EXAMINE CARBON MARKETS AND PROGRAMS | THESE PRACTICES HELP BOOST CROP RESILIENCE | WHAT DOES IT MEAN TO FARM CLIMATE SMART?

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Climate-Smart Farming

Growers consider measures to counter weather extremes.

By **Matthew Wilde,** @progressivwilde

MATTHEW WILDE

Conservation and other cropping practices mitigate weather extremes.

Resilient Fields Grow Weather-Hardy Crops

A hard-driving, 4.5-inch rain this spring pounded Dick Sloan's recently planted farm in east-central Iowa. If his gently rolling fields were tilled—a smooth surface of pulverized soil void of surface residue—precious topsoil and hopes for a bountiful harvest would have washed away.

Instead, the farmer, near Rowley, was confident all was well. In addition to no-till, he plants cover crops on his entire farm, which also has grass waterways and prairie strips in areas where needed to stop erosion and boost water infiltration.

Dick Sloan uses prairie strips, no-till and other measures to protect crops from extreme weather.

"After the rain, I walked out to the bottom of a waterway near a prairie strip where water was running off a field. I put my hand down, and the water was deep, but I could see my rings. It was running clear," Sloan recalls. "I'll still raise 220-bushel-per-acre corn and 60-bushel-per-acre soybeans (this year).

"That's the most satisfying experience, to be able to go out there and know that I'm not losing soil under extreme (weather) conditions," he adds.

Climate extremes such as the downpour on Sloan's farm pose a threat to crop production and food security, according to a study co-authored by Amin Nouri, a former University of Tennessee postdoctoral research associate and current senior agricultural research scientist at Monty's Plant Food Co.

Published in 2021, the research documents how conservation practices can increase soil resiliency and offer substantial climate adaptation benefits. To view

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the study, visit **www.nature.com/articles/s43247-021-00223-6**.

According to the study, the planet will continue to get warmer, and precipitation contrasts between wet and dry regions will increase. The adverse impact on crop production from weather variability will be more pronounced in the future.

That's one reason Sloan is taking steps now. He believes his farmland, which wasn't negatively affected by two large rain events that included the spring deluge and a 3.5-inch downpour, is prepared to handle almost anything Mother Nature throws at it.

"You always have to be prepared for those (rain events or droughts), because you never know when they're going to occur," Sloan explains.

Farmers and researchers say adopting various conservation practices that fit a grower's operation, such as prairie strips, relay cropping, no-till, cover crops and conservation tillage, can be one path for making cropland more weather resilient and protect farm profitability.

Here are examples and benefits of production practices farmers can implement to be more climate smart.

PRAIRIE STRIPS

Prairie strips involve taking small portions of cropland out of production to plant strips of perennial native prairie. The Science-based Trials of Rowcrops Integrated with Prairie Strips (STRIPS) program at Iowa State University (ISU) is researching and promoting the practice.

A variety of prairie species—big bluestem, purple coneflower and Indiangrass, to name a few—are planted in strips ranging from 30 to 120 feet wide through a field, along waterways or in a terrace channel. The strips typically cost $28 to $39 per acre to install, ISU data indicates.

The native plants, with deep, strong roots and stiff stems, help keep soil and nutrients in place. Thirteen years of STRIPS trials have demonstrated that converting 10% of a crop field to prairie strips could result in the reduction of 95% of sediment, 90% of the phosphorus and 84% of the nitrogen from overland flow of surface water. All the experimental sites were no-till systems and not tile drained.

STRIPS farmer liaison Tim Youngquist says the conservation practice is growing in popularity as more landowners strive to protect land from extreme weather and provide more wildlife habitat.

Youngquist says he's worked with dozens of farmers and landowners in Iowa to implement the practice. STRIPS projects are in the works in Minnesota, Nebraska, Wisconsin and several other states.

"The corn and soybean system we have in the Midwest is incredibly productive thanks to some of the best soil on the planet," he says. "Prairie strips are another conservation tool ... to help keep that valuable topsoil in place."

Cost and loss of income potential is often a stumbling block to implementation, Youngquist continues. Funding is available to plant prairie strips, and land can be enrolled in the Conservation Reserve Program (CRP) to receive a payment of up to $300 per acre annually.

Sloan recently reenrolled 4.5 acres of prairie strips, which he's had for a decade, in CRP for the annual maximum payment. "I'm renting the land out to the environment," he quips.

Learn more about the STRIPS program at **www.prairiestrips.org**.

Prairie strips consist of strategically placed native prairie plantings in a crop field and may include pollinator-friendly plants such as milkweed.
MATTHEW WILDE

RELAY CROPPING

Relay cropping is a version of double-cropping, but the second crop (in this case, soybeans) is planted into the first crop (winter wheat) before it's harvested, not after. Both crops share a portion of the growing season, increasing solar radiation and heat available to each.

Yield loss from drought and wind erosion are big worries in Oklahoma and other Plains states. Josh Lofton, an Oklahoma State University (OSU) cropping systems specialist, says farmer inquiries about relay cropping prompted him to examine the practice last year.

In relay cropping, winter wheat acts as a cash cover crop, protecting the soil in the late fall and winter, and providing beneficial residue to improve soil health and preserve moisture for the second crop.

By planting soybeans into winter wheat in April (normal time) instead of late May or after the winter wheat is harvested, soybeans enjoy a longer growing season and get established before the hottest days of summer, which is often the driest time of the year. Relay-cropped soybeans typically yield better than double-cropped soybeans because of the difference in growing seasons. ➤

"There's something always growing to protect the land that farmers can harvest," Lofton says. "You can have two potentially high-yielding, high-money-making crops."

In 2021, OSU research results showed winter wheat yields averaged about 50 to 60 bushels per acre, which is 10 to 15% less than nonrelay-cropped winter wheat because of damage from soybean planting. Relay-cropped soybean yields were unaffected by the winter wheat harvest, Lofton explains, averaging 50 to 60 bushels per acre.

Financial results weren't calculated, but he says relay cropping has more profit potential, despite possible lower winter wheat yields, than raising one crop a year or double-cropping.

Lofton plans to include milo and cotton in the multiyear relay-cropping study. Learn more about relay cropping at **cropwatch.unl.edu/wheat/relaycrop**.

NO-TILL AND COVER CROPS

Research from Nouri and his team reinforces the long-known benefits of no-till and cover crops. Their study examined 29 years of climate data, cotton yields and soil data under 32 management practices in Tennessee. The practices include a combination of cover crops, tillage (no-till and conventional tillage) and various nitrogen application rates.

Relay cropping helps protect the soil during the winter months (wheat) and preserve moisture for the second crop (soybeans).
PHOTO COURTESY OF OKLAHOMA STATE UNIVERSITY

Even though the study focuses on cotton-yield stability in the Southeast, Nouri points out the goal to help farmers adapt to extreme hot, wet or dry conditions is the same for all regions and crops.

Results show that a long-term, no-tillage system enhances agroecosystem resilience and yield stability under climate extremes. No-till also maximizes yield potential under favorable climate conditions.

Nouri says after at least five years of no-till and cover crops, the benefits over conventional-tilled fields include:

- reduced soil erosion and nutrient loss
- increased soil biological activity
- decreased heat stress on crops
- improved soil structure and organic matter
- increased water infiltration and holding capacity
- suppresses weeds
- mitigation of compaction.

No-till cotton yields were 22% better than conventional-tilled fields in wet conditions, according to study data. In extremely dry conditions, the study concludes no-till significantly lowers the risk of yield loss compared to conventional tillage. Fifty percent less nitrogen can be applied to no-till cotton fields with legume cover crops than conventional-tilled fields with no cover crop to get roughly the same yields under all climate conditions, according to the study.

No-till can greatly improve soil health and a farmer's bottom line, Nouri says.

"I want to emphasize that long-term no-till is key for long-term soil-system resilience and yield stability under all climate extremes," he adds.

Drought generally isn't a concern for Jason Luckey, whose west-central Tennessee farm usually receives more than 50 inches of precipitation a year. Heat, though, can be worrisome. This year, both were a problem.

Luckey grows cotton, corn, winter wheat and soybeans. He says it's years like this that no-till pays off, especially for cotton. The soil, with ample surface residue, is better insulated from multiple days of 100-plus°F heat and retains available moisture better to mitigate crop stress during flowering and boll development.

"The cotton withstood the heat and dry conditions better," the Humboldt farmer says. He notes 900- to 1,500-pound-per-acre cotton is doable this year (depending on field production potential), much like in 2012 under similar climatic circumstances. If it wasn't for no-till, Luckey says yield potential wouldn't be nearly as promising.

When his family started to transition to no-till in the 1990s, he could see disked cotton fields showed signs of heat and moisture stress several days before no-tilled fields. "That made us believers in the no-till system," he emphasizes. ///

Defining Climate-S

Farmers use different terms but share similar motives for making their operations more resilient to extreme weather conditions.

By **Chris Clayton,** @ChrisClaytonDTN

The hot August sun beats down as a group of farmers stand in cotton, soybean and corn fields in south-central Kansas, looking at the remaining cover-crop residue and condition of the crops that desperately need rain.

The farmers, who are on a tour led by the Kansas Soil Health Alliance, traipse through cover-crop fields, digging up plants, examining the crop residue and soil to find signs of moisture and organic activity. It becomes more of a challenge when the temperature is topping 100°F, and the area hasn't seen rainfall in more than a month.

But, those in the group who are farming dryland on fields with cover crops typically feel confident their crops will last longer than their neighbors' fields without the covers.

Austin Schweizer has integrated cover crops partly to hold down the soil but also capture moisture. The Sterling, Kansas, farmer says the sandy soils in the area are a challenge, especially if you can't lean on irrigation. He describes some of the fields around his farm as a "desert" and points to ridges that aren't natural but were created by the dunes during the Dust Bowl.

His neighbors see the cover-crops strategy as giving up moisture to cover crops, but Schweizer says rainfalls flow so quickly through the sandy soils, it becomes hard to capture moisture otherwise.

"With the cover crops, we are pumping carbon back into the ground. That's how we get the energy we need," Schweizer says. "The more covers I grow, the more I help the moisture. I have to find a way to use more carbon to hold more water."

Such sandy soils take a long time to build up the organic profile. Standing in a field he took over in 2017, Schweizer says organic matter has gone from 0.3% to more than 1% since he's farmed that ground. "We've moved it, but it's been a slow change," he says.

Even though nobody on the tour is using the term "climate-smart agriculture," and no one is signed up to get a carbon credit for not tilling or using cover crops, both are getting a lot of attention these days. Agriculture is seen as playing a major role to help reduce greenhouse gas emissions, and other industries are banking on carbon credits supplied by farmers to help meet their environmental objectives.

Where is it all headed? And, what does it mean for the future of farming as growers contend with more frequent weather extremes while trying to balance

e-Smart Agriculture

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efforts to use production practices that boost production and benefit the environment?

DON'T FOCUS ON TERMINOLOGY

While the terms have shifted some from "soil health" to "regenerative agriculture" to "climate-smart agriculture," they are all related, though banking carbon in the soil is one of the key aspects to climate-smart agriculture.

"Ultimately, soil health, water quality, regenerative agriculture—they all kind of run together," says Kellie Blair, a farmer who co-chaired the group Iowa Smart Agriculture. "So, on our farm, we have cattle, and the manure feeds the soil and then the crop, and the crop feeds the cattle. It's kind of a closed system or circulatory. We're using less commercial inputs, which is good for the climate. Really, our focus is to try new ideas that will increase profitability but protect the climate, the water and the soil."

On the Blairs' farm, they began focusing on monitoring their tiles. At one point, they were leaching 42 parts per million (ppm) of nitrogen. With a more diversified crop rotation, reducing tillage and growing cover crops, the nitrate coming out of their tile lines is now under 10 ppm.

"The changes that you make on the farm don't have to be huge," she says. "They can start small and go from there. But, they do need to be intentional."

MANY QUESTIONS REMAIN

Jimmy Emmons, a farmer from Dewey County, Oklahoma, says the various terms used today are sometimes confusing to producers.

"We started years ago talking about healthy soils, and then regenerative ag came along, and I really liked it because when you regenerate something, you rebuild it, and you repair it, then you revitalize it," Emmons says. "Right now, everybody is trying to figure out how to capture CO_2 out of the atmosphere and turn it into carbon and store it." ➤

Farmers take a closer look at how soybeans can benefit from cover crops in south-central Kansas.
CHRIS CLAYTON

CHRIS CLAYTON

Emmons speaks across the country and internationally to farmers about how soils function and the value of soil health. Just trying to understand the basics of soil is important, and farmers in different climates will have different priorities.

"Water is our limiting factor here," he says of south-central Oklahoma. "I want to capture every drop of water in my soil. In other areas with a lot of water, they sometimes want to get rid of water. But, it's still about the ability of the soil to do that. The worst thing you can do is not plant a cover crop."

Still, Emmons isn't ready to enroll in a private carbon credit program despite multiple companies trying to recruit him. They've come to his farm to take soil samples in some cases. Emmons isn't convinced everyone has figured out how to measure carbon in the soil.

"And, everybody is trying to make a buck. Whether you are trying to trade the carbon or store the carbon on the farm side, as well, I just don't think we're there yet," Emmons says.

ATTENTION ON CARBON

Right now, there are at least a dozen companies enrolling farmers in some sort of carbon program (see "Carbon Markets," on page 30). Some companies are aggressively recruiting producers, while others are testing their own methodologies on exactly how this will work.

"About half of the whole carbon industry right now is educating growers about how it works," says Clay Craighton, an agronomist working with Agoro, a company that offers a carbon program.

There are multiple strategies at work. Even without government mandates, corporate America has challenged itself to lower its carbon footprint, and businesses see agriculture as a way to do that. Within ag, ethanol producers continue looking for new strategies to drive down their carbon scores to sell more ethanol and get carbon credits in regulated markets such as California.

"There's a general acceptance now that ag can be part of the solution, obviously, or they wouldn't have been throwing money at us like that," says Ron Alverson, a South Dakota farmer who has worked with the ethanol industry on carbon scores. "If climate-smart agriculture can reduce the carbon intensity of corn production, what does that translate into for every acre out there?"

BIG INVESTMENT

Visiting an Iowa farm in mid-August, Secretary of Agriculture Tom Vilsack described the $19.5 billion in funding for climate-smart agricultural practices included in the Inflation Reduction Act (IRA) as "transformational" and "the largest investment in conservation since the Dust Bowl."

Vilsack added, "This is an extraordinary opportunity for us to embrace climate-smart agriculture and invest in it with these resources."

Collectively, crops and livestock account for about 11% of all U.S. greenhouse gas emissions. Since coming into office, President Joe Biden has focused on incentives to move the economy, including agriculture, toward "net-zero" emissions by 2050.

Vilsack and USDA also surprised the industry in mid-September when the department took its $1 billion climate-smart pilot program and tripled it in size to $3.5 billion in USDA funding. USDA rolled out $2.8 billion in 70 initial grants under the Partnership for Climate-Smart Commodities.

To note, DTN (parent company of *Progressive Farmer*) is part of a $95-million grant with a coalition of groups called Farmers for Soil Health (FSH), a project that will work to increase cover crops and ➤


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Cover crops help to capture moisture and carbon, while building soil organic matter.
CHRIS CLAYTON

conservation tillage in 20 states that produce more than 85% of the country's corn and soybean crops. Part of the goal is to help double cover-crop acreage nationally.

The Farmers for Soil Health news release stated, "FSH will also work with data insights and publishing company DTN to develop a digital platform that will use satellite imagery, allowing farmers to receive an 'eco-score' for corn and soybeans produced with cover crops and conservation tillage. This platform will facilitate the marketing of crops to parties interested in securing a documented source of sustainably produced corn and soybeans."

Overall, the goal for USDA's pilot projects is to help farmers receive premiums for their crops or livestock based on their conservation practices.

USDA's focus on climate-smart agriculture has multiple goals to drive down greenhouse gas emissions with farming practices that build resiliency in the soil and, ultimately, reduce nutrient pollution in rivers and streams.

"You're going to see more productive soil and cleaner water as a result of embracing climate-smart agriculture," says Robert Bonnie, USDA undersecretary of Farm Production and Conservation. "What we are focused on is those practices that are going to benefit the climate, but a bunch of these practices also benefit productivity, they benefit water quality, all kinds of other things. There's an alignment between good agronomic practices and good climate practices. So, we're trying to take advantage of that."

REDUCING FERTILIZER NEEDS

Climate-smart agriculture goes beyond no-till practices, cover crops or grazing management. Technology and equipment used to make the most efficient use of fertilizer and chemicals—precision agriculture—will also need to play a key role, especially if agriculture is going to drive down nitrous oxide emissions from nitrogen fertilizer.

Companies are enrolling farmers in different ways to reduce nitrogen applications. Practical Farmers of Iowa (PFI), for instance, worked with PepsiCo Inc. and the Foundation for Food and Agriculture Research this fall to enroll 120 farmers in a program specifically to work on strategies that use cover crops to reduce nitrogen use. The program includes compensating farmers if they lose yield because of cutting back on nitrogen.

PFI's Sarah Carlson talks to DTN about Practical Farmers of Iowa's work with PepsiCo to enroll farmers in a cover-crop program to reduce nitrogen use.

"Pepsi's goal is to see how they can help farmers who grow corn for their supply chain for high-fructose corn syrup dial back nitrogen to help cut greenhouse gas emissions," says Sarah Carlson, PFI senior program manager.

COURTESY OF BRAD MCDONALD

Eastern Iowa farmer Brad McDonald talks to DTN about signing up with CIBO's test pilot program.

Separately, the Soil and Water Outcomes Fund is paying farmers for strategies that prevent nitrogen and phosphorus from entering waterways.

Brad McDonald, a farmer in eastern Iowa, enrolled his farm in a pilot program created by CIBO Technologies in order to better understand the process of signing up for a program. McDonald says if farmers are going to implement soil-health practices, they might as well get paid for it. His main goal, however, isn't just the carbon payment.

"The carrot that I'm really chasing here is to decrease my chemical fertilizer use over time," McDonald says. "So, we've seen it time and time again—a 40% reduction in chemical needs, a 25% reduction in fertilizer needs over time. Once you get the biology working for you, it just makes everything so much easier."

THE ADDITIONALITY PROBLEM

The difference between practicing climate-smart agriculture and carbon programs often comes down to how carbon-credit companies treat early adopters, or legacy growers. Looking at no-till alone, there are

thousands of farmers who have converted to pure no-till practices going back decades. In turn, they've banked a lot of carbon in their soils. But, companies buying credits want additional carbon banked—"additionality" beyond what has already been achieved.

"We've looked at a lot of the private programs, but we're ineligible for anything because we don't have an additional practice change, essentially," says Keith Alverson, who farms with his father, Ron, in South Dakota. "What options we've received or been eligible for haven't been attractive as far as the economics over it. We've struggled to make the economics work on cover crops if it costs you $40 [to plant] and you get $6 back."

Instead, the Alversons are focusing on the limited tillage and the large volumes of crop residue from corn production that have built up organic matter in their soils over time.

They are part of an early Regional Conservation Partnership Program (RCPP) involving South Dakota State University, the American Coalition for Ethanol, Dakota Ethanol plant and the South Dakota Corn Growers Association. The project received a $7.5-million grant with a goal to develop a template for states such as California that have low-carbon fuel standards to audit and verify the carbon sequestration practices of farmers delivering corn to ethanol plants.

Right now, the RCPP grant shows that signing up for USDA's climate-smart programs could be more profitable than the voluntary carbon market. The RCPP grant will pay farmers in the program as much as $50 an acre to switch to no-till. Using the 4Rs of applying nitrogen fertilizer—right source, right rate, right time, right place—can pay $40 an acre. Adding cover crops can pay as high as $50 an acre.

A lower carbon score for an ethanol plant from a state such as California can translate into hundreds of millions of dollars for those ethanol producers. "That's potentially a lot of money across the Midwest," Ron Alverson points out. "What we're hoping for is a state or regional low-carbon fuel standard will develop in the Midwest—something that will ensure you get paid for how you farm if you are a low-carbon farm."

CRITICS REMAIN

Private carbon credits and USDA's climate-smart focus continue the long-term strategy of using voluntary practices to achieve environmental outcomes. The Environmental Working Group, for instance, looked at USDA's Conservation Stewardship Program (CSP) and Environmental Quality Incentives Program (EQIP), and found a lot of the "enhancement" practices do little to reduce greenhouse gas emissions. ➤

Multiple groups are educating farmers on how certain practices can keep crops productive regardless of the weather.
CHRIS CLAYTON

Among the biggest complaints is the lack of measurement and metrics of what is being sequestered.

"All of these offsets are based on soil organic matter," says Silvia Secchi, a professor of geographical and sustainable sciences at the University of Iowa. "A lot of the focus is on the kind of activities and practices in the Corn Belt where we already have high soil organic carbon, and so it's hard to increase it. The choice of metric is problematic, but the other thing is that it doesn't really reflect the greenhouse gas emissions from agriculture."

Much work is still going into measuring the potential of soil organic carbon to mitigate climate change. Rattan Lal, a distinguished soil science professor at Ohio State University and a 2020 World Food Prize laureate, is now leading a new $20-million global research project with a long list of university, corporate and agricultural collaborators to detail strategies that capture carbon in the soil and improve the rate at which carbon dioxide is captured by plants.

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"This project will provide the needed tools and data to help farms across the United States and around the world reach their full potential as a carbon sink and be part of the solution to combating climate change and advancing the Sustainable Development Goals of the UN," Lal stated in announcing the project.

Secchi is skeptical about the permanence of soil carbon sequestration, as some producers get payments for no-till production on their soybeans one year, then they will till the soil for the next corn crop. She takes the opposite stance from farmers who want to get paid for their no-till history.

"In a lot of these cases, farmers are going to get paid for a practice they are already doing, even if it is not a permanent sequestration tool, leaving aside the issue of whether there is actually carbon being sequestered in this way," Secchi says. "And, then if a farmer has a three-year, six-year contract and on year seven when the payment ends, the farmer is not going to reenroll, is he going to till again? So, it's not a permanent solution."

BENEFITS BEYOND THE CARBON PAYMENT

Tom Cannon is a farmer and rancher near Blackwell, Oklahoma, who got involved with Indigo Ag's carbon program because he was a research partner with Indigo on the company's biological products.

Cannon says his soils are fragile, and the topsoil is shallow, so he constantly looks for strategies to make the farm more resilient. He also finds it rewarding—almost on a spiritual level—to help farmers and work on climate change at the same time.

"Climate-smart agriculture to me is what is that climate in the soil? What is the climate below the surface, and is it beneficial to the biology that drives the system? Whenever I think about soil health and the climate down there, it's a pretty good term. But, most people don't see it that way," Cannon says.

He hears a lot of criticisms about carbon programs from the lack of recognition over legacy practices to the company's share of the payments. Indigo, for instance, takes a 25% cut, which Cannon compares to a 75/25 cost-share.

"I just don't understand why people are so negative about it," he adds. "If you can get some payments while accomplishing everything else I'm really passionate about, then why not?"

While a carbon program may not credit past soil-health practices, Cannon says legacy farmers are already way ahead when it comes to achieving lasting improvements in their soil. "I would absolutely love to put 100% of my acres into a program, but I would never go out and disk my ground just so I can get a carbon payment," he points out. "I would never do that, because the greatest value in these practices is the resiliency in your soil, the yields in your soil and profitability. But, it would have been nice if this program was already in effect back when I started." ///

Advancing soil-health practices produces more resilient soils and growing environment for crops.
CHRIS CLAYTON

By **Todd Neeley,** @DTNeeley
Photos By **Joel Reichenberger**

Weather-Ready Farms

This program helps growers enhance sustainability and safety efforts now and in the future.

Three-year-old Brooks Bohling gleefully chases his father, Trenton, around their family farm in Johnson, Nebraska, not a care in the world. Brooks is often seen pedaling a red tricycle with all his might, while his 1-year-old sister, Karsyn, follows the leader as best as she can.

Trenton and Ashton Bohling say their two toddlers are the reason they need their farm to be sustainable and safe for the long term.

The way they see it, making the farm weather-ready and safe go hand in hand when planning for the future. That's why the Bohlings opted to take part in the University of Nebraska Extension's Weather Ready Farms program as one of eight pilot farms.

Weather-ready farm is more than a catch phrase to describe the myriad ways producers can prepare for abruptly changing and severe weather on the farm.

"I think it's important to remember the context of time and to realize that we're a small piece of the puzzle; but with any puzzle, it only takes a small piece to be noticeable," Trenton Bohling says.

"I don't necessarily believe climate change is a new phenomenon, although the reasons for it may be different in each decade, century or millennia. The climate and weather will always be changing and will always keep us guessing. With change being the only constant, isn't it our duty to prepare our families, our farms and our future for whatever it is to come? The realization that things will forever be fluctuating should be all the reason we need to implement long-term plans. I feel it's our duty to our families, communities and country to do all we can to become less dependent on things we cannot control."

The Bohlings signed up for the pilot program to find ways to produce more with fewer resources.

PROGRAM DETAILS

Farmers in the two-year program learn about conservation, natural resource management, improving soil health, disaster preparedness, farm financial management and climate-smart agriculture—but there are no limits as to how farmers can make improvements to their farms.

The program includes an on-site evaluation of each operation by Nebraska Extension, seeking out what farms do well and what might be improved. Visit **weather-ready.unl.edu/weather-ready-farms** for more information.

Producers are offered educational events through Nebraska Extension and other resources, and are required to log 40 hours of education through Extension. ➤

Each farm must work on a specific project, anything from installing farm maps to weather stations to learning CPR.

Once farmers have completed the program, they undertake a verification process to gain the Weather Ready Farm designation. Farmers receive $1,300 toward their projects and about $1,200 in stipends for the work they do in the program.

The term "weather ready" means different things to every farm. But, concerns boil down to a number of issues: How can producers make do with fewer inputs and rainfall? What can farmers do now to help the farm survive severe storms, floods, colder winters, more prolonged heat in the summer and drought? How can they make farms safe for the unexpected?

Rotational grazing requires moving fencing on a regular basis.

NEW WATERING SYSTEM

As part of their weather-ready program, the Bohlings are installing an energy-free water system that uses a 10-foot black tube installed in the ground. It uses ground heat to keep water free of ice for livestock.

Maintaining an available water supply for livestock is increasingly important in preparing for potentially farm-debilitating and animal-threatening weather.

"We won't have to worry about running hoses across our yard, making sure we're filling them up, making sure we're shutting off the water," Trenton Bohling says.

"It seemed kind of silly at first, but the more you think about things like, 'OK, if the electricity goes out in the middle of winter, what happens?'" he continues. "Some of the webinars and education we've been on really makes you think about what if, and that's more at the front of your mind after the last couple years of supply chain issues."

The Bohlings usually run 70 pair of seedstock Angus-based cows and sell a few bulls and bred cows and heifers annually to repeat customers. They recently have been breeding for more of a grass-based genetics program and crossbreeding with breeds like Fleckvieh for grass efficiency, as well as Wagyu for heifer calving ease and meat quality of the finished calves.

Brooks Bohling lends a helping hand setting up fenceposts.

In addition, the farm row-crops around 200 acres, diversified with corn/soybean/wheat/cover-crop rotations that allow livestock feed and integration, as well as a few acres of pumpkins.

Trenton Bohling says his operation strives for "very high" profit per acre on a smaller scale by utilizing efficient cattle, lower overhead inputs and resilient/regenerative cropping and livestock systems.

The Bohlings also rotationally graze cows, moving them every week to 10 days. "If time allows, I try to move them every day or every two to three days," he says.

SUSTAINED RELATIONSHIPS

University of Nebraska Extension agent and program director Nathan Mueller says the program is designed to create "sustained relationships" with other farmers and Extension educators by identifying educational opportunities and areas of expertise outside the program that could help farmers.

"It's a way for us to continue to make sure they're aware of all of our programs and then get credit for it somehow," Mueller says.

"But, part of the idea was also to acknowledge the time that producers were willing to put in a group like this with acknowledgement in their community. So, the goal when they get through this [program] is they'll ➤

get a sign [to display on their farm]. Part of farming is rural sociology."

Mueller says Weather Ready Farms is an individualized program designed to "meet producers" where they are in their operations.

Not only would Mueller like to see the program grow and expand in Nebraska, but also on a national level. He's working with Extension educators in other states, including at Purdue University, to launch similar programs.

He also wants to find ways for producers to get credit for the work they do to make their farms more sustainable. That includes efforts to have the program acknowledged by USDA.

"I've seen a change in attitude, in terms of weather, changing climate," Mueller says, "knowing that what they're doing now, they need to make some adjustments."

Producers do a number of things, he explains, that may be worthy of a reduction in crop-insurance premiums, for example.

What if insurance companies were to credit farmers for installing backup generators, creating windbreaks, installing terraces, improved irrigation scheduling?

"I think that's something our team would like to see long term, that this designation provides more financial benefits to the producers than it does now," Mueller points out.

Trenton Bohling says the weather-ready program has helped the family take stock in what its farm is already doing. "First of all, my parents were doing cover crops back in the '70s and '80s," he says.

"They didn't necessarily call it cover crops. It was feed for the dairy cows," he continues. "There was always a continuous run in the soil, always something growing. So, we do a lot of that stuff already that they were introducing but maybe some nitrogen management."

ATTENTION ON WATER USE

Bismarck Township, Nebraska, corn and soybean farmer Travis Runge has used the Weather Ready Farms program to sharpen his attention to water usage on his farm. He installed a weather station to improve irrigation efficiency on his 150-acre operation.

"It saves me from driving clear over here to look at a rain gauge," he says. "If it's raining or not, then I know I don't have to physically be here all the time."

Travis Runge installed a weather station to improve irrigation scheduling and efficiencies.

Runge wants to strike a better balance by tracking rainfall and other weather events more closely before turning on the pivots.

He had a tract of land enrolled in the Natural Resources Conservation Service Conservation Stewardship Program for a time, during which he learned his irrigation system was just 83% efficient.

Like many farmers, Runge has an off-farm job and wants to monitor his crops as closely as possible.

What's more, installing a weather station allows him to also view data coming from other nearby stations, which, in turn, is helpful in making other cropping decisions.

Prior to installing a weather station, Runge says it was a challenge deciding whether to run pivots depending on wind speeds. "I look at my weather station like, 'Ooh, it is a 15-mile-an-hour wind, maybe I should wait until it calms down a little bit'," he explains.

He leases the ground he farms and gives the landowner access to the weather station. Other area farmers also are benefiting from his efforts.

"I have a farmer friend over by St. Edward, and his farms are 50 miles apart. He has no weather station, and he calls me all the time. He's like, 'I spent half a day driving around checking my fields.'"

For farmers such as Trenton Bohling, the Weather Ready Farms program provides a way to enhance his farm's sustainability.

"Sustainable is an overused term; you're starting to see regenerative used more," he says. "They all have the same meaning today. How can we do better with less, still make a profit without using resources that are finite? Either way, whether it's changing or not, there's certain things that we need to be doing. The goal is to reduce reliance on outside forces that we can't control." ///

Steps To Weatherproof The Crop

Story and Photo By **Pamela Smith,** @PamSmithDTN

Companies eye new technologies to help corn withstand the storm.

The roiling wind that blew through a Bayer weed-control research plot in western Illinois this past summer made a short-stature corn believer out of Dave Shenaut.

"There were pockets of the traditional corn that were 70% lodged or green snapped during that event. The short-stature corn had 5% or less injury," says Shenaut, a Bayer technology development representative. "Simple physics should indicate it would do better in these kinds of winds, but when viewed from air by drone, the difference was dramatic."

Compared to traditional hybrids, short-statured plants stand about one-third shorter with a lower ear set at least 24 inches above the soil surface. Several seed companies have the concept in development pipelines.

Short-statured corn (left) stands about 33% shorter and has a lower ear set than traditional hybrids.

Reduced-stature corn mostly began to increase population density and simplify over-the-top application of inputs. But, extreme weather events now have seed companies shining a resiliency spotlight on the system. "One thing we are seeing is the roots of these new shorter hybrids tend to explore more soil faster," Shenaut notes.

SIP DON'T SLURP

When it comes to weatherproofing corn, seed companies have long concentrated research and development on identifying native genetics that allow hybrids to convert water more efficiently and better tolerate drought. Farmers have access to those products through market names such as DroughtGard (Bayer), Optimum AQUAmax (Corteva) and Agrisure Artesian (Syngenta).

Tom Greene, Corteva Agriscience biotechnology leader, expects breeding efforts with native traits to continue to be important. But, he sees new genetic tools allowing scientists to deliver even more stress tolerance and yield stability in the future.

"We have a yield stability trait that is working through our pipeline today that is very complementary to what we've done with AQUAmax," Greene says. This gene will promote small yield advantages in normal environments but provide a bigger advantage under environmentally challenged environments.

"We basically take a corn gene and modulate its transcription factor," he explains. Transcription is the process of copying a segment of DNA into RNA. Think of it as giving the plant instructions to endure a particular stressor.

"By extending and elevating expression just a bit, we see improvements in several agronomic attributes. Photosynthetic capacity is up a bit. Leaf area index is up a little bit. We see improvements in nitrogen uptake and assimilation—a lot of agronomic properties that lead to overall stability across environments," Greene says of the yield stability trait, estimated for launch early in the next decade.

ROOTS THAT REACH

Greene points to the already large gap between average national yields and genetic potential of corn. "Heap climatic challenges upon that, and it's a daunting task to stay ahead," he notes. He believes it will take combinations of approaches to weather climate changes.

Corteva is developing short-statured hybrids with this in mind, as well. "There's no doubt we're seeing enhanced stability and better stalk strength, which leads to more yield in those years where wind events play a factor," Greene says.

At a Bayer field day this fall, Kelly Gillespie, vice president of Digital Ecosystem Services, noted the root structure of short-statured corn in what Bayer will call the Smart Corn System upon commercialization. "We are seeing differences in how tap roots and secondary corn roots explore the soil," she says.

Whether this root race leads to increased water and nutrient uptake to better withstand variable environments is still on trial. "But, we've measured the ability of these roots to grow deeper and faster many times," Gillespie adds.

Shenaut is excited about the possibility of increasing plant populations without a reduction in standability. "All of this makes sense if you think about how the corn plant stores carbohydrates," he observes.

"A tall plant sends a lot of those carbohydrates to the internodes. In the case of short-statured corn, they aren't allowed to continue to extend, so the excess carbohydrates could or may be sent to the root system," he says. "We're still working to understand it all, but water and fertility benefits to the system are exciting." ///

By **Chris Clayton,** @ChrisClaytonDTN

Carbon Markets

Carefully review requirements before enrolling.

Carbon credits give farmers a chance to get paid for practices that sequester carbon in the soil or reduce greenhouse gas emissions, such as lowering fertilizer inputs.

The entire voluntary carbon market—of which agriculture is just a small slice—was worth an estimated $2 billion in 2021. Still, that was four times the value from 2020, according to Forest Trends' "Ecosystem Marketplace" report, released in August.

JOSEPH L. MURPHY

VALUE TO GROW

The growth, though, is exponential. Bloomberg's analytical arm projects carbon offsets could become a $190-billion market by 2030. Bloomberg and others project companies will move aggressively toward carbon offsets to achieve their sustainability goals, and there won't be enough supply of projects such as direct carbon capture to meet the demand. That's going to lead the price of carbon to spike to as high as $200 per metric ton for some markets.

Forestry and renewable energy are the dominant markets for voluntary carbon credits. In 2021, agriculture overall traded slightly less than 1 million metric ton (mmt) for about $8.7 million, though the average price for agricultural offsets at $8.81 per metric ton (mt) was the highest of any category. Offsets for forestry were running around $5.80 per ton.

California's compliance market in mid-October was trading at just $26.85 per mt, down more than 16% since the beginning of the year. The federal government pegs the "social cost of carbon" at $51 per mt. However, a study led by Resources for the Future puts the social cost of carbon—the estimated economic damages of climate change—as high as $185 per mt. That same study pegged the cost of carbon pollution to agriculture at $84 per mt.

Credits are traded on a purely voluntary basis largely because corporations have set specific goals to lower greenhouse gas emissions in their supply chains. Some companies are selling agricultural carbon credits to buyers across corporate America, including airlines and technology companies. Others are specifically looking to offset their own supply chain emissions through existing relationships with farmers, known as "carbon insets."

MANY PROGRAM OPTIONS

Every agricultural carbon credit program is unique. Some pay by acre, some pay by (metric) ton, and some pay by the practice. They have different rules, payment plans and requirements, and they are enrolling farmers based on their commodities or region of the country.

Yet, each company already in the game claims it is looking to enroll millions of acres over time. If each company hits its acreage targets, then roughly 1 in every 3 farm acres would be part of a carbon program by 2030.

Right now, there are roughly a dozen companies enrolling and paying farmers, though some of those programs are simply pilot projects.

In some cases, farm organizations are working with companies to sign up farmers for certain cropping practices, as well.

The payments in summer 2022 can range from as low as $2 an acre to as high as $40 per mt of carbon. Pricing for carbon credits is opaque in a lot of cases because there is no defined pricing platform in a voluntary carbon market.

As of now, there are no standards for carbon markets. Legislation passed by the U.S. Senate in 2021, the Growing Climate Solutions Act, allows USDA to set standards for carbon markets and create a certification program. The bill also authorizes USDA to provide technical service to producers so they can qualify for a carbon contract. That legislation, however, has been stalled in the House of Representatives for more than a year.

Carbon Credit Programs

While there are new players in the carbon space popping up, these are some of the major carbon programs in the U.S. already established by the end of summer 2022.

Agoro Carbon Alliance. Formerly part of the fertilizer company Yara, Agoro is working to enroll 1 million acres of crop, pasture and rangeland in the U.S. Several payment options are available based on the program selected. Agoro is offering its program in 48 states but is focusing on the Midwest. Farmers working with Agoro sign 10-year contracts. **www.agorocarbonalliance.com**

Bayer Carbon. Bayer has enrolled more than 2,600 farmers in 10 countries, involving 1.4 million acres. The program was offered in 17 states in 2022. Bayer Carbon pays farmers $5 to $12 an acre for on-farm conservation practices. The program uses Bayer's Climate FieldView platform. Bayer launched a new digital platform, ForGround, in August. **www.bayerforground.com**

Cargill Regenerative Agriculture. Cargill seeks to enroll 10 million acres in its RegenConnect program by 2030. The program was offered in 15 states for 2023 with a payment of $25 per acre. Cargill's program will enroll farmers for contracts as short as a single year. **www.cargillregenconnect.com**

CIBO. CIBO has signed up a small number of farmers in a pilot project for carbon sequestration, mainly to determine how well its software tools work. **www.cibotechnologies.com/g**

Corteva Agriscience. About 1 million acres are enrolled in Corteva's program, which it operates using its Granular program to verify practices. Credits are measured and marketed through Indigo. Corteva guarantees a minimum $20 per credit, projected to go to $30. **www.corteva.us/carbon**

Farmers Edge. Growers enrolled in the Smart Carbon program collect data using the company's digital platform. They are credited for practices such as reduced tillage/no-till, cover crops and reducing nitrogen use. The company conservatively estimates a payment of $10 per acre. **www.farmersedge.ca/carbon**

Gradable Carbon. Part of the Farmers Business Network, Gradable started in 2021 with a $20-per-carbon-credit floor price. Farmers can sell credits or bank them for selling later. Credits are generated through practices like cover crops, conservation tillage and nitrogen management. **www.gradable.com**

Indigo Ag. With more than 5 million acres enrolled, Indigo is signing up farmers in as many as 30 states. Indigo has no limit on the number of acres it looks to enroll. It's selling credits at $40 a ton, of which farmers get 75% of the market value of the credit. **www.indigoag.com**

Locus Ag Solutions CarbonNOW. About 320,000 acres were enrolled last year with plans to quickly reach 1.32 million acres by the end of the year. CarbonNOW is available in all 50 states. Farmers are guaranteed a minimum of $12 an acre, of which 75% is paid up front. **www.locusag.com**

Nori. Enrolled are 35,387 acres with another 10,466 ➤

acres under verification, as well as projects for another 24,000 acres. Most of Nori's projects currently are in the Midwest and Atlantic states. Nori doesn't have a specific acreage goal but does have limits on crops and practices that are part of the program. Currently, Nori's projects are paying $20 a ton. **www.nori.com**

Nutrien Carbon Program. At the end of 2021, Nutrien reported 225,000 pilot acres in three Canadian provinces and 15 states in the U.S. Nutrien's program uses several partners including other carbon programs. Nutrien looks to reach 1 million tons of carbon equivalent sequestered in the soil or in emission reductions. Payment is up to $15 per acre. **www.nutrien.com/sustainability**

Rabobank. Growers upload data into Rabo Carbon Bank's farmer portal, create future regenerative plans and agree to have on-site soil sampling done. Minimum number of acres required. Payment info is unavailable. **www.rabobank.com/carbonbank**

Soil and Water Outcomes Fund (AgOutcomes Inc.). The Fund looks to finish 2022 with 200,000 acres enrolled in 13 states. A subsidiary of the Iowa Soybean Association, the Fund pays farmers in two yearly installments, including 50% when signing a contract. AgOutcomes pays for carbon sequestered but also pays for nitrogen and phosphorus prevented from entering waterways. **www.theoutcomesfund.com**

Truterra TruCarbon. Truterra, part of Land O'Lakes, did not detail its acreage enrollment but paid out $4 million in 2021 for sequestering more than 200,000 tons of carbon, which equates to $20 a ton. Payments ranged from $2 per acre to up to $25 per ton. Truterra markets its program through the Land O'Lakes cooperative network. **www.truterraag.com**

FOR MORE INFORMATION
www.unitedsoybean.org/usb-carbon-toolbox/carbon-programs

Contract Considerations

Farmers looking to sell carbon credits have a lot to think through. Dave Aiken, an agricultural law professor at the University of Nebraska Department of Agricultural Economics, says he's been fielding more questions from farmers looking into signing a carbon contract.

"They want to know which one is going to pay the most money and stuff like that. But, there are also landlord/tenant issues that have come up," Aiken says. "I want them to better understand it's kind of the wild Wild West out there, and at the moment, it's not a stable market."

Trying to provide some principles for farmers and landowners, several carbon companies got together to create the Agricultural Climate Markets Collaborative. The goal was to provide more transparency so both farmers and carbon buyers can be more confident in the market.

A key point Aiken recommends is having an attorney go over the contract with you to understand all the details, "Because there is likely going to be some fine print, and if you just sign it so you could get the money, you could end up holding the bag."

Here are a few questions Aiken and the University of Illinois farmdoc economists recommend farmers consider before signing a carbon credits contract:

- How much will you get paid, and how will that payment come? Some companies are paying flat fees for conservation practices, while others are pegging prices of a credit to a metric ton of carbon.
- How much is the company's cut per credit? If you are selling for $15 a ton, and the company is taking a 15% cut, then your payment is $12.75 a ton.
- Does the payment move upward with the price of carbon, and if so, how is that price determined? Nobody wants to get locked in at $15 a ton if the price of carbon credits is going to move to $50 a ton.
- How long are you locked in? Some companies are signing up farmers for just a year or two, while other buyers want to lock in a longer-term deal. Shorter terms make it easier down the line to potentially shift to a more profitable market, assuming you can provide some new additionality to your farm acreage.
- What practices do you need to implement? Again, each company is different, but tillage practices, cover crops and fertilizer practices are often key considerations. Some programs could pay for retiring marginal lands, but would that be as beneficial as a Conservation Reserve Program contact?
- Can farm tenants enroll in a contract? What happens if the land ownership changes? These are critical questions to understand concerning the length of a carbon program and who will be paid. Tenant and landowner need to be on the same page.
- How much data needs to be reported? Who owns the data off the farm? Companies have specific software tools they want producers to use to measure the emissions from farming practices, carbon being sequestered and reductions in emissions over time. Companies also may want to send third-party verifiers to the farm. Farmers need to understand how much of their data will remain private and whether any of their information will be sold or shared. ///