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# How to Grow and Sell Carbon Credits in US Agriculture

This report compares the requirements to grow and sell carbon credits across 13 private voluntary agricultural programs in the United States.

## Why agriculture credits?

A growing number of private initiatives are offering producers compensation for the generation of agriculture carbon credits as well as other ecosystem services such as improvements in water quality. Credits and ecosystem services are purchased by large corporations and other entities pursuing a reduction in their environmental footprints. Some private and public entities are already purchasing carbon credits generated outside agriculture to comply with environmental regulations and to improve their appeal to environmentally-conscious stakeholders.

According to a 2019 report by the National Academy of Sciences, agricultural practices to enhance soil carbon storage can sequester 250 million tons of carbon dioxide annually in the US, equivalent to around 4% of the country's emissions. An economic assessment conducted by IHS Markit in 2018 concludes that the potential demand for agriculture carbon credits in the US is 190 million tons per year, falling short from the supply potential of 326 million tons per year. That report estimated the size of the US market for carbon credits at \$5.2 billion, and the market for other ecosystem services related to nitrogen and phosphorous management at \$8.7 billion annually.

In an attempt to jump start the incipient voluntary agriculture credits market, a few large companies have announced their intentions to purchase credits in the near future: Microsoft announced an agreement with Truterra, while IBM, JP Morgan Chase, Boston Consulting Group, Dogfish Head Craft Brewing, Shopify, Anheuser-Busch, and Barclays announced agreements with Indigo Ag. However, little is known about the exact details of those transactions. On the supply side, Peoples

Company announced the enrollment of 20,000 managed acres with CIBO Impact in January 2021.

A number of federal programs – including the Inflation Reduction Act of 2022 and the USDA Partnership for Climate-Smart Commodities – were designed to support the development of voluntary markets for carbon credits to help reduce carbon emissions by 40% by 2030. Agriculture, in particular, will receive \$19.5 billion through existing USDA programs over the next five years to expand the adoption of conservation practices, plus \$1 billion in technical assistance by NRCS, \$2.8 billion in grants to spur the development of climate-smart commodities, and \$1 billion for climate-smart commodities market expansion.

The complexities involved in the comparison of agriculture carbon initiatives might discourage agricultural producers from properly evaluating relevant alternatives, resulting in a protracted adoption process, and even an accelerated dis-adoption process if initiatives fail to satisfy producers' expectations. In an attempt to help producers navigate the complexities associated with carbon and ecosystem services programs, the present report compares 13 private voluntary programs across 28 variables. The programs include two carbon and ecosystem services credit entities (Ecosystem Services Market Consortium-ESMC and Soil and Water Outcomes Fund), two carbon credit entities (Indigo and Nori), five input suppliers (Agoro Carbon Alliance, Bayer, Corteva, Locus, and Nutrien), and four data platforms (CIBO Carbon Bridge, CIBO Carbon Credits, Cargill's RegenConnect™, and Truterra Carbon).

## How was the data collected?

We developed a set of 28 questions based on conversations with producers and agricultural stakeholders, using the article by Sellars and colleagues (2021) as a reference. We answered the questionnaire in as much detail as possible based on

publicly available information collected via online search and interviews with representatives from some of the 13 carbon programs. A list of sources is available in the last section of this report.

### What are the main findings?

The emerging agriculture credits market can be currently characterized as an unarticulated patch of coexisting programs with different rules, incentives, and penalties, rather than as a cohesive and transparent market where the same activity has the same implication across programs. In its formative stage, the incipient agriculture credits market is very dynamic, focused on testing protocols through small-scale pilot programs, and lacks transparency and liquidity. The side-by-side comparison of the 13 programs is organized into four groups, corresponding to Tables 1-4: carbon and ecosystem services credit entities, carbon credit entities, input suppliers, and data platforms.

While all programs require **additionality** to generate a credit, not all programs require that producers change their production practices. **Additionality** means that producers must do something **different** to reduce carbon and increase ecosystem services. However, programs use a wide array of benchmarks to determine what is **different**. Some programs require a change of practices with respect to past practices on the same field, while some others require that practices in the field be different from common practices in the area (even if the same practices have been implemented for many years in the field under consideration). See “credit generation” in Tables 1-4.

With the exception of Bayer Carbon, which compensates producers for implemented practices (payment per practice), all other programs compensate producers for carbon credit generation (payment per output).

### Further Considerations

An advantage of the emerging agriculture credits market over the failed carbon credit exchange from the late 2000s is that the expected farm size to participate in the carbon market is much smaller than before (Ribera and McCarl, 2009).

As protocols to generate agriculture credits become more encompassing and transparent, a price discovery process for agriculture credits becomes functional, and credit buyers build trust in the integrity of the system and the permanence of carbon reductions, the agriculture credits market should consolidate and possibly grow. As long as buyers of agriculture credits perceive differences in the quality of credits generated through alternative protocols, it can also be expected that initiatives generating high-quality credits will gain market share while other initiatives will exit the market (via bankruptcies or mergers and acquisitions).

The dynamism of this incipient market can be illustrated by the discontinuation of the Farmers Business Network’s Gradable Carbon program in 2022, after one year in the market, and the dissolution of the partnership between Corteva and ESMC; and the newly developed partnerships between Nori and Bayer, and between Corteva and Indigo Ag.

While carbon credits are the major focus of the present article, other ecosystem markets from agricultural production could develop in the future to foster water quality and quantity, wetlands, pollinators, and biodiversity. The performance of the voluntary agriculture credits market will set a precedent for those other markets.

### More Information

[Agoro Carbon Alliance](https://agorocarbonalliance.com) agorocarbonalliance.com

[Bayer Carbon](https://bayercarbon.com) bayercarbon.com

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[CIBO Impact](https://www.cibotechnologies.com/cibo-impact/) <https://www.cibotechnologies.com/cibo-impact/>

[Corteva Carbon Initiative](http://www.corteva.us/products-and-solutions/digital-solutions/carbon.html) [www.corteva.us/products-and-solutions/digital-solutions/carbon.html](http://www.corteva.us/products-and-solutions/digital-solutions/carbon.html)

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[Nutrien Carbon Program](https://bit.ly/2U0cJZg) <https://bit.ly/2U0cJZg>

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Sellers, S., G. Schnitkey, C. Zulauf, K. Swanson and N. Paulson. 2021. "What Questions Should Farmers Ask about Selling Carbon Credits?" farmdoc daily (11):59, Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, April 13.

[Soil and Water Outcomes Fund](http://theoutcomesfund.com) [theoutcomesfund.com](http://theoutcomesfund.com)

[Truterra](http://truterraag.com/Carbon) [truterraag.com/Carbon](http://truterraag.com/Carbon)

All links accessed December 2022.

**Table 1. Carbon and Ecosystem Services Market Entities**

Voluntary Program	ESMC's Eco-Harvest	Soil and Water Outcomes Fund
Ecosystem services covered	Carbon offsets, carbon insets, improvements in water quality and quantity, and biodiversity.	Carbon dioxide equivalents (soil carbon sequestration and nitrous oxide reductions) and water quality (nitrogen and phosphorous improvements).
Geographical coverage	Portions of the Corn and Soybean Belt, Southern and Northern Great Plains, and Great Lakes.	Selected areas in 18 states: DE, IL, IN, IA, KS, MD, MI, MN, MO, NE, ND, NY, OH, PA, SD, VA, WV, and WI.
Eligible crops	Corn, soybeans, wheat, alfalfa, and oats.	All crops in selected areas
Covered new practices	Agricultural practices referenced in NRCS Conservation Practice Standards, e.g., cover crop, reduced tillage, and nutrient management. Non-NRCS recognized practices may be used, provided there are sufficient published scientific data and outcomes justify their use.	List not prescriptive, but includes no-till, cover crops, land retirement, conversion to pasture, extended rotations.
Minimum acreage enrollment	None	None
Minimum contract length	5-year contract. Optional: 1-year contract in the pilot program with an option to sign additional 4-year contract.	1 year, annual renewal
Payment currency	Not specified	Cash
Payment per new practice	Not applicable	Not applicable
Payment per new carbon credit and environmental services	Not specified. Based on ESMC quantification, verification, and third-party certification.	Up to \$40 per acre per year across all environmental services.
Payment for past practices/ carbon removal (look-back)	Not for carbon credits. Evaluating payments for past carbon insets.	None
Payment schedule	Annual for carbon credits and water quantity. Every 5 years for carbon insets.	50% after signing agreement (spring), 50% after annual verification (November/December)
Required data sharing	To enroll: 3 years of historical operational data is required. If producers are not aware of prior land practices, remote sensing can be used to ensure cover crops or reduced tillage have not been used in the past 10 years. Detailed farm operational data for carbon credits. Some operational data for carbon insets. Soil sampling and remote sensing data for both.	To enroll: 2-3 years of historical data, and 2-3 years of proposed practice change: field data, agricultural data crop rotations, fertilization rate, seeding type and rates, tillage type, residue management, and manure applications. Once enrolled: environmental data (includes soil and water sampling results).
Other requirements	Not specified	Must enroll fields in online account at <a href="http://theoutcomesfund.com">theoutcomesfund.com</a> , map field boundaries, and enter baseline and future cropping system information. Review the proposed payment offering emailed within 1-2 weeks after data submission and determine if you wish to continue to participate. E-sign the contract to confirm participation. Fields must comply with the USDA Highly Erodible Land and Wetland Conservation provisions.
Credit quantification	Using Regrow's soil carbon DeNitrification-DeComposition (DNDC) model and the remote sensing algorithm OpTIS <sup>1</sup> . The quantification approach is aligned to the SustainCERT's Value Change Initiative (VCI) Guidance.	Environmental outcomes and payments are estimated using a publicly supported model (COMET Farm and Nutrient Tracking Tool) and soil and water testing.
Carbon registry	Own credit and asset generation protocol based on soil sampling, a proprietary model, and remote sensing. Under review by Gold Standard.	Own registry
Credit verification	Third-party verification: site visits to small subset of randomly selected producers and remote sensing.	Verification by Soil and Water Outcomes Fund: Yearly field visits, remote sensing, and soil and water sampling tests in 10% of the fields.

<sup>1</sup> OpTIS: [Operational Tillage Information System](http://OperationalTillageInformationSystem), [www.ctic.org/OptIS](http://www.ctic.org/OptIS), a publicly available automated system that uses remote sensing satellite-based data to monitor conservation practices in agricultural systems.

**Table 1. Carbon and Ecosystem Services Market Entities**

Voluntary Program	ESMC's Eco-Harvest	Soil and Water Outcomes Fund
Limit to credits and outcomes per acre	Not specified	Limits on water quality outcomes per acre are location dependent.
Storage of carbon credits	Not specified	None. Soil and Water Outcomes Fund arranges the sale of credits and outcomes with guaranteed buyers prior to contracting with producers.
Retained carbon credits	Not specified	None
Soil tests required	At offset and every 5 years.	Soil tests required every 5 years on 10% of the fields. Water quality tests required multiple times each year.
Out of pocket program costs	None	None
Other costs	Soil sampling paid by ESMC and included in credit/asset price to buyer.	Soil and water tests paid by Soil and Water Outcomes Fund.
Breach of contract	Soil carbon gains must be realized before additional credit issuance or payment.	Producer would not receive payment.
Agronomic assistance	Provided by ESMC's member organizations and partners, such as conservation districts and NGOs.	Free conservation agronomists on staff.
Stacking payments	Stacking with government payments is allowed, but not with other private programs. ESMC stacks carbon credits with other environmental credits/assets internally.	Not allowed to stack other government or ecosystem service payments from other programs.
Other information	No enrollment fee or requirement to purchase ag products; producers may be responsible for potential program expenses; ESMC is a non-profit subsidiary of the Soil Health Institute.	Soil and Water Outcomes Fund is a partnership of AgOutcomes (a subsidiary of the Iowa Soybean Association) and ReHarvest Partners (a subsidiary of Quantified Ventures). Soil and Water Outcomes Fund does not sell production inputs or services. Soil and Water Outcomes Fund connects producers with guaranteed buyers of carbon credits and ecosystem services.
Enrollment period	Anytime	Enrollment will typically open around the start of the calendar year and remain open until all acre limits have been reached.
Market launch date	May 2022	2020

**Table 2. Carbon Market Entities**

Voluntary Program	Carbon by Indigo	Nori
Ecosystem services covered	Carbon offsets	Carbon offsets
Geographical coverage	30 states: AL, AR, CO, DE, GA, IL, IN, IA, KS, KY, LA, MD, MI, MN, MS, MO, NE, NY, NC, ND, OH, OK, PA, SC, SD, TN, TX, VT, VA, and WI.	US croplands
Eligible crops	Field crops: barley, canola (fall & spring planted), corn, cotton, dry edible beans, dry field peas, flax, oats, peanuts, rye, sorghum, soybeans, sugar beets, sunflowers, wheat (winter & spring).	Row crop/hay/grass: Alfalfa, barley, broccoli, carrots, cauliflower, clover, corn (grain or silage), cotton, dry field beans, dry field pea, fallow, grass, grass-legume mix, lettuce, millet, oats, peanuts, potato, rye, sorghum, soybeans, strawberries, sugar beets, sunflowers, switchgrass, tomato, wheat (spring or winter). Orchard/vineyard: Almond, avocado, cherry, English walnut, grapefruit, grape, lemon/lime, olive, orange, peach/nectarine, pistachio, tangerine/mandarin.
Covered new practices	Cover crops, targeting nitrogen, reducing tillage, diversifying crop rotation, and grazing livestock.	Changing or expanding crop rotations and cropping intensity; cover crops; shifting from annuals to perennials; reducing tillage events/intensity; adopting new residue management techniques; substituting synthetic fertilizers with organic matter additions.

**Table 2. Carbon Market Entities**

Voluntary Program	Carbon by Indigo	Nori
Minimum acreage enrollment	150 acres in 1 field.	None
Minimum contract length	5 years, twice renewable.	10 years, plus an additional 10-year retention period.
Payment currency	Cash	Cash currently and Nori Carbon Removal Tonnes (NRT) tokens in the future.
Payment per new practice	Not applicable	Not applicable
Payment per new carbon credit	Subject to market conditions. \$15 in 2019; guaranteed \$10 minimum for fields enrolled in 2021 and credits sold before the end of 2022 as part of their first carbon crop. A guaranteed minimum payment of \$15 per credit for the 2022 carbon crop.	One NRT token, or a floor price per NRT set by the NRT owner (Nori adds a transaction fee to complete the final price of an NRT to the buyer).
Payment for past practices/ carbon removal (look-back)	Possibly, up to 2 growing seasons prior to joining the program.	Up to 5 years look-back during the pilot phase; switch date after January 1, 2011.
Payment schedule	After Indigo sells credits: 50% paid in year 1 (when credit is generated and sold), 20% in year 2, 10% in years 3-5.	End of month when NRT is sold. A share of the revenue from NRTs sales will not be distributed for 10 years to incentivize retention of the practices that generated the NRTs for 10 years. Some tokens will be restricted based on an NRT score.
Required data sharing	3-5 years of historical data and current season details about planting and harvest dates, tillage, and fertilizer applications.	10 years of historical operating data and at least 3 years of pre-switch operating data or records to support claim of new practice adoption; annual updates on management practices.
Other requirements	A producer must contract at least 1 eligible crop field, hold exclusive operating rights to their land, have not cleared the land in the past 10 years, and not receive payments for the land through another carbon credit program. Field cannot contain histosols.	A farm tenant can meet enrollment and continuing data reporting requirements without the land owner(s) assignment of authority for up to 3 years. Nori will issue NRTs to the project when that assignment of authority is received and a Primary Contact named.
Credit quantification	Net changes in GHG emissions and soil carbon levels are calculated by Indigo using DayCent model.	NRTs are only based on the difference between the two soil organic carbon stock change (SOCSC) trends between baseline and new practices or a 10-year annual average, whichever is less. Nori relies solely on the <a href="#">Greenhouse Gas Implementation Tool (GGIT)</a> to measure SOCSC trends ( <a href="http://comet-farm.com">http://comet-farm.com</a> ). Producers can opt to ground-truth model results via soil sampling but must bear associated costs.
Carbon registry	Carbon credits are independently issued by <a href="https://bit.ly/2TVPE9V">Verra</a> , <a href="https://bit.ly/2TVPE9V">https://bit.ly/2TVPE9V</a> , and <a href="https://bit.ly/3gQVpOa">Climate Action Reserve</a> , <a href="https://bit.ly/3gQVpOa">https://bit.ly/3gQVpOa</a> .	Own registry
Credit verification	Third-party verification: random site visits and evidence checks, registry-approved methodology.	Third-party verification of practices: at offset to qualify for program, at least every 3 years (at most once a year) during the 10-year NRT agreement term following registry-approved methodology; final project audit in year 10..
Limit to credits per acre	2 carbon credits per acre per year	Not specified
Storage of carbon credits	None	Up to 30 days in a first in, first out system.
Retained carbon credits	None	Nori will retain an unspecified share of revenue from the NRT sale for 10 years. If practices that generated the NRT were maintained over that period, Nori will disburse the retained revenue to the NRT seller.
Soil tests required	At offset on a subset of fields. Not specified whether further testing is required.	No, but producers can opt to ground-truth model results with soil tests at their own expense.
Out of pocket program costs	None	Verification costs: at offset, at least every 3 years, and in year 10.
Other costs	Not specified	Soil testing costs if producers choose to ground-truth model results with soil tests.

**Table 2. Carbon Market Entities**

Voluntary Program	Carbon by Indigo	Nori
Breach of contract	Payment paused until soil carbon returns to previous level.	Temporary breach: producer commits to make best effort to retain carbon stocks, not liable for force majeure carbon losses. Sustained breach: the contract is invalidated, subject to dispute resolution by arbitration.
Agronomic assistance	Free in-house agronomic support.	None
Stacking payments	Stacking across private and government programs is allowed, but the same field cannot be enrolled in other programs that pay for GHG reduction assets (such as carbon credits).	Stacking across private and government programs is allowed, but the same field cannot be enrolled in other programs that pay for carbon removal and retention.
Other information	Fields with tile drainage added or expanded during an Indigo Carbon contract (repair or replacement of preexisting tile drainage is permissible) are disqualified from program participation.	The GGIT model enables producers to evaluate and choose the best changes in practice. Nori uses blockchain technology to register NRTs transactions. Upon contract renewal, producers must use updated baselines. The minimum renewal term is likely to be shorter than the initial term.
Enrollment period	Anytime	Anytime
Market launch date	June 2019	September 2019

**Table 3. Input Supply Companies**

Voluntary Program	Agoro Carbon Alliance	Bayer Carbon	Corteva	Nutrien (Pilots only)	Locus AG's CarbonNOW®
Ecosystem services covered	Carbon offsets and insets	Carbon offsets	Carbon offsets	Carbon offsets and insets, improvements in water quality	Carbon offsets
Geographical coverage	Continental states of the United States	16 states: AL, AR, IL, IN, IA, KS, KY, LA, MI, MN, MS, MO, NE, OH, TN, and WI.	30 states in 2022: AL, AR, CO, DE, GA, IL, IN, IA, KS, KY, LA, MD, MI, MN, MO, MS, NE, NY, NC, ND, OH, OK, PA, SC, SD, TN, TX, VT, VA, and WI.	Geographical coverage varies by pilot program, currently operating in more than 15 unspecified US states.	US cropland
Eligible crops	Row crop, range, and pasture.	Corn and soybeans (intermittent rotation with wheat).	15 crop types: barley, canola, corn, cotton, dry edible beans, dry field peas, flax, oats, peanuts, rye, sorghum, soybeans, sugar beets, sunflowers, and dry wheat.	Pilot-dependent, including corn (grain and silage), dairy, wheat, barley, and sweet potato. Unclear which crops will be eligible for market launch.	Not specified
Covered new practices	No-till or reduced tillage; cover crops; nitrogen management; management of pasture, degraded and livestock lands; agroforestry.	No-till, strip-till, and cover crops.	Strip-till or no till; cover crops; reducing nitrogen application; increasing biodiversity.	Nitrogen management via slow release/inhibitors, variable rate nitrogen application; no-till or low-till; cover crops.	The use of Locus AG's soil probiotics.
Minimum acreage enrollment	500 acres	10 acres per field	None	None	Not specified
Minimum contract length	10-year contract.	10 years (minus any years for which the producer receives payment for historical practices), plus an additional 10-year retention period.	5-year contract.	1 to 3 years, depending on pilot.	4 years, with the option to increase compensation by extending to 10 years or more.

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<b>Voluntary Program</b>	<b>Agoro Carbon Alliance</b>	<b>Bayer Carbon</b>	<b>Corteva</b>	<b>Nutrien (Pilots only)</b>	<b>Locus AG's CarbonNOW®</b>
Payment currency	Cash	Cash	Cash	Cash (pilot programs)	Cash
Payment per new practice	\$0.05 per lbs of Nitrogen reduced per acre per year. \$2.50 per acre per year for utilizing one of the 4Rs of nutrient stewardship.	\$5-6 per acre per year no-till/strip-till. Up to \$6 per acre per year cover crops. \$12 per acre per year for both.	Not applicable	Not applicable	Guaranteed minimum of \$12 per acre per year, plus the chance for bonuses.
Payment per new carbon credit	Undisclosed minimum price guarantees plus extra if the market price of carbon credits increases.	Not specified	75% of carbon credit price sold in Indigo Ag that year with a minimum of \$20 per credit.	Expected \$10-20 per ton of carbon removed, pilot-dependent. Water credits: TBD.	Carbon credits generated will be sold via Anew's strong network of global buyers.
Payment for past practices/ carbon removal (look-back)	Not applicable	One-time payment for up to 5 years of past practices after January 1, 2012, at same rate for new practices.	None	None	None
Payment schedule	Two payment options: (i) payment at verification/ issuance with a high price floor guarantee; and (ii) guaranteed annual prepayments in years 1-4 and variable payments based on verified carbon results after years 5 and 10.	Annual, upon practice verification.	Payments made after Corteva sells carbon credits. In pilots, payments made after change of practices is verified. Payment for credits produced in a given year vest over a 5-year period.	Pilot-dependent, typically after practice implementation is verified.	Producers receive 75% of their annual payment upfront at the start of the season, and the remainder as a secondary payment.
Required data sharing	Current crop year and 5 years of historical field data: crop rotations, nitrogen management, tillage, harvest data, cover crop usage.	Necessary data to verify performance of the practices and calculate the number of carbon credits, including soil samples every 5 years.	Current crop year and at least 3 years of historical field data: crop type, nitrogen applications, tillage, harvest data, and cover crops use.	Field level practice data, soil samples, and field shape files. Nitrogen management: 3 years of data prior and data for 1 full crop rotation after change in practices. Other practices: 5 years of data prior and 5 years of data after change in practice.	3-5 years of historical management data, field areas, and information about regenerative practice changes currently being practiced.
Other requirements	For leased farmland, landowner(s) must consent to tenant's participation in Agoro program. Producers have been in crop production at least 3 years.	An active ForGround account.	Producers must show that they will farm the enrolled land, while the landowner's signatory permission is not required.	Not specified	Producers on leased land can participate with landowner approval.
Credit quantification	Own calculation based on Verra's VM0042 (Methodology for Improved Agricultural Land Management) using soil analyses and data.	Not applicable	Practice changes registered in the Granular Insights platform. Carbon credits will be measured by Indigo's carbon quantification model.	Not specified	Not specified



**Table 3. Input Supply Companies**

Voluntary Program	Agoro Carbon Alliance	Bayer Carbon	Corteva	Nutrien (Pilots only)	Locus AG's CarbonNOW®
Carbon registry	Soil organic carbon is verified and issued by Verra.	Producers not paid for credits generated.	Carbon credits will be verified and issued by the Climate Action Reserve.	Carbon credits will be certified by the Gold Standard Registry.	Not specified
Credit verification	Carbon credits will be verified and issued by Verra.	Internal: Data collected through the ForGround platform is verified through OpTIS and soil samples every 5 years.	Carbon credits will be verified and issued by the Climate Action Reserve.	Third-party verifiers such as SustainCERT.	Third-party verification
Limit to credits per acre	Not applicable	Not applicable	Not specified	Not specified	Not specified
Storage of carbon credits	Not applicable (credits are owned by Agoro).	Not applicable	None	Not specified	Not specified
Retained carbon credits	Not applicable (credits are owned by Agoro).	Not applicable	No. Credits generated will be sold via Indigo's buyer network.	Nutrien will maintain a carbon credit reserve to compensate setbacks but this will not affect producers participating in pilot programs.	Not specified
Soil tests required	Soil tests required in sign-up year, and in years 1, 3, 5, and 10.	At offset and every 5 years.	Yes. Timing and frequency TBD. Tests only measure carbon in the soil (not fertility or other soil characteristics).	Yes. Timing and frequency TBD.	Yes, every year at no cost.
Out of pocket program costs	None	None	None	Maybe verification and soil test costs.	None
Other costs	None. Certification and soil test costs paid by Agoro.	Soil test and verification costs paid by Bayer.	None. Soil tests and certification costs paid by Corteva and Indigo.	Not specified	The cost of Locus AG's soil probiotics.
Breach of contract	Temporary breach due to weather factors results in delay in annual payment. Permanent breach triggers repayment obligation of cumulative carbon payments by producers.	Temporary breach evaluated on a case-by-case basis. No penalty for leaving the program. Must notify Bayer in writing at least 30 days prior to the end of the program year.	Temporary breach: reduced carbon crediting resulting in lower payments. Permanent breach is allowed but producers will not receive any unvested payments.	No penalty for pilot programs.	Not specified
Agronomic assistance	Free agronomic recommendations by local Agoro Carbon agronomists.	Dedicated agronomic support provided.	Free agronomic recommendations by local Pioneer Seed Agents or other Corteva Advisors.	Free in-house agronomic support.	Free in-house agronomic support.

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Voluntary Program	Agoro Carbon Alliance	Bayer Carbon	Corteva	Nutrien (Pilots only)	Locus AG's CarbonNOW®
Stacking payments	Agoro currently does not allow stacking payments but that could change in the future.	Stacking across private and government programs is allowed, but the same field cannot be enrolled in other programs that pay for GHG reduction assets (such as carbon credits).	Stacking with public cost-share programs allowed.	Pilot-dependent.	Not specified
Other information	Agoro is an initiative of Yara Crop Nutrition, but participating producers are not required to purchase inputs from Yara International. Agoro is evaluating ways to develop markets for climate-smart certified crops that capture price premiums. Data will be collected through the Agoro platform.	Program contracts directly with producers; discounts on cover crop seeds are available; no need to purchase Bayer products.	The farm management software Granular is priced as an annual subscription based on crop mix and farm size.	Data will be collected through the Agrible platform. Nutrien's pilot carbon program has the partnership with Soil and Water Outcomes Fund and ESMC.	Locus AG is a partnership with Anew Climate, LLC ("Anew", formerly Bluesource). Funding for the upfront payments was provided by Green Star Royalties Ltd.
Enrollment period	Anytime	Before the beginning of the calendar year.	Anytime	Anytime	Anytime
Market launch date	2021	2020	2021	2022 (pilots only today)	2021

**Table 4. Data Platforms**

Voluntary Program	CIBO Carbon Bridge	CIBO Carbon Credits	Truterra Carbon	Cargill's RegenConnect™
Ecosystem services covered	Carbon offsets	Carbon offsets	Current focus on carbon offsets. Plan to add carbon insets and water quantity and quality credits in the future.	Soil carbon sequestration and positive environmental outcomes.
Geographical coverage	All US cropland.	All US cropland.	19 states: AR, IL, IN, IA, KS, KY, LA, MD, MI, MN, MS, MO, NE, OH, PA, SD, TN, TX, and WI.	15 states: AR, IL, IN, IA, KS, KY, MI, MN, MO, NE, ND, OH, SD, TN, and WI.
Eligible crops	Corn and soybeans.	Corn and soybeans; expected to add cotton.	Crop rotations must include at least 1 supported crop: corn, soybeans, cotton, and wheat.	Corn, soybeans, wheat.
Covered new practices	Cover crop; no/reduced till.	Cover crops; no/reduced till; nitrogen management.	Changing or expanding crop rotations and cropping intensity; cover crops; reducing tillage events/intensity; enhanced nitrogen management; shifting from annuals to perennials.	Sustainable practices such as cover crops and reduce tillage.
Minimum acreage enrollment	None	None	2.5 acres	None
Minimum contract length	10-year contract with an option to opt out starting in year 4.	10-year contract with an option to opt out starting in year 4.	5-year commitment.	1-crop-year contract.

**Table 4. Data Platforms**

Voluntary Program	CIBO Carbon Bridge	CIBO Carbon Credits	Truterra Carbon	Cargill's RegenConnect™
Payment currency	Cash	Cash	Cash	Cash, possibly
Payment per new practice	Up to \$35 per acre in year 1 for cover crops and no-till. Up to \$25 per acre in year 2 for cover crops and no-till. Up to \$15 per acre in year 3 for cover crops and no-till. Up to \$10 per acre in year 4 for cover crops and no-till.	Not applicable	Not applicable	Not applicable
Payment per new carbon credit	80% of credit value when producers directly sell their credits to buyers on the CIBO marketplace.	80% of credit value when producers directly sell their credits to buyers on the CIBO marketplace.	\$25 per carbon credit from practice changes in crop year 2021 (corn and soybeans). \$15 per carbon credit from practice changes in crop years 2019 and 2020 (corn, soybeans, wheat, and cotton).	Minimum guarantee payment of \$25.
Payment for past practices/ carbon removal (look-back)	None, but early adopters may be eligible for one-time payment via CIBO Certified Regenerative Grain program.	None, but early adopters may be eligible for one-time payment via CIBO Certified Regenerative Grain program.	Yes, earn \$20 per ton for carbon removal from practice changes up to 5 years back.	None
Payment schedule	Producers own carbon credits starting year 4. Able to sell credits at market rate starting year 5 on the CIBO Impact marketplace.	80% of credit value when producers directly sell their credits to buyers on the CIBO marketplace.	Spring 2021 pilots offered full payout in summer 2021 for additional carbon removed in 2016-2020. Terms will change in the future.	Receive a minimum guarantee payment in February of the year following the enrollment and the balance after the verification in the next January.
Required data sharing	Crop rotation, cover cropping, tillage type, field boundaries, and nitrogen applied for the growing season for which producer is enrolling; soil tests only if farm is audited.	Crop rotation, cover cropping, tillage type, field boundaries, and nitrogen applied for the growing season for which producer is enrolling; soil tests only if farm is audited.	Field management data including planting, fertility, in-season applications, harvest, cover crop, and tillage information.	4-year historical management data.
Other requirements	Producers must enroll their farms in CIBO Impact online platform.	Producers must enroll their farms in CIBO Impact online platform.	Must enroll fields in Truterra™ Insights Engine. Fields that adopt regenerative practices for more than 5 years are not eligible for TruCarbon. Producers who operate rented land will be required to provide an attestation of their right to market carbon on the property as part of the required program agreements.	Must be a current or future Cargill grain customer and have a Cargill account number.
Credit quantification	Carbon credit is measured by using remote sensing, advanced algorithm, neural networks, and AI given the data on cash crops, cover crops, tillage practices, and managed boundaries.	GHG emission reduction and soil organic carbon removal will be quantified by the Verra's VM0042 Methodology for Improved Agricultural Land Management, v1.0.	A combination of soil sampling and an unspecified carbon modeling.	FluroSense is used to check user inputs, data from OptIS and to quantify carbon sequestration potential along with the DNDC (DeNitrification-DeComposition) model.

**Table 4. Data Platforms**

<b>Voluntary Program</b>	<b>CIBO Carbon Bridge</b>	<b>CIBO Carbon Credits</b>	<b>Truterra Carbon</b>	<b>Cargill's RegenConnect™</b>
Carbon registry	Not specified, likely Verra.	Verra-verified agricultural carbon credits.	TruTerra is working with the Soil Health Institute to develop credit generation protocols. TruTerra is also collaborating with Nori and Bayer.	Not specified
Credit verification	Satellite data to verify crop rotation, cover cropping, and tillage practices; time-stamped 'as applied' electronic nitrogen application data must be uploaded by producers to verify nitrogen management; audit soil sampling of subset of farms every 5 years.	Satellite data to verify crop rotation, cover cropping, and tillage practices; time-stamped 'as applied' electronic nitrogen application data must be uploaded by producers to verify nitrogen management; audit soil sampling of subset of farms every 5 years.	Third-party verification: organized and paid by Truterra.	FluroSense is used to verify results using field data and OpTIS remote sensing.
Limit to credits per acre	None	None	Not specified	Not specified
Storage of carbon credits	Producers retain ownership of the carbon credits. Verified carbon credits from prior seasons are immediately available for purchase on the open CIBO Impact marketplace.	Producers retain ownership of the carbon credits. Verified carbon credits from prior seasons are immediately available for purchase on the open CIBO Impact marketplace.	Not specified	Not specified
Retained carbon credits	CIBO retains 20% of carbon credits as compensation for transaction fees.	CIBO retains 20% of carbon credits as compensation for transaction fees.	Not specified	Not specified
Soil tests required	Only required for audited farms every 5 years.	Only required for audited farms every 5 years.	Yes, when enrolled, at no cost. Timing and frequency TBD.	Yes. Timing and frequency TBD.
Out of pocket program costs	None	None	Not specified	Not specified
Other costs	Transaction fees paid with retained carbon credits.	Transaction fees paid with retained carbon credits.	Not specified	Not specified
Breach of contract	None. Producers will not get paid for ungrown cover crops for the year.	None. Producers stop generating credits in the interrupted farm for the year.	Temporary breach: risk management strategy employed to account for the limited number of such instances. Details disclosed in program agreements.	Temporary breach: risk management strategy employed to account for the limited number of such instances. Details disclosed in program agreements.
Agronomic assistance	Free agronomic support, e.g., soil heath, cover crop types, and seeding method.	Free agronomic support, e.g., soil heath, cover crop types, and seeding method.	One-on-one technical support.	One-on-one support from a Cargill Conservation Agronomist.

**Table 4. Data Platforms**

Voluntary Program	CIBO Carbon Bridge	CIBO Carbon Credits	Truterra Carbon	Cargill's RegenConnect™
Stacking payments	Stacking across private and government programs is allowed, but the same field cannot be enrolled in other programs that pay for carbon removal and retention.	Stacking across private and government programs is allowed, but the same field cannot be enrolled in other programs that pay for carbon removal and retention.	Stacking with public cost-share programs allowed. Might change in the future.	Fields enrolled in the Cargill program cannot be dual-enrolled in other privately funded programs. However, this program can be stacked with public/government program payments if eligible.
Other information	CIBO Carbon Bridge is a partnership with Continuum Ag and Bushel.	None	TruCarbon is a program by Truterra, which is a wholly owned subsidiary of Land O'Lakes, Inc. Optional: Corn and soybean producers may choose to participate in Truterra carbon market access program, which pays \$2 per acre for newly adopt cover crops or reduced/no tillage with no long-term commitment. The participant in the market access program can participate in future carbon program(s) for carbon removed through these practices at the end of crop year 2022.	Cargill's RegenConnect is a partner with Regrow platform.
Enrollment period	Anytime	Anytime	By February 1, 2022 for 2022 carbon program.	May 16 - September 16, 2022.
Market launch date	2022	2022	February 2021	2022

The information reported in Tables 1-4 was gathered through Fall 2022, interested producers should carefully research programs before signing a contract as programs continue to evolve.

For flowcharts showing the direction data, payments, methods, and carbon credits move within select carbon programs, see AgDM File A1-77, [How do Data and Payments Flow through Ag Carbon Programs?](https://go.iastate.edu/QGA627), <https://go.iastate.edu/QGA627>.

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