmers decreased seeding rates when planting cotton with a SHMS, resulting in an average reduced seed cost of $11.63/acre in Table 3.

Adopting SHMS can reduce some expenses and increase others. For example, long-term use of SHMS can increase nutrient availability in soils, and indeed, four of these farmers reduced their fertilizer expenses, while also implementing a nutrient management program of soil testing and plant monitoring. Net fertilizer and amendment expenses were reduced by an average of $18.33/acre (20.33 – 2.00 in Table 3). Reduced expenses due to SHMS were similar for farms with high input and low input practices (e.g., irrigated and non-irrigated).

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. Consequently, when averaging across all 8 farms, we found that pesticide expenses were both reduced by $12.69/acre and increased by $12.86/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 ($35.34/acre) and associated expenses ($15.22/acre and $21.69/acre) totaled $72.25/acre. Extreme wind is a common issue in the Texas Southern Great Plains, and five of the farms reported reduced expenses that included field trips with sand fighters (implements used to reduce wind erosion) in conventional tillage for managing impacts of wind erosion. Examples of SHMS additional expenses in Table 3 for equipment ownership ($16.22/acre) and associated expenses ($2.86/acre and $8.97/acre) included spray applications and planting cover crops. Additional expenses totaled $28.05/acre.

All farms reported increased cotton yield from adopting SHMS with an average increase of 134.00 lb./acre (Table 3), though high input farms (i.e., irrigated farms) tended to have greater increases in yield. 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, as shown in the footnote to Table 3. Using those prices, revenue from growing cotton in a SHMS increased by $93.80/acre.

Combining the changes in expenses and revenue showed that a SHMS increased net income for these eight farms by an average of $157.28/acre for cotton (Table 3). Although higher yield contributed substantially to this increase, it cost $63.48/acre less to grown cotton using a SHMS when averaged across all 8 farms (116.90-53.42 in Table 3). This means that even if yield did not increase, the SHMS was still more profitable on these farms due to the reduced expense of growing cotton with a SHMS.

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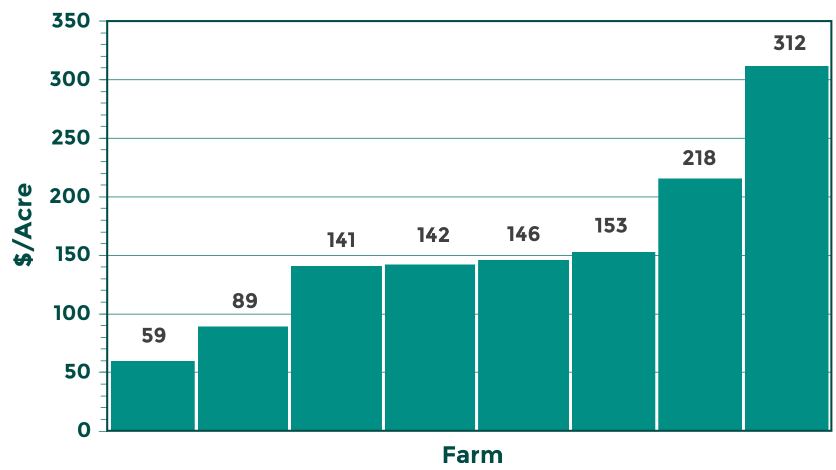
While economic benefits ranged from $59.00 to $312.00 per acre, all farmers reported an increase in net farm income when growing cotton with a SHMS (Fig. 3). The farm with the greatest net farm income increase ($312.00 /acre) had the greatest net decrease in expenses of $207.00/acre (Fig. 3). This farm adopted 80-inch row spacings which led to reduced expenses for seed, fertilizers and amendments, and pesticides. The farm with the second greatest net farm income increase ($218.00/acre) had the greatest yield increase of 250.00 lb./acre (Fig. 3). The two farms with the lowest increases in net farm income ($59.00/acre, $89.00/acre) each had the lowest yield increase of 50.00 lb./acre, and the farm with net farm income of $59.00/acre had the lowest net expense decrease of $24.00/acre (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. Farmers growing grain sorghum reported net farm income to increase from $60.83 to $85.64/acre (averaging $73.24/acre) when adopting SHMS. One farm growing corn with a SHMS increased net farm income $130.12/acre. Those growing winter wheat reported net farm income to change from a decrease of $32.53/acre to an increase of $12.78/acre (averaging $-9.88) when adopting SHMS. In addition to cotton included in Table 3 and Fig. 3, one farm reported organic cotton separately with a net farm increase of $186.17/acre. One farm included grazing of cover crops as a component of the SHMS and realized additional net income of $225.00/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. Seventy-five 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 (75%), and improved water quality (75%) (Table 4). Changes in water quality were based on visual differences in water clarity observed by the farmers. Some farms of the Texas Southern Great Plains are not associated with nearby streams and waterways that involve potential water quality issues. Fifty percent of the farmers stated that adoption of SHMS improved public perception of agricultural production.

All farmers reported SHMS benefits associated with improved water infiltration and soil moisture efficiency. Of the seven farmers with irrigation in Table 2, two reported measurements of decreased irrigation water applied due to the SHMS. Limited water availability in the Texas Southern Great Plains impacts irrigation amounts applied per acre, and farmers often view the benefit as more of their acreage having irrigation capabilities rather than applying full levels on only some acreage. The benefit of improved soil moisture efficiency is increased yield spread over more acreage.

Interestingly, many of these farmers were monitoring changes in their soil organic matter levels, and 50% reported that those levels increased due to the SHMS (Table 4). Measured increases were consistent with 0.1% per year increases attributable to soil health practices. 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.

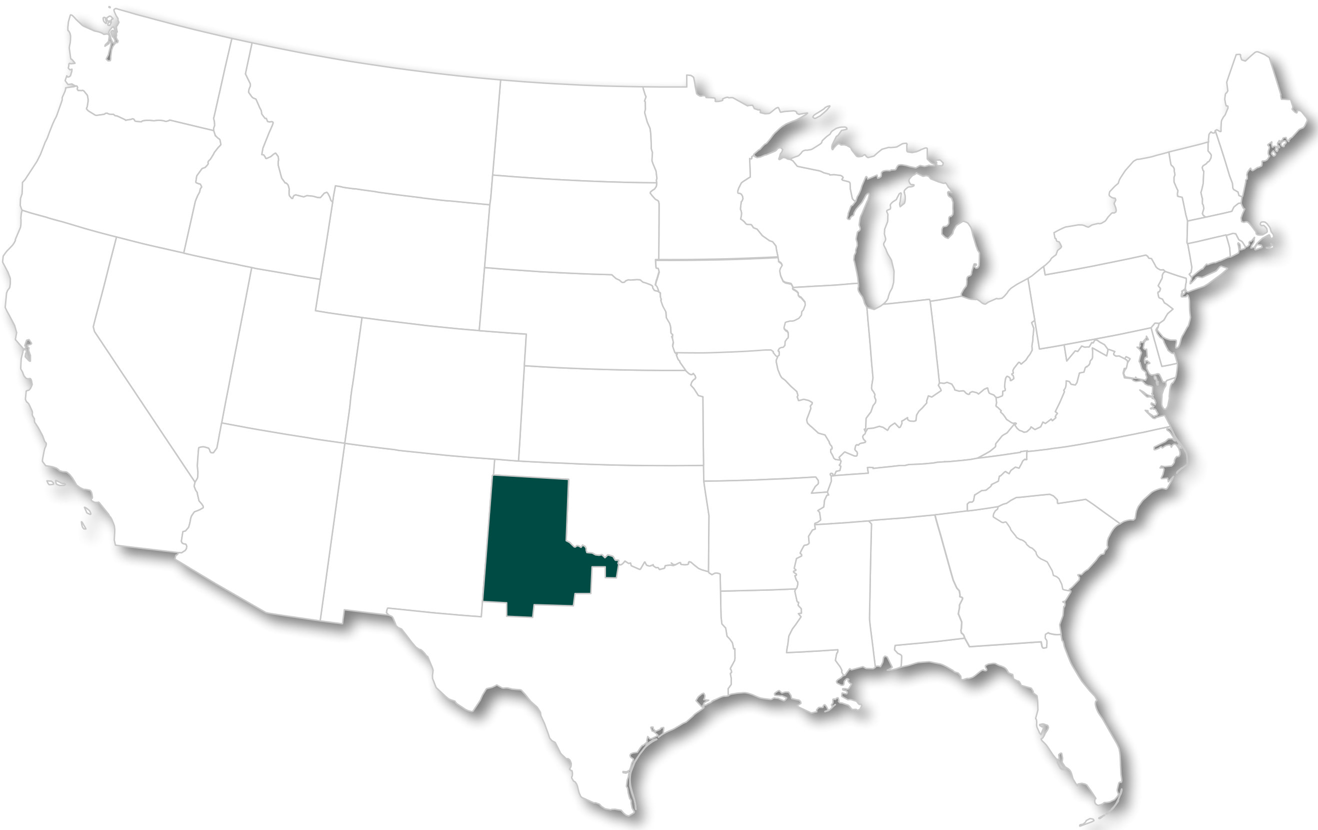
**Table 4.** *Summary of additional soil health management system benefits reported by eight cotton farmers.*

| Benefit | % Responding Yes |
|---|---|
| Decreased Value of Equipment Owned | 75 |
| Increased Crop Resilience | 88 |
| Increased Field Access | 75 |
| Improved Water Quality | 75 |
| Increased Soil Organic Matter | 50 |
| Improved Public Perception of Agriculture | 50 |

## Summary

The Soil Health Institute conducted this project to provide farmers with the economic information they need when deciding whether to adopt soil health management systems (SHMS). The eight farmers interviewed in the Texas Southern Great Plains grew crops on an average of 4,752 acres, using no-till on 63%, reduced tillage on 37%, and cover crops on 84% of those acres. All eight farmers reported increased yield from using a SHMS. Based on the information provided by these farmers, it cost an average of $63.48/acre less to grow cotton using a SHMS. Based on standardized prices, the SHMS increased net income for these eight farmers by an average of $157.28/acre for cotton. Average net farm increases for farmers adopting a SHMS were $73.24/acre for grain sorghum and $130.12/acre for corn. 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 (46%) and cover crops (6%) in Texas indicate that other cotton farmers may improve their profitability by adopting a soil health management system.

# ECONOMICS OF SOIL HEALTH SYSTEMS ON EIGHT COTTON FARMS



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