THE FINANCIAL IMPACTS OF REDUCED TILLAGE

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PRACTICE OVERVIEW

Reduced tillage (or conservation tillage) refers to tillage methods that leave at least 30% of the plant residue on the field following harvest or have a lower level of soil disturbance than conventional tillage, as measured by the Soil Tillage Intensity Rating.[1] Conventional tillage systems prepare the soil for planting by inverting it partially or completely. Reduced tillage methods include no-till, strip-till, ridge-till, and mulch-till, among others.

The number of acres farmed with reduced tillage and no-till methods has increased in recent decades. Between 2012 and 2017, the USDA Census of Agriculture reported that acreage under reduced tillage increased by 28% and no-till acreage increased by 8%, while conventionally tilled acreage declined by 24%.[2] A study of recent Agricultural Resource Management Surveys (ARMS) found that reduced tillage is used on the majority of wheat (67%), corn (65%), and soybean (70%) acres.[3]

Reduced tillage is a system-level change that can require upfront investment in new machinery and adjustments to other inputs. By making fewer trips across the field, reduced tillage can lower fuel, machinery, and labor costs for an increase in profitability.

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1 Claassen, R., Bowman, M., McFadden, J., Smith, D., & Wallander, S. (September 2018). "Tillage intensity and conservation cropping in the United States." EIB-197, U.S. Department of Agriculture, ERS, https://www.ers.usda.gov/webdocs/publications/90201/eib-197.pdf. Conservation tillage methods have a STIR of less than or equal to 80.

2 National Agriculture Statistics Service (NASS). (2020). "Land use practices." https://www.nass.usda.gov/Publications/Highlights/2020/census-land-use-practices.pdf; Economic Research Service (ERS). (2021). "Cover crop trends, programs, and practices in the United States." https://www.ers.usda.gov/webdocs/publications/100551/eib-222.pdf. The number of farmers practicing reduced tillage and cover cropping rose between the 2012 and 2017 Census of Agriculture.

3 Claassen, R., et al. (September 2018). "Tillage intensity"

REDUCED TILLAGE AFFECTS PROFITABILITY THROUGH YIELD IMPACTS AND COST SAVINGS

The studies described in the bulleted lists below show that reduced tillage practices can impact yields positively and negatively, depending on various factors. Reducing tillage can require investment in new equipment and can impact other input needs, such as herbicide, fertilizer, and pesticide application. Even with the costs of the transition, agricultural producers can realize sufficient cost savings to make reduced tillage financially profitable. The following studies present the financial impacts reduced tillage can have on yields and production costs.

- **Reduced tillage was more profitable on high-productivity Illinois corn fields from 2015 to 2021.** Seven years of production data from 590 Illinois corn fields gathered by Precision Conservation Management (PCM) found that two passes of low-disturbance tillage was the most profitable system, averaging $328/acre returns. As shown in Table 1, the data show that two tillage passes, one high-disturbance pass, and one low-disturbance pass is not as profitable, averaging $217/acre returns. Tillage systems with one light pass were more profitable than the two-moderate pass system, averaging $320/acre returns. No-till systems and strip-till systems came in lower at $298/acre and $290/acre returns, respectively. Conventional tillage with more than two passes had the lowest profitability at $260/acre returns. PCM is a collaboration between the University of Illinois and the Illinois Corn Growers Association. The program uses field pass data to determine the most profitable farming systems for corn and soy on high-productivity soils.[4]

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4 Precision Conservation Management (PCM). (2022). "The business case for conservation." https://www.precisionconservation.org/wp-content/uploads/2022/06/PCMBooklet_WEB_FINAL_05-13-22.pdf

Table 1: Profitability of tillage systems in Illinois from 2015 to 2021.
Adapted from Precision Conservation Management.

Corn | TILLAGE HIGH SPR | 2015-21 AVG VALUES	NO-TILL	STRIPTILL	1-PASS LIGHT	2-PASS LIGHT	2-PASS MODERATE	2+ PASSES
# of fields	590	731	1,312	442	638	88
Yield per acre	213	218	219	225	225	218
GROSS REVENUE	$826	$845	$851	$876	$873	$845
TOTAL DIRECT COSTS*	$390	$402	$385	$393	$397	$410
Field work	$0	$20	$11	$22	$26	$38
Other power costs	$101	$95	$98	$96	$96	$99
TOTAL POWER COSTS**	$101	$115	$109	$118	$122	$137
OVERHEAD COSTS	$37	$37	$37	$37	$37	$37
TOTAL NON-LAND COSTS	$528	$555	$531	$548	$556	$585
OPERATOR & LAND RETURN	**$298**	**$290**	**$320**	**$328**	**$317**	**$260**
Estimated soil loss (tons/a)	0.55	0.52	1.12	1	1.03	1.39
GHG emissions (metric tons CO2e/a)	-0.32	0.31				1.16

***Direct Costs** = fertilizers, pesticides, seed, cover crop seed, drying, storage, and crop insurance

****Power Costs** = tillage, fall fertilizer application, spraying, planting, cover crop planting, spring/in-season fertilizer application, harvesting, and grain hauling

No-Till = No tillage; **Strip-Till** = Less than full-width tillage of varying intensity; **1-Pass Light** = 1 pass w/low-disturbance tillage; **2-Pass Light** = 2 passes w/low-disturbance tillage; **2-Pass Medium** = 2 passes (1 low-disturbance tillage +1 high-disturbance tillage); **2+ Pass** = more than 2 tillage passes, any intensity level **SPR** = soil productivity rating

- **No-till and cover crops reduced crop loss during severe precipitation.** A 2023 study by the Meridian Institute and the University of Illinois found that fields with cover crops and no-till management were 24% less likely than conventional fields to be declared "prevent plant" and receive insurance payments during the 2019 severe precipitation and flooding in the Upper Mississippi River Basin. The study also found that farmers were able to plant fields that used no-till and cover crops earlier in the critical planting window as compared to fields using conventional practices.[5]
- **Strip-till and conventional tillage had the greatest yields in Minnesota on-farm trials.** A study by the University of Minnesota Extension and Monsanto Corporation found that average corn yields were greatest for strip-till (188 bu/acre) and conventional methods (190 bu/acre) compared to one-pass (185 bu/acre) and to no-till (180 bu/acre).[6] The study compared the four tillage systems across 10 farms in a series of on-farm trials over 2 years.
- **Iowa farmers experienced cost savings using reduced tillage in a 20-farm study.** A case study of 20 Iowa soybean farmers found that the study participants realized cost savings between $10/acre and $88/acre in equipment, fuel, and labor by transitioning from conventional tillage to strip and no-till.[7]
- **Midwest farmers achieved higher returns and lower costs from reduced tillage.** A study of seven farms across the Midwest—conducted by the Soil Health Partnership, Environmental Defense Fund, and Pinion— found that reduced tillage had lower operating costs and higher returns for corn and soybeans in comparison to conventional tillage. The return for corn averaged $377/acre for reduced tillage and $324/acre for conventional tillage, and returns for soybeans averaged $251/acre for reduced tillage compared to $216/acre for conventional tillage.[8]

Figure 1: Per acre costs by tillage type for corn from SHP, EDF, and Pinion study.

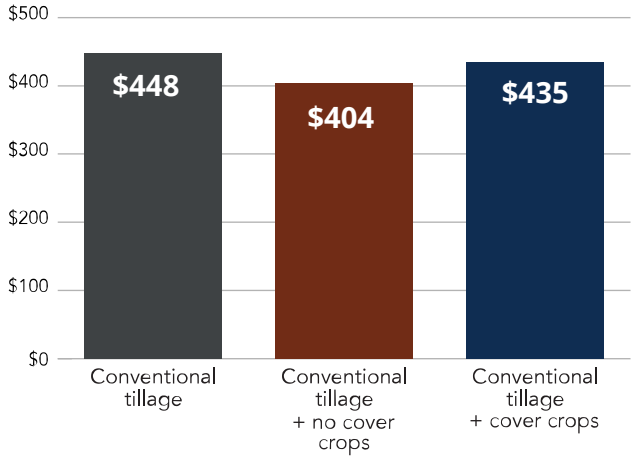
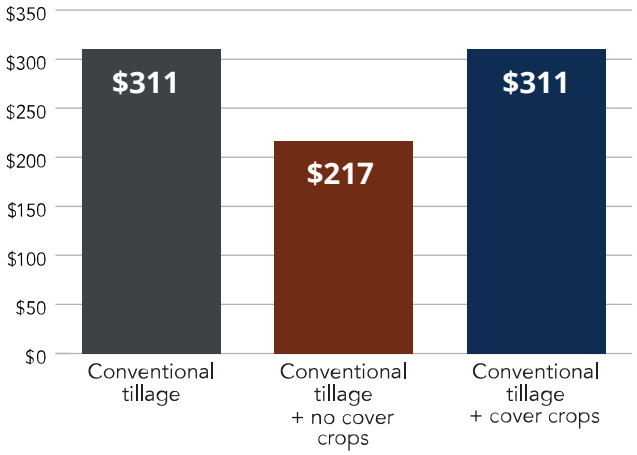


Figure 2: Per acre costs by tillage type for soybeans from SHP, EDF, and Pinion study.



5 Meridian Institute. (2023). "Conservation and crop insurance research pilot." https://foodandagpolicy.org/wp-content/uploads/sites/17/2023/03/Conservation-Crop-Insurance-Data-Pilot-Results-1.pdf

6 DeJong-Hughes, J., & Vetsch, J. (2007). "On-farm comparison of conservation tillage systems for corn following soybeans." University of Minnesota Extension Publication BU-08483. The study had 10 farmers in 2004 and 9 in 2005 due to one site being lost to wind.

7 Imerman, M. & Imerman, E. (2019). *Estimation of financial implications resulting from the implementation of farm conservation practices.* Regional Strategic, Ltd. https://regionalstrategic.com/portfolio-items/estimation-of-financial-implications-resulting-from-the-implementation-of-farm-conservation-practices/

8 Soil Health Partnership (SHP), Environmental Defense Fund (EDF), & KCoe Isom (Pinion). (2021). "Conservation's impact on the farm's bottom line," http://www.soilhealthpartnership.org/wp-content/uploads/2021/02/Conservation-Impact-On-Farm-Bottom-Line-2021.pdf

- **Illinois farm achieves positive net return from reduced tillage.** A case study of Thorndyke Farms in Illinois conducted by the American Farmland Trust reported a positive net return of $12.68/acre when they reduced tillage on half of their corn and soybean acres. The changes in costs included a $5.00/acre increase in herbicide costs and a $17.68/acre cost saving in machinery.[9]

IN SOME CASES, NO-TILL CAN BE PROFITABLE IN THE LONG-TERM

Studies show that no-till can be, on average, less profitable than conventional and reduced tillage systems. But in some cases, no-till can be profitable, especially when no-till helps address erosion and other costly challenges. The following studies provide greater detail:

- **No-till is associated with increased land value in the U.S. Midwest.** A 2022 study found that no-till farming was associated with an increase in land value in the Midwest. By analyzing data from 12 states, the study found a $7.86/acre increase in agricultural land value for every 1% of no-till farming.[10]
- **No-till soybean fields in Illinois are among the most profitable.** In PCM's 2021 report of 280 Illinois farmers, 44% of the most profitable soybean fields were no-till. The study also found that no-till fields had about half the amount of erosion of fields with at least one tillage pass.
- **No-till yields were comparable in well-drained Minnesota soils, but less productive in clay soils.** A University of Minnesota Extension and Monsanto study found that no-till had similar corn yields as the other reduced tillage systems in well-drained loess soils in southeast Minnesota, but less yields on glacial till, heavy clay soils.
- **An Illinois farm experiences financial benefits from no-till after 4 years.** A case study by Datu Research of Kuhns Family Farm in Illinois describes the financial impacts of no-till on their farm. The farm has been under no-till practices for 23 years to produce corn and soybeans.[11] The farmers initially transitioned to no-till to address the poor quality of their soil and reduce erosion costs. They began to see benefits in the fourth year, and after 23 years, their soil organic matter had increased from the pre-adoption level of 1.89% to 2.32%. Their corn yields had increased by 46 bu/acre and their soybeans increased by 26 bu/acre. The farmers attribute 25% of the corn yield increase to using no-till and 40% of the soy yield increase to using to no-till. The cost reductions for machinery, fuel, labor, and fertilizer, combined with the increased yields, netted an increase in income of $107.81/acre. The farm consistently outperformed the county average, especially during bad weather years, due to the increased moisture levels in the soil.

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9 American Farmland Trust (AFT). (2019). "Soil health case study: Larry, Adam, and Beth Thorndyke, Thorndyke Farms, IL," https://farmlandinfo.org/wp-content/uploads/sites/2/2020/02/IL_ThorndykeFarms_Soil_Health_Case_Study_AFT_NRCS.pdf

10 Le Chen, R. M. Rejesus, S. A., Hagen, S. & Salas, W. (2022). "The impact of no-till on agricultural land values in the United States Midwest." *American Journal of Agricultural Economics, 1–24.* https://doi.org/10.1111/ajae.12338.

11 Datu Research, LLC. (2017). "Datu case study on the economics of no-till: Kuhns Family Farm." https://www.researchgate.net/publication/321654427_Datu_Case_Study_on_the_Economics_of_No-till_Kuhns_Family_Farm

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