ECONOMICS OF SOIL HEALTH SYSTEMS ON FIVE SMALL GRAIN FARMS IN MANITOBA, SASKATCHEWAN, AND ONTARIO, CANADA

SOIL HEALTH INSTITUTE

General Mills

Highlights

- The Soil Health Institute and General Mills conducted partial budget analyses to provide farmers in Manitoba, Saskatchewan, and Ontario, CA, with the economic information they need when deciding whether to adopt soil health management systems.
- The five farmers interviewed grew crops on an average of 3,851 acres, using conservation tillage on 100% with no-till on 96% and cover crops on 61% of those acres.
- Based on the information provided by these farmers, it cost an average of US$27/acre less to grow small grains using a soil health management system.
- Based on standardized prices, soil health management systems increased net farm income for these five farmers by an average of US$31/acre for small grains.
- Farmers adopting soil health management systems for other crops also increased net income by an average of US$29/acre for corn, US$7/acre for soybean, US$54/acre for canola, and US$58/acre for sugar beet.
- One farmer realized additional revenue of US$25/acre for grazing cover crops.
- Farmers reported additional benefits of their soil health management system such as increased resilience to extreme weather, more timely access to their fields, and improved water quality.
- Results of this study indicate that other farmers in these Canadian provinces may improve their profitability by adopting soil health management systems.

Introduction

Improving soil health can build drought resilience, reduce 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 Canada by the Soil Health Institute (SHI) and General Mills to provide small grains growers with the economic information they need when making that decision.

SHI interviewed five Canadian farmers (Fig .1) who have adopted soil health systems to acquire production information for evaluating their economics based on partial budget analysis. In using this approach, 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 five farms used for economic analysis of soil health management systems.*

Farm Characteristics

The five farms in this project produced crops on an average of 3,851 acres cropping wheat, oats, corn, soybean, canola, sunflower, sugar beet, and various other crops (Table 1).

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

Characteristics	Value
Mean Annual Precipitation (mm)[1]	330 to 890
Mean Annual Temperature (°C)[1]	2.8 to 8.9
Total Farm (acres)	3,851
Wheat (acres)	1,110
Oat (acres)	389
Corn (acres)	300
Soybean (acres)	151
Canola (acres)	534
Sunflower (acres)	277
Sugar Beet (acres)	8
Other Crops[2]	1,082

[1] *Canadian Climate Normals (1981 to 2010).* https://climate.weather.gc.ca/climate_normals/index_e.html

[2] *Other crops include azuki beans, barley, coriander, flax, lentils, mustard, pea, triticale, and winter/cereal rye.*

These five farmers interviewed reported adopting no-till on 96% and reduced tillage on 4% of their planted acreage. This is greater than the 61% adoption of no-till for Canada and surpasses no-till adoption in each of the regions represented in this study with 30% in Ontario, 29% in Manitoba, and 78% in Saskatchewan (Fig. 2).

The five farms used cover crops on 61% of their cropland, whereas across Canada, among farms that report using cover crops, only 23% of their cropland was planted in cover crops (Statistics Canada, Table 32-10-0387-02). Canadian farms that report using cover crops plant cover crops on an average of 26% of their cropland in Ontario, 6% in Manitoba, and 14% in Saskatchewan.

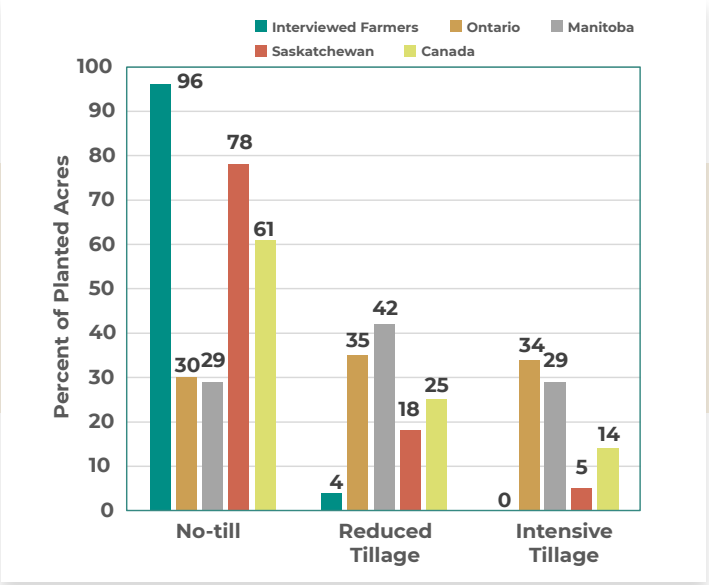

Figure 2. *Percentage of planted acres in no-till, reduced tillage, and intensive tillage for the five interviewed farmers in Canada as compared to adoption of those practices in Ontario, Manitoba, Saskatchewan and across Canada (Statistics Canada, Table 32-10-0367-01).*

Partial Budget Analysis

Partial budgets were calculated to assess changes in expenses and revenues associated with adopting SHMS for small grains. Average results for the five farms are presented in Table 2. One farm produced wheat and oats in their SHMS, therefore averages are based on six small grains crop reports.

Table 2. *Partial budget analysis[1] of adopting a soil health management system for small grains production on five farms. Expense, revenue, and net farm income units are US$/acre (2020 U.S. dollars).*

	Small Grain	
	Benefits	**Costs**
Expense Category	**Reduced Expense**	**Additional Expense**
Seed	0.00	3.50
Fertilizer & Amendments	21.02	0.00
Pesticides	2.04	1.62
Fuel & Electricity	2.54	1.03
Labor & Services	5.82	2.89
Post-harvest Expenses	0.11	0.20
Equipment Ownership	10.28	5.45
Total Expense Change	**41.81**	**14.69**
	Additional Revenue	**Reduced Revenue**
Yield, bu./acre.	1.00	1.00
Price Received[2], US$/bu.	6.50	3.00
Revenue Change	**6.50**	**3.00**
	Total Benefits	**Total Costs**
Total Change	48.31	17.69
Change in Net Farm Income	**30.62**	

[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 Grains Prices?" Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, January 11, 2019.*

Four of the farmers reported using cover crops on at least a portion of their crop acreage with two planting them before small grains production. One farm, using cover crops before small grains production, planted a barley, pea, and fava bean mix before spring wheat and spring oats, while the other farm planted winter/cereal rye and clover before spring oats. Cover crop seed expenses averaged US$8.75/acre for the two farms. Additional seed expense averaged US$3.50/acre for all farms (Table 2).

Three farmers reported reducing their fertilizer and amendment expenses when using a SHMS, amounting to US$21.02/acre, when averaged across all five farms (Table 2).

Reducing tillage and planting cover crops may enhance weed suppression and lead to changing or eliminating some herbicide applications. Reduced pesticide expenses averaged US$2.04/acre (Table 2). In other circumstances, additional herbicide is used for weed management or cover crop termination. Such additional pesticide expenses averaged US$1.62/acre (Table 2).

Adopting no-till decreased costs for equipment ownership, fuel, labor, and other expenses totaling US$18.64/acre (Table 2). Some additional expenses for equipment ownership and expenses associated with spray applications and planting cover crops did increase with no-till adoption.

Yield outcomes varied by farmer. One farm reported increased spring wheat yield from adopting SHMS (Table 2). One farm reported decreased yields of spring oats from adopting SHMS.

Market prices for crops fluctuate, so revenue due to changing yield was calculated based on long-term average prices (Table 2 footnote). Using that price, net revenue from growing small grains in a SHMS increased US$3.50/acre (US$6.50 to US$3.00) due to increased yield (Table 2).

Overall a SHMS increased net income for these five farms by an average of US$30.62/acre for small grains (Table 2). The higher net income was primarily due to lower costs of producing small grains in a SHMS (US$27.12/acre less; US$41.81 minus US$14.69 = US$27.12 in Table 2). As a result, even if yield did not increase, the SHMS was still more profitable on these five farms due to the reduced expense of growing small grains.

Farms in this study were assigned identification numbers based on order of interview, and change in net farm income is presented for each farm in Fig. 3. While economic benefits ranged from US$4 to US$54/acre, all farmers reported an increase in net farm income when growing small grains with a SHMS (Fig. 3). The farms with the two greatest income increases (US$54 and US$50/acre) were the only farms with reduced expenses for fertilizers and amendments (Table 2). These were the two farms planting cover crops before small grains production. The farm with US$50/acre net farm income increase had a 5 bu./acre yield decrease for spring oats which was offset by reduced expenses due to SHMS.

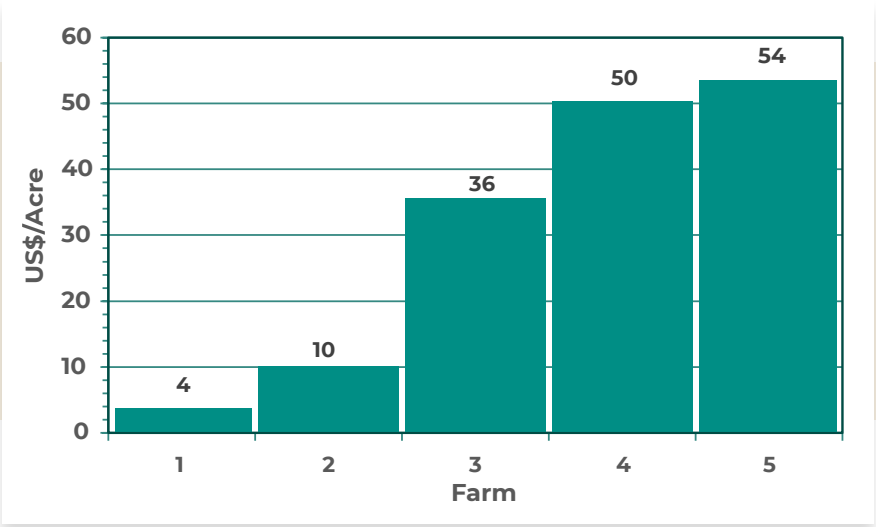

Figure 3. *Change in net farm income from five farms after adopting a soil health management system compared to a conventional system. The average increase in net farm income is US$31/acre.*

Generally, financial benefits for growing other crops with SHMS were also reported by these farmers. Three farmers growing corn with a SHMS reported net farm income to increase by an average of US$29.39/acre (ranged from -US$25 to US$89.70/acre). Three farmers growing soybean using SHMS had net farm income increase by an average of US$6.84/acre (ranged from -US$12.41 to US$22.50/acre). One farm growing canola with a SHMS increased net income by US$54.06/acre, and one farm growing sugar beet increased net income by US$58.42/acre. One farm had a net decrease of US$14.39/acre producing sunflower with a SHMS. One farm included grazing of cover crops as a component of the SHMS and realized additional net income of US$25/acre for each acre grazed.

Upon incorporating the effects of adopting a SHMS on all of these crops, including the grazing value of cover crops, net farm income increased by an average of US$37/acre across all five farms (ranging from US$1 to US$75/acre, Fig. 4).

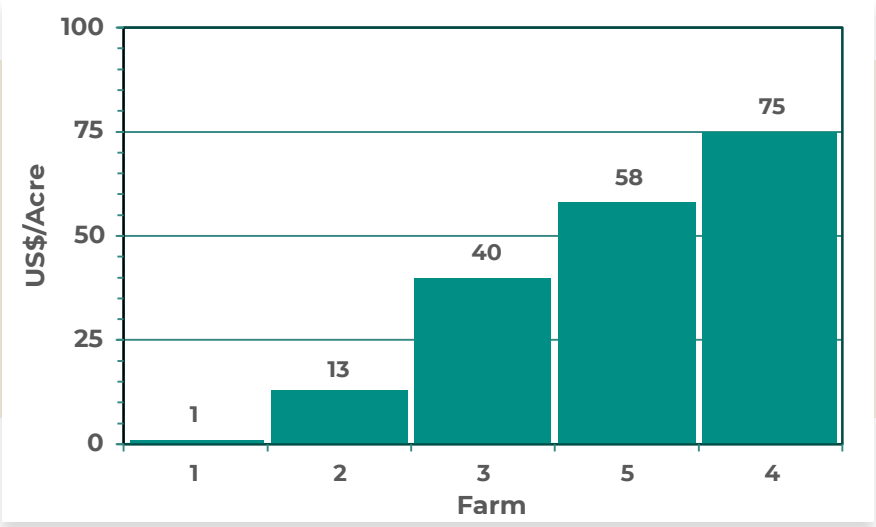

Figure 4. *Change in net farm income from five farms after adopting a soil health management system across many crops and including grazing cover crops. The average increase in net farm income is US$37/acre.*

Additional Benefits

In addition to equipment ownership expenses being reduced in a SHMS (Table 2), a SHMS can also reduce the total value of equipment owned. Long-term capital debt on high-value equipment exposes a farm to financial risk, especially during periods of lower commodity prices. All farmers interviewed reported decreased value of owned equipment, reducing exposure to financial risk (Table 3).

In addition to benefits that directly impact profitability, these farmers also reported other benefits from their SHMS, such as increased crop resilience (100%), more timely access to their fields (80%), and improved water quality (80%) (Table 3). Changes in water quality were based on visual differences in water clarity observed by the farmers. Twenty percent of the farmers stated that adoption of SHMS improved public perception of agricultural production.

Research has shown that higher soil organic matter increases nutrient availability and available water holding capacity. This is consistent with the experiences reported by farmers in this project, where adopting a SHMS allowed for reduced fertilizer applications (Table 2), increased crop resilience, and improved field access (Table 3). Most of these farmers were monitoring changes in their soil organic matter levels, and 80% reported that soil organic matter increased due to their SHMS (Table 3). Measured changes in soil organic matter showed 0.1% increases per year attributable to soil health practices.

Table 3. *Summary of additional soil health management system benefits reported by five small grains farmers.*

Benefit	% Responding Yes
Decreased Value of Equipment Owned	100
Increased Crop Resilience	100
Increased Field Access	80
Improved Water Quality	80
Improved Public Perception for Agriculture	20
Increased Soil Organic Matter	80

Summary

The Soil Health Institute conducted this project to provide farmers with the economics information when deciding whether to adopt soil health systems. The five Canadian farmers interviewed grew crops on an average of 3,851 acres, using no-till on 96% and cover crops on 61% of those acres. It cost an average of US$27.12/acre less to grow small grains using a SHMS. Based on standardized prices, the SHMS increased net farm income by an average of US$30.62/acre for small grains. Adopting a SHMS also increased net farm income by US$29.39/acre for corn and US$6.84/acre for soybean. Individual farmers using SHMS to grow canola and sugar beet increased net farm income by US$54.06 and US$58.42/acre, respectively. One farmer producing sunflowers decreased net farm income of US$14.39/acre by adopting a SHMS. One farm included grazing of cover crops as a component of the SHMS with a value of US$25/acre.

Upon including the effect of SHMS on all these crops and grazing cover crops, net income increased by an average of US$37/acre. Farmers also reported additional benefits of their SHMS, such as increased resilience to extreme weather, increased access to fields, and improved water quality. Results of this analysis indicate that small grains farmers in Canada currently practicing conventional production methods may improve their profitability by adopting SHMS.

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

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