Sustainable Agriculture Programs Driving Carbon Markets

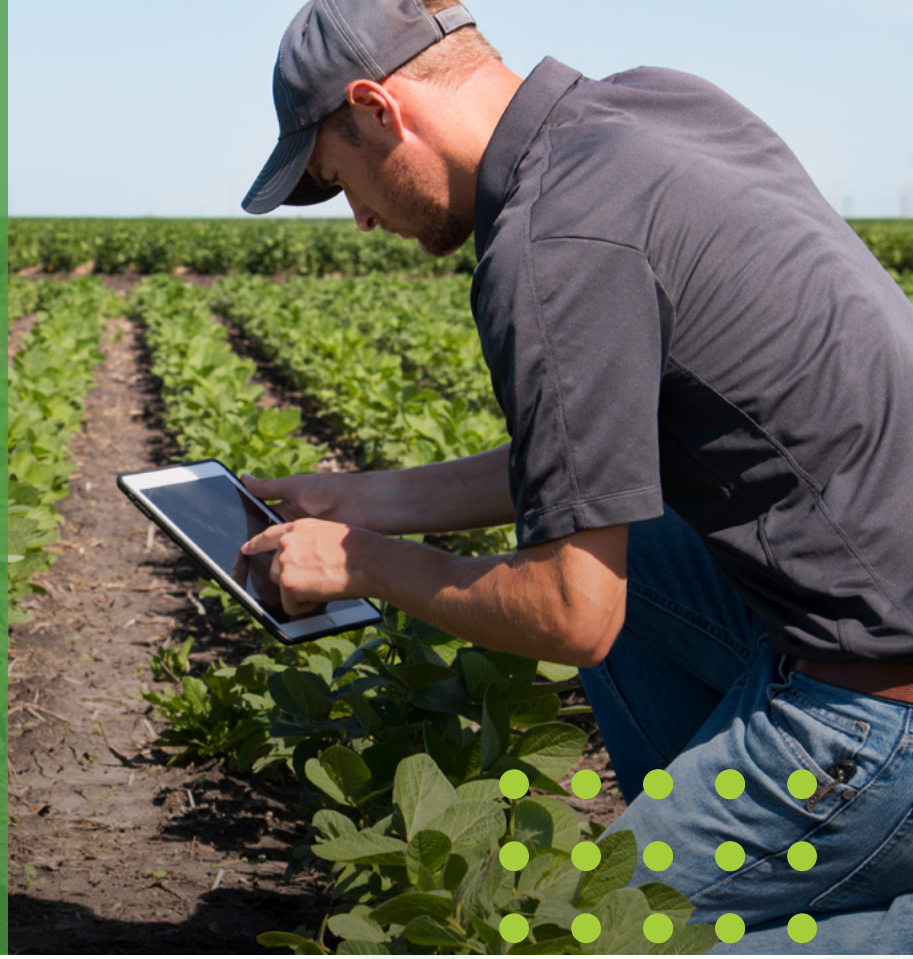
Nutrien® Ag Solutions™

April 2022

The results are in from over 540,000-acre North American sustainable agriculture pilot programs - and the experts on the ground have a message to share.

Sustainable and productive agriculture requires whole-acre solutions and carbon markets play a role in the future of agriculture. This isn't new, but it's critical in feeding the world's growing population with the same amount or even less resources.

However, the carbon market and protocols for agricultural systems remain immature and need to continue to evolve following a science-based and practical approach to scale the industry's positive global impact.



WHOLE-ACRE SOLUTIONS

Farming is complex. There is no easy, one-size-fits-all answer. Every farm is different because every acre is unique, and solutions need to be tailored to meet the specific environmental needs of local geography, climate, soil and agricultural market. Whole-acre solutions begin with strategic field planning, sometimes years in advance, followed by precise application of crop inputs (such as fertilizers and crop protection products) during the growing season, and end with measurement to quantify results and analytics to inform the next season's program.

Whole-acre solutions can improve soil health, protect natural carbon sinks, increase soil carbon sequestration, optimize nutrient-use efficiency, and retain water while conserving and restoring biodiversity. As a result, crop yields may increase, which further builds soil organic matter and reduces the pressure to convert additional land to food production.

CARBON MARKETS:

Voluntary carbon markets have been in the process of development for more than ten years. Recently, many organizations from the agricultural supply chain have been developing programs for growers to measure and verify carbon credits. However, with these opportunities, comes challenges for growers and for those wanting to purchase carbon credits.

Voluntary Carbon Markets Explained:

In a **voluntary carbon market**, trading is on a voluntary basis, but still structured with verified credits.

As crops grow, carbon is sequestered into soil and with improved management of nitrogen inputs, there is an opportunity for growers to also measure, track and verify emissions reductions. Both carbon sequestered in the soil and emission reductions qualify as carbon credits, which may be purchased by other parties to offset their own greenhouse gas emissions (carbon offsets). Whereas carbon insets are when an organization invests in sustainable practices within its own supply chain to reduce its own emissions.

TAKING ACTION

Nutrien is the world's largest provider of whole-acre crop inputs and services, playing a critical role in helping growers increase food production in a sustainable manner.

The greatest asset we have are the people at Nutrien who work to understand the individual challenges our growers face in order to design and deliver solutions. Through our retail business, Nutrien Ag Solutions, we have approximately 3,900 agronomists and field experts ("crop consultants") working directly with over 500,000 growers from over 2,000 global locations in 13 countries.

In 2021, Nutrien released its Feeding the Future Plan – a strategy to help drive sustainability forward in our operations and in the agriculture industry as a whole. The plan intends to drive systemic change and lead the next wave of agricultural evolution. Within this plan are several 2030 commitments, one of which is to **enable growers to adopt sustainable and productive agricultural products and practices on 75 million acres globally. Nutrien also launched and is now scaling a comprehensive carbon program.**

Carbon programs are the hot topic in the agricultural value chain these days. Nutrien is uniquely positioned to help implement and advance one of the industry's most comprehensive carbon programs, with the goal of delivering verified, high-quality carbon assets for both voluntary and regulated carbon markets. Nutrien considers the entire value chain and with its extensive global network, has strategically designed a scalable, science- based approach that works directly with growers, suppliers and downstream partners.

>500,000
Grower Customers

13
Countries

~3,900
Agronomists and Field Experts

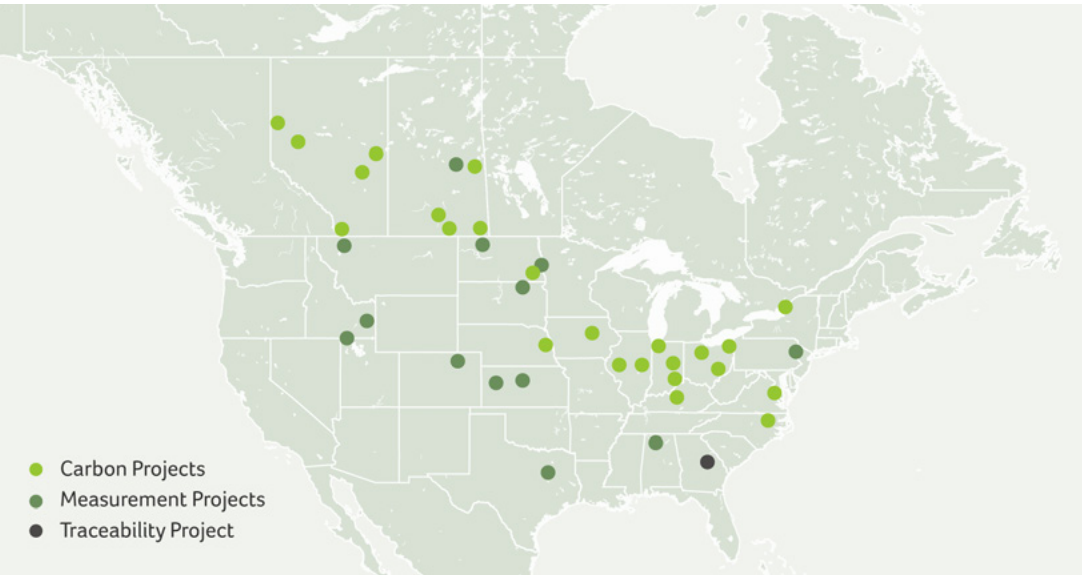
>2,000
Retail Locations

SUSTAINABLE AGRICULTURE PILOT PROGRAMS

Nutrien's carbon, traceability and measurement programs include partners across the agricultural supply chain to build connections and drive farm productivity, profitability, and natural resource management.

With our sustainable agriculture programs, Nutrien is creating input strategies that increase grower profitability while improving and measuring environmental outcomes.

Nutrien's 2021 Sustainable Agriculture Program Locations



~545K
Acres Enrolled/Tracked

22
Projects in 15 US States and 3 Canadian Provinces

14
Supply Chain Partners

What is a sustainable acre?

Click here to find out!

Nascar driver, Jeb Burton visits with a North Dakota, US grower to discuss the parallels between agriculture and racing. While not all seasons end with a trophy, it's the drive to succeed and make a difference that keeps them coming back for more.

Read more in our
2022 ESG Report

KEY LEARNINGS FROM PILOT PROGRAMS

Nutrien has the products, practices, and services to increase soil carbon sequestration, but challenges remain for grower participation in carbon markets. Grower eligibility, data availability and quality, and cost to participate are the top three challenges identified.

The agriculture sector has always had a deep commitment to environmental stewardship. Growers rely on the land, air, and water to support their operation and livelihood. There is great pride in each and every harvest, which is only possible through a balance of prosperity, social and environmental factors.

While grower participation in carbon markets appears simple in theory, we have seen complex layers of requirements, costs, and returns on investment that inform how and if a grower will make a practice change in the field. Change often occurs more efficiently when the grower works with a trusted advisor, such as a crop consultant.

Historically, much of the interaction between a crop consultant and a grower was based on the best price and a volume of product. Today, Nutrien Ag Solutions crop consultants work with growers on whole-acre solutions such as precision agriculture, nutrient management, environmental farm plans, and integrated pest management. These efforts may result in soil testing, tissue testing, yield monitoring, crop scouting, and the use of digital tools for in-field management (satellite imagery, sensors, drones and more). Ultimately, the goal is to help growers determine the best mix of products, practices, and services to optimize crop yields while balancing economic, social, and environmental pressures.

The three most commonly discussed practice changes for sustainable agriculture programs, including those that can potentially generate carbon offsets or insets, are nutrient management, reduced or no-till, and cover crops.

Nutrient Management: Plant nutrients increase crop yields and plant biomass, which helps build soil organic matter. Nutrient management involves determining the Right Source of plant nutrients at the Right Rate, Right Time and Right Place ("4Rs") to optimize the efficiency of nutrient use and minimize environmental impacts. Each "R" requires thoughtful consideration. For example, the Right Source of nitrogen evaluates liquid, solid, gas, and enhanced efficiency products like slow-controlled release fertilizers and nitrification or urease inhibitors (which varies depending on the market the grower lives in and the demand for the product). The performance of enhanced efficiency products will vary depending on climate and geography.

Image courtesy of The Fertilizer Institute

Reduced or No-Till: Reduced till or conservation tillage means the grower minimizes tillage to reduce soil compaction, leaving at least 30 percent crop residue on the soil surface. No-till farming means the grower does not till and leaves all crop residue on the ground. The goal for both is minimal soil disturbance and increased organic matter left on the field.

Cover Crops: Cover crops can cover the soil as suggested by the name. They are a useful conservation practice for controlling erosion, adding nutrients, like nitrogen, in the soil after the cropping season, building soil health, and sequestering carbon.

Growers and crop consultants need to discuss if cover crops fit in their management system, the type of cover crop to plant such as grass, legume, multi-species mix (legume, grass, and radishes), or small grains (winter wheat or rye). A large part of that decision is the availability of seed in the geography, as cover crop seed is often locally sourced and limited in supply. An important part of the effectiveness of cover crops is good establishment, and good establishment is directly related to seeding method. However, timing of crop harvest can limit options as to how a cover crop can be seeded, as well as if a grower is practicing reduced or no-till. Direct seeded cover crops will generally have the best germination and establishment, but seedbed preparation can be a challenge following the harvest of row crops.

Following establishment and growth, growers must decide how long the cover crop will be allowed to grow and how it will be terminated before the next crop is planted. Cover crops are terminated from the field to limit the competition for nutrients and water with the primary crop. Cover crops can be terminated with tillage, harvest, grazing with livestock, or harvest as a forage or grain.

The more biomass that is grown, the more potential there is for the amount of carbon sequestered, erosion controlled, and runoff and nutrient loss reduced. The whole benefit can take three to five years to see results in the field. In addition, adding cover crops increases the grower's costs, management complexity, time and labor requirement with decisions around how the cover crop is removed from the field (sprayed, tillage, or harvest), how the following crop is planted, and the availability of nutrients in the soil.

DID YOU KNOW?

*The concept called **Regenerative Agriculture** ("RA") is receiving a lot of attention as well. Food companies are subscribing growers to specific sets of practices, such as cover crops and thereby trying to differentiate foods produced with regenerative agriculture labeling. RA is being promoted as a solution to various agricultural production issues, as well as a solution for many of the environmental and social risks associated with crop and animal production. However, with the many benefits claimed for regenerative agriculture, come many questions. Scientific studies validating the claims are often lacking - some claims are extraordinary and defy our knowledge of soils. Indeed, some proponents say RA systems don't fit our existing knowledge of soils and new research is needed to understand regenerative systems, validate claims, and quantify actual benefits. Many of the answers are likely highly specialized to a specific environment, cropping system, and management schedule. Dr. Alan Blaylock, Nutrien Director of Agronomy, offers food for thought for those exploring RA practices. Read more here.*

ADDRESSING CHALLENGES

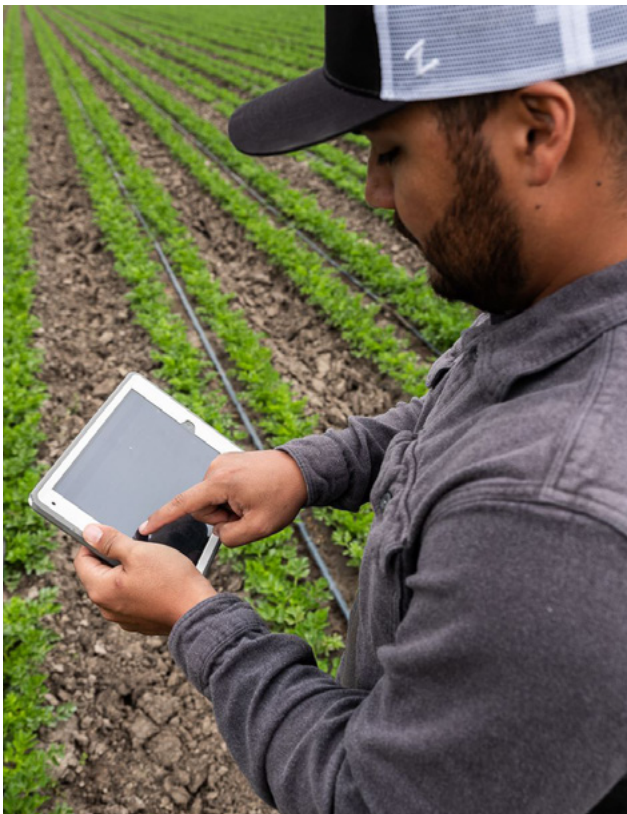
It is challenging for growers to navigate all available carbon and sustainability opportunities, especially with the frequent release of new programs. Currently, there are at least 13 carbon or sustainability offerings available to growers in the US from a variety of companies, including Nutrien.

Through discussion with growers regarding Nutrien's sustainable agriculture programs, we have identified three priority challenges:

Grower Eligibility: Two of the most common words used in carbon market discussions are **additionality and permanence**.

- **Additionality:** When carbon registries, markets, and buyers are interested in credits generated from practices that would not be implemented in the absence of a carbon market offering and those practices will provide a permanent sink of carbon, this is called, 'additionality'. Additionality represents a challenge in generating carbon credits from agricultural practices because many growers are interested in participating in the marketplace are early adopters of conservation practices like nutrient management, reduce or no-till or cover crops. While carbon can still be sequestered from these practices, buyers are looking to show that the implementation of a carbon market is the cause for the practice implementation. This generally gets communicated to growers as a need for a "new" practice in the field that will increase carbon sequestration or reduce carbon-related emissions. Unfortunately, this leaves many early adopting growers out of the current markets because there may not be any new, or potentially only small practice changes that they could make that would generate a positive return for them.

- **Permanence:** Permanence is when credits are generated only from carbon that will be removed from the atmosphere for a period roughly equivalent to the life of a CO_2 molecule in the atmosphere. This can be up to 100 years. Permanence is a challenge in the agricultural landscape for many reasons such as land ownership, reporting timeline for ensuring the practice stays in place, and the impact of other environmental conditions on practice continuation.



Data Collection and Management: A key element to the implementation of carbon markets or sustainability programs is setting baselines to show continuous improvement in a field and across the industry. Without a baseline for level of practice implementation or practice change in a field, there is no ability to show progress. Programs can be scaled more quickly when a baseline is available for use.

There are two challenges to baselines for agricultural land programs: **data availability and quality**. Baselines can be set at a grower or field level, but if the grower does not have the required amount of data to set the baseline, they may not be able to participate, even if they are adding a new practice. Second, the publicly available data for setting baselines is often dated and inaccurate for comparing current infield practices. For example, data on nitrogen application rates that can be collected from survey methods in the US, when compared to current infield practices, are often much lower or much higher than agronomic recommendations or actual implementation in the field.

Demonstrating continuous improvement and generating credits are data heavy processes. Depending on the program a grower is enrolling in, there are large variations in the amount of data the grower will be required to submit. For some programs, growers may need to supply five years of field history and five years of crop planning. Growers today are on a wide spectrum of data collection and management, from handwritten records to full digital collection of every field operation. Although digital data collection may be more convenient, if ill-managed, it will not be of adequate accuracy required to meet the needs of a sustainable agriculture program. A critical piece to the expansion of agricultural carbon markets will be improvements in data collection, management, and transfer.

DID YOU KNOW?

Agricultural carbon credits are generated based on ***modeled outcomes*** *or the use of emissions factors that were modeled based on expected practices and practice changes. Challenges to modeled outcomes include:*

- *A lack of data available to calibrate models for a wide geography and a wide variety of crop types*
- *A lack of accepted models in the marketplace (currently there are only two available)*
- *The expense of model runs makes it restrictive to update outcomes as grower data changes due to environmental conditions.*

Cost to Participate: Changes in nitrogen management, tillage, or cover cropping can come with additional costs. Improved nitrogen management may be achieved by splitting nitrogen applications throughout the growing season to improve nutrient uptake. This may require a grower to invest in the proper equipment for in-season applications. Tillage changes can require alterations in how weed or pest control is implemented, or the use of planting equipment that works with a less prepared seedbed. Over time there may be economic and environmental benefits to cover crops; however, there are additional implementation costs such as seed and termination.

Soil sampling is a valuable tool for grower's nutrient management plan; however, carbon programs require more than what is commonly needed. Soil sampling to determine the baseline soil organic carbon content and to verify the carbon that was modeled to be sequestered is an additional cost. Variability in the soil organic carbon within a field requires a high density of samples to be taken per acre to have the most accurate estimate for the field. Further, the type of soil sample needed for soil organic carbon (2" by 12" soil core) versus common soil samples for nutrient recommendations (5/8" x 8" soil core) results in an additional soil sample that has little or no use for general field management. The cost of collection and analysis of soil samples that can only be used for generating a carbon credit can be restrictive to growers and program developers looking to participate, ranging from $6 to $15 USD per acre, based on Nutrien Ag Solutions' sustainable agriculture programs.

MAXIMIZING OPPORTUNITIES

While there are challenges and obstacles to enrolling and generating verified carbon outcomes with growers, there are economic and environmental benefits for the grower. Benefits may include improved record keeping, increased adaptive crop management, and over-time, improved soil health and crop production.

Management changes that fit additionality and permanence requirements can also have whole-acre benefits such as improved nutrient-use efficiency, better return on the use of inputs in the field, crop production increases, improved water quality, and overall improved soil health and function. These additional benefits of enrollment in a carbon-based program should be captured and reported to show the overall progress in environmental impacts and not just carbon reductions or removals.

To address reporting and data challenges, Nutrien offers technological guidance through its Digital Hub, which provides historical and real-time information, grower-specific analytics and performance measurements to help growers make informed decisions.

The demand for precision agriculture is on the rise; this is an exciting time for the industry as these new advances in technology can have a tremendous impact on both sustainability and farm profitability. We can gather, mine, and disseminate data like never before, allowing us to make decisions to optimize every acre. This means growers can manage their operations and invest in inputs to help them do more with less. This also means less waste and helps ensure the land gets exactly what is needed - when it is needed, without sacrificing yield so we can continue to feed a growing world.

CONTINUE TO SCALE

Global food security and addressing the impacts of climate change are interconnected challenges. Through on-the-ground support for farmers and advancements in sustainable and productive agriculture programs, the industry will continue to evolve and grow.

Nutrien is striving to take a whole-acre approach with growers to address resource concerns and report on environmental outcomes.

We will look to expand our sustainable agriculture programs in North America with a primary focus on nitrogen management practice improvements, resultant emission outcomes, and continuing to incubate scalable options for soil carbon sequestration. We also plan to establish pilot acres in South America and Australia.

We are focusing on five key components:

1. **Grower Engagement and Whole-acre Solutions:** In 2021, we conducted multiple program pilots in the US and Canada enrolling and tracking approximately 545,000 acres. We also partnered with key accounts to build and scale program functionality through collaboration. Our sustainability solutions pilots began in 2019 and continue to engage growers in determining and incentivizing optimal practices, products and services.

2. **Digital Hub Development:** The Nutrien Ag Solutions Digital Hub includes a grower-specific "toolbox" with features like streamlined and organized grower-approved and provided data, annual field planning sustainability analytics. We primarily use our Agrible sustainability platform to track and measure the results growers share.

3. **Value Chain Partner Outreach:** We have broad partner outreach with strategic suppliers, downstream partners, non-governmental organizations (NGOs), academic institutions, governments and execution partners.

4. **Methodology:** Carbon credits will be generated using existing and developing protocols to independently verify and validate carbon performance, leveraging proven agronomic modeling and soil sampling methods to generate high-quality credits.

5. **Carbon Credit Transaction and Market:** Our intention is to create high-quality carbon credits that can be monetized in voluntary and compliance markets. The agriculture industry needs a framework for measuring the success of its emissions-reduction initiatives. For carbon, Nutrien is working to build that framework by advancing a low-carbon certification scheme, which aims to create a universally recognized standard for low-carbon ammonia products to support pricing, market transparency, verification and boost confidence around emissions claims.

No one company, no single government and no standalone framework of regulations can effectively tackle food security and climate action alone. Only by working together can we make the meaningful changes needed to preserve our planet for future generations.

Join us on this journey.

Podcast

Hear from agricultural experts about what's happening in the field to advance sustainable agriculture.

ABOUT NUTRIEN

Nutrien is the world's largest provider of crop inputs and services, playing a critical role in helping growers increase food production in a sustainable manner. We produce and distribute around 27 million tonnes of potash, nitrogen and phosphate products world-wide. With this capability and our leading agriculture retail network, Nutrien Ag Solutions, we are well positioned to supply the needs of our customers. We operate with a long-term view and are committed to working with our stakeholders as we address our economic, environmental and social priorities.

Learn more: **https://www.nutrien.com/sustainability**