ECONOMICS OF SOIL HEALTH SYSTEMS IN ILLINOIS

A project to evaluate profitability of soil health systems on 100 U.S. farms

SOIL HEALTH INSTITUTE

Cargill™

Highlights

- The Soil Health Institute and Cargill conducted this project to provide farmers with the economics information they need when deciding whether to adopt soil health practices and systems.
- The 11 farmers interviewed in Illinois grew crops on an average of 934 acres, using no-till on 74% and cover crops on 71% of those acres.
- Seventy-three 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 $19.25/acre less to grow corn and $15.96/acre less to grow soybean using a soil health management system.
- Based on standardized prices, the soil health management system increased net income for these 11 Illinois farmers by an average of $39.12/acre for corn and $37.56/acre for soybean.
- The current adoption rates of no-till (29%) and cover crops (3%) in Illinois indicate that many other 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 increased access to their fields.

Introduction

Improving soil health can help farmers 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 carbon, reducing greenhouse gas emissions, and improving water quality. However, investing in soil health management systems is also a business decision. This project was conducted by the Soil Health Institute (SHI) and Cargill to provide farmers with the economics 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 100 farmers were interviewed across nine states (Illinois, Indiana, Iowa, Michigan, Minnesota, Nebraska, Ohio, South Dakota, and Tennessee), which collectively represent approximately 71% of the total amount of corn and 67% of the total amount of soybean produced in the United States (USDA, NASS Crop Production 2019 Summary). The following summarizes the results obtained from 11 farmers interviewed in Illinois (Fig. 1).

Figure 1. ***Geographic distribution of the 11 farms in Illinois used for economic analysis of soil health management systems.***

Farm Characteristics

The 11 Illinois farms assessed in this project raised crops on an average of 934 acres, with 459 acres of corn, 459 acres of soybean, and 34 acres of wheat (Table 1). The growing conditions under which these farmers successfully adopted a soil health system ranged from 36-46 inches of annual precipitation, 46-57°F average annual temperature, and 2800-3400 growing degree days for corn (Table 1).

Table 1. ***Growing conditions and crops for the 11 Illinois farmers interviewed.***

Characteristic	Value
Range in Average Annual Precipitation (inches)[1]	36 - 46
Range in Mean Annual Temperature (°F)[1]	46 - 57
Range in Average Annual Growing Degree Days for Corn[2]	2800 - 3400
Average Acres in Corn	459
Average Acres in Soybean	459
Average Combined Acres in Wheat and Double Crop Wheat[3]	34
Average Total Crop Acres	934

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

[2] *Purdue Extension Publication NCH-40.*

[3] *Double crop wheat acres were not added to the total crop acres.*

The 11 farmers interviewed reported that they have adopted no-till on an average of 74% of their planted land. This is considerably greater than the 29% cropland adoption of no-till in Illinois and 37% cropland adoption of no-till for the U.S. (Fig. 2). The 11 farmers interviewed also reported using cover crops on 71% of their cropland, as compared to 3% for the state and 5% for the nation (Fig. 2).

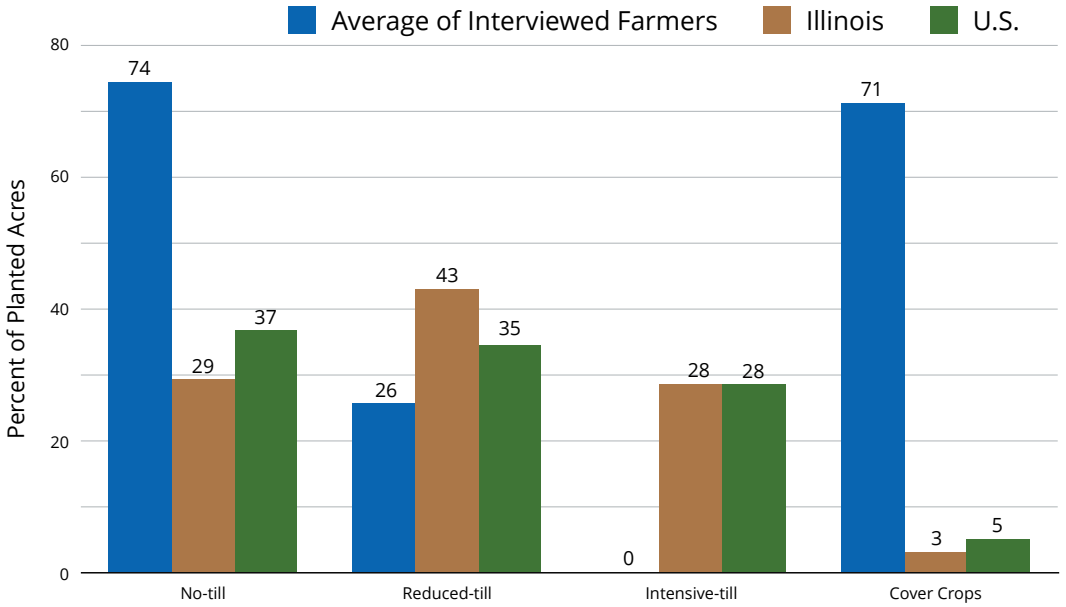

Figure 2. ***Percentage of planted acres in no-tillage, reduced tillage, intensive tillage, and cover crop practices for the 11 Illinois farmers as compared to cropland adoption of those practices in Illinois and the U.S.***

USDA-NASS (2017)

The farmers we interviewed who have been practicing no-till have been doing so for about 16 years, and those growing cover crops have been doing so for approximately nine years. Such levels of experience, along with the above comparisons with state and national adoption levels, show that the farmers interviewed for this project are clearly leading the way and therefore offer substantial opportunity for others to learn from their experiences in adopting soil health systems. It is also clear that these farmers have been successful at implementing soil health systems across a range of climates in Illinois (Table 1).

Partial Budget Analysis

Partial budgets were calculated to assess changes in expenses and revenue associated with adopting a soil health management system. The results were averaged across the 11 Illinois farms, as presented in Table 2.

Table 2. ***Partial budget analysis[1] of adopting a soil health management system averaged for 11 Illinois farms. Unless shown otherwise, the units are $/acre (2019 dollars).***

	CORN		SOYBEAN	
	Benefits	**Costs**	**Benefits**	**Costs**
Expense Category	**Reduced Expense**	**Additional Expense**	**Reduced Expense**	**Additional Expense**
Seed	8.64	22.30	5.45	17.80
Fertilizer & Amendments	28.91	7.47	12.20	0.00
Pesticides	13.26	6.65	16.38	5.11
Fuel & Electricity	3.27	2.63	4.02	2.68
Labor & Services	10.99	7.61	9.79	10.67
Post-harvest Expenses	0.00	2.37	0.00	0.70
Equipment Ownership	15.09	14.25	19.66	15.28
Total Expense Change	**80.16**	**63.28**	**67.50**	**52.24**
	Additional Revenue	**Reduced Revenue**	**Additional Revenue**	**Reduced Revenue**
Yield, bu.	5.27	0.00	2.18	0.00
Price Received[2], $/bu.	4.22	4.20	10.23	10.00
Revenue Change	**22.24**	**0.00**	**22.30**	**0.00**
	Total Benefits	**Total Costs**	**Total Benefits**	**Total Costs**
Total Change	102.40	63.28	89.80	52.24
Change in Net Farm Income	**39.12**		**37.56**	

[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.*

Fertilizer and amendment expenses were reduced by an average of $28.91/acre for corn and $12.20/acre for soybean, with a majority of farmers implementing nutrient management practices such as grid soil sampling (91%), variable rate fertilizer application (82%), and split application of nitrogen (100%) as part of their overall soil health management system.

None of the 11 Illinois farms reported a yield decline from adopting a soil health management system. In fact, 73% reported increased yield, averaging 5.27 bu./acre for corn and 2.18 bu./acre for soybean (Table 2).

While these yield increases are important, we also wanted to evaluate changes in expenses that are attributed to the soil health system. To do this, we subtracted the average post-harvest expenses associated with check-off fees and hauling/drying the higher yielding corn ($2.37/acre) and soybean ($0.70/acre) from the "Additional Expenses." This allowed us to compare expenses that were not associated with a change in yield (e.g., $80.16 – ($63.28 - $2.37) = $19.25 for corn in Table 2). That comparison showed it cost an average of $19.25/acre less to grow corn and $15.96/acre less to grow soybean using a soil health management system. This means that even if yield did not increase, the soil health management system was still more profitable on these farms due to the reduced expense of growing a crop by using a soil health system.

Recognizing that market prices fluctuate, we calculated revenue by using a standardized set of long-term average prices, as shown in the footnote to Table 2. One farm was enabled to plant non-GMO corn and soybean, and one farm was enabled to plant non-GMO soybean due to benefits of the soil health management system. Price premiums for non-GMO corn and soybean increase additional revenue prices in Table 2 to $4.22/bu. for corn and $10.23 for soybean. Using those standardized prices with price premiums, revenue from growing corn in a soil health management system increased by $22.24/acre, and for soybean increased by $22.30/acre.

Combining the changes in expenses and revenue showed that the soil health management system increased net income for these 11 Illinois farms by an average of $39.12/acre for corn and $37.56/acre for soybean (Table 2). The range in net farm income for all farmers interviewed shows that seven of 11 farmers reported a higher net income for corn (Fig. 3) and nine of 11 farmers reported a higher net income for soybean (Fig. 4) with a soil health management system.

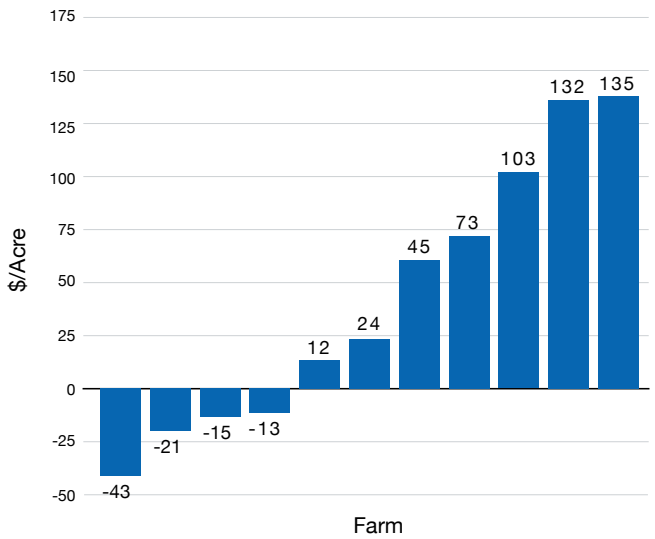

Figure 3. ***Change in net farm income for 11 farms after adopting a soil health management system compared to a conventional system, corn, $/Acre.***

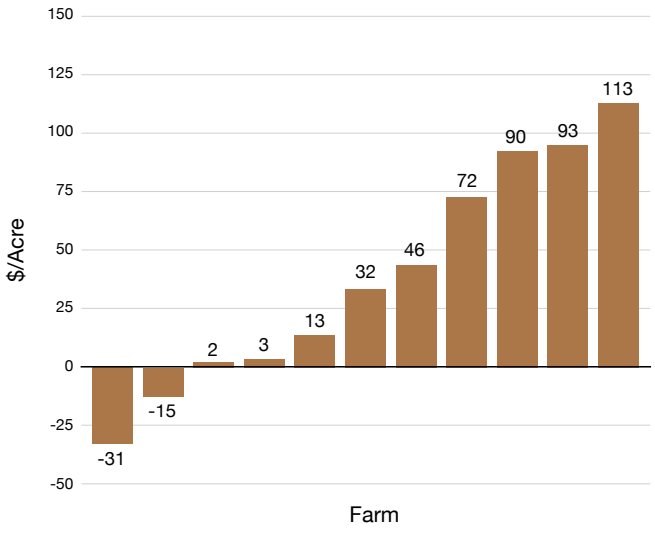

Figure 4. ***Change in net farm income for 11 farms after adopting a soil health management system compared to a conventional system, soybean, $/Acre.***

Additional Benefits

As previously stated, 73% of the farmers interviewed reported a yield increase associated with adopting a soil health management system (Table 3). Eighty-two percent also reported that they reduced fertilizer inputs while implementing nutrient management as part of their overall soil health management system, and 100% reported increased resilience to extreme weather such as drought and heavy rain.

Table 3. Summary of soil health management system benefits reported by 11 Illinois farmers.

Benefits Reported	% Responding Yes
Increased Yield	73
Reduced Applied Fertilizer	82
Increased Crop Resiliency	100
Increased Field Access	100
Improved Loan, Land, or Insurance Terms	18
Improved Water Quality	100
Protects License to Operate	100
Increased Soil Organic Matter	36

In addition to such benefits that directly impact profitability, these farmers also reported several other benefits from adopting a soil health system. These included increased access to the field and increased resilience to drought and heavy rain. Several farmers also cited measured reductions in nutrient levels in tile drainage water, thereby resulting in improved water quality and a protected license to operate (Table 3).

Interestingly, these farmers were monitoring changes in their soil organic matter levels, and 36% reported that those levels increased by an average of 1.5% due to the soil health management system. Research has shown that higher soil organic matter increases a soil's available nutrients and available water holding capacity, which is consistent with reduced fertilizer application, increased crop resilience, and improved field access observed by these Illinois farmers.

Summary

The Soil Health Institute and Cargill conducted this project to provide farmers with the economics information they need when deciding whether to adopt soil health practices and systems. The 11 farmers interviewed in Illinois grew crops on an average of 934 acres, using no-till on 74% and cover crops on 71% of those acres. Seventy-three 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 $19.25/acre less to grow corn and $15.96/acre less to grow soybean using a soil health management system. Based on standardized prices, the soil health management system increased net income for these 11 Illinois farmers by an average of $39.12/acre for corn and $37.56/acre for soybean. The current adoption rates of no-till (29%) and cover crops (3%) in Illinois indicate that other Illinois farmers may improve their profitability by adopting a soil health system. Farmers also reported additional benefits of their soil health system, such as increased resilience to extreme weather and increased access to their fields.

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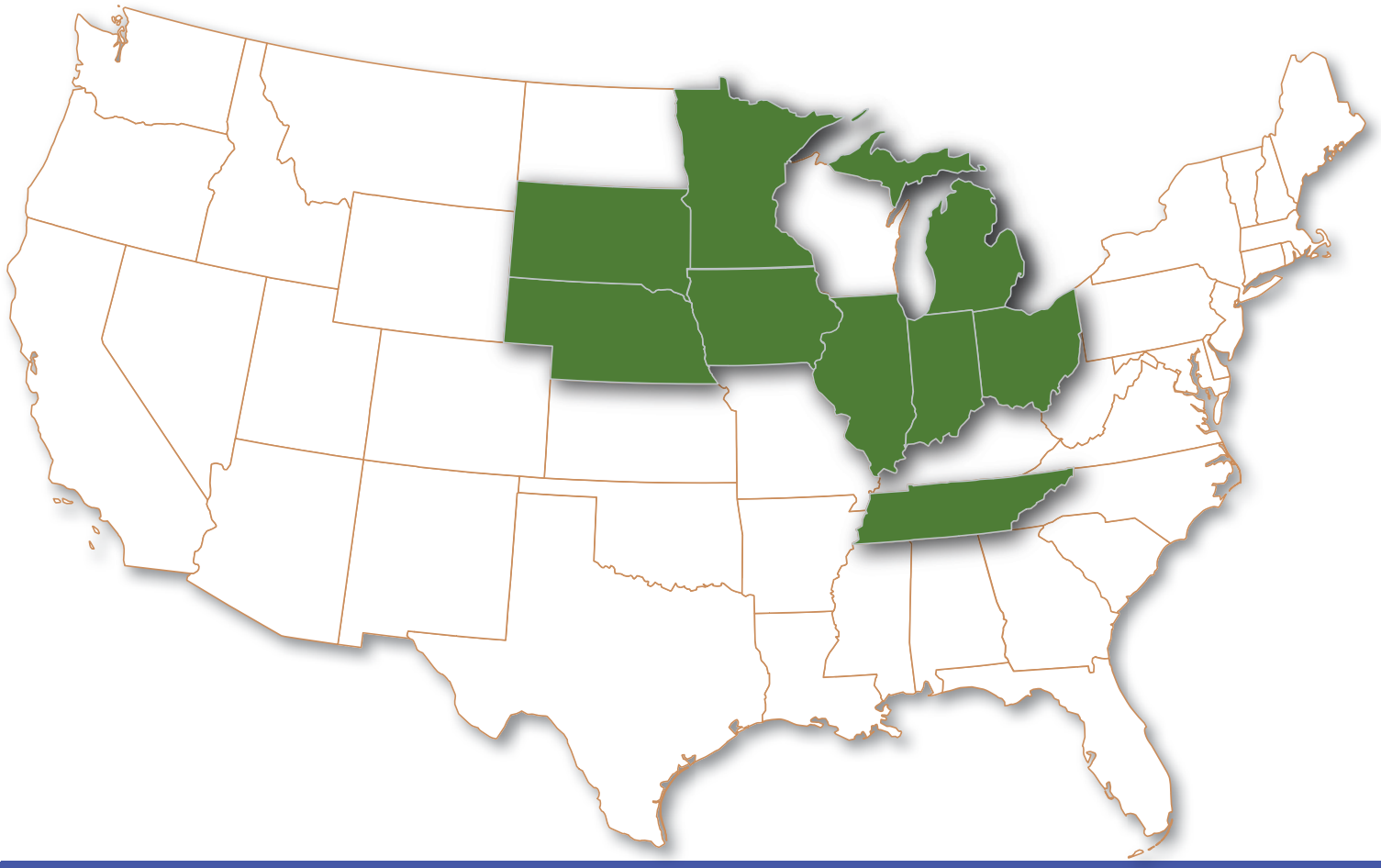

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