

REGENERATIVE AGRICULTURE FINANCING PROGRAM

Results of the 2022 pilot



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INTRODUCTION

The Regenerative Agriculture Financing, also known as RAF, program was launched in January 2022 by Farmers Business Network in collaboration with Environmental Defense Fund. The 2022 pilot year of the RAF program involved 48 corn, wheat and soybean farmers interested in gaining access to lower interest rates on operating loans upon achieving standards for soil health and nitrogen (N) management practices.

A major barrier to developing financial solutions that support regenerative agriculture is the lack of farm data connecting farms' financial and environmental performance. Agricultural lenders, who are farmers' closest financial partners, typically do not collect financial information about the connection between regenerative practice adoption, financial performance and risk associated with their loans.

59% of agricultural lenders expect climate change-driven business opportunities, including increased demand for new financial products and services.

Emerging from the desire to recognize the positive long-term financial value of regenerative farming in financing, the RAF program was developed to benefit farmers, agricultural finance providers, and the environment. A global survey of agricultural finance institutions shows that 59% of agricultural lenders expect climate change-driven business opportunities, including increased demand for new financial products and services.¹ This stems from expressed interest from farmers in financial tools that enable them to adapt successfully to climate change. As an example of that demand, a 2021 market research study reported that half of responding Iowa farmers were interested in transition loan products that would support them in adopting soil health practices.² Despite this interest, such financial solutions are in a nascent stage with few examples currently in the marketplace.

Absent this information, it is challenging for farmers and their lenders to appropriately target financial solutions that navigate the financial transition to regenerative practices or recognize the superior financial performance and resilience of long-term practitioners of regenerative agriculture.

Established in 2014, FBN® aims to be an unbiased and farmer-centric information hub. Among several businesses, FBN includes Gradable®, a farm data platform that provides sustainability metrics, and FBN Finance, which offers traditional farm financial products such as loans for farmland and operating expenses. FBN's ability to connect environmental and financial data through its farm management platforms provides the foundation of the RAF program.

The RAF program is one of the first U.S. agriculture financing programs to reward farmers who meet specified environmental standards for regenerative agriculture. The environmental standards are paired with the farmer's operating line of credit, which farmers typically renew annually and use for common expenses such as seed and fertilizer. Upon completing their loan repayment, implementing soil health practices and operating with an efficient level of N fertilizer,³ farmers in the RAF program are rewarded with an incentive equal to a 0.5% reduction in their operating loan interest rate. The investment approach showcased in the RAF program has the potential to be scaled across millions of acres because it is embedded in the financial products commonly used by the majority of farmers.

In the pilot year, FBN and EDF sought to learn about the efficacy of the RAF program and farmer participants' experiences to inform its development and future expansion. Some of the key questions for the pilot included whether farmers would be interested in enrolling, the farmers' ability to meet the environmental standards in order to receive the rebate, and additional insights on the relationship between farms' environmental performance from the analysis of the pilot data.

This report serves as a concise overview of the observations and outcomes derived from the first year of implementing the RAF program.

The investment approach showcased in the RAF program has the potential to be scaled across **MILLIONS OF ACRES.**



PROGRAM STRUCTURE

A collaboration between FBN and EDF



EDF and FBN share common goals of connecting the environmental and financial performance of farms, integrating farm financing with practices that reduce climate impacts and build resilience, and maximizing farmers' profit potential with the help of technology and data transparency.

FBN is a technology platform specializing in helping farmers optimize their profits through technology and transparent data. Their finance division makes it easy for family farmers to finance their operation for the next generation through loans, operating lines, farmland capital, input financing and more. FBN's Gradable platform enables data collection at scale with proprietary technology and uses an open-source platform to validate the use of several regenerative practices. In the RAF program, FBN brought these two capabilities together to link farms' environmental performance, tracked through Gradable, with an operating line and rebate program administered by FBN Finance.

EDF developed the environmental standards that must be met for RAF eligibility and advises FBN on implementing those standards, performing data analysis, and making any adjustments to the standards needed to achieve the desired outcomes.

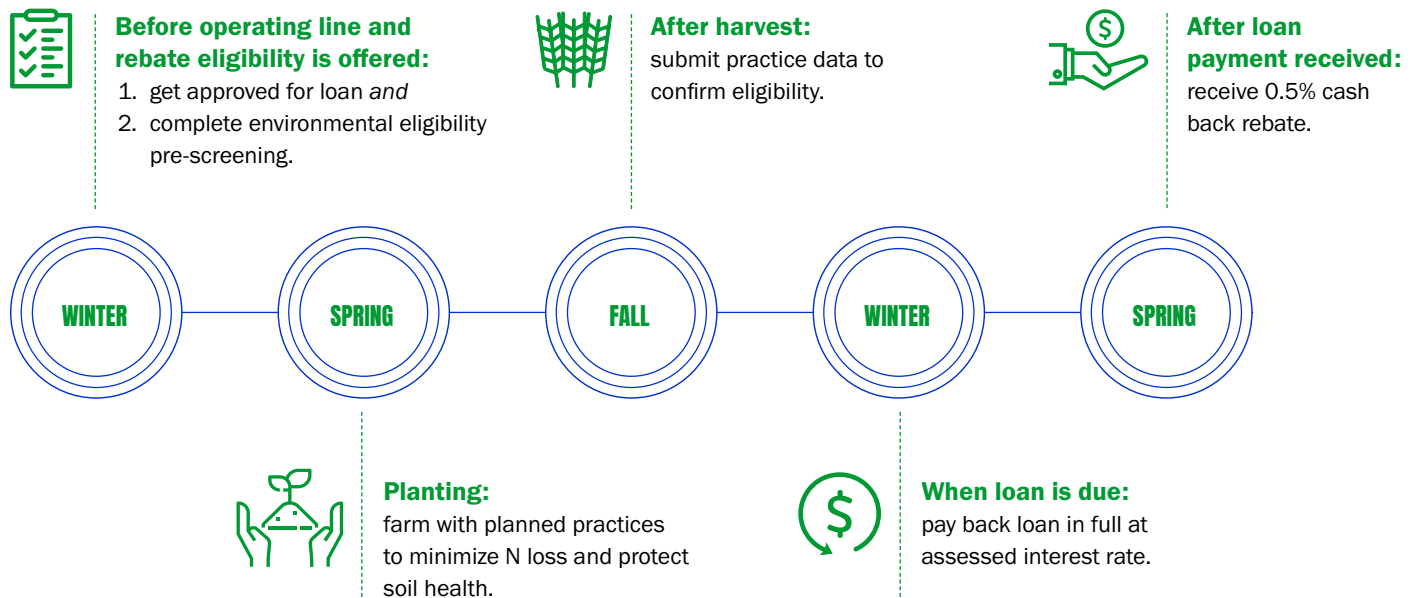
Regenerative Agriculture Financing program and environmental standards

The RAF program launched in January 2022, providing \$25 million in annual lines of credit to eligible farmers. Farmers can use the RAF program operating line for all their typical operating expenses, such as seeds and fertilizer, and are not required to purchase inputs from FBN to participate. To receive the rebate payment, farmers had to meet environmental standards for N management and soil health practices. Figure 1. presents the annual timeline for the program.

Farmer eligibility for the RAF program is based on meeting the environmental standards above and does not require the farmer to adopt new conservation practices. Both farmers who are currently meeting the standards, and farmers who improve their practices to meet the standards, can equally participate in the RAF program. This is a different approach from many existing conservation incentive programs that require new practice adoption for participation.

Additionally, participating farmers retain ownership of quantified environmental impacts and therefore have the flexibility to combine RAF with other financial incentive programs as long as permitted by the other program's requirements.

FIGURE 1. Annual timeline for RAF program.



Environmental standards for the RAF program

1 Eligible crops: corn, wheat and soybeans.

2 Nutrient efficiency, measured by N balance: 80% of farmed acres achieve an N balance score between 25–75 lbs N/acre on a three-year average.

A three-year average cannot be calculated in the first year of the pilot, so the nutrient efficiency standard was modified to require 80% of the farmed acres to achieve an N-balance score between 0–100 lbs N/acre and/or a Nitrogen Use Efficiency (NUE) score ≤ 1.2 lbs N/bu.

3 Soil health practices: on at least 70% of farmed acres, farmer utilizes one or more of the following practices:

- Ground is minimally disturbed (e.g., reduced tillage or no-till).
- Crop rotation has live roots (e.g., cash crop, cover crop, or perennials) in the soil for at least 70% of the year.
- Other regionally appropriate regenerative practices outlined by the NRCS (e.g., riparian buffers or windbreaks) and approved by the program.

4 Evidence of soil sampling: show evidence of soil sampling per 10-acre density in at least 1 of the last 4 years and use soil sampling to inform fertilizer application rate.

Application of the nutrient efficiency standard: minimizing climate and water quality impacts

Nitrogen is an essential element for feeding and providing clothing to the global population of eight billion people and is commonly introduced to farm fields through commercial fertilizer, manure, and/or leguminous plants. However, imbalances of N can lead to severe consequences. Insufficient amounts can reduce crop yields, whereas excessive N can accelerate climate change and contribute to the degradation of water and air quality.⁴

The N balance framework developed by EDF and research collaborators offers a scientifically sound approach for food and agriculture companies to measure and monitor N levels, determining when it is excessive or optimal. Numerous scientific studies have identified and confirmed N balance as the preferred metric for gauging the environmental risks associated with N loss.⁵

Nitrogen balance is calculated as the N added to a farm field, subtracting the N removed during harvest (Figure 2). Residual N can be lost to the atmosphere as nitrous oxide, a potent greenhouse gas 300 times stronger than carbon dioxide, or to water as nitrate. This contaminant can adversely affect both the ecosystem and drinking water. Excess N not taken up by the crop also represents a wasted cost to farmers. For two key reasons, N balance is a valuable qualifying metric for financial incentive programs. First, this practical approach focuses on variables that farmers can control and is calculated with minimal data that is easy for farmers or their advisers to report. Second, when a program collects data from a sufficient number of fields, N balance can be used to quantify climate and water quality outcomes in the form of nitrous oxide emissions and nitrate losses. This is an essential distinction between N balance and NUE, another widely used metric of N use.

The ideal N balance score should fall within the range of 25–75 lbs N/acre, which is considered a “safe zone.” Staying within this range allows farmers to optimize yields, use N additions efficiently, protect soil health, and minimize N losses to the environment.

FIGURE 2. The N balance calculation.



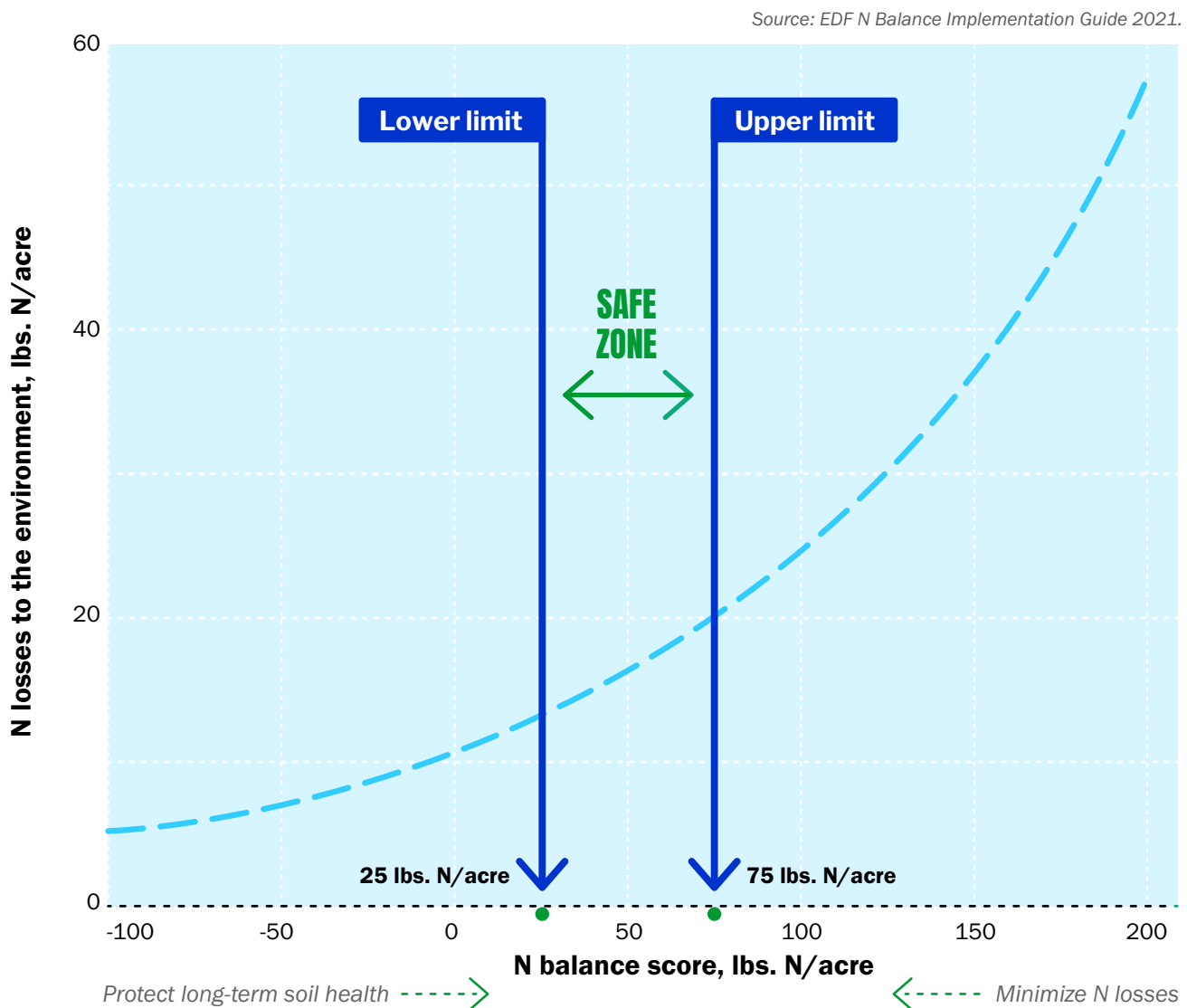
As seen in Figure 3, as N balance scores increase beyond 75 lbs N/acre and leave the safe zone, there is a significant increase in the risk of N losses to the air as nitrous oxide and to the water as nitrate.⁶ At this point, the crop does not require or use the extra N added. Therefore, staying below the upper limit helps to minimize N losses to the environment while efficiently using the added N without compromising productivity.

It is important to note that N losses to the environment increase exponentially as the N balance exceeds the safe zone by a larger margin. For this reason, while the N balance concept is a useful goal for farmers

to minimize environmental loss, there is also a substantial difference in environmental outcomes when comparing an N balance just above the safe zone to a much higher score.

On the other hand, N balance scores that fall below 25 lbs N/acre indicate that the applied N from external sources may be insufficient to replace the N that is mineralized from the soil and utilized by the crop during the growing season. If the plants rely on N mineralized from soil organic matter that is not replenished, it can lead to long-term damage to soil health and reduced productivity.

FIGURE 3. The N balance safe zone.



Modifying the nutrient standards to accommodate a single year of data

Scientific research finds that analyzing the average N balance over multiple years for a field effectively demonstrates the effects of management practices.⁷ However, the N balance can fluctuate every year for each field. For this reason, EDF recommends using a three-year average when quantifying N balance data and outcomes. In the 2022 pilot year of the RAF program, farm data from just one year were collected. This meant that the environmental standards qualifying farmers for the rebate needed to be adjusted to avoid disqualifying farmers likely to fall within the N balance safe zone over a three-year average.

EDF analysis using this information and basic statistics determined that a field in a safe zone range between 25 and 75 lbs N/acre for a three-year average could have individual-year values between 0 and 100 lbs N/acre. The acceptable N balance zone was thus expanded to this broader range when only one year of data is available.

In addition, EDF and FBN incorporated NUE as a program eligibility criterion to provide another measure of farmers' N use. For corn and wheat in this program, NUE was calculated as pounds of N fertilizer per bushel of grain yield (lb N/bu). Trials conducted in

the 1960s and 1970s found that corn needed no more than 1.2 lbs N/bushel, leading to a general rule of thumb still accepted in many states that "1.2 is the most [we] should do".⁸

With only one year of data available for most participating farmers, including NUE less than 1.2 lbs N/bu corn as a secondary evaluation measure helps tell the story of the relationship between this well-known measure and the more recent N balance metric. Some farmers who fell slightly outside (above) the N balance safe zone were within a reasonable range of NUE and have a good chance of achieving an N balance within the safe zone once three years of data are available. This broadened evaluation criteria allows these farmers to continue working within the program, advising the data collection and feedback process for adaptive improvement.

In summary, FBN and EDF extended the N use criteria in the pilot year to an N balance range of 0–100 lbs N/acre and/or a NUE score less than or equal to 1.2 lbs N/bu corn. As the program continues and more data are gathered, it is likely that the average N balance score for participating fields will fall within the N balance safe zone of 25–75 lbs N/acre. At that point, and with an improved understanding of the relationship between NUE and N balance, the modification that added NUE should no longer be needed.

N balance application to soybeans

Soybeans are legumes that fix N from the atmosphere into a plant-usable form. The total amount of N fixed by soybeans through this process can vary depending on N left over from the previous crop.

Nitrogen management standards for soybeans are in a nascent stage of development and need to be more well-defined, due to limited research data on nitrate and nitrous oxide losses from soybean. Therefore, while data were collected from soybean acreage, soy fields were not scored with the N balance criteria. EDF scientists are collaborating with university researchers to improve their understanding of the appropriate N balance safe zone for soybeans and how that translates to climate and water quality outcomes.

There is some evidence that nitrate and nitrous oxide losses during the soybean phase of a corn-soy rotation are generally lower than those of corn.⁹ This is because most soybeans obtain the majority of their N from biological fixation, providing the ammonia and nitrate (high-loss-risk) forms of N over time as needed by the plant in contrast to larger doses from fertilizer. The major risk for N loss in soybeans is after the leaves have fallen, during a period when no roots are growing. In addition, losses of nitrate and nitrous oxide tend to be lower for corn that follows soybean when compared with corn following corn. This is because the corn in rotation can make use of the N left behind by the soybeans, reducing the need for fertilizer and often increasing corn yield, both of which would contribute to a lower N balance score.¹⁰



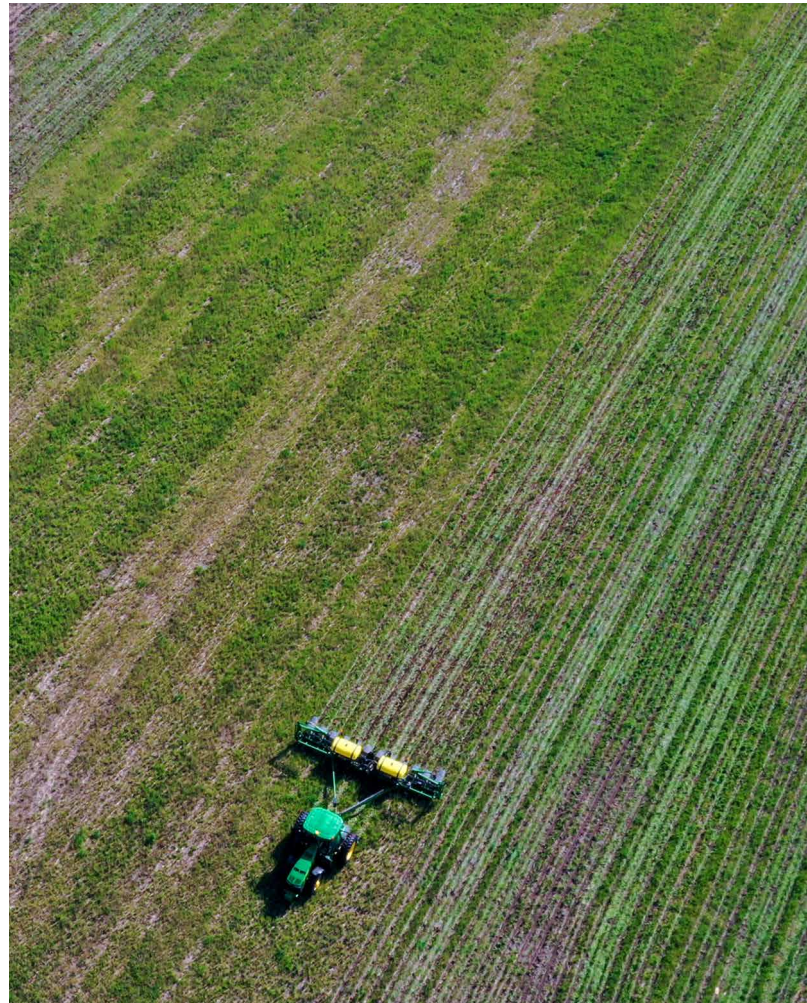
Application of the soil health standard: increasing resilience of crop yields

In addition to the nutrient management standard, farmers were required to meet a soil health standard. The soil health standard developed for the RAF program requires that the farmer uses one or more of the following practices on at least 70% of farmed acres: the ground is minimally disturbed (strip-till or no-till); crop rotation has live roots (cash crop, cover crop, or perennials) in the soil for at least 70% of the year; and/or other regionally appropriate soil conservation practices.

The benefits of cover crops include preventing erosion and nutrient runoff, improving soil microbial activity, and increasing soil water-holding capacity and soil organic matter. Similarly, decreasing or eliminating tillage passes improves soil structure and water filtration/drainage. It enhances the retention of plant-available water, improves microbiological activity and reduces machinery emissions.¹¹

Improved soil health and structure can reduce damage to crop yields following excess rain, an important factor in mitigating risk to farms and building long-term resilience.

For example, a study by the Meridian Institute and economists at the University of Illinois analyzed USDA data following the large rainfall events of 2019. They found that fields with cover crops and no-till had a 24% lower odds ratio to be declared “prevent plant” and receive an insurance payment.¹²



Studies on the connection between soil health practices and crop yield resilience are critical to show that farms implementing soil health practices are at lower risk than farms using conventional practices. Such data is important both for crop insurance and agricultural finance. As this body of evidence improves, agricultural finance providers will be able to link farm risk to loan pricing and interest rates more explicitly.

Finally, while the RAF program does not quantify soil carbon sequestration, cover crops may also be able to increase soil organic carbon in several ways. While growing, they pull carbon dioxide from the atmosphere and convert it to biomass, and after termination, the plant residue and roots decompose into soil organic matter.¹³ In addition, the improvements to soil structure provided by the root systems of the cover crop helps prevent soil organic carbon loss.

Data collection and analytics

Collecting and reporting data can be challenging for farmers and is often a significant entry barrier for many existing sustainability programs. To address this, the RAF program was designed to reduce the amount of self-reported data required from farmers. Farmers often also have concerns about data privacy and how data will be used. All data gathered by FBN, including that of the farmers in the RAF program, is anonymized and aggregated for privacy.

Farmers participating in the RAF program enter data into FBN's Gradable platform. The information necessary to calculate N balance includes crop type and field area, N fertilizer inputs, and N removed (calculated through yield and stover removal). Additional data collected includes N fertilizer management practices, tillage type and timing, planting date, pest management, field history and climatic and geographic identifiers. Farmers can enter data themselves or choose to share details with FBN's team over the phone. However, whenever possible, data collection is automated. Field boundaries are uploaded via John Deere Link or FHA records, and Google Earth Engine satellite imagery is used by FBN to validate reports of cover crop usage, field burning and other practices.

Gradable improves the accuracy of shared data in several ways. Firstly, the system verifies that the contributed data aligns with the intended information, detecting unexpected details like excessive or insufficient application rates and confirming if they align with the grower's intentions. Secondly, the software layers in third-party data and remote sensing to both add context to grower outcomes and visually identify practices. In cases where doubts persist regarding the accuracy, growers have the option to submit additional documentation, such as

crop insurance reports or commercial receipts for applications, to increase the reliability of the reported data and measured results. Finally, program data errors are minimized by collecting data at the field and subfield level to evaluate impact at a program level.

Gradable provides analytics back to growers to help them understand both how their practices compare to peers and the potential range of agronomic and economic outcomes for the adoption of new practices. FBN's approach allows a grower to see both regional recommendations, such as local university application recommendations, as well as comparison results for fields with similar characteristics.

Overlaying the economics of input changes and potential yield impacts helps provide the full picture for growers to make business changes that align with improved environmental outcomes.

This analysis, while incorporating more traditional environmental practices such as fertilizer efficiency and cover crops, also includes more core agronomic decisions such as seed selection, seed spacing, and input type which can also greatly impact productivity per working acre. Farmers looking for insights from Gradable are incentivized to enter accurate information because the value of agronomic guidance coming from the system is directly related to the quality of data entered into the platform.

RESULTS

Farmer enrollment

FBN tapped into their U.S. network of over 60,000 farmer members, covering over 100 million acres, to promote the RAF program operating loan. The marketing effort started by contacting farmers who had previously expressed interest in operating loans through FBN Finance. The program was presented by FBN's experienced team of Sustainability Program Leads to potential candidates within their network, and the response was overwhelmingly positive. The available spots for RAF were filled up quickly, and a waitlist had to be created for an expanded fund.

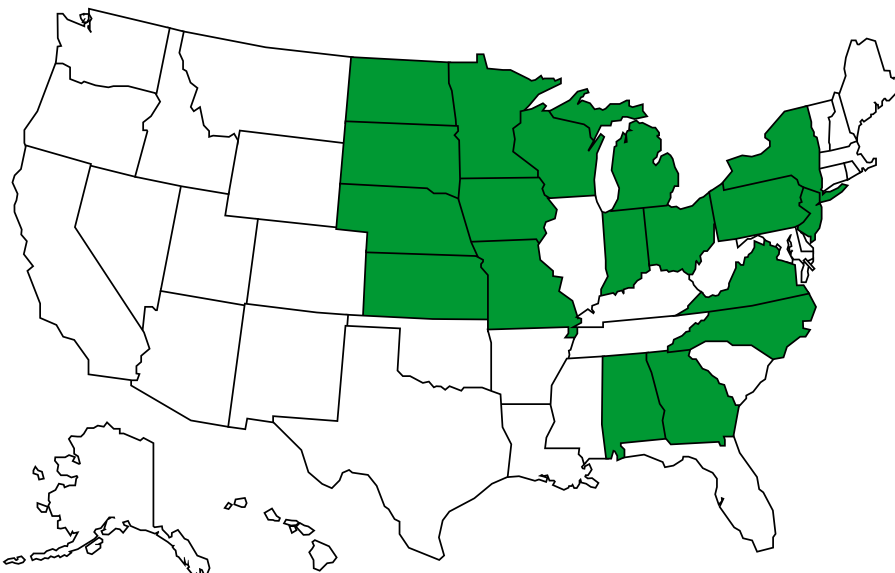
The RAF program turned out to be a resounding success, becoming the fastest-selling financial product ever launched by FBN. A total of 48 farmers across 18 states and over 42,000 acres enrolled in the pilot program. The loans ranged in size from under \$100,000 to over \$2 million, with an average loan size of \$500,000. The enrolled farms averaged over 2,000 acres, with participants ranging from those with under

500 acres to those with over 7,000 acres. The average interest rate was 4.08% before the RAF program discount.

To provide an example of how this incentive translates to dollars per acre, the average farm size enrolled in the RAF program was 2,000 acres, and the average loan size was \$500,000. Assuming an operating loan interest rate of 4.08%, the annual interest cost would be \$20,400. However, farmers typically only utilize 50 to 75% of their operating loan annually. Assuming 50% utilization of the operating loan, the total interest cost would be \$10,200. If the farmer had a 0.5% lower rate of 3.58% due to their participation in the RAF program, interest costs would be lowered to \$8,950 for a total rebate of \$1,250.

Farmers from the following states enrolled in the pilot: Alabama, Georgia, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Dakota, Virginia, and Wisconsin (Figure 4).

FIGURE 4. States with farmers in the pilot year of the RAF program.



The RAF program was the fastest-selling financial product ever launched by FBN.

Overall participation and rebate results

Farmers reported management and yield data from over 700 fields growing corn (43%), wheat (6%), soybeans (46%), and double-crop wheat-soy (4%) in 2022. This represents data collected from nearly 42,000 acres.

Of the 48 pilot participants, **6 of the 48** (12.5%) growers decided to withdraw from the RAF program after signing up and securing an operating loan. In FBN's experience with other sustainability programs, this is a typical level of attrition after sign up.

6 of the 42 participating growers did not complete environmental data collection, meaning only 36 growers have been evaluated for the environmental criteria. This is an area for FBN to examine whether any changes to data collection processes can improve timeliness. Three of the growers submitted their data after the analysis for this report was complete, so they are reflected in the overall participation numbers but not in the detailed data analysis to follow.

30 of 36 (83%) participating growers who completed data collection met the environmental standards and received the rebate payment.

6 of the 36 (17%) growers who completed data collection did not meet the eligibility requirements to receive the interest rate rebate. The majority of growers who did not meet the requirements had less

than 80% of their acres meet the N-balance and NUE criteria. Most of these growers had 40–70% of acres meeting the nutrient efficiency criteria.

FBN provided the farmers who completed data collection but did not qualify for the rebate with 50% of the amount they would have received had they met the standards as a sign of goodwill for their participation in the pilot and providing data. They were advised to contact FBN if they faced exceptional circumstances on their farms that would have impacted their ability to meet the standards, such as a severe weather event. FBN and EDF intend to continue collaborating with the pilot participants and providing them with data-based insights to help optimize nutrient management, enabling them to meet RAF program eligibility requirements in future years.

83%

of participating farmers who completed data submission met the environmental standards and received the rebate payment.

FIGURE 5. Reported management data from pilot participants.



REGENERATIVE AGRICULTURE FINANCE PROGRAM

Rusty Olson is a crop farmer running a diverse operation in Garner, Iowa. Currently, he farms 1,000 conventional acres and 500 organic acres with the goal of ultimately having two-thirds of the operation be organic. Making the gradual move to organic farming is one of many management changes Rusty has been implementing. He has also utilized split applications of nitrogen for several years.

Olson says this prior experience with changing farming practices made FBN's Regenerative Agriculture Financing program attractive to him. In addition, he appreciates how FBN's flexibility allows him to implement conservation practices that work for his specific operation and the fact that the RAF program is outcome based instead of being a program that tells a farmer exactly what they can and cannot do with practices.

The process to apply for the RAF program "was straightforward and simple", according to Olson. Much of it was done over the phone and with a couple of clicks on the computer. Olson has two operating lines of credit with FBN. He borrows at a 3.75% rate for his conventional operation. This line of credit receives a 0.5% discount. He borrows at a 5.16% fixed rate for his organic production. This was not eligible for the rebate program because it was set up after the enrollment timeframe. The operating line of credit with FBN created significant savings from other lenders, who would have charged up to 5%.

Along with the ease of the application process, Olson valued the simplicity of program participation. He collects the information FBN requires, such as planning, spraying and cover crop information, along with yield results by utilizing John Deere Operations Center™ and Climate FieldView™ management



Rusty Olson and his family on their farm.

systems and uploads that information into FBN's system. The prospect of drowning in paperwork had once made Olson leery of pursuing organic farming in the first place. In his experience, keeping documentation and reporting to a minimum is an enormous value to any agricultural producer. Olson describes himself "as a numbers guy." He appreciates being able to immediately see that he is saving money. For Olson, this puts the RAF program above other programs in which realizing and seeing the financial benefits is less clear. In addition, the financial benefits are a result of Olson's dedication to conservation. The RAF program encourages conservation-minded producers to look for even more ways to enhance soil health, improve nutrient management, and increase sustainability. Olson appreciates that FBN rewards his commitment.¹⁴



Crop-specific environmental results

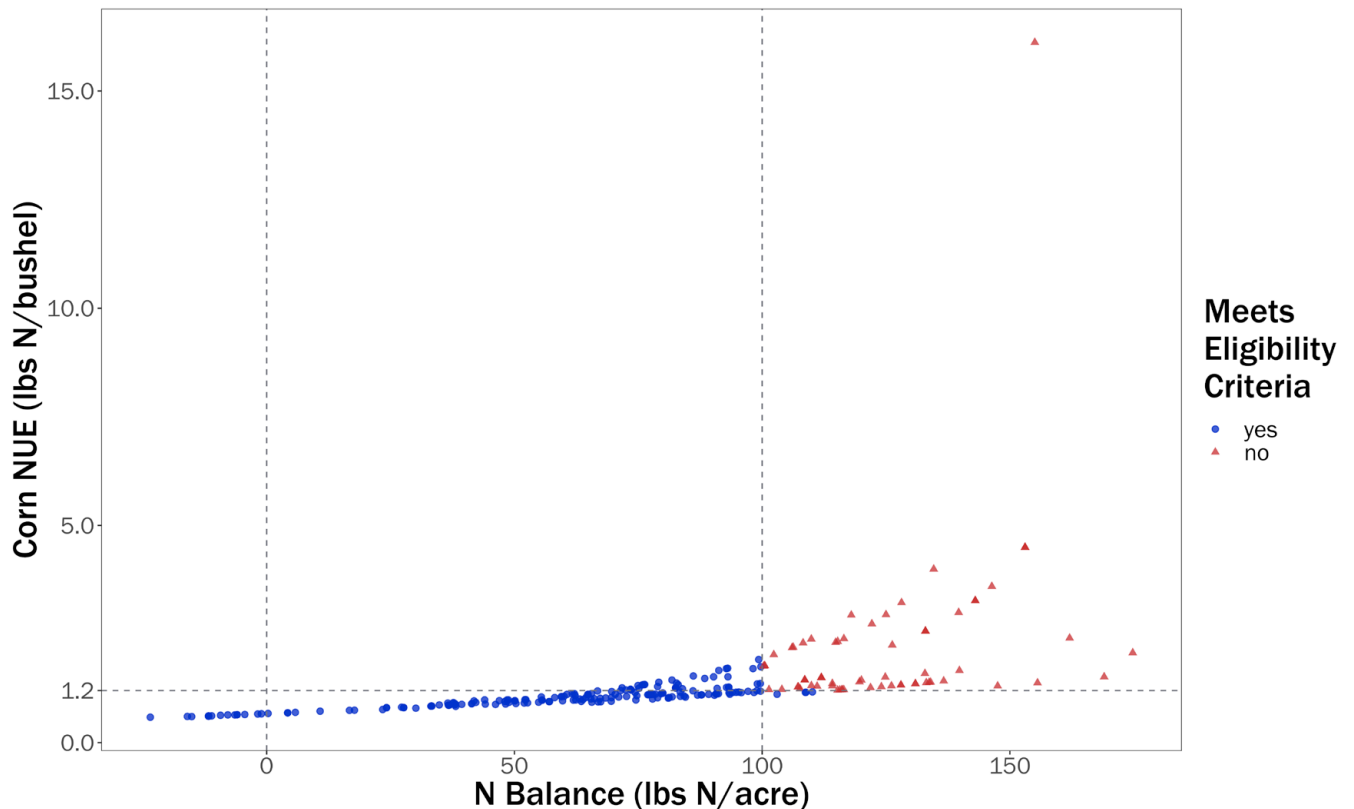
Below, crop-specific environmental results are presented for corn, wheat, and soybeans, including average yields and N application rates. Field-level data are plotted for corn and wheat in graphs comparing N balance and NUE scores. This comparison allows for a simple assessment of which fields meet the environmental standards when a single year of data is available: N balance scores between 0 and 100 or NUE scores of 1.2 or less. Blue dots represent fields that passed the environmental standards, and red dots represent fields that did not pass the environmental standards. All soybean fields are considered to pass because the science underlying N balance measurements in soybean are still under development.

Corn

The average (median) yield for corn fields in the pilot program was 175 bu/acre, in line with the 2022 national average of 173 bu/acre.¹⁵ The average N application rate for corn fields was 176 lb N/acre. The majority of corn fields (78%) met the broadened environmental standards during the pilot year, as shown in Figure 6. For these fields the average N application rate and yield were 164 lb N/acre and 188 bu/acre.

Farmers in the pilot year of the RAF program achieved average crop yields equal to or greater than national averages for corn, soybeans and wheat.

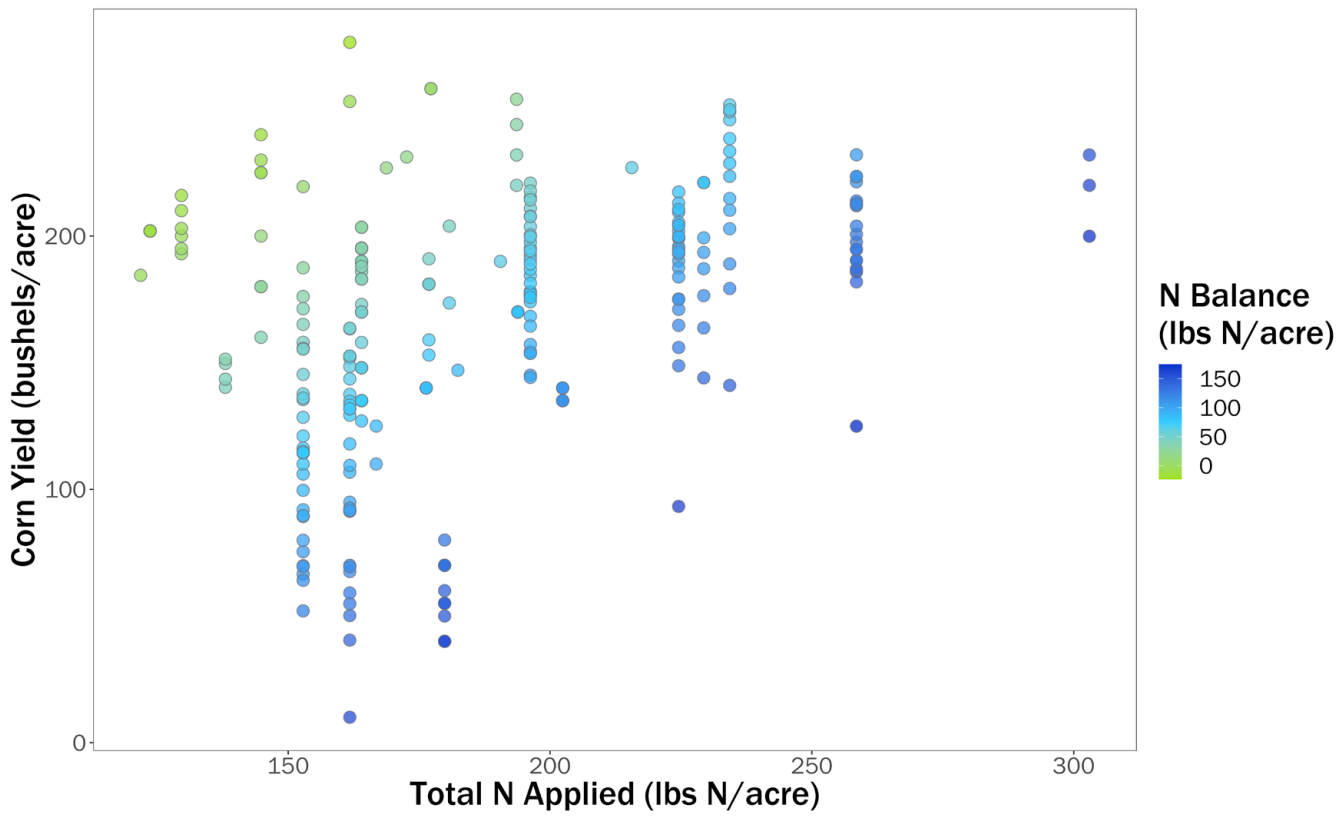
FIGURE 6. RAF program corn N management results, field level.



The 22% of corn fields that did not meet the eligibility criteria for N management had high N balance scores that put them at high risk of significant losses to the environment. As can be seen in Figure 7, fields with higher N balance scores (dark blue) include those with good crop yield but the highest N application rates (in the top right of the graph) as well as those with lower N application rates and very low yield (in the bottom left

of the graph). This illustrates two different reasons for a mismatch between crop N needs and N application. The first, too much fertilizer, may be easiest to fix – that is, reduce the overapplication. The second situation, low crop yield with more than adequate N supply, means that while reducing N rates may help, other inputs, weather or soil challenges should also be considered and addressed if possible.

FIGURE 7. RAF program corn grain yield, N applied, and N balance by field.



Wheat

During the pilot year, data was obtained from a limited number of wheat fields; specifically, there were six enterprises that planted wheat across a total of 42 fields. Additionally, there were 31 fields where wheat was double-cropped with soybeans. However, determining whether the yield data pertained to the wheat or soybeans was challenging in those cases. Therefore, the assessment of wheat is solely based on the 42 fields dedicated to wheat only. Despite the relatively small sample size, wheat is an appropriate crop for measurement using the N balance methodology due to the need for effective N fertilizer management in wheat production.

Both yield and N application rates for wheat varied across fields in the pilot, resulting in one group of lower N rate fields that tended to be lower yield, and another group of higher N rate fields with higher wheat yield (Figure 8). The average wheat yield reached 51 bu/acre, slightly outperforming the 2022 national average wheat yield of 47 bu/acre.¹⁶ The average fertilizer application rate among pilot participants was 50 lb N/acre.

As shown in Figure 9, all 42 wheat fields met the environmental standards required under the broadened eligibility parameters.

FIGURE 8. RAF program wheat yield, N applied, and N balance, by field.

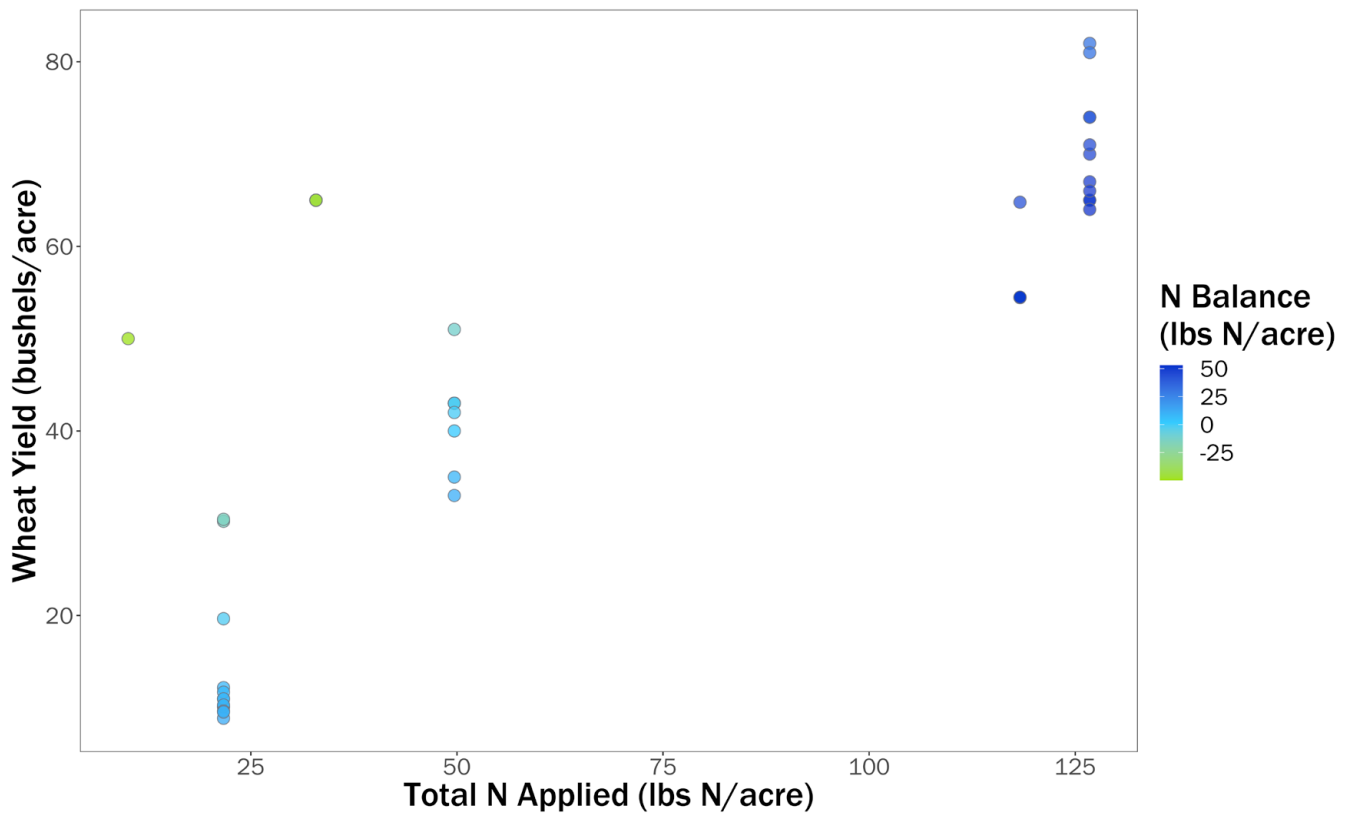
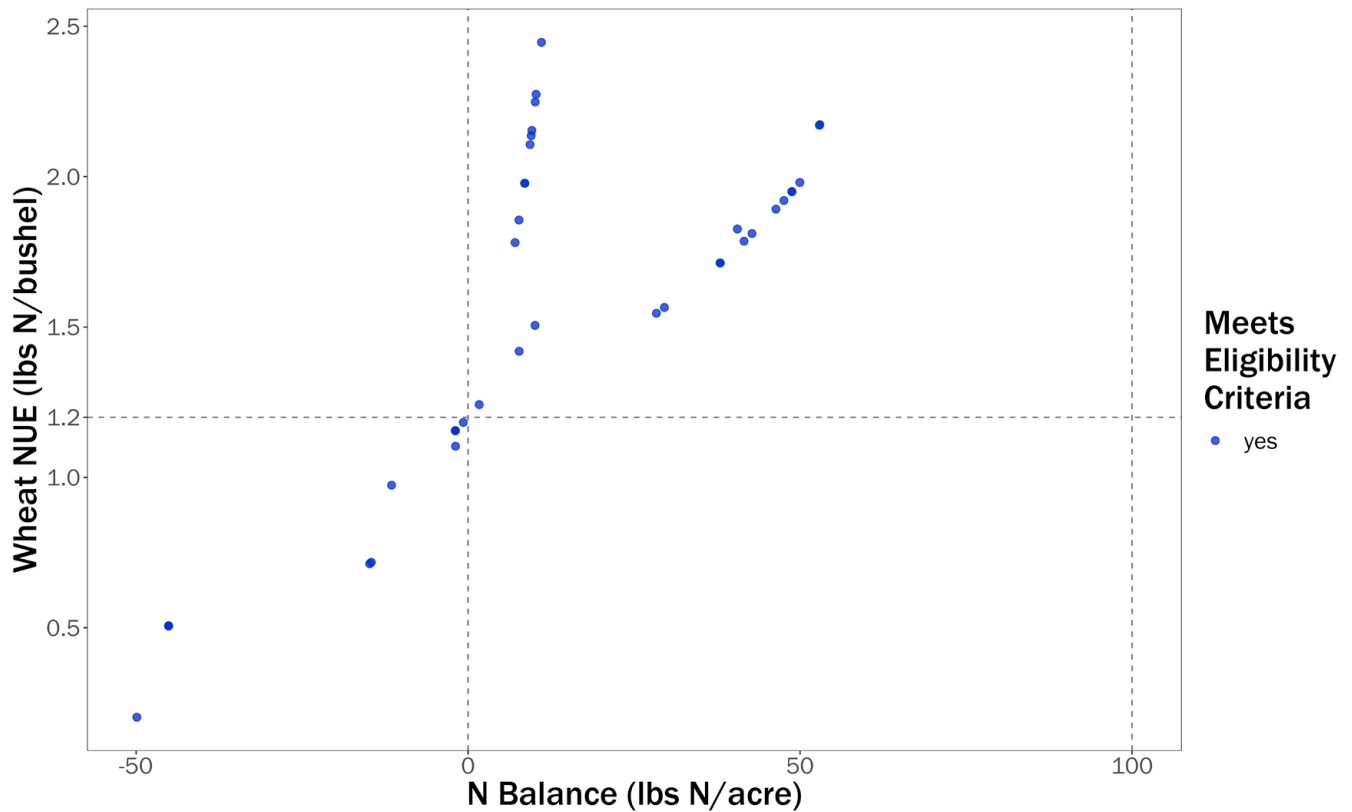


FIGURE 9. RAF program wheat N management results, by field.

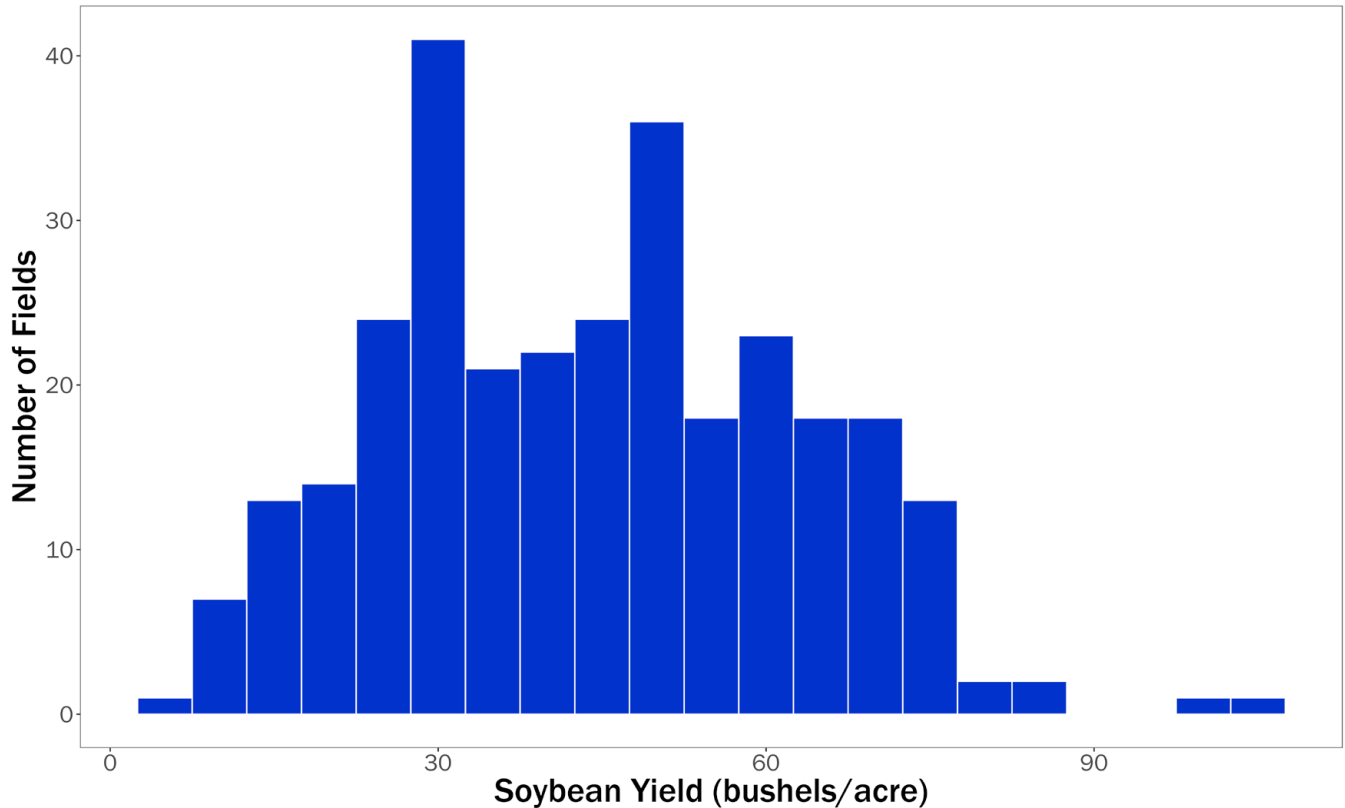


Soybeans

The average soybean field in the pilot received a small amount of starter N fertilizer (11 lb N/acre) and yielded 46 bu/acre (Figure 10), on par with the 2022 national average of 50 bu/acre¹⁷. As noted previously, the application of the N balance framework to soybean crops is still under development, with research actively investigating the relationship of N balance in soybean to N losses. In the current protocol, N added to the field via biological N fixation is estimated as a portion (79%) of the soybean seed N harvested. As a result, typical soybean fields that receive minimal amounts of fertilizer will have N balances below zero. This was the

case for 2 out of 3 of soybean fields in the 2022 pilot year RAF program. In the context of the multi-year crop rotation, soybeans would likely have a beneficial effect on the average N balance compared to continuous corn. This fits with the available evidence showing lower N losses from soybeans when compared to corn, and lower N losses from corn-soy rotations compared to continuous corn. Due to the evolving science in this area and the importance of soybean within crop rotations, all soybean fields were considered a “pass” for the nutrient management standards.

FIGURE 10. RAF program soybean yield.



Soil health practice implementation

Most of the fields included in the RAF program were under some sort of reduced tillage, with no-till (direct seeding) on over 24,000 acres, more than half of the total cropped area. This represents 44% of the area growing corn (53% of fields), 60% of the area growing soybeans (41% of soybean fields), and 48%

of the area growing wheat (66% of wheat fields). Strip tillage and shallow vertical tillage were the next most common options for seedbed preparation – used on 30% of corn acreage, 29% of soybean acreage, and 36% of wheat acreage. Cover crops were used on over 6,000 acres. They were more common before wheat than before soybeans and corn, with 43% of the wheat field area preceded by a cover crop, but only 9% each of soybean and corn field area.

Quantifying environmental outcomes

A key advantage of using N balance to measure N use is that N balance data can quantify climate and water quality outcomes in the form of nitrous oxide emissions and nitrate losses. EDF's open-source implementation guide¹⁸ provides the methodology to do so.

As with most models, having more observations (in this case, N balance scores) provides more precise and accurate results. To have statistical confidence that a program or project has led to real environmental improvement — reduced nitrous oxide emissions and nitrate leaching — EDF recommends aggregating N balance scores from a minimum of 300 fields together and having three years of baseline data from the same 300 fields. Emissions and leaching from subsequent years can then be compared to the three-year baseline to measure change.

The equations found in the N balance implementation guide estimate average nitrous oxide emissions and nitrate leaching for a field, and the estimated outcomes improve in accuracy when large numbers of fields are aggregated. Because many environmental and management factors affect N cycling, the losses from an individual field can be quite variable. While direct measurements, if feasible, would find exact losses from an individual field to be higher or lower than the average, the high values balance out the low ones, and vice versa, when looking at the group as a whole.

During the initial pilot year, the RAF program collected one year of data from over 700 fields spanning 42,000 acres. Of that total, 597 fields (36,000 acres) met the established environmental standards. Once FBN has implemented the RAF program for three years or

accumulated at least three years of historical data from these farms, it will be possible to confidently quantify nitrous oxide and nitrate losses from these fields. This will enable meaningful comparisons with other groups or benchmarks to be made.

At the same time, abundant evidence demonstrates that farmers who consistently maintain N balance scores within the safe zone over a 3-year average generate significant benefits to climate and water quality by minimizing the risk of N losses. For example, analysis by EDF of another N balance data set that represents 544,116 corn acres in the Midwest estimated that farmers whose N balance scores are above the safe zone could reduce nitrous oxide emissions by up to 15% and nitrate losses by up to 17% by improving their N balance scores.¹⁹ Cui et al. 2021,²⁰ assessed the global potential for nitrous oxide mitigation in crop production based on N balance and estimated that the United States alone could mitigate nearly 28 Gg N₂O-N per year (approximately 12 Tg [MMT] CO₂e). Furthermore, their calculations suggested that implementing targeted interventions in regions and fields with high emissions could reduce nitrous oxide emissions from cropland by 30% globally without adversely affecting crop yields.

The prevalence of N pollution worldwide is very well documented, as is the evidence linking farmers operating within the N balance safe zone to minimal environmental losses.²¹ Consequently, it can be asserted that farmers enrolled in the RAF program who successfully receive the rebate demonstrate superior environmental performance to the average grain farmer. As the RAF program continues for three years and more, it will be possible to incorporate additional claims, such as the reduction of nitrous oxide emissions over time and lower emissions compared to comparable groups of farmers, provided that relevant data is accessible for comparison.

REGENERATIVE AGRICULTURE FINANCE FARMER PROFILE: MIKE NEFF

Mike Neff’s conservation journey goes back decades. Working with his dad, Mike started no-till farming back in the mid-1980s. At first, Neff and his father started with just a few fields. But over the next 15 years, they transitioned 100% of their operation to no-till. Along with saving money on water, there was an improvement in organic matter which added resilience to their Decatur County, Kansas operation.

As a participant in the Regenerative Agriculture Finance program, Neff appreciates “finally being acknowledged” for the cutting-edge conservation practices he has utilized on the operation over the past several decades. In his experience, incentive programs are frequently only available to farmers who implement a new practice and it is rare for farmers like Mike to be rewarded for their decades of conservation. He believes FBN understands the importance of supporting committed conservation champions. Neff appreciates how his conservation path has led him to interact with different people. In addition to the other attractive aspects of the RAF program, this program helped him develop a better relationship



Mike Neff farming on his operation in Kansas.

with FBN and its community. He believes neighbors and peers play a key role in leading by example and increasing participation in conservation efforts.²²



Regenerative agriculture is important to ensuring family farms are protected against small margins.

- Mike Neff



Lessons learned from the pilot year of the RAF program

The RAF program, being one of the pioneering farm loans that incorporate environmental standards and financial incentives for regenerative agriculture, offers valuable insights that will aid in the ongoing advancement and enhancement of the program. Moreover, it will provide guidance to other agricultural finance institutions seeking to establish similar financial solutions.

At the onset of the pilot year of the RAF program, FBN and EDF embarked on addressing several questions: firstly, whether farmers would demonstrate an interest in enrolling for a farm loan connected to their environmental performance, and if the offered interest rate rebate would be compelling to them; secondly, whether farmers would successfully meet the environmental standards; and finally, what the environmental outcomes would be for the participating farmers and the RAF program as a whole.

Farmer interest and enrollment in the RAF program exceeded expectations

The RAF program exceeded expectations regarding farmer interest and enrollment, demonstrating noteworthy achievements in several aspects. First, the program experienced a rapid filling of available slots, indicating a high demand from farmers. Second, farmers from various states enrolled in the program, showcasing its broad geographical reach. Additionally, the program attracted participants with diverse farm sizes and loan requirements. This is significant because the RAF program deviates from the traditional approach of conservation delivery, which

primarily relies on government cost-share programs, by integrating a financial incentive for regenerative agriculture into an existing operating line for farmers.

Market research conducted by EDF prior to the development of RAF revealed that only 35% of farmers discuss soil health practices with their lenders. However, the same research also highlighted that 50% of farmers expressed interest in a soil health transition loan that offers an interest rate reduction.²³ This disparity underscores the gap that the RAF program successfully filled—agricultural lenders currently do not offer loan products with environmental components. Yet, farmers exhibit a strong willingness to participate in such opportunities when presented.

FBN chose the interest rate rebate of 0.5% for the RAF program after considering its significance to farmers and its potential scalability with additional investors. In terms of monetary value, this rebate is smaller in comparison to many other financial incentives for regenerative agriculture. However, other unique aspects of the program may compensate for this in the eyes of potential farmer participants. These include the opportunity for early adopters of regenerative practices to join the program and the flexibility for farmers to combine their participation in the RAF program with other incentive programs, provided they are eligible for and allowed by those programs.

The launch of the RAF program coincided with a period of rising interest rates and increased costs of N fertilizer, which likely contributed to its appeal among farmers. It is important to note that offering a rebate based on a percentage of the farm interest rate results in larger rebates for farms with larger loans. Moving forward, FBN and EDF will evaluate whether a minimum rebate should be offered to smaller farms or another means of encouraging their participation.

Farmers successfully met environmental standards that were adjusted for a single year of data

The RAF program incorporates an important innovation through its implementation of environmental standards developed by EDF with multiple objectives in mind. These objectives include reducing the data collection burden on farmers while ensuring environmental stewardship, applicability to diverse grain production systems across the United States, rewarding farmers who effectively manage N fertilizer and maintain soil health, and enabling the quantification of climate and water quality outcomes once an adequate amount of data is gathered.

The N balance framework developed by EDF and research collaborators offers a scientifically sound approach for food and agriculture companies to measure and monitor N levels, determining when it is excessive or optimal. Numerous scientific studies have identified and confirmed N balance as the preferred metric for gauging the environmental risks associated with N loss.²⁴ To implement the N balance “safe zone” framework with one year of data, FBN and EDF expanded the N use criteria to an N balance range of 0–100 lbs N/acre and/or a NUE score less than or

equal to 1.2. As the pilot continues and more data is gathered, N balance scores will likely cluster within the N balance safe zone of 25–75 lbs N/acre, and this modification will no longer be needed.

Like all sustainability programs, some level of attrition is expected, and FBN has found that a rate of 15–20% is generally common. The withdrawal of six farmers from the program aligns with the attrition rate observed in FBN’s other sustainability programs. However, the count of six farmers who did not fulfill the data submission requirements slightly exceeded the anticipated level. This presents an area for FBN to investigate whether improvements to the data collection processes can improve timeliness and address this issue.

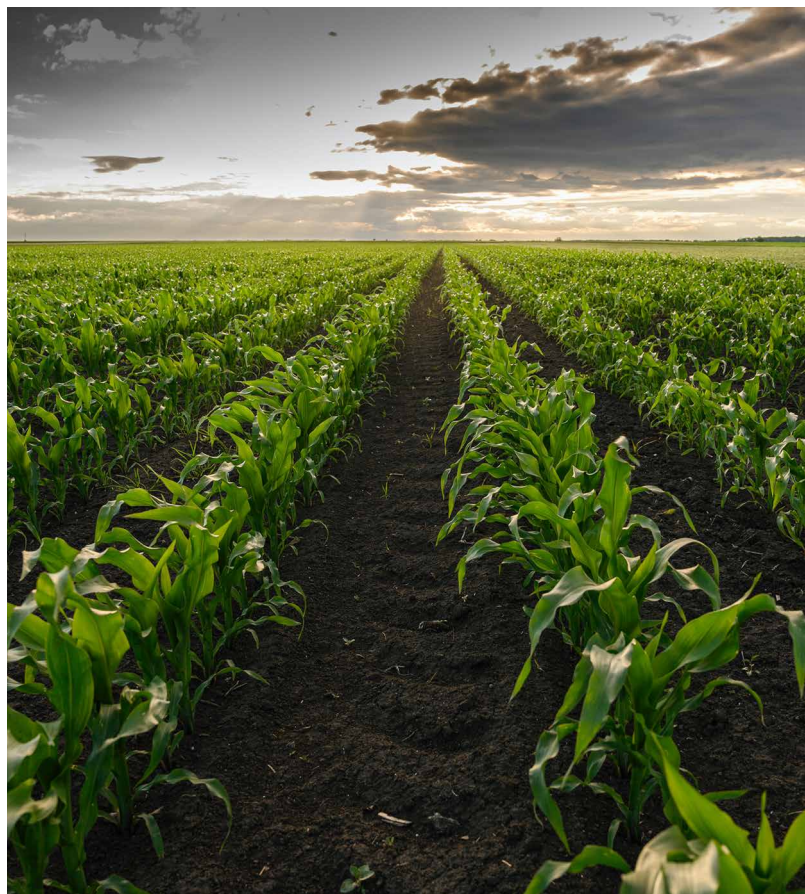
The enrollment outcomes mentioned earlier demonstrate that the environmental standards successfully facilitated the participation of farmers from diverse grain-producing regions across the U.S., spanning from North Dakota to Georgia. The inclusion of multiple approaches to meet the soil health metric played a crucial role in achieving this outcome. While a majority of farmers qualified based on their adoption of no-till or reduced tillage practices, other improved soil management practices were cited as well, including cover crops.



Farmers in the RAF program are on track to generate quantifiable benefits to climate and water quality

Three years of data across hundreds of fields are needed to generate a reliable calculation of nitrous oxide and nitrate losses from RAF program participants to ensure that the data offers a representative view of each farm. Even though the RAF program does not require a practice change for qualification – having been designed to reward good management – the insights generated provide an opportunity for farmers to reduce excess N balances and generate environmental benefits over time. To substantiate environmental impact claims for a program that seeks to reduce N losses, a minimum of four years' N balance data is necessary, comprising a three-year average baseline and at least one year of data after implementing interventions. In the meantime, single-year data are valuable in showcasing progress to select stakeholders. The RAF program demonstrates success in several aspects, including farmer engagement, enrolled acreage, farmer interest in adopting desirable management practices, and the distribution of N balance and NUE scores. These indicators suggest the ability to make confident environmental impact claims related to calculated changes in nitrous oxide emissions and nitrate losses.

Estimates of the potential for global agriculture to reduce nitrous oxide emissions while maintaining crop yields range from 15–30%. As nitrous oxide has almost 300 times the climate-warming impact of carbon dioxide, any reduction in emissions has an outsized benefit for the climate. Agriculture is responsible for about 75% of all human-managed nitrous oxide emissions, so reducing these emissions also provides a unique opportunity for agriculture to be part of the climate solution.²⁵ The actual scope of progress in mitigating nitrous oxide from the RAF program participants will only become evident as time passes and additional data are collected. After this first year of farmer engagement, the RAF program showcases encouraging indications of advancement toward establishing credible environmental outcome claims.



Path forward

Over time, FBN aims to connect farm environmental performance with the financial performance of the farmers and the RAF program, creating insights into the relationship between regenerative practices and farm risk and creditworthiness. This link will provide investors and agricultural lenders with a new investment opportunity that has the potential to scale across millions of acres.

In response to the positive reception, FBN has expanded the program's size to \$50 million in 2023 and is actively pursuing its rapid expansion. FBN plans to scale the fund to \$500 million over five years by accessing public markets to securitize and sell these loans to investors seeking liquid, environmentally friendly investments. In addition, FBN is exploring additional opportunities for farmers in the RAF program to stack other incentive programs. FBN and EDF expect partnerships to drive continued growth of the RAF program in the coming years.

CONCLUSION

Farmers can reap various advantages by embracing regenerative practices, such as enhanced soil health, reduced expenses on fertilizers, and increased resilience in crop yields. The introduction of innovative financial mechanisms, like the RAF program, will support farmers to adopt such practices profitably and allow for integration with other financial incentives and programs. Ultimately, this will expand the accessibility of regenerative agriculture to growers throughout the country.

Agricultural finance providers can play a crucial role in facilitating the expansion of regenerative agriculture by adapting financial solutions to align with the financial needs of farmers in the transition to regenerative

practices and recognizing the long-term financial value of regenerative agriculture. This could include offering lower interest rates, longer terms, flexible repayment arrangements or other adjustments. The advantage of this approach is that it allows farmers to access financial support through their existing trusted financial partners.

Data linking the environmental and financial performance of farms can allow financing to align with the value generated by farmers who use regenerative agriculture. As one of the first agricultural loans to put this ambition into practice, the RAF program provides valuable learning and replication opportunities for the broader finance sector.

Ultimately, the RAF program will help to will expand the accessibility of regenerative agriculture to growers

**THROUGHOUT
THE COUNTRY.**

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