ECONOMICS OF SOIL HEALTH MANAGEMENT SYSTEMS ON FIVE COTTON FARMS IN ARKANSAS



U.S. REGENERATIVE COTTON FUND
SOIL HEALTH INSTITUTE

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Highlights

- The Soil Health Institute conducted partial budget analyses to provide Arkansas farmers with the economic information they need when deciding whether to adopt soil health practices and systems.
- The five farmers interviewed grew crops on an average of 7,443 acres, using no-till on 19% and reduced tillage on 66% with cover crops on 72% of those acres.
- Based on the information provided by these farmers, it cost an average of $85/acre less to grow cotton using a soil health management system.
- No farmers interviewed reported decreased cotton yield, and soil health management systems increased net income for these five farmers by an average of $85/acre for cotton.
- Soil health management systems for other crops in the cotton rotation also increased net income by an average of $42/acre for soybean and $37/acre for corn.
- 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 Arkansas of no-till (17%), reduced tillage (45%), and cover crops (11%) indicate that more Arkansas cotton farmers may improve 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 Arkansas by the Soil Health Institute (SHI) to provide cotton growers with the economic information they need when making that decision.

SHI interviewed five Arkansas farmers who have adopted SHMS to evaluate their economics based on partial budget analysis (Fig.1). In using this approach, the costs and benefits of a SHMS are compared before and after adoption of that system. A detailed description of the partial budget methodology can be found at https://tinyurl.com/SHImethodology.



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

Farm Characteristics

The five cotton farms assessed raised crops on an average of 7,443 acres, cropping cotton, soybean, corn, rice, peanut, and winter wheat. All wheat acreage was double cropped with soybean (Table 1).

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

Characteristics	Value
Mean Annual Precipitation[1] (inches)	50 to 60
Mean Annual Temperature[1] (°F)	61 to 64
Cotton (acres)	3,005
Soybean (acres)	2,198
Corn (acres)	1,090
Rice (acres)	768
Peanut (acres)	382
Wheat (acres)	200
Double Crop (acres)	200
Total Crop Acres	7,443

[1] *PRISM Climate Group 30 Year Normals (1991-2020) (https://prism.oregonstate.edu/normals/).*

One farmer interviewed reported adopting no-till on all acreage and four reported reduced tillage, including reshaping beds approximately once in three years to facilitate furrow irrigation. No-till averaged 19% of planted acreage, with reduced tillage averaging 66%. This compares to 17% no-till/45% reduced tillage for Arkansas and 38% no-till/35% reduced tillage nationwide (Fig. 2).

Intensive tillage averaged 15% of cropland for the five farmers interviewed, associated with rice, peanut, and corn production, compared to 38% for Arkansas and 27% nationwide. The farmers interviewed also reported using cover crops on 72% of their cropland, considerably greater than averages of 11% for Arkansas and 7% nationwide (Fig. 2).

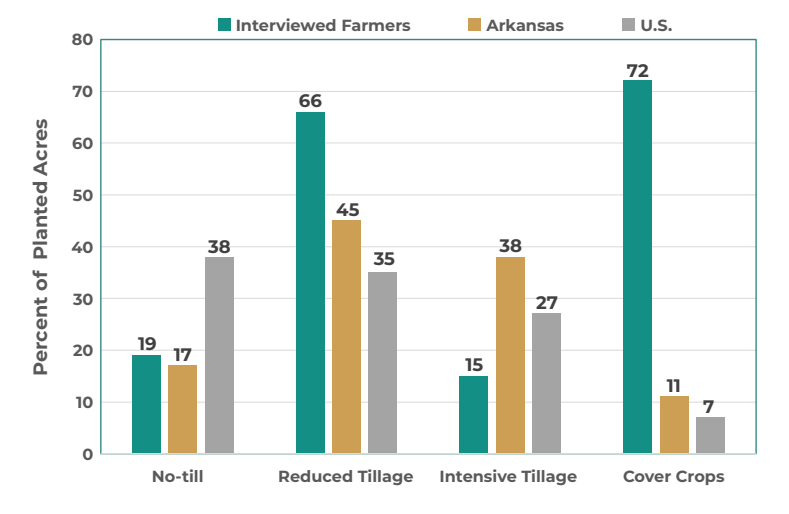


Figure 2. *Percentage of planted acres in no-till, reduced tillage, intensive tillage, and cover crop practices for the five Arkansas farmers, all of Arkansas, and the U.S. (2022 U.S. Census of Agriculture, Volume 1, Table 47).*

The interviewed farmer who used no-till has been doing so for seven years, while those practicing reduced tillage have been doing so for an average of 14 years. The farmers planting cover crops have an average of nine years experience with cover cropping. Such levels of experience indicate opportunity for learning from these farmers when considering the business case for adopting SHMS.

Soil types on the interviewed farms were representative of row crop fields in Arkansas with soil texture from sandy to clay (Table 2). Prior to cotton, four farms planted cover crop mixes with one to five species (Table 2). Almost all of the acreage represented was irrigated (Table 2).

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

Farm	Surface Soil Texture	Tillage Type	Cover Crop Species	Percent Irrigated
1	silt loam, silty clay loam, silty clay, clay	reduced tillage	none	93
2	clay loam, silt loam, sandy loam	no-till	black oat, radish	95
3	sand, silt loam, sandy loam, clay	reduced tillage	grass, legume, brassica	100
4	sandy	reduced tillage	winter/cereal rye, oat, pea, vetch, clover	100
5	sandy loam	reduced tillage	winter/cereal rye	100

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 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. Expense, revenue, and net farm income units are $/acre (2024 dollars).*

	Cotton	
	Benefits	**Costs**
Expense Category	**Reduced Expense**	**Additional Expense**
Seed	12.90	21.80
Fertilizer & Amendments	14.59	0.00
Pesticides	36.00	0.00
Round Module Covers	0.00	0.00
Fuel & Electricity	11.16	1.20
Labor & Services	17.31	7.92
Post-harvest Expenses	0.00	0.00
Equipment Ownership	31.06	7.44
Total Expense Change	**123.02**	**38.36**
	Additional Revenue	**Reduced Revenue**
Yield, lb./acre	0.00	0.00
Price Received[2], $/lb.	0.70	0.70
Revenue Change	**0.00**	**0.00**
	Total Benefits	**Total Costs**
Total Change	123.02	38.36
Change in Net Farm Income	**84.66**	

[1] *Expenses and expected yields based on farmer reported production practices. https://tinyurl.com/SHImethodology.*

[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.*

Four farmers reported using cover crops and planting them prior to cotton production. Cover crop seed expenses ranged from $13.50/acre for a mix of black oat and radish to $49.00/acre for a five-species mix (Table 3). One farm decreased their seeding rate to 25,000 seeds/acre, while the typical planting seed rate is 47,500 seeds/acre.

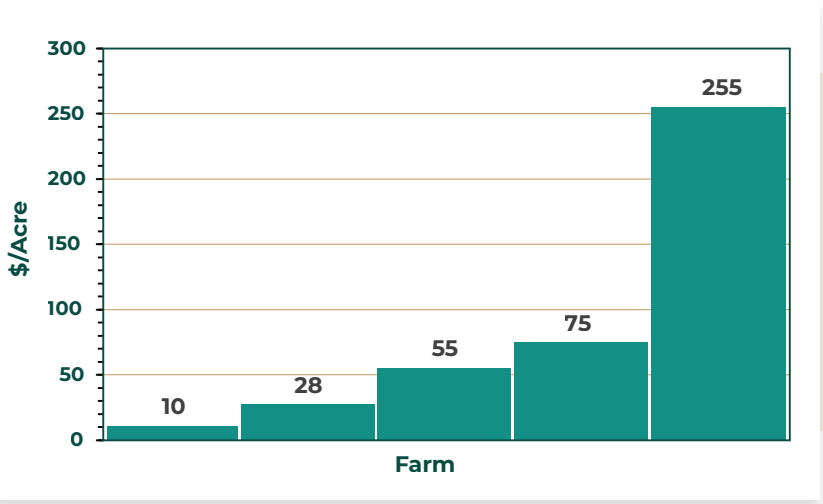
Adopting SHMS can reduce some expenses and increase others. For example, long-term use of SHMS can improve nutrient cycling in soils, and two of these farmers reduced their fertilizer expenses. All farmers implemented nutrient management programs that included soil testing costs. Net fertilizer and amendment expenses were reduced by an average of $14.59 with no farms having increased expenses (Table 3).

Reducing tillage and planting cover crops can suppress weeds and lead to changing or eliminating some herbicides. On the other hand, herbicides are increased to terminate cover crops or to control weeds that had previously been controlled with tillage. Farmers in Arkansas reported reduced insecticide use because of cover crops attracting beneficial insects and reduced fungicide use because of better crop disease resistance – both attributable to improved soil health systems. Consequently, when averaging across all five farms, we found that pesticide expenses were reduced by $36.00/ acre with no expense increases (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 ($31.06/acre) and associated expenses ($11.16/acre and $17.31/acre) totaled $59.53/acre. Additional expenses for equipment ownership ($7.44/acre) and associated expenses ($1.20/acre and $7.92/acre) totaled $16.56/acre (see Table 3). Additional expenses included planting and roller crimping cover crops.

While economic benefits ranged from $10.00 to $255.00 per acre, all farmers reported an increase in net farm income due to reduced expenses when growing cotton with a SHMS (Fig. 3). The farm with the greatest net farm income increase of $255.00/acre had the greatest decrease in production expenses. Seeding rates were reduced by increasing row spacings, which reduced all inputs. Fertilizer expenses were reduced by cover crop mixes, which included legumes for nitrogen, and improved nutrient cycling reduced phosphorous and potassium needs. Pesticide expenses were reduced because cover crops provided weed suppression and attracted beneficial insects. Irrigation expenses decreased as water holding capacity and infiltration improved with soil health. The farm with a net farm income increase of $10.00/acre was the most recent adopter of SHMS, and full benefits of no-till and cover crops may not yet be realized (Fig. 3).

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



Financial benefits for growing other crops with SHMS were also reported. All five farmers also grew soybean and reported net farm income to increase from a range of $7.08/acre to $148.37/acre (average $42.23/acre) from adopting SHMS. Three farms growing corn with a SHMS averaged $37.21/acre increased net farm income with ranges from a $27.71/acre decrease to a $128.98/acre increase. One farm increased net farm income $124.90/ acre for rice production with a SHMS that included reduced tillage, eliminating levees, reduced seeding rates, and decreased irrigation water expenses. One farm decreased net farm income $27.71/acre for peanut due to adopting SHMS.

Additional Benefits

In addition to benefits that directly impact profitability, all farmers reported increased crop resilience, more timely access to their fields, and improved water quality (based on observed differences in water clarity). All farmers stated that adoption of SHMS improved public perception of agricultural production (Table 4).

These farmers visually monitored for observable changes in their soil organic matter levels, and all reported that those levels appeared to have increased due to the SHMS (Table 4). Two monitored soil organic matter, with one reporting an increase of 1.0% and another 1.5%. Higher soil organic matter increases available nutrients and available water holding capacity, consistent with reduced fertilizer applications, increased crop resilience, and improved field access observed.

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

Benefit	% Responding Yes
Increased Crop Resilience	100
Increased Field Access	100
Improved Water Quality	100
Improved Public Perception of Agriculture	100
Increased Soil Organic Matter	100

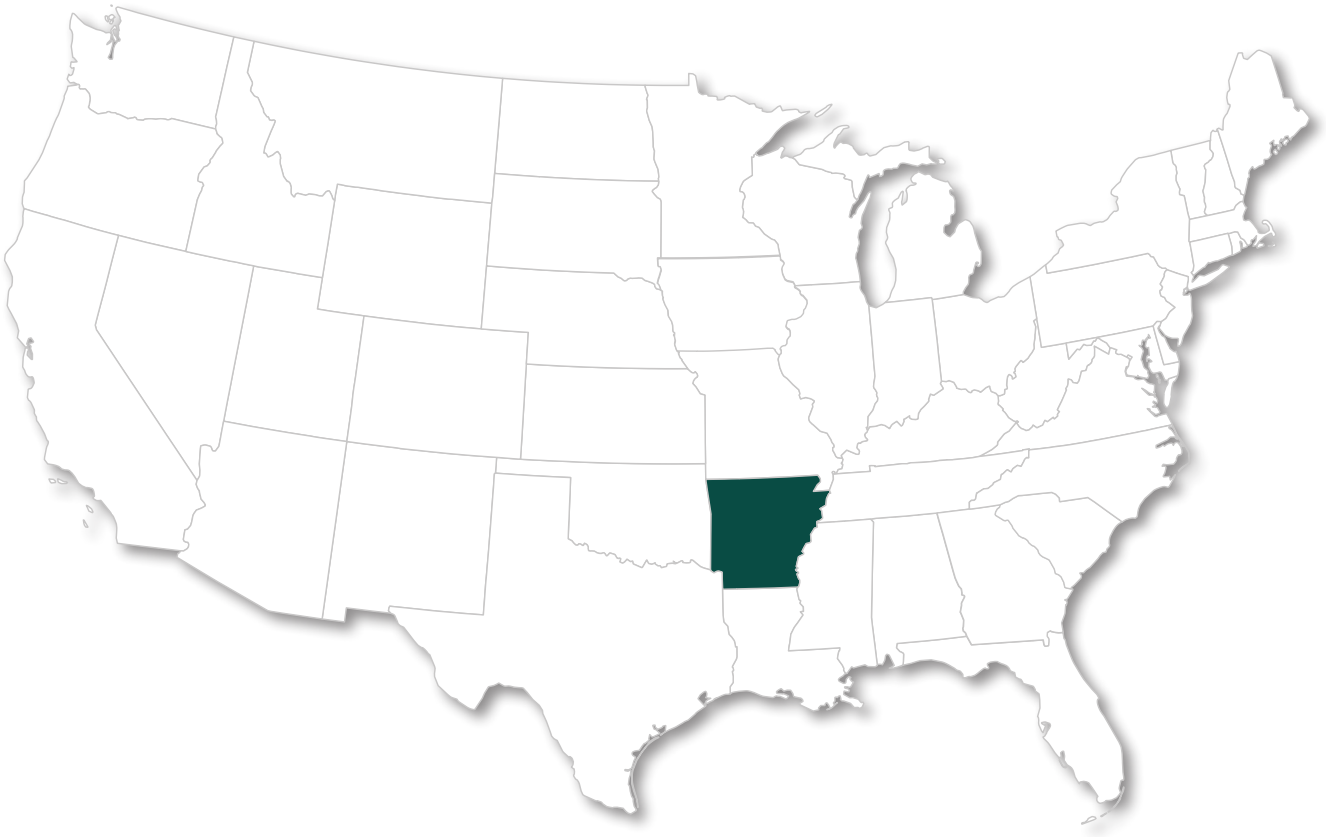
Summary

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 five farmers interviewed in Arkansas grew crops on an average of 7,443 acres, using no-till on 19%, reduced tillage on 66%, and cover crops on 72% of those acres. Based on information provided by these farmers, it cost an average of $85/acre less to grow cotton using a SHMS. No farmers reported decreased cotton yield from using a SHMS, and net farm income for these five farmers increased by an average of $85/acre for cotton. Average net farm increases for farmers adopting a SHMS with other crops included $42/acre for soybean and $37/acre for corn. Farmers also reported additional benefits of their SHMS, such as increased resilience to extreme weather and improved access to their fields. The current adoption rates of combined no-till and reduced tillage (62%) and cover crops (11%) in Arkansas indicate that additional cotton farms may improve their profitability by adopting a soil health management system.

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