The Financial Implications of Conservation Agriculture

Insights from Analyses of Farms in the Upper Midwest

NORTH CENTRAL REGION WATER NETWORK
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UNIVERSITY OF MINNESOTA EXTENSION
Environmental Defense Fund
COMPEER FINANCIAL
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EXECUTIVE SUMMARY

Farmers and ranchers are increasingly interested in conservation practices to strengthen soil health and improve water quality for present and future generations.[1] Conservation practices can also help farmers improve their profitability in the face of increasingly volatile weather and uncertain market conditions.

Some farmers and ranchers hesitate to adopt these practices because of perceived financial risks or uncertainty about what they would mean financially for their operations.[2]

This booklet aims to inform farmers' key partners—in particular, farm business management educators, agricultural lenders, and conservation educators and professionals—about the financial costs and benefits of conservation agriculture practices to assist their work with farmers. Strengthening these professionals' knowledge about the financial implications of conservation agriculture will enable them to engage farmers in making informed decisions to optimize the sustainability and profitability of their operations.

The information included in this booklet was gathered through a review of existing research on the financial impacts of conservation practices on production systems in the Upper Midwest region. The research includes national statistics from the United States Department of Agriculture's (USDA) Census of Agriculture and the National Cover Crop Surveys. Sources at the regional and state level come from Extension reports, multi-farm case studies, on-farm comparison trials, and state Department of Agriculture reports.

Jason Cavadini

1 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.

2 SARE, CTIC, & ASTA. (2020). "Annual report 2019–2020: National cover crop survey." https://www.ctic.org/files/20192020-CoverCropSurvey(2).pdf

ABOUT THIS PROJECT

This booklet is an outcome of a North Central Sustainable Agriculture Research and Education (SARE) grant called "Closing the Financial Information Gap in Conservation Agriculture." The project is a collaboration between the North Central Region Water Network, the University of Wisconsin–Madison Division of Extension, the University of Minnesota Water Resources Center, Environmental Defense Fund (EDF), Compeer Financial, and Croatan Institute. Through training and resource development, the project aimed to increase knowledge about the financial impacts of conservation practices among conservation educators, farm business management educators, and agricultural lenders to enhance their abilities to support farmers' decisions.

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Environmental Defense Fund, a leading international nonprofit organization, creates transformational solutions to the most serious environmental challenges. EDF links science, economics, law, and innovative private-sector partnerships. EDF's agricultural finance work includes farm financial analyses, collaborating with finance providers to develop solutions, and agricultural finance policy. To learn more, visit **business.edf.org/farm-finance**.

LAUREN MANNING AND DAVID LEZAKS, CROATAN INSTITUTE

Croatan Institute is an independent, nonprofit research and action institute. Our mission is to build social equity and ecological resilience by leveraging finance to create pathways to a just economy.

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HOW TO USE AND INTERPRET THE CONTENTS OF THE BOOKLET

This booklet is a resource for farm business management educators, agricultural lenders, and conservation educators to aid their conversations with farmers about the financial implications of conservation practices. The booklet can be separated into fact sheets specific to each of the four conservation practices presented; these separated fact sheets can also be found **at this link**. The subheadings within each fact sheet could serve as talking points to support your conversations with farmers.

CONSERVATION PRACTICES PRESENTED IN THE BOOKLET

This booklet describes existing information on the financial impacts of these four conservation practices.

REDUCED TILLAGE

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.[3] Conventional tillage systems prepare the soil for planting by inverting it to some degree or completely.[3] Reduced tillage methods include no-till, strip-till, ridge-till, and mulch-till, among others.

COVER CROPS

Cover cropping is the practice of planting a crop after harvesting the cash crop in the fall to maintain soil cover and root growth before planting the next cash crop in the spring. This differs from conventional cropping systems that leave the soil bare over the winter months between harvest and planting, exposing the soil to wind and rain erosion. Cover crops can help increase soil organic matter in the surface soil layers, improve soil structure, improve water retention and drainage, and reduce erosion.[4] The increase in plant residue may also increase biodiversity, leading to stronger suppression of opportunistic pests and weeds.

NUTRIENT MANAGEMENT

Effective nutrient management meets the nutrient needs of the plant and minimizes losses to the environment.[5] Efficient nutrient management involves using the correct fertilizer product and applying the right amount of it at the right time and right place. Achieving these best management practices can reduce nutrient runoff into surface waters and help improve downstream water quality.

MANAGED GRAZING

Managed grazing is the practice of creating and following a grazing plan that is tailored to the manager's production and conservation goals and features of the property, including plant productivity, topography, and water availability. Managed grazing benefits producers by giving them the ability to determine their animal forage balance distribution, timing, and density. It can also help producers adapt to ever-changing weather conditions such as drought.

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3 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.

4 Daryanto, S., Fu, B., Wang, L., Jacinthe, P. A., & Zhao, W., (2018). "Quantitative synthesis on the ecosystem services of cover crops." *Earth-Science Reviews, 185,* pp.357–373.

5 McLellan, E. L., Cassman, K. G., Eagle, A. J., Woodbury, P. B., Sela, S., Tonitto, C., Marjerison, R. D., & Van Es, H. M. (2018). "The nitrogen balancing act: Tracking the environmental performance of food production." *BioScience, 68(3),* pp.194–203.

INTERPRETING FINANCIAL IMPACTS OF CONSERVATION PRACTICES

The management and financial impacts of conservation practices vary based on geographic location, soil type, production type, producer experience, weather, and other variables. It is therefore critical to interpret the results of financial analyses of conservation practices only for the region and production types evaluated in each study. Additionally, while conservation practices can have immediate impacts on both production and financial outcomes, many practices require consistent long-term adoption—and some adaptation to local conditions—to achieve maximum impact.

Conservation practices can impact various revenue and cost categories of agricultural enterprises. Some of the most common revenue and cost categories impacted include:

- **Revenue:** Conservation practices can impact the productivity of a farming enterprise, represented by changes in crop yields, dairy cow milk production, or livestock weight gain. Conservation practices can also bring in additional revenue when the producer receives a financial incentive for adopting the practice.
- **Input costs:** Conservation practices can impact the input costs of an operation through changes in the amount of seeds planted and fertilizer, herbicide, and pesticide applied.
- **Machinery costs:** Conservation practices can affect the use of machinery and its associated costs, including fuel, depreciation, repairs, and maintenance.
- **Labor costs:** Conservation practices can affect the amount of labor needed to manage the production system, which affects labor costs of the operation.
- **Erosion repair costs:** Some conservation practices can reduce the risk of erosion and, thus, the costs associated with repairing erosion.

THE FINANCIAL IMPACTS OF REDUCED TILLAGE

Beth Baker

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.[6] 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%.[7] 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.[8]

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.

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

7 National Agricultural Statistics Service (NASS). (2020). "Land use practices"

8 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.[9]

April Opatik

9 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.[10]
- **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).[11] 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.[12]
- **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.[13]

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

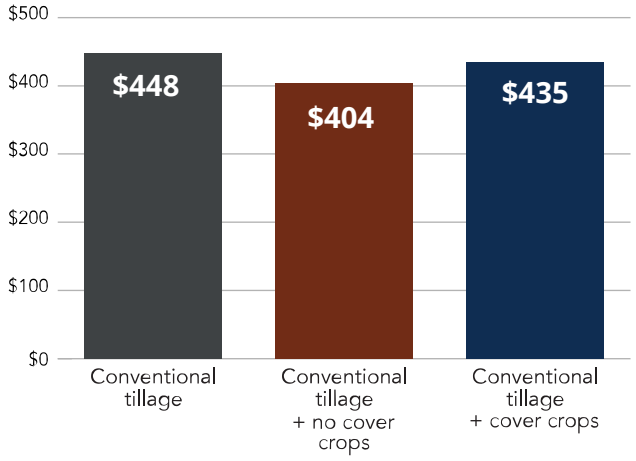
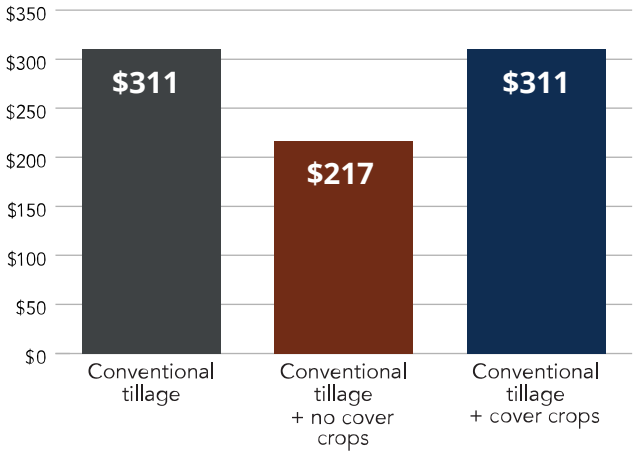


Figure 2: Per acre costs by tillage type for soybeans from SHP, EDF, and Pinion study.



10 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

11 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.

12 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/

13 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.[14]

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.[15]
- **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.[16] 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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14 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

15 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.

16 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

THE FINANCIAL IMPACTS OF COVER CROPS

UW Discovery Farms

PRACTICE OVERVIEW

Cover cropping is the practice of planting a crop after harvesting the cash crop to maintain soil cover and root growth before planting the next cash crop. This differs from conventional cropping systems that leave the soil bare over the winter months between harvest and planting, exposing the soil to wind and rain erosion. Cover crops can help increase soil organic matter in the surface soil layers, improve soil structure, improve water retention and drainage, and reduce erosion.[17] The increase in plant residue may also increase biodiversity, leading to stronger suppression of opportunistic pests and weeds.

Cover crops also help retain nitrogen already in the soil, and leguminous cover crops can add new nitrogen to the soil. In both cases, this can reduce the amount of nitrogen fertilizer farmers need to apply to sustain crop yields.

Improving soil health can provide better tolerance to severe weather events like flooding. 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 severe precipitation and flooding that occurred in the Upper Mississippi River Basin in 2019.[18]

17 Daryanto, S., et al. (2018). "Quantitative synthesis"

18 Meridian Institute. (2023). "Conservation and crop insurance research pilot"

Cover crops can also be more profitable when addressing particular soil health needs. Specific species can be selected to reduce erosion, alleviate compaction, improve water filtration, suppress weeds, and increase nutrient uptake. Cover crop species used in the Midwest include cereals (rye, wheat, barley, oats, and triticale), legumes (red clover, crimson clover, vetch, peas, and beans), grasses (annual ryegrass), and broadleaf species (buckwheat, mustards, brassicas, and forage radish).[19]

The USDA Census of Agriculture reports that the acreage planted with cover crops nationally increased by 50% between 2012 and 2017.[20]

COVER CROPS ADD DIRECT COSTS

Planting cover crops presents additional costs to the farm budget, including the cost of the cover crop seed, fuel and equipment for applying the seed, and herbicide for terminating the cover crop. The studies and analyses in the bulleted list below provide greater detail:

- **The median cost nationally of planting a cover crop is roughly $37/acre.** The National Cover Crop Survey—conducted annually by the Conservation Technology Information Center (CTIC), the Sustainable Agriculture Research and Education (SARE), and the American Seed Trade Association—captures responses from over 1,000 farmers using cover crops to provide a snapshot of cover cropping practices nationwide. An analysis of 5 years of the survey's data between 2012 and 2016 found that the median cost to plant cover crops was $37/acre, as shown in Table 2.

Table 2: Cost of seeding cover crops from "Cover Crop Economics: Opportunities to improve your bottom line in row crops."[21]

Item	Cost Per Acre
Cover crop seed	$10-$50
Seeding the cover crops	$5-$18
Termination	$0-$10
Subtotal range	$15-$78
Median cost from survey	$37

- **Midwest farmers report median cover crop costs of $15/acre for seed and $12/acre for application.** A survey by the Soil Health Partnership of 82 farmers across 11 states in the Midwest found that the median cover crop seed cost was $15/acre and the median application cost to be $12/acre.[22]

19 Clark, A. (2015). *Cover crops for sustainable crop rotations.* Sustainable Agriculture Research and Education. https://www.sare.org/resources/cover-crops/

20 NASS, "Land use practices"

21 SARE. (2019). "Cover crop economics: Opportunities to improve your bottom line in row crops." https://www.sare.org/wp-content/uploads/Cover-Crop-Economics.pdf

22 Soil Health Partnership. (2020). "2019 cover crop planting report." http://www.soilhealthpartnership.org/wp-content/uploads/2020/08/SHP-cover-crop-survey-results-2020.pdf

- **Minnesota farmers spent $25/acre for cover crop seed and $17/acre on fuel and repairs.** Cover crop financial data in the FINBIN database, one of the largest publicly available farm financial databases in the country, show that Minnesota corn farms using cover crops spent $25.10/acre on cover crop seed and $16.61/acre on fuel and repair.[23] Data from Minnesota soybean farms using cover crops show expenditures of $23.51/acre for cover crop seed and $18.84 in fuel and repairs.[24]

COVER CROPS CAN BE PROFITABLE OVER TIME

Achieving profitability using cover crops can take time as farmers learn the most effective cover crop seed, application, and termination methods for their operations. After the transition period of about 3 to 5 years, some studies have found that farmers who use cover crops can see an increase in profitability.

- **A national cover crop survey found significant cost savings after 5 years of cover crop experience.** In the National Cover Crop Survey's 2012–2016 analysis, cost savings for farmers in the fifth year of cover crop usage were estimated at $21.90/acre for fertilizer, $10–$25/acre for weed control, and $2–$4/acre for erosion repair. After added costs of $37/acre, farms using cover crops for at least 5 years experienced a net return of $17.90 from growing cover crops.[25]
- **Farmers experience negative returns in year one, but positive net returns over time.** The National Cover Crop Survey's 2012–2016 analysis found that farmers increasingly realized cost savings over the first 5 years. Despite a negative net return per acre in year one (–$31/acre) and minimal return in year three ($1.42/acre), farm data from the survey show substantive returns after 5 years of cover crop use ($18/acre). By the fifth year, farmers saw corn yields increase by 3% and soy yields increase by 4.96%.[26]
- **Farmers with more than 5 years of experience have lower cover crop costs than farmers with less than 5 years of experience.** A Soil Health Partnership, Environmental Defense Fund (EDF), and Pinion study of seven farmers in the Midwest found that farms with more than 5 years of experience with cover crops had lower costs and higher net returns as compared to farms with less than 5 years of cover crop experience. The producers with more than 5 years of experience with cover crops had $95.88 higher net returns on corn and $123.29 higher net returns on soybeans as compared to the producers with less than 5 years of experience. Compared to recent cover crop adopters, experienced adopters saved $9.19/acre for cover crop seed, $25/acre for fertilizer, and $25/acre for equipment to grow corn, and then $5.90/acre on cover crop seed, $48/acre on fertilizer, and $28/acre for equipment to grow soybeans.[27] Experienced cover crop adopters had some of the lowest costs and highest profitability per acre compared to the other groups, as shown in Figure 3 and Figure 4. Figure 3 shows the costs, revenue, and net return for each of the farmer groups for corn, and Figure 4 shows the costs, revenue, and net return for each of the farmer groups for soybeans. Costs are represented in brown, revenue is represented in dark blue on top, and the net return is in gray in the middle. The experienced cover crop adopters have the second highest revenue after the farmers who practice conservation tillage without cover crops.

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23 FINBIN. (2021). "Cover crop analysis: Corn on cash rent." https://finbin.umn.edu/Output/787935.pdf

24 FINBIN. (2021). "Cover crop analysis: Soybeans on cash rent." https://finbin.umn.edu/Output/787936.pdf

25 SARE. (2019). "Cover crop economics"

26 SARE. (2019). "Cover crop economics"

27 SHP, EDF, & Pinion (2021). "Conservation's impact"

Figure 3: Net returns for corn by tillage and cover crop groups.
"Experienced adopters" are farmers with more than 5 years of cover crop experience.[28]
Adapted from the study by Soil Health Partnership, EDF, and PInion.

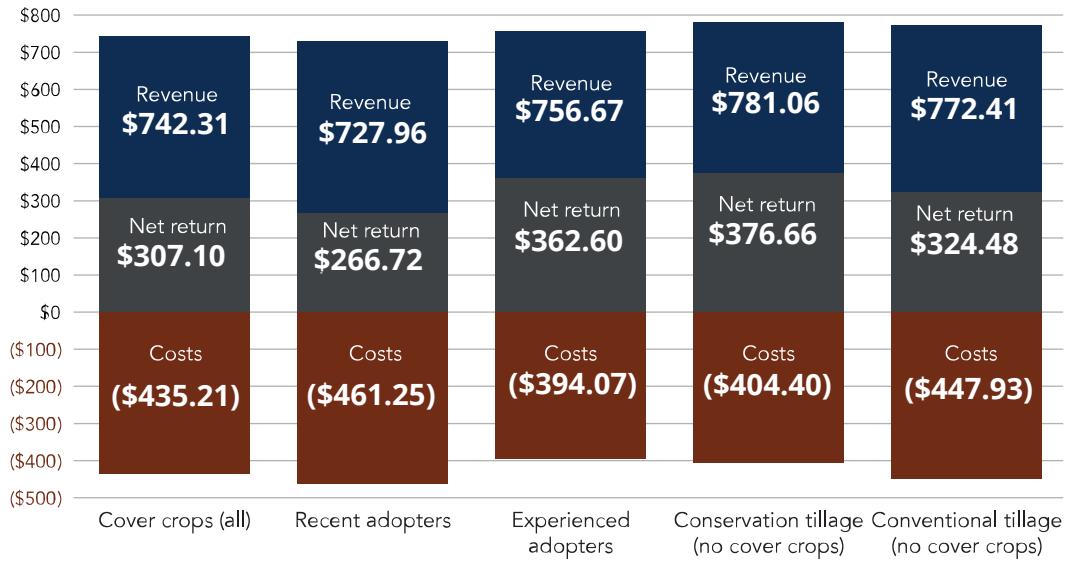
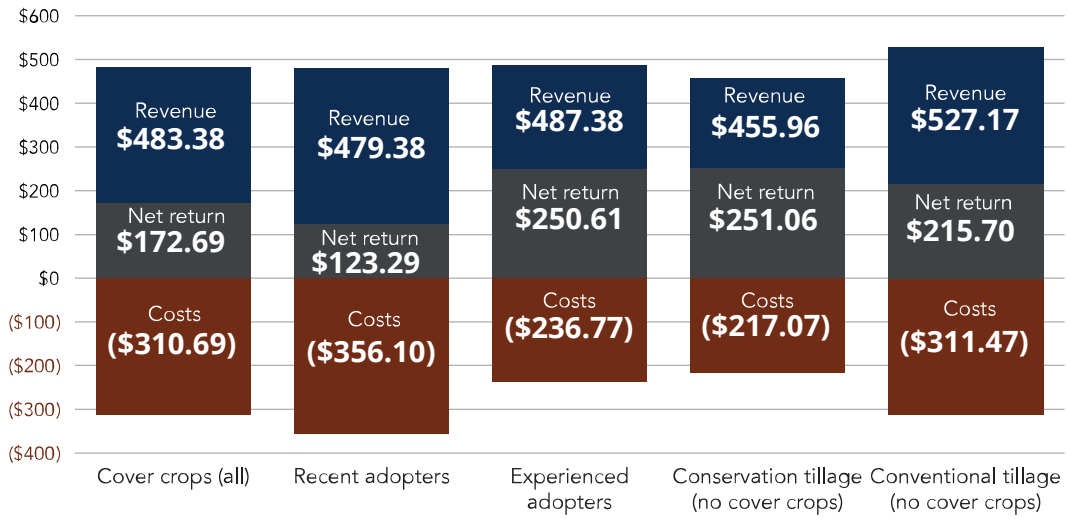


Figure 4: Net returns for soybeans by tillage type and cover crop groups.
"Experienced adopters" are farmers with more than 5 years of cover crop experience.[29]
Adapted from the study by Soil Health Partnership, EDF, and PInion.



28 SHP, EDF, & Pinion (2021), "Conservation's impact."

29 SHP, EDF, & Pinion (2021), "Conservation's impact."

- **An Illinois farm attributes cover crop use to increased corn and soybean yields.** A case study of Thorndyke Farms in Illinois by the American Farmland Trust attributed a 4% corn yield increase and a 2% soybean increase to cover crops resulting in an average increase in income of $12.95/ acre.

COVER CROP IMPACTS ON YIELDS VARY BASED ON SOIL TYPE AND WEATHER

- **Cover crops reduced yields, especially in high productivity soils.** A 2022 study using satellite imagery and machine learning found that cover crops, on average, reduced corn yields by 5.5% and soybean yields by 3.5% in 2019–2020. The study found that yield losses were more severe on fields with higher productivity soils and in instances with less spring rainfall.[30]
- **Farmers reported higher yields in cover cropped fields during the 2012 drought.** During the drought year of 2012, corn and soybean farmers reported 9.6% and 11.6% higher yields in fields using cover crops than fields without them.[31]
- **An Iowa farm experiences higher yields in 2017 by using cover crops.** As part of a case study of three farms by EDF and Pinion, LongView Farms, a corn, soybean, and sorghum farm in Iowa, reinforced the previous finding by reporting that, during the drought year of 2017, fields with cover crops had higher yields due to better water retention.[32]

INTEGRATING COVER CROPS WITH GRAZING OR A TRANSITION TO NO-TILL CAN MAKE THEM MORE PROFITABLE

The benefits of cover crops are accelerated when they are used to transition to no-till and as forage for grazing livestock.

- **National survey data shows grazing cover crops and integrating them with no-till increases their profitability.** Using the National Cover Crop Survey data, SARE estimated that cover crops can be more profitable when assisting the transition from conventional tillage to no-till. Integrating cover crops and no-till together increases the net returns of the system by $24/acre. Cover crops can also be more profitable when they are used as forage for livestock, which provides an additional $49 in net returns.[33] SARE also estimated that cover crops can be more profitable when addressing challenges such as herbicide-resistant weeds and compacted soils by increasing net returns by $27/acre and $15.30/acre, respectively.
- **An Iowa study finds cover crops systems that are grazed have a net return of $35/acre.** A study of the net returns to cover crops in Iowa found that grazing cover crops for forage and using cost-share payments helped achieve positive financial returns.[34]

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30 Deines, J. M., Guan, K., Lopez, B., Zhou, Q., White, C. S., Wang, S., & Lobell, D. B. (2023). "Recent cover crop adoption is associated with small maize and soybean yield losses in the United States." *Global Change Biology, 29,* pp.794–807. https://doi.org/10.1111/gcb.16489

31 Deines, J. M., et al. (2023). "Recent cover crop adoption"

32 Monast, M., Sands, L., & Granfton, A. (2019). *Farm finance and conservation: How stewardship generates value for farmers, lenders, insurers and landowners.* Environmental Defense Fund. **https://business.edf.org/insights/how-on-farm-conservation-can-generate-financial-value/**

33 SARE. (2019). "Cover crop economics"

34 Alejandro Plastina, A., Fangge Liu, F., Wendian Sawadgo, W., Miguez, F. E., & Marcillo, S. C. G. (2018). "Annual net returns to cover crops in Iowa." *Journal of Applied Farm Economics, 2:2.*

- **Another Iowa study finds cover crop systems have positive returns with grazing, especially with cost-share.** A farmer-led research study by the Practical Farmers of Iowa compared the economic returns on corn-soybean rotations for "no cover crops and no grazing," "just cover crops," and "cover crops and grazing." The study concluded that cover crops plus grazing averaged a net profit of $42.52/acre, which rose to $73.52/acre with cost-share assistance.

COST-SHARE CAN HELP MAKE COVER CROPS PROFITABLE

Cost-share assistance is available from several sources and is an important way to offset the costs of incorporating cover crops. The University of Illinois estimated, on average across the country, a cost-share payment of $37/acre is needed to cover the cost of seeds, application, equipment, and labor to make cover crops profitable. These are the most common sources of cost-share payments for cover crops:

- **EQIP and CSP provide annual cost-share payments based on state-determined rates.** Federal funding is available to assist in the 3-to-5-year transition typically needed to realize financial benefits. Cost-share assistance can be obtained through the federal NRCS programs Environmental Quality Incentive Program (EQIP) and Conservation Stewardship Program (CSP), which pay farmers per acre to plant cover crops.
- **State programs also provide cover crop incentive payments.** State governments provide incentives that include grants, low-interest loans, tax credits, or insurance discounts.[35]
- **Corporate programs provide incentive payments for cover crops in some areas.** Some companies and nonprofits provide incentive payments—for example, the Practical Farmers of Iowa partnered with PepsiCo, Unilever, and Cargill to provide per-acre payments for cover crops.

35 Feldmann, J., Gauthier, V., Monast, M., Rupp, M., & Aasmundstad, B. (2019). "Innovative state-led efforts to finance agricultural conservation." https://www.edf.org/sites/default/files/documents/innovative-state-led-efforts-finance-agricultural-conservation.pdf

THE FINANCIAL IMPACTS OF NUTRIENT MANAGEMENT

UW Discovery Farms

PRACTICE OVERVIEW

Nitrogen, phosphorus, and potash are critical inputs to support optimal crop productivity. However, overapplying these nutrients can contribute to runoff that pollutes waterways and to nitrous oxide emissions, a greenhouse gas, into the atmosphere. Overapplying these inputs also increases input costs and decreases profitability.

Effective nutrient management meets the nutrient needs of the plant and minimizes losses to the environment.[36] Efficient nutrient management involves using the right fertilizer product and applying the right amount of it at the right time and in the right place, also known as the 4Rs of nutrient management. Farmers use practices such as diverse crop rotations, split-applying fertilizer, variable rate application, and soil testing to reduce the risk of overapplying nutrients.

36 McLellan, E. L., et al. (2018). "The nitrogen balancing act"

EFFICIENT NUTRIENT MANAGEMENT PRACTICES CAN INCREASE PROFITABILITY BY REDUCING INPUT COSTS

Adopting efficient nutrient management practices can save farmers roughly $30/acre on land currently receiving excess nutrients, according to the USDA, with some examples approaching $50/acre.[37]

- **Illinois farmers applying the university-recommended rate achieve the greatest returns.** A Precision Conservation Management study of 280 farmers found that nutrient management was important for corn profitability and that most farms were applying nitrogen fertilizer at more than the most profitable rate. The most profitable farms applied nitrogen at the maximum return to nitrogen (MRTN) rate in the 150–200 lb. N/a range, as recommended by some land grant universities, as a preplant or side dress application. Sixty-five percent of participating farmers were applying nitrogen in excess of that rate, which decreased profitability and water quality, as shown in Table 3.

Table 3: Nitrogen rates, yields, returns, and environmental assessments of corn on high SPR, 2015–2021[38]
Adapted from Precision Conservation Management.

Corn | N-RATE HIGH SPR | LBS PER ACRE	**<150**	**151-175**	**176-200**	**201-225**	**>225**
# of fields	103	348	1,121	1,478	825
AVG Corn Yield (bu/a) 2015-21	204	214	217	219	228
OPERATOR & LAND RETURN (2015-21)	**$297**	**$319**	**$318**	**$307**	**$307**
GHG emissions (metric tons CO2e/a)	-0.07	0.16	0.14	0.18	0.48

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37 Knight, L. G., & Suhr Pierce, J. (2022). "Estimated potential economic benefits from implementation of Practice 590 – Nutrient Management on acres with excessive nutrient loss." https://www.farmers.gov/sites/default/files/2022-08/farmersgov-nutrient-management-economic-benefits.pdf

38 Precision Conservation Management (PCM). (2022). "The business case for conservation"

- **Wisconsin farms experience savings and, in some cases, yield increases from efficient nutrient management.** A 2012 study involving 250 Wisconsin farms that adopted nutrient management plans concluded that 69% of farmers reported financial savings averaging $18/acre. Two-thirds of operations reduced their nitrogen applications by an average of 32 pounds per acre. Three-quarters of the study participants saw no change in their corn yields, while 18% reported an increase.[39]
- **Variable rate technology helps an Illinois farm cut costs.** In a single-farm case study of the Ifft family farm conducted by the American Farmland Trust, the farmers began using variable rate technology to apply phosphorus and potassium in 2010. They pay an annual $0.50/acre for the technology, which has enabled them to lower their nutrient applications by 20% for an annual cost savings of $20/acre.[40]
- **Nutrient management saves fertilizer and machinery costs on an Illinois farm.** In a case study of Thorndyke Farms in Illinois by the American Farmland Trust, the farmers credited nutrient management to saving them $66/acre in nutrients and $2.73/acre in machinery costs.[41]

39 Genskow, K. D. (2012). "Taking stock of voluntary nutrient management: Measuring and tracking change." *Journal of Soil and Water Conservation, 67(1),* pp.51–58. https://www.semanticscholar.org/paper/Taking-stock-of-voluntary-nutrient-management%3A-and-Genskow/5cdb94d33bab4ab52fcf39d5e8e51a64ef4d550b

40 American Farmland Trust. (2019). "Soil health case study: Jim, Julie, and Josh Ifft, Ifft Yorkshires, IL." https://farmlandinfo.org/wp-content/uploads/sites/2/2020/02/IL_IfftYorskhiresFarms_Soil_Health_Case_Study_AFT_NRCS.pdf

41 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

THE FINANCIAL IMPACTS OF MANAGED GRAZING SYSTEMS

UW Discovery Farms

PRACTICE OVERVIEW

Managed grazing is the practice of creating and following a grazing plan that is tailored to the manager's production and conservation goals and the features of the property, including plant productivity, topography, and water availability. Managed grazing benefits producers because it gives them the ability to determine their animal forage balance distribution, timing, and density. It can help producers adapt to ever-changing weather conditions such as drought. All of these factors in combination can help with profitability. Many different approaches of managed grazing have emerged, including multi-paddock grazing, holistic planned grazing, mob grazing, management intensive grazing, and more.

Managing ruminant animals' grazing activity can generate a variety of benefits.[42] Ensuring that ruminants do not overgraze a pasture or smaller areas within pastures can help provide continuous living cover for soil, which helps mitigate soil loss and encourage soil water retention.[43]

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42 Teague R., & Kreuter, U. (2020). "Managing grazing to restore soil health, ecosystem function, and ecosystem services." *Frontiers in Sustainable Food Systems, 4:534187.* doi: 10.3389/fsufs.2020.534187

43 USDA. (2015). "Grazing economics: Conservation solutions for your Pennsylvania farm." **http://www.paglc.org/wp-content/uploads/2015/02/Grazing-Economics_Final.pdf**

Managed grazing systems that aim to prevent overgrazing, protect soil health, and support profitability succeed when they achieve an optimal stocking rate, as measured by the number of animals per acre. An optimal stocking rate is achieved when the number of animals grazed over time is balanced with the plant productivity of the land.[44] These systems can also benefit from improved distribution of livestock to prevent overgrazing in some areas and undergrazing in others. Improving the distribution of livestock can be achieved in many ways, including subdividing pastures into smaller paddocks to limit cattle's access to each paddock or moving water sources and mineral blocks around the pasture to distribute grazing pressure more evenly. This is compared to continuous grazing systems, where livestock are generally allowed to graze large areas for extensive periods of time without active measures to distribute their grazing across the pasture. A variety of factors are taken into consideration when determining how large of an area to provide a group of livestock, how long to keep them in that area, how often to move their water and minerals, or at what time during the grazing season to allow them to graze that area. Some of these factors include nutritional needs, seasonality, forage type, management goals, convenience, and weather conditions. Managed grazing systems are also deployed differently across geographies, such as rangeland versus highly productive pastures.

Because of these variabilities, widespread data about the ecological and economic outcomes associated with managed grazing systems is limited or geographically specific.

PRODUCERS CAN ADOPT MANAGED GRAZING WITH SOME UPFRONT CAPITAL EXPENDITURES

Typically, the primary upfront capital cost for managed grazing implementation is fencing and water system infrastructure.[45] Many producers who adopt managed grazing already have land and cattle and simply need to develop a grazing plan that helps them meet their conservation, production, and profitability goals within the limits of their property. Achieving their grazing plan can help producers optimize productivity for short-term profitability, reduce costs, and maintain soil and pasture health to ensure long-term profitability.

Producers often use temporary fencing materials, such as electrified polywire and portable fencing chargers, to distribute livestock among multiple pastures. Permanent fencing can also be used in the form of single-strand or multi-strand electrified high-tensile wire, which is typically cheaper to construct than barbed wire. Long-term adoption of managed grazing usually involves installing a water system to provide more watering points throughout an operation. Having more water points increases the flexibility that producers have with creating paddock sizes and the associated grazing efficiency increases when livestock are required to walk less than 800 feet to reach a water source.[46]

Cost-share assistance via NRCS' Environmental Quality Incentives Program (EQIP) can help producers install this infrastructure while also providing access to developing a grazing plan. In general, costs for fencing range from $1.18/acre for mobile electric fencing to $18.27/acre for high-tensile electric fencing.[47]

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44 Pratt, M., & Rasmussen, G. M. (2001). *Determining your stocking rate.* Utah State University Extension. https://digitalcommons.usu.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1992&context=extension_histall#:~:text=To%20determine%20how%20many%20animals,much%20forage%20you%20have%20available.

45 Wong, T. (2020). "Rotational grazing improves stocking capacity and ranch profitability." https://extension.sdstate.edu/rotational-grazing-improves-stocking-capacity-and-ranch-profitability

46 USDA. (2015). "Grazing economics"

47 Undersander, D., Albert, B., Cosgrove, D., Johnson, D., & Peterson, P. (1993). "Pastures for profit: A guide to rotational grazing." https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1097378.pdf

MANAGED GRAZING SYSTEMS CAN IMPROVE PROFITABILITY

Studies have shown that using managed grazing systems can help producers achieve their income goals, lower income variability, and produce returns on investment.[48] Managed grazing systems can produce more forage if producers have the appropriate stocking rate and encourage optimal distribution of forage consumption within a pasture or paddock. Subdividing pastures or strategically moving water and mineral sources encourage livestock to consume forage across a pasture more uniformly and force them to eat less palatable forages, thereby increasing forage efficiency and uptake.[49] Improved animal health is another benefit of managed grazing, according to the USDA.[50]

NRCS/SWCS photo by Lynn Betts

MANAGED GRAZING CAN OPEN NEW MARKET AND SERVICE OPPORTUNITIES

A pasture-based approach to livestock production opens new market opportunities for producers beyond conventional sales channels. Producers grazing their livestock on pasture have a variety of market opportunities to choose from, such as direct-marketing grass-finished beef or selling live animals to brands that advertise grass-finished livestock production.

Producers have opportunities to perform custom grazing services for other cattle owners, which can reduce the upfront capital costs of acquiring cattle if a producer does not already own any. More experienced producers may also take advantage of growing knowledge and information around grazing cover crops. Seeding certain forages can provide a source of forage-based feed while increasing soil health.

Notwithstanding these unique market opportunities, managed grazing can be beneficial and increase profitability for producers selling into conventional markets. Better managing forage reduces dependence on supplemental feed inputs, including grain and hay. Having higher quality pasture can also lead to increased milk production, better weaning weights, and heavier finishing cattle.[51] According to the USDA, beef cattle finished on high-quality pasture can achieve average daily gains of 2 or more pounds and reach market weight within 20 months at a cost comparison of $27 per hundred-weight of gain versus $60 in confinement systems.[52] Dairy producers in Wisconsin saw a $200 increase in net profit per cow using managed grazing, for example.[53]

48 Teague R., & Kreuter, U. (2020). “Managing grazing”

49 Undersander, et al. (1993). “Pastures for profit.”

50 USDA. (2015). “Grazing economics”

51 USDA. (2015). “Grazing economics”

52 USDA. (2015). “Grazing economics”

53 Undersander, D., et al. (1993). “Pastures for Profit”

CLOSING THOUGHTS

Adopting conservation agriculture practices is an investment. Incorporating reduced tillage, cover cropping, nutrient management, and managed grazing can enable farmers to build resilient enterprises in a changing climate. The synthesized financial research on conservation practices in the Upper Midwest contained in this booklet offers planning guidance that farm business management educators, agricultural lenders, and conservation educators can use to support farmers and ranchers interested in adopting conservation agriculture practices.

Like other systems-level changes, transitioning to conservation agriculture practices involves new expenses, learning, and time. The information in this booklet shows that these investments have the potential to reduce farm costs, increase yields in some cases, and ultimately increase net income. Some practices can realize benefits in the first few years, while others take longer to build soil health. Cost-share assistance is available from federal, state, and other sources to ease the cost burden on farmers making these transitions. With the right information and resources, farmers can be productive and profitable while strengthening the health of farmland for future generations. [54]

April Opatik

54 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

The Financial Implications of Conservation Agriculture

Insights from Analyses of Farms in the Upper Midwest

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