# Long-term Soil Health Pays in South-Central Nebraska




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 – 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.

Understanding this, the Nebraska Soil Health Coalition partnered with the Soil Health Institute (SHI) to provide farmers with the economic information they need when making that decision. The Nebraska Soil Health Coalition promotes adoption of soil health systems, leveraging collaborative efforts to increase sustainable agricultural production and foster thriving rural communities. Addressing the economic case for soil health is a key part of this producer-focused education and outreach.

The Soil Health Institute interviewed 35 Nebraska farmers across two cohorts (Hub 1a: 20 farmers; Hub 1b: 15 farmers) who have adopted soil health management systems to evaluate their profitability based on partial budget analysis. In using this approach, we compare costs and benefits before and after adoption.

The bottom-line benefits farmers saw include:

- Savings of $92/acre for irrigated corn and $55/acre for irrigated soybean
- Improved yields leading to increased crop revenue of $57/acre for irrigated corn and $38/acre for irrigated soybean
- Increased farm income of $154/acre for irrigated corn and $92/acre for irrigated soybean with grazed cover crops
- Increased farm income $157/acre for non-irrigated corn and $90/acre for non-irrigated soybean
- Increased farm income of $264/acre for pasture

Before we break down the cost and revenue changes due to managing for soil health, let's take a look at the farms in the study.

## ABOUT THE

# Farms

The 35 farms ranged in size from 222 to 32,500 acres. Row crop acres were primarily planted in corn and soybean representing 62% and 33% of row crop acres, respectively. Wheat, winter/cereal rye, grain sorghum, and other crops were planted on the remaining acres.

| LAND USE | ACRES |
|---|---|
| Pasture | 1,023 |
| Corn | 1,182 |
| Soybean | 635 |
| Wheat | 49 |
| Winter/Cereal rye | 16 |
| Grain sorghum | 6 |
| Other crops | 44 |
| Double Crop | 27 |
| Total Crop Acres | 1,905 |

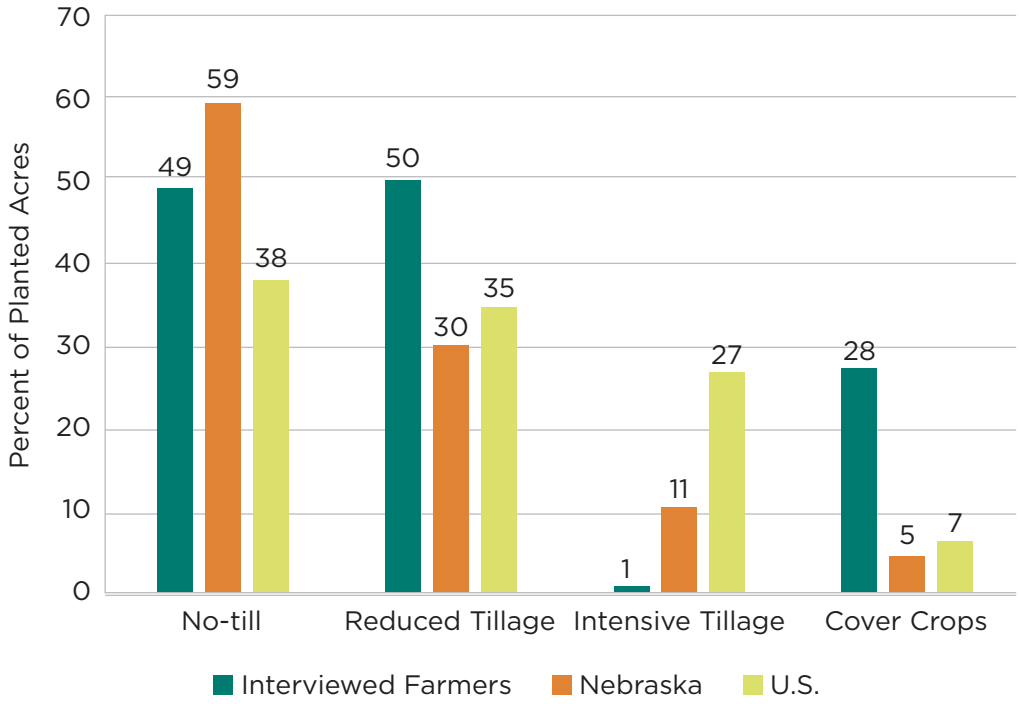


| Town Name | Number of Farms |
|---|---|
| Bladen | 4 |
| Geneva | 2 |
| Gibbon | 1 |
| Grand Island | 3 |
| Guide Rock | 1 |
| Hardy | 1 |
| Hastings | 6 |
| Lawrence | 3 |
| Minden | 1 |
| Sutton | 6 |
| Utica | 3 |
| Wood River | 2 |
| York | 2 |

Mean annual precipitation was 23 to 31 inches, while mean temperature was 50 to 53 degrees F. For rotations that included corn and soybean, 79% of acreage was irrigated. Irrigation was predominantly with center pivot systems, with some farms using combinations of center pivot and gravity irrigation on selected acreage. Fourteen farms were entirely irrigated, and one farm was entirely non-irrigated, with the balance having combinations of irrigated and non-irrigated production.

Soil types in this region are moderately to very deep, loamy to clayey in texture, with drainage ranging from poorly drained to well drained. Due to low rainfall in the region, much of the agricultural production relies on irrigation. While some irrigation water is available from surface bodies like the Platte River in the north of the region, the majority comes from ground water sources. The High Plains aquifer supplies much of the ground water for irrigation and quantity and quality of irrigation water are chief resource concerns in the region.

Sixteen farms planted cover crops before corn production, and nine planted cover crops before soybean. The farmers using no-till have been doing so for an average of 23 years, while those practicing reduced tillage have been doing so for an average of 22 years. Farmers planting cover crops had an average of 11 years of experience. The farmers interviewed primarily practiced no-till and reduced tillage. The farmers also reported using cover crops considerably more than the state average for Nebraska.




**VISIT US AT**

**https://soilhealthinstitute.org/economics**
for a detailed description of our partial budget methodology

## BOTTOM-LINE BENEFITS

# for irrigated corn and soybean production

Managing for soil health slightly increased per-acre expenses — primarily from cover crop seed — however, those costs were offset by reduced fertilizer, pesticide, and tillage expenses, as well as greater yields. Results were averaged across 29 farms with irrigated production. On average, net income rose by $154 per acre for corn and $92 per acre for soybeans.

### Partial budget analysis of adopting a soil health management system in irrigated corn and soybean, $/acre

| | CORN | | SOYBEAN | |
|---|---|---|---|---|
| **Expense Category** | **Reduced Expense** | **Additional Expense** | **Reduced Expense** | **Additional Expense** |
| Seed | 9.38 | 9.83 | 3.57 | 4.75 |
| Fertilizer & Amendments | 54.91 | 25.93 | 15.11 | 12.89 |
| Pesticides | 29.04 | 5.13 | 17.72 | 4.67 |
| Fuel & Electricity | 15.93 | 2.52 | 15.90 | 2.20 |
| Labor & Services | 24.95 | 9.46 | 22.71 | 8.08 |
| Equipment Ownership | 27.09 | 15.94 | 26.51 | 14.21 |
| Post-harvest Expenses[2] | 0.00 | 5.68 | 0.06 | 1.22 |
| **Total Expense Change** | **161.30** | **74.49** | **101.58** | **48.02** |
| | **Additional Revenue** | **Reduced Revenue** | **Additional Revenue** | **Reduced Revenue** |
| Yield, bu. | 12.76 | 0.00 | 3.79 | 0.18 |
| Price Received,[3] $/bu | 4.50 | 4.50 | 10.50 | 10.50 |
| Other Revenue[4] | 9.60 | 0.00 | 0.11 | 0.00 |
| **Total Revenue Change** | **67.02** | **0.00** | **39.91** | **1.89** |
| | **Total Benefits** | **Total Costs** | **Total Benefits** | **Total Costs** |
| Total Change | 228.32 | 74.49 | 141.49 | 49.91 |
| **Change in Farm Income** | **153.83** | | **91.58** | |

[1] Expenses and expected yields based on farmer reported production practices. https://soilhealthinstitute.org/economics/

[2] Check-off fees and hauling for corn and soybean with drying expense for corn applied to yield change.

[3] 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.

[4] Other revenue includes revenue from grazing in row-crop systems.



# Expenses

## Seed, Fertilizer, and Amendments

Cover crop seed expenses for planting prior to corn production ranged from $2/acre for wheat to $35/acre for a winter/cereal rye and hairy vetch mix. Cover crop seed expenses for planting prior to soybean production ranged from $8/acre for winter/cereal rye to $26/acre for an alternative seeding of winter/cereal rye. Reduced seed expenses reflect the capability to produce non-GMO crops and reduce seed treatments.

Phosphorous applications were reduced for both corn and soybean, and nitrogen applications were reduced for corn. Nitrogen reductions averaged 66 units/acre for irrigated corn. Several farmers reported using fertigation with precision nitrogen management tools. Average reductions in phosphorous were 34 lb/acre for corn and 18 lb/acre for soybean. Additional fertilizer and amendment expenses reflect applications of compost, manure, and biological inputs. Net fertilizer and amendment reductions were approximately $29/acre for corn and $2/acre for soybean.

## Pesticides

Reducing tillage and planting cover crops can suppress weeds and lead to changing or eliminating some herbicides. On the other hand, herbicide use may increase to terminate cover crops or to control weeds previously controlled with tillage. Averaged across all farms, reduced net pesticide expenses were $23.91/acre for corn and $13.05/acre for soybean.

## Equipment Ownership, Fuel, Labor and Services, and Other Expenses

Adopting no-till and reduced tillage decreases costs for equipment ownership, fuel, labor, and services for expenses associated with conventional tillage practices. Reduced equipment expenses were approximately $27/acre for both corn and soybean. Additional expenses included planting cover crops, spraying biological inputs, and strip tillage. Additional equipment expenses were approximately $16/acre for corn and $14/acre for soybean.

Fuel and electricity expenses are associated with powering equipment and irrigation. Net reduced expenses were $13.41/acre for corn and $13.70/acre for soybean. Irrigation was reduced by 3.0 acre-inches for corn (-26%) and 3.1 acre-inches for soybean (-28%). Net reduced expenses for labor and services were $15.49/acre for corn and $14.63/acre for soybean.

Reduced production expenses contributed $92.49/acre for corn and $54.72/acre for soybean to increased farm income.





## Revenue

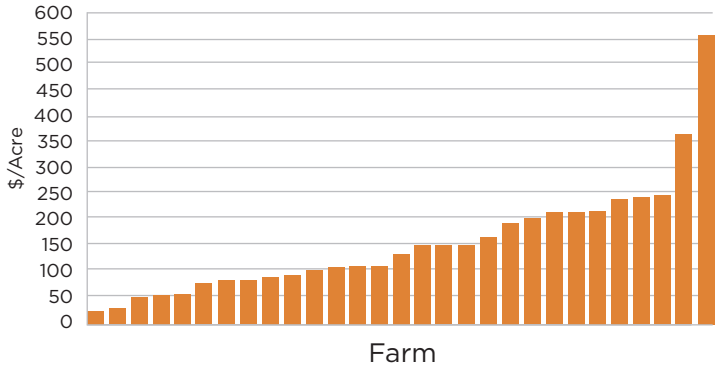
Yield increases averaged 12.76 bu/acre for corn and 3.61 bu/acre for soybean. Because market prices for crops fluctuate, revenue for increased yield was calculated by applying long-term average corn and soybean prices. Average revenue increases were $57.42/acre for corn and $37.91/acre for soybean.

Most farms grazed stover and/or cover crops, with farmers valuing grazing as either feed costs saved or as a payment rate received from others. Other revenue from grazing averaged $9.60/acre for corn and $0.11/acre for soybean.

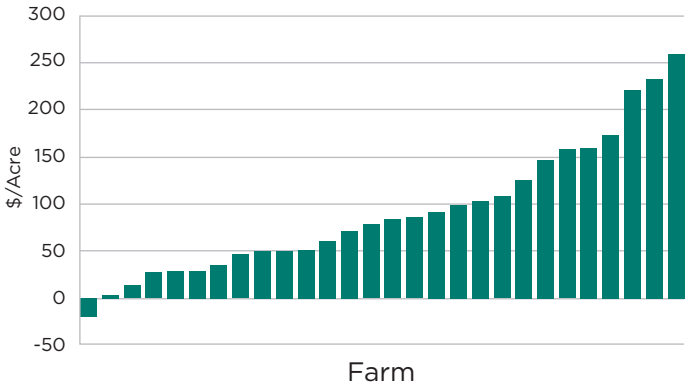
Combining yield increases and grazing value resulted in increased revenue of $67.02/acre for corn and $38.02/acre for soybean. With reduced expenses, farm income increased $153.83/acre for corn and $91.58/acre for soybean. Results for these 29 farmers with irrigated production indicate that even when yield does not increase and value of grazing cattle is not considered, profitability increased because of the reduced expense of growing corn and soybean.

All irrigated corn farms reduced expenses, with additional farm income contributions from increased yield and grazing value. All but one grower with irrigated soybean increased farm income. The farm reporting decreased farm income for soybean had increased expenses offset by income gains in corn, resulting in an overall farm income increase.

**Change in farm income, irrigated corn**




**Change in farm income, irrigated soybean**



## BOTTOM-LINE BENEFITS

# for non-irrigated corn and soybean production

Managing for soil health increased some per-acre expenses — primarily from cover crop seed, compost and biological inputs — however, those costs were offset by reduced pesticide and equipment expenses, as well as greater yields. Results were averaged across 11 farms with non-irrigated production. On average, net income rose by $157 per acre for corn and $90 per acre for soybean.

### Partial budget analysis for non-irrigated corn and soybean, $/acre

| | CORN | | SOYBEAN | |
|---|---|---|---|---|
| **Expense Category** | **Reduced Expense** | **Additional Expense** | **Reduced Expense** | **Additional Expense** |
| Seed | 6.82 | 9.05 | 1.36 | 3.95 |
| Fertilizer & Amendments | 35.87 | 31.82 | 14.83 | 17.49 |
| Pesticides | 28.84 | 5.29 | 12.15 | 2.65 |
| Fuel & Electricity | 3.86 | 2.42 | 3.66 | 1.83 |
| Labor & Services | 19.22 | 10.43 | 15.69 | 7.60 |
| Equipment Ownership | 24.86 | 15.44 | 22.84 | 11.89 |
| Post-harvest Expenses | 0.00 | 9.83 | 0.00 | 2.05 |
| **Total Expense Change** | **119.47** | **84.28** | **70.53** | **47.46** |
| | **Additional Revenue** | **Reduced Revenue** | **Additional Revenue** | **Reduced Revenue** |
| Yield, bu. | 22.09 | 0.00 | 6.36 | 0.00 |
| Price Received, $/bu | 4.50 | 4.50 | 10.50 | 10.50 |
| Other Revenue[1] | 22.57 | 0.00 | 0.28 | 0.00 |
| **Total Revenue Change** | **121.98** | **0.00** | **67.06** | **0.00** |
| | **Total Benefits** | **Total Costs** | **Total Benefits** | **Total Costs** |
| Total Change | 241.45 | 84.28 | 137.59 | 47.46 |
| **Change in Farm Income** | **157.17** | | **90.13** | |

[1] Commodity prices applied to yields based on long-term average prices



# Expenses

## Seed, Fertilizer, and Amendments

Seed expenses for cover crops planted prior to corn ranged from $12/acre for a winter/cereal rye and hairy vetch mix to $35/acre for a sorghum Sudan, millet, cowpea, and radish mix. Additional seed expense for soybean was also for planting cover crops prior to production. Reduced seed expenses reflect farmers reducing seed treatments or producing non-GMO crops made possible by managing for soil health.

Phosphorous applications were reduced for both crops, and nitrogen was reduced for corn. Reduced nitrogen that averaged 39 units/acre for non-irrigated corn. Average reductions in phosphorous were 23 lb/acre for corn and 18 lb/acre for soybean. Additional fertilizer and amendment expenses reflected applications of compost, manure, and biological inputs by some farms.

## Pesticides

Farms reporting reduced pesticide expenses entailed herbicides, insecticides, and fungicides for both corn and soybean, while additional pesticide expenses included herbicides to manage weeds previously controlled by tillage. Averaged across all farms, reduced net pesticide expenses were $23.55/acre for corn and $9.50/acre for soybean.

## Equipment Ownership, Fuel, Labor and Services, and Other Expenses

Eequipment expenses decreased as farmers reduced tillage operations. Additional expenses included planting cover crops, spraying biological inputs, and using a no-till planter. Net reduced equipment expenses were $9.42/acre for corn and $10.95/acre for soybean.

Fuel expense, labor (operating hours), and services (repairs and maintenance) are associated with equipment ownership expenses. Corn net reduced expenses associated were $1.44/acre for fuel and $8.79/acre for labor and services. Soybean net reduced expenses were $1.83/acre for fuel and $8.09/acre for labor and services.

Reduced production expenses totaled $119.47/acre, with $74.45/acre in additional production expenses. Soybean reduced production expenses totaled $70.53/acre, with $45.41/acre in additional production expenses. Reduced production expenses contributed $45.02/acre for corn and $23.12/acre for soybean to increased farm income.



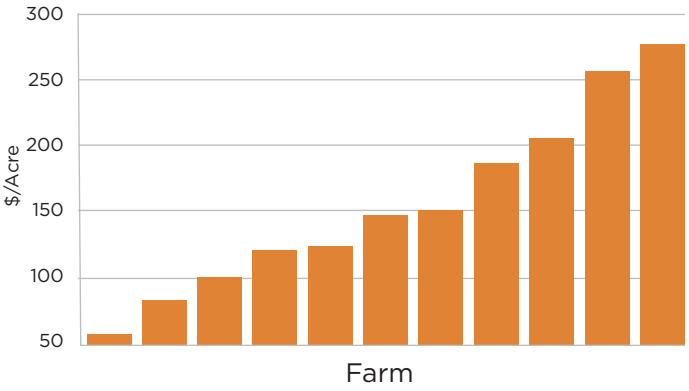
## Revenue

The 11-farm average yield increases were 22.09 bu/acre for corn and 6.36 bu/acre for soybean. Average crop revenue increases were $99.41/acre for corn and $66.78/acre for soybean. Six farms grazed stover or cover crops, with other revenue from grazing averaging $22.57/acre for corn and $0.28/acre for soybean across all farms.

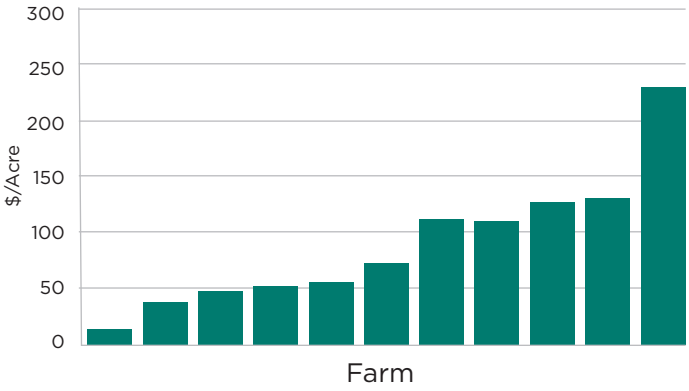
Combining yield increases and grazing value resulted in increased revenue of $121.98/acre for corn and $67.06/acre for soybean. With reduced production expenses, farm income increased $157.17/acre for corn and $90.13/acre for soybean. Results indicate that even when yield does not increase and value of grazing cattle is not considered, profitability increased because of the reduced expense of growing corn and soybean.

Economic benefits increased income for all farms with a range for non-irrigated corn from $58 to $279 per acre. Economic benefits for non-irrigated soybean ranged from $13 to $234 per acre.

**Change in farm income for 11 farms, non-irrigated corn, $/Acre**




**Change in farm income for 11 farms after adopting a soil health management system, non-irrigated soybean, $/Acre**



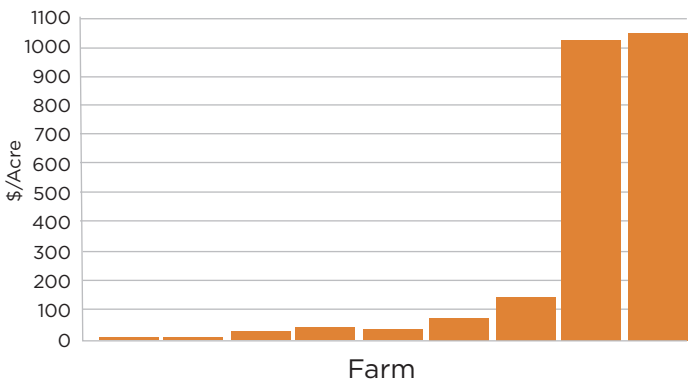
## BOTTOM-LINE BENEFITS

# for pasture and forage production

Nine farmers reported adopting soil health practices for pasture and forage acreage, including rotational grazing for seven farms and cover crops with permanent pasture for two farms. Average farm income increase of $264/acre included combinations of reduced production expenses, increased quantity of grass produced, increased stocking rates, and increased marketing value due to increased grazing capacity.

One farm with rotational grazing using movable electric fencing increased income over $1,000/acre through a combination of selling additional calves, annualized savings in permanent fencing, net savings for grazing cover crops, and savings on fertilizers and herbicides. Another farm planted cover crops over permanent pasture, enabling increased stocking of six lambs per acre with a marketing value of $196 per head. One farm switched from corn and soybean production to teff grass production, with an oat/pea mix cover crop over teff grass reducing irrigation applications and generating additional revenue as baled hay.

**Change in farm income, pasture and forage, $/acre**






## Additional benefits

In addition to benefits that directly impact profitability, all farmers reported reduced erosion, while 97% saw improved water infiltration and increased resilience to stressful conditions such as drought. Improved water quality was reported by 84% of farmers based on observations of clear runoff from fields. Improved soil structure was reported by 90% of farmers, with greater field access for equipment after rainfall events that would otherwise cause ruts or delay planting and harvest. Some farmers visually monitored changes in soil organic matter, and 87% reported that those levels appeared to have increased. Those who measured soil organic matter found increases ranging from 0.4% to 2.0%, averaging 1.3%, supporting nutrient and water availability for crops and improving soil structure. Improved soil biology or biological diversity was reported by 94% of farmers, with some observing more earthworms and others more birds, beneficial insects, or other wildlife. Many farmers also mentioned the additional benefit of improved public perceptions of agriculture.



*The Soil Health Institute's Agricultural Economist, Dr. Archie Flanders, conducted this research and analysis. We thank the farmers who participated, as well as Soil Health Educator Shannon Moeller for her input on the experimental design and for conducting the interviews. This material is based upon work supported by the U.S. Department of Agriculture, under agreement number NR246526XXXXC014. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Agriculture. In addition, any reference to specific brands or types of products or services does not constitute or imply an endorsement by the U.S. Department of Agriculture for those products or services. USDA is an equal opportunity provider, employer, and lender.*



-Jordan Uldrich, Hub 1 farmer

"It was getting to where the cost of fertilizer was outrageous. Herbicides were getting outrageous. I also realized I'm not going to be able to use chemistry forever to take care of the weeds. If you can work at building your soil to be more resilient, at improving the biological features of your farm, you can start weaning yourself off the synthetic inputs."

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## Join the soil health movement

Long-term adoption of soil health practices is improving profitability for corn and soybean farmers in Nebraska. These findings underscore the importance of supporting growers who are interested in transitioning to these practices, where 89% of cropland combines no-till/reduced tillage and cover crops use represents just 5% of planted acres.

**To learn more about managing for soil health, please visit**

**nesoilhealth.org or soilhealthinstitute.org.**