



Rural & Farm Finance Policy Analysis Center University of Missouri

Can Carbon Payments make Cover Crops Profitable?

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Rural & Farm Finance Policy Analysis Center University of Missouri

https://ruralandfarmfinance.com/

Missouri Farm Income Outlook Fall 2024

Kansas Farm Income Outlook Fall 2024

Arkansas Farm Income Outlook Fall 2024

Nebraska Farm Income Outlook Fall 2024

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SCAN ME



Potential Paths to Cleaner Corn

Dr. Plastina speaks about the 45Z Tax Credit, which rewards producers for achieving a CI score below the qualifying threshold. This could incentivize corn growers to consider climate-agricultural practices.

Learn more about how the 45Z Tax Credit could benefit corn: <https://ethanolproducer.com/articles/calculating-paths-to-45z>

Texas Farm Income Outlook Fall 2024

Iowa Farm Income Outlook Fall 2024

Illinois Farm Income Outlook Fall 2024

Minnesota Farm Income Outlook Fall 2024

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Cover Crops in the Midwest



➤ What is a cover crop?

- A plant that covers the soil between cash crops

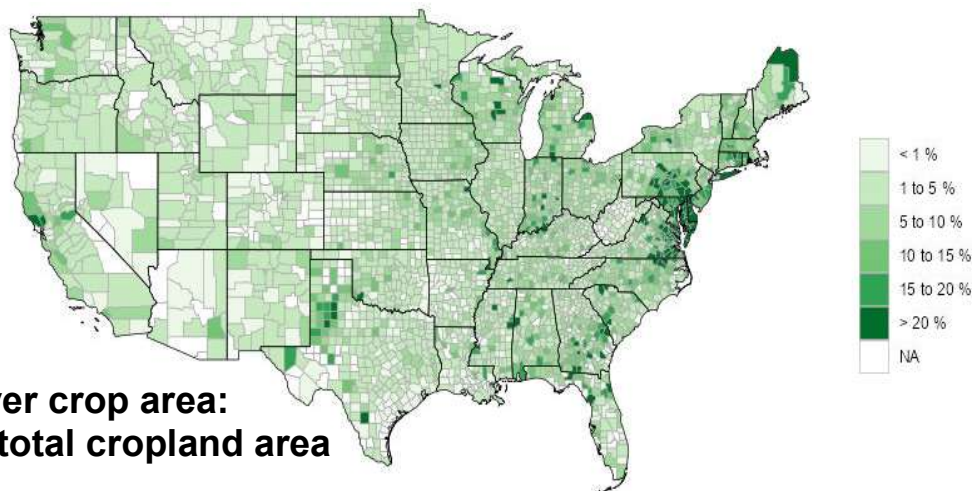
➤ Why use cover crops?

- Water Quality
- Soil Health (↓ soil erosion)
- Pest management (?)
- Iowa Nutrient Reduction Strategy :
29% reduction in Nitrogen load
28% reduction in Phosphorous load



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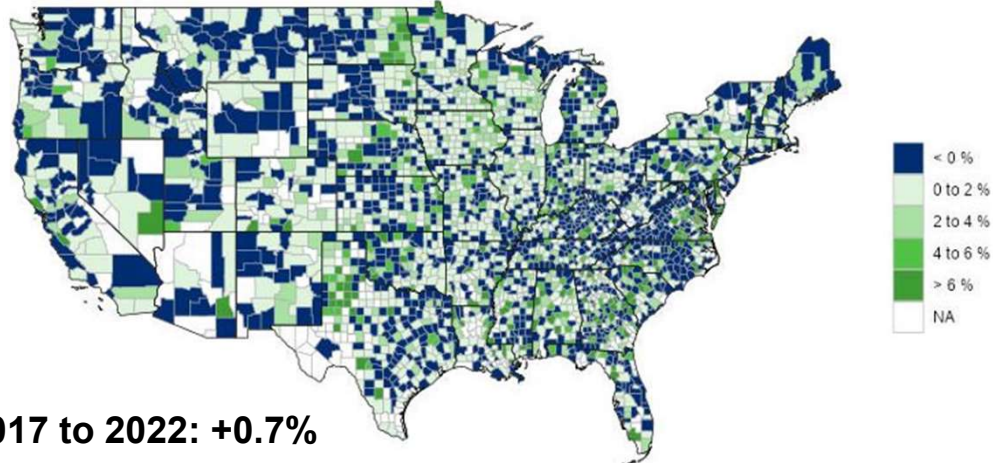
2022 Rate of Adoption of Cover Crops by County*



*Plastina, Sawadgo, and Okonkwo. 2024. *Choices*

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Change in Cover Crop Adoption Rate, 2022 vs. 2017*



From 2017 to 2022: **+0.7%**

→ Changing farming practices is **costly** to farmers

*Plastina, Sawadgo, and Okonkwo. 2024. *Choices*

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Comparison of “Average” Net Returns to Cover Crops, in \$ per acre

Economic concept	Focus groups IA IL MN (n=14) 2016	Regional Survey^ (n=79) Corn 2017	Regional Survey^ (n=79) Soy 2017	Statewide IA Survey (n=440) Corn 2017	Statewide IA Survey (n=440) Soy 2017	Experimental Plots 3 locations in IA 24 treatments Corn 2019&2020
Value of Yield Change	9	-9	32	0	0	-13
Planting CC	-41	-32	-31	-32	-32	-28
Extra Termination Cost	-2	-5	-4	-3	-2	-9
Net Returns	-34	-46	-3	-35	-34	-50
NR + Cost Share	-23	-21	+25	-15	-19	n/a
NR+ Grazing Livestock	-34	n/a	n/a	-13	-14	n/a
NR + CS + Grazing L.	-22	n/a	n/a	+7	+1	n/a

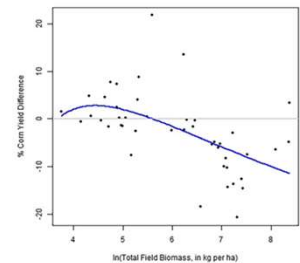
^MN, IA, IL, ND, IN, NE, OH, MI, MO, SD, WI.

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Grazing Cover Crops (Experimental Data+Simulation)

- Assumptions:
 - 160 acres, square field adjacent to feedlot, with 48 cow-calf pairs, 1250 lbs cows, consuming 4% of own weight daily in hay (85% dry matter)
 - Depreciation of removable electrified fence along perimeter
 - Labor to install/remove/repair fence, refill waterer, move cows

	No Grazing (only agronomic data)	Grazing (agronomic & simulation)
Mean corn yield difference with check plots	-4.7 bu/a	+6.5 bu/a
Mean Net Returns	-\$50.08 /a	-\$6.17 /a
% of treatments with negative net returns	82.2%	54.8%



Plastina, et al. 2023.

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Study	Peer-Reviewed Publication
Focus groups IA IL MN (n=14) 2016	Plastina, A., Liu, F., Miguez, F., and S. Carlson. 2018 . "Cover Crops Use in Midwestern U.S. Agriculture: Perceived Benefits and Net Returns." <i>Renewable Agriculture and Food Systems</i> 1-11.
Regional Survey (n=79) 2017	Plastina, A., Liu, F., Sawadgo, W., Miguez, F., and S. Carlson. 2018 . "Partial budgets for cover crops in Midwest row crop farming." <i>Journal of the American Society of Farm Managers and Rural Appraisers</i> .
Statewide IA Survey (n=440) Corn 2017	Plastina, A., Liu, F., Sawadgo, W., Miguez, F., Carlson, S., and G. Marcillo. 2018 . "Annual Net Returns to Cover Crops in Iowa." <i>Journal of Applied Farm Economics</i> 2(2):19-36.
Experimental Plots & Simulation in IA Corn 2018-19	Plastina, A., Acharya, J., Marcos, F., Parvej, M., Licht, M., & Robertson, A. 2023 . Does grazing winter cereal rye in Iowa, USA, make it profitable? <i>Renewable Agriculture and Food Systems</i> , 38, E45. doi:10.1017/S1742170523000388

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Reported Yield Change by Years of Experience, Iowa*

Reported Yield Change from Cereal Rye before...	Exp. ≤ 3 years Mean [min, max]	Exp. 4-9 years Mean [min, max]	Exp. 10+ years Mean [min, max]
CORN (in bu/a)	-5.0 [-15,0]	-0.1 [-8, 7]	0.5 [0, 4]
SOYBEANS (in bu/a)	0.43 [-4, 5]	0.25 [-7, 4]	-0.09 [-5, 4]

*Plastina, A., Liu, F., Sawadgo, W., Miguez, F., Carlson, S., and G. Marcillo. 2018. "Annual Net Returns to Cover Crops in Iowa." Journal of Applied Farm Economics 2(2):19-36.

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What's the cost of CC in MN according to NRCS?

Cereal rye, herbicide termination:

\$85.26 /a
- EQIP pmt \$34.10 /a

Out of pocket cost:
\$51.16 /a

USDA United States Department of Agriculture
Natural Resources Conservation Service

Minnesota
Practice Scenarios - Fiscal Year 2025

Practice: 340 - Cover Crop

Scenario: #1 - Basic

Scenario Description:
Typically a small grain or legume (may also use forage sorghum, radishes, turnips, buckwheat, etc.) will be planted as a cover crop immediately after harvest of a row crop, and will be followed by a row crop that will utilize the residue as a mulch. This scenario assumes that seed will be planted with a drill. The cover crop should be allowed to generate as much biomass as possible, without delaying planting of the following crop. The cover crop will be terminated using an approved herbicide prior to planting the subsequent crop.

Before Situation:
Row crops such as corn, soybeans, or cotton are grown and harvested in mid-late fall. Fields are disked immediately following harvest, with rows in some fields being hipped for drainage. Residue amounts after harvest average 30% or less, resulting in bare

After Situation:
Implementation Requirements according to Cover Crop (340) are prepared and implemented. Within 30 days after harvest of the row crop, fields are planted with a small grain or legume cover crop (may also use forage sorghum, radishes, turnips, buckwheat, etc.), typically rye or clover. The average field size is 40 acres. The cover crop is seeded with a drill. No additional fertilizer is applied with the cover crop. The cover crop provides soil cover by late fall, throughout the winter, and into the early spring. Runoff and erosion are reduced. Wind erosion is reduced by standing residues. The cover crop is terminated with an approved herbicide prior to spring planting as late as feasible to maximize plant biomass production. Over time, soil health is improved due to the additional biomass, ground cover, soil infiltration, and plant diversity introduced to the cropping system. Cover crop residues left on the surface may maximize weed control by increasing allelopathic and mulching effect.

Feature Measure: Area planted

Scenario Unit: Acre

Scenario Typical Size: 40.0

Scenario Total Cost: \$3,410.35

Total Cost per Unit: \$85.26

Based on Minnesota average costs. Individual county costs may vary.

<https://www.nrcs.usda.gov/getting-assistance/payment-schedules#I-M>

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Research-based findings

- In crop-only production systems, cover crops tend to generate private economic losses
- Cost-share payments help, but not all farmers break-even with cost-share payments.
- In mixed production systems with cows, cover crops are more likely to be profitable under the “right” conditions
- Caution: if little biomass
 - little social & environmental benefits
 - little feed cost savings



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Can Carbon Payments spur Cover Crop Adoption?

1. What types of carbon payments are available?
2. What is the carbon “sequestration” potential of cover crops?
3. How about the 45Z Tax Credits for “Clean Fuel”?

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Types of Carbon Payments

What is traded?	Carbon Offsets	Carbon Insets	Carbon Insets for Clean Fuels
Typical buyers	Large corporations	Large corporations	Fuel refineries with Tax Credits
Typical goal	Reduce carbon footprint of the corporation	Reduce carbon footprint of a specific value chain/product	Incentivize production of low-GHG-emission transportation fuels
Farmers' role	Adopt conservation practice & reduce GHG emissions	Implement conservation practice	Produce a low-carbon commodity for biofuel production (feedstock)
Payments to farmers	\$ per Mt CO ₂ e	\$ per acre in conservation practice	\$ per reduction in Carbon Intensity (kg CO ₂ e/MJ)
Additionality	Required	Not always required	Not required

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Voluntary Ag Carbon Initiatives

- **Payments per Output** (\$ per ton of CO₂e removed/avoided)
 1. Carbon by Indigo
 2. CIBO Carbon Credits
 3. Corteva
 4. ESMC's Eco-Harvest
 5. ~~Nori~~
 6. Cargill's RegenConnect
 7. Soil and Water Outcomes Fund
 8. TruTerra Carbon
- **Payments per Practice** (\$ per acre, or \$ per N reduction)
 1. ADM's re:generations
 2. Bayer Carbon
 3. Indigo Ag:Market+ Source
 4. PepsiCo-PCM
 5. TrueTerra N Mgmt Incentive
 6. TruTerra Finan. Assist.
- **Practice- and Outcome-based payments**
 1. Agoro Carbon Alliance
 2. Locus Ag CarbonNow
 3. CIBO Carbon Bridge
 4. Nutrien's Sustainable N Outcomes

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How large does the Carbon Payment need to be?

Cereal rye, herbicide termination (NRCS):

\$85.26 /a

- EQIP pmt \$34.10 /a

Out of pocket cost:

\$51.16 /a

Example 1. Assume:

- Farmer willing to invest \$10/a to leave the farm better than he found it
- In this farm, CC bumps up corn yields + 3 bu/a
- Corn price \$4/bu
- Calculation:

$$\$51.16 - \$10 - 3 \times \$4 = \$29.16$$

Lowest carbon payment: \$29.16 /a

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How much are Voluntary Carbon Initiatives paying?

• **Payments per Practice:**

\$5 - \$15 per acre → **Insufficient** < \$29.16 per acre

• **Payments per Output:**

\$25 - \$40 per MtCO₂e

→ How much Carbon must be sequestered to break-even?

\$29.16 per acre / \$25 per MtCO₂e = **1.17 MtCO₂e per acre**

\$29.16 per acre / \$40 per MtCO₂e = **0.73 MtCO₂e per acre**

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Annual average GHG emission reduction (COMET-P.)



	Cover Crops (mtCO ₂ e/acre)		
	Mean	Min	Max
Heartland	0.282	-0.121	1.900
Northern Crescent	0.089	-0.089	0.778
Northern Great Plains	0.047	-0.388	0.353
Prairie Gateway	0.146	-0.408	1.285
Eastern Uplands	0.353	-0.111	1.925
Southern Seaboard	0.297	-0.099	1.925
Fruitful Rim	0.188	-0.998	1.680
Basin and Range	0.027	-0.998	0.788
Mississippi Portal	0.615	-0.153	1.982
U.S. Total	0.230	-0.998	1.979

The net effect of cover cropping on GHGs is measured in metric tons of Carbon Dioxide Equivalent (CO₂e) units per acre.

The net effect is measured by comparing GHG emissions without cover crops and GHG emissions with cover crops

All GHGs are expressed in CO₂e units according to their relative global warming potential (gwp).
Ex.: CO₂=1; N₂O=298; CH₄=28 gwp units over 100 years.

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Northern Crescent	0.089	-0.089	0.778
Northern Great Plains	0.047	-0.388	0.353

\$25/MtCO ₂ e → Min 1.17 MtCO ₂ e	\$40/MtCO ₂ e → Min 0.73 MtCO ₂ e
Feasible	Feasible
✘ Not Feasible	Barely Feasible
✘ Not Feasible	✘ Not Feasible

Northern Great Plains (brown): Not feasible to break-even in this example



Northern Crescent (red): Only in counties with the **highest sequestration potential**, carbon payments may be sufficient when carbon price = **\$40 per MtCO₂e**

Heartland region (yellow): In counties with **high sequestration potential**, carbon payments may be sufficient when carbon price = **\$25 per MtCO₂e**

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How about the 45Z Federal Tax Credits?

- 45Z credit = \$0.20 X gallon of Clean Fuel sold X Emissions Factor
- Note: \$0.35 for Sustainable Aviation Fuel
- Emissions Factor = 1- (kg of CO₂e per mmBTU/ 50)
- Bonus rate \$1 (\$1.75 in the case of SAF) if certain wage and apprenticeship requirements are met.
- Rules and models for the 45Z tax credit under development.

→ **Tax Credits to Fuel Refineries: What % of tax credit will be passed on to farmers selling low CI corn and soybeans?**

Sources: <https://crsreports.congress.gov/product/pdf/IF/IF12502>

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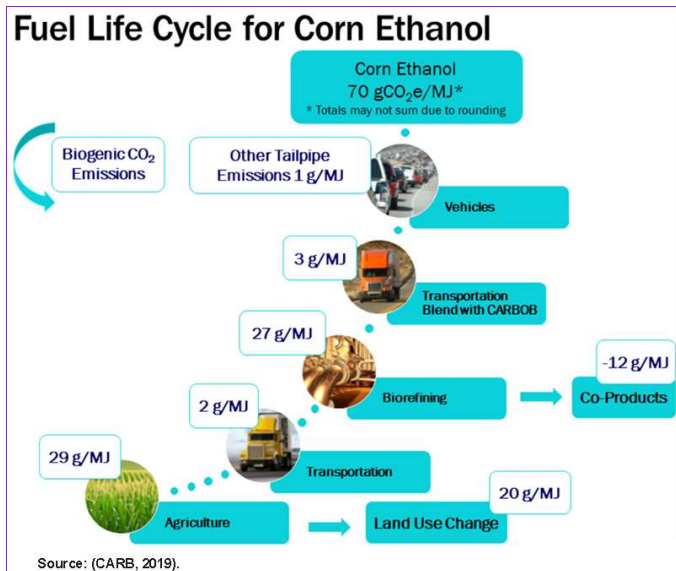
Fuel Life Cycle for Corn Ethanol (CARB 2019)

Example:

California GREET (Greenhouse Gases, Regulated Emissions, and Energy Use)

Ag + Land Use Change: 70% of Corn Ethanol Emissions

Agriculture: 41% of Corn Ethanol Emissions

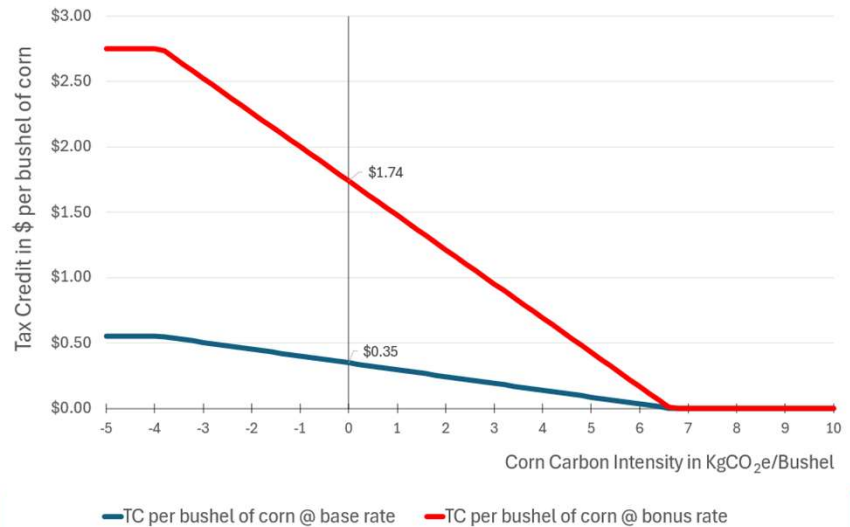


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What is the highest possible price premium for low carbon intensity corn?

Assuming:

- 100% pass-through to farmers
- Non-SAF
- Engineering process adds 18.4 KgCO₂e/mmBTU per gallon



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Example for Non-SAF in Blue Earth County, MN



Scenarios	Δyield bu/acre*	Yield bu/acre	ΔCI gCO ₂ e/bu	CI gCO ₂ e/bu	Lost Revenue [^] \$/acre	CI Revenue (bonus rate) \$/acre	Pass Through Required to Offset Lost Revenue ⁺ (bonus rate)
Baseline: CT		200		7,292	\$0.00		-
CC	-10	190	-429	6,863	\$40.00	\$0.00	Insufficient
CC, M	-15	185	-1,070	6,222	\$60.00	\$10.84	Insufficient
CC, RT	-10	190	-1,661	5,631	\$40.00	\$40.60	99%
CC, NT	-20	180	-3,292	4,000	\$80.00	\$115.43	69%
CC, M, RT	-15	185	-2,466	4,826	\$60.00	\$78.55	76%
CC, M, NT	-25	175	-4,239	3,053	\$100.00	\$155.68	64%

Example calculations illustrating how changes in practices could impact CI scores, yield, and revenues:

CT – Conventional Till, CC – Cover Crops, M – Manure, RT – Reduced Till, NT – No Till

* 1 lb N/bu

[^]Corn price \$4/bu

<https://www.extension.iastate.edu/agdm/crops/html/a1-78.html>

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Concluding Remarks

- CC provide multiple environmental benefits, but not all farms find the practice profitable.
- Stacking payments from cost-share programs (EQIP, CSP, etc.) and voluntary carbon initiatives brings some farmers closer to break-even and might help make a profit.
- 45Z Tax Credits paid to Fuel Refineries. Crop CI score is location- and practice-specific. Local price premiums for low-CI feedstocks might be insufficient to entice farmers.
- Producers should evaluate individual costs and benefits & ask many questions before agreeing to change practices.

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Extension Reports

1) **Carbon Intensity Score Calculator**

<https://www.extension.iastate.edu/agdm/crops/html/a1-80.html>

2) **How to Grow and Sell Carbon Credits in US Agriculture**

<https://www.extension.iastate.edu/agdm/crops/pdf/a1-76.pdf>

3) **What's in Store for Voluntary Agricultural Carbon Markets?**

https://www.card.iastate.edu/ag_policy_review/article/?a=136

4) **Net Returns to Carbon Farming**

<https://go.iastate.edu/B46UXX>

5) **Carbon Farming: Stacking Payments from Private Initiatives and Federal Programs**

<https://www.extension.iastate.edu/agdm/crops/pdf/a1-40.pdf>

6) **Economics of Cover Crops**

<https://www.extension.iastate.edu/agdm/crops/html/a1-91.html>

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Thank you for your time!

Dr. Alejandro Plastina

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