

PROJECT NARRATIVE

i. Project background

NRCS defines soil health as “the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.”^[1] Recent studies reinforce this definition: Improving soil health metrics like organic matter (OM), active carbon or microbial activity reduces crop response to purchased inputs like N fertilizer.^[2–5] Put another way, the fertilizer requirement of a crop can be reduced because “a biologically healthy soil supplies a greater amount of nitrogen to crops.”^[6] Soil health management systems foster this capacity through minimizing disturbance, maximizing soil cover, maximizing biodiversity and maximizing the presence of living roots.

These soil health principles are also highlighted in the Iowa Nutrient Reduction Strategy, which identifies several successful practices for farmers to lessen agriculture’s negative impact on water quality.^[7] These practices include, but are not limited to, cover crops, extended/diverse crop rotations, grazing livestock and reduced tillage. Diverse growing seasons of cash crops and cover crops means roots are actively using soil-water during most months of the year, and that soil is covered, reducing leaching and soil erosion. Moreover, reducing N fertilizer application rate is another practice cited in the Iowa Nutrient Reduction Strategy. Thus, soil health practices can have a double-positive effect on water quality by both reducing leakiness (living roots) and reducing N fertilizer input to a system (improved biological functioning).

Crop production systems that include soil health management systems also show environmental benefits in the form of reduced greenhouse gas (GHG) emissions thanks largely in part to reduced N fertilizer requirement.^[8] This is because the production, transportation and application of synthetic nitrogen fertilizer are highly energy intensive. And the fate of much nitrogen fertilizer is nitrous oxide—a potent GHG. Soil N interactions in row crop agriculture are the source for about 50% of global anthropogenic nitrous oxide emissions.^[9] Adopting soil health practices like reduced tillage and legume cover crops while reducing N fertilizer application is estimated to result in 37% decrease in energy use and 42% reduction in GHG emissions.^[10]

Many farmers admittedly over-apply N fertilizer because doing so acts as insurance for a good corn crop.^[11] We argue that this behavior could be curtailed thanks to soil health management systems because (1) Improved soil health reduces crop response to applied N and (2) Recent scientific evidence also points to less yield variability (e.g. risk) from improved soil health.^[12–14] And the time is right for this intervention *right now* because we are already seeing fertilizer prices rising in response to corn prices.^[15,16]

Practical Farmers of Iowa (PFI) has a proven track record facilitating and organizing farmer-led research, outreach and education. Operating on the simple framework that farmers learn best from other farmers, PFI seeks to leverage the experience, expertise, and dedication of its more than 4,600 members to equip farmers to build more resilient farms and communities. A key cornerstone of farm and community resiliency is healthy soil. The demonstration of practical, effective implementations of soil health management practices like cover crops, diversified crop rotations and managed grazing on farms is critical to building both technical knowledge and community and social support, the lack of which many producers cite as dual barriers to the adoption of soil health practices.^[17–19] Networks that encourage social learning help participants

overcome uncertainty when managing complex systems.^[20] They expand participants' access to information resources and fellow participant experiences and provide social support. In our farmer-to-farmer network model, the farmers are the solution. They provide the on-the-ground place-based experiences and knowledge that support and empower others to broaden their thinking.

PFI has a history of helping farmers evaluate N fertilizer use on-farm. From 1988-1993, PFI farmers conducted 57 paired strip trials that compared their typical N-rate (high) with a reduced rate of their choosing (low). Across sites, the average difference between high and low rate was 56 lb N/ac. In 50 of the 57 trials (88%), there was no statistical advantage to corn yield from the high rate (**Figure 1**). The farmers involved learned that in most cases they were applying more N than they needed – applying less N would not harm corn yield and it would actually improve their bottom lines.

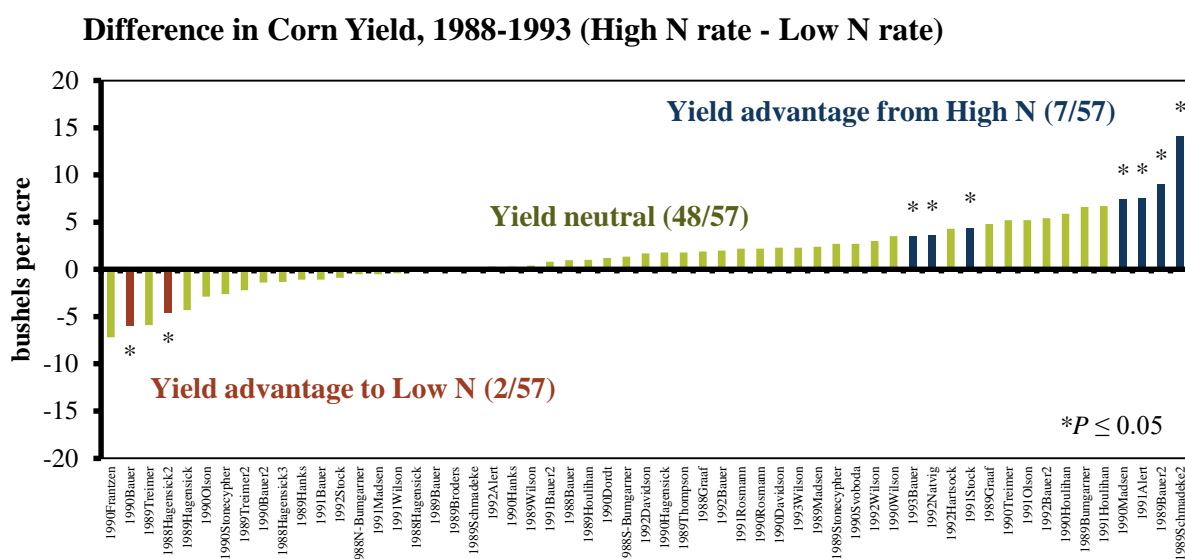


Figure 1. Results of 57 paired strip trials on PFI farms that tested High and Low N-rates applied to corn.

These on-farm trials were the beginning of PFI's Cooperators' Program, which serves to empower farmers to generate and share knowledge through timely and relevant on-farm research. The program brings together a community of curious and creative farmers who take scientific approach to improving their farms. Since 1987, more than 250 different farmers have conducted nearly 1,500 research trials on their farms. Results from this research are shared through research reports, PFI's quarterly magazine, in various agriculture magazines, at field days and workshops, and at our annual conference and other events. In our most recent member survey, 70% of respondents told us that the material portrayed in PFI research reports was important or very important when it came to their learning. Put another way, the products of the Cooperators' Program are used by farmers to make informed decisions. Said one PFI cooperator recently when considering the earlier on-farm research: "The idea of coordinated, PFI-wide N-rate trials is enticing. I wonder: 'What if PFI could help reduce Iowa's nutrient load in its water supply while also increasing our bottom line?' Reducing N-rates by 50 units addresses both the farmer and the community in PFI's mission statement: 'Equipping farmers to build resilient farms and communities.'"

This Conservation Innovation Grant would fund part one of a two-part intervention: secure new on-farm evidence and the farmer-champions for N-rate reductions in soil health management systems. Specifically, this CIG would fund (1) 40 on-farm research trials to test N fertilizer rates in soil health management systems; and (2) education and outreach activities designed to increase the technical expertise and economic understanding of soil health practices as well as build social and community capital that is ultimately necessary for true landscape-level change. PFI members are leading the charge when it comes to soil health practice adoption; 84% of PFI farming members use cover crops, compared to 25% of the total Iowa farming population. Furthermore, 54% of PFI farmer members use extended crop rotations, compared to 22% of the general Iowa farming population.^[21] Thus, PFI is well-positioned to recruit on-farm research sites and this project would build on current efforts by PFI to develop soil-health focused programming for farmers and guided by farmers' expertise and experience.

Part two of our overall innovation would take the information generated from part one and eventually develop and pilot a yield warranty for farmers who reduce N rates in soil health management systems and evaluate its appropriateness for behavior change. Part two would be funded through a partnership from established relationships with food and beverage companies and Growers Edge and involve a postdoctoral research scientist at Iowa State University. Ultimately, our overall innovation seeks to test and promote soil health management systems as a better form of risk management than over-applying N fertilizer and that confidently applying less N maintains farmer ROI while also improving farm impact on water quality and GHG emissions.

ii. Project goal/objectives

Main goal

The goal of this project is to evaluate and quantify the ability of soil health management systems to improve economic and environmental performance of farms across Iowa. We will help farmers assess N fertilizer rates to corn in fields they have committed to soil health management systems. Ultimately, we hope farmers who have made a long-term investment to soil health will gain confidence to practice fertilizer reductions while maintaining crop yields. In so doing they will improve the financial viability and environmental footprint (e.g., water quality, GHG emissions) of their soil health management systems and encourage other farmers to do the same along the way. The critical information collected, generated, shared and vetted by farmers in this CIG project will inform part two of a larger project: Assessing the potential and appropriateness for a yield warranty for farmers who reduce N rates in soil health management systems. The information generated from this CIG will provide the critical foundation to deploy a yield warranty pilot in the future.

Objectives

In order to achieve the project goal, we developed the following objectives:

Objective 1: By September 2024, PFI coordinates 40 on-farm research trials in order to determine if farmers can reduce N fertilizer application rate by 50 lb N/ac without reducing corn yield in fields employing soil health management systems.

- Eligible fields for on-farm trials will have at least a 5-year history of soil health management systems (e.g., cover crops, integrated grazing livestock,

diversified crop rotation, etc.) and will be equally distributed among the four largest landform regions across Iowa.^[23]

- PFI will alleviate the concern for potential reduced revenue from yield loss by providing a de-risking incentive payment to farmers who test reduced N fertilizer rates in on-farm trials.
- PFI will quantify the return on investment (ROI) from reducing N fertilizer rate using yields, costs and returns resulting from these trials.
- Dr. Marshall McDaniel's lab (ISU Agronomy) will assess soil health metrics from 12 on-farm trial sites in both Year 1 and Year 2.
- PFI will determine the risk of yield loss using trial results and actual production history (APH) of fields, which will inform a future yield warranty pilot project.

Objective 2: Increase awareness, knowledge, adoption and support of soil health management systems.

- By September 2024, PFI will arrange events; educational and networking opportunities; farmer presentations and interviews; and various media and communications outreach focused on the agronomic, economic and environmental outcomes of soil health management systems and reducing N fertilizer inputs. 80% of attendees to educational events on soil health management systems will report an increase in knowledge.
- 75% of farmer researchers who conduct the trials and 40% of attendees at educational events will reduce N application on some of their farm as a result of participating in this project.
- Incorporate trial results and farmer-leaders who conducted the on-farm research into a two-part docu-series that is partially supported by a grant from EPA by September 2024. PFI YouTube channel gains 4,800 new subscribers, 750,000 views and 105,000 hours of watch time.
- Using a smart directory that is currently in development and supported by a grant from EPA, PFI empowers and connects at least 100 farmers one-on-one to encourage and support one another.

Innovation

The project is innovative because it will gather the necessary information from farmer champions that will inform a future pilot of a yield warranty for farmers who reduce N rates in soil health management systems. The future project, which will be funded separately, would involve estimating the percentage of times a warranty, covering 85% or 90% expected yield, would pay to farmers when reducing N rate in soil health management systems. Somewhat similarly, a prototype product for insuring the risk to sugarcane yield from reduced N rates was recently developed in Australia from a collaboration of researchers, farmers and insurance companies.^[22] This future project would involve a postdoctoral research scientist at Iowa State University as well as established partnerships with food and beverage companies and Growers Edge, a company that leverages data science to build grower-relevant risk management solutions to meet ever-changing agriculture demands.

Our project is also innovative in that it supports farmers to truthfully be part of climate change mitigation in the form of reducing GHG emissions. In a recent piece published by *Harvest Public Media*, Rolf Nordstrom, President and CEO of The Great Plains Institute, a nonpartisan energy advocacy group, insists the need to incentivize farmers to reduce their carbon footprint.^[24] In recent years, many incentive programs have emerged that involve paying farmers for management practices that claim to sequester carbon in soils (e.g., IndigoAg,^[25] Nori,^[26] Soil and Water Outcomes Fund^[27]). The science is not clear, though, about whether management practices shown to potentially sequester carbon in one region or climate extends to all regions.^[28–30] Moreover, there is no guarantee that management practices that potentially sequester carbon will be maintained in the long-term (e.g. conversion from perennial to annual system).^[30,31] It is abundantly clear, however, that using less N fertilizer reduces GHG emissions because (1) the production of N fertilizer is an energy intensive practice,^[10] and (2) the application of N fertilizer is associated with nitrous oxide emissions resulting from volatilization.^[9] Thus, de-risking and incentivizing reduced N fertilizer application (and by proxy reduced GHG emissions) serves as a more plausible alternative for climate change mitigation to programs aimed at carbon sequestration.

NRCS conservation practice standard 590

This project addresses a subject in NRCS conservation practice standard 590 (Nutrient Management Standards)^[32] regarding N rate and soil health management systems (namely, cover crops): “... management systems to optimize immobilization and to make subsequent agronomic N management decisions still need to be developed and tested. On-farm cover crop field trials are encouraged to test management options (species, planting method, timing of planting, timing of manure application, timing and method of killing, etc.), to estimate subsequent N availability, and to assess the impact on water quality.” (p. 590-4). We are proposing to conduct on-farm trials in fields with a history of soil health management systems in order to test agronomic N management decisions. We hope that our results will better inform NRCS personnel working with farmers who use conservation practices standard 590 when determining N rates for corn in soil health management systems (currently, guidelines are for corn in continuous corn or corn-soybean systems; no instruction or guidelines for corn in soil health management systems).

iii. Project design and methods

By organizing on-farm research trials, events and producing targeted outreach and media, PFI will facilitate increased knowledge among producers related to soil health management systems. All of the activities in this project will disseminate knowledge, skills, and experiences from farmers to farmers, eroding technical barriers to the adoption of soil health practices.

OBJ. 1: PFI coordinates 40 on-farm research trials in order to determine if farmers can reduce N fertilizer application rate by 50 lb N/ac without reducing corn yield in fields employing soil health management systems. Ideally, sites will represent an equal number of soil health management systems (e.g., cover crops, integrated grazing livestock, diversified crop rotation, etc.) and be equally distributed among the four largest landform regions across Iowa (Des Moines Lobe; Iowan Surface; Northwest Iowa Plains; Southern Iowa Drift Plain).^[23]

We will recruit farmers from within our network to conduct trials in fields with at least a 5-year history of soil health management systems. Trials will compare two treatments:

1. Typical – the farmer’s typical N fertilizer rate;
2. Reduced – their typical rate less 50 lb N/ac.

For instance, if a farmer’s typical rate is 170 lb N/ac, the reduced rate will be 120 lb N/ac.

These treatments will be tested using a statistically valid design: randomized, replicated paired strip-trial (**Figure 1**). Each strip will comprise up to 2 acres. In these paired strip trials, 8 acres (4 strips) will be dedicated to the ‘Typical’ rate and 8 acres (4 strips) will be dedicated to the ‘Reduced’ rate. Farmers will implement the trials themselves using farm-scale equipment: treatment strips run the length of a field and are as least as wide as one combine-header. We will coordinate 40 on-farm research trials (20 in Year 1 and 20 in Year 2).

TYPICAL	REDUCED	REDUCED	TYPICAL	REDUCED	TYPICAL	TYPICAL	REDUCED
REP 1		REP 2		REP 3		REP 4	

Figure 1. Example paired strip trial experimental design used to compare a farmer’s typical N-rate and a reduced rate (typical rate less 50 lb N/ac). Strips comprise up to 2 acres each and run the length of a field and are as least as wide as one combine pass.

Crop yield. Farmers will report corn grain yield and moisture from each individual strip using either a weigh wagon and moisture meter or an onboard yield monitor.

Return on investment. Returns on investment (ROI) will be calculated from partial budgets that consider the differing costs and returns for the two treatments in each on-farm trial. Farmers will report all field management activities, products applied, costs incurred and prices received for corn grain sold. Alternatively, we will access costs and prices from Iowa State University Extension and Outreach publications.^[33–35] By design, the ‘Reduced’ treatment will incur less costs (less fertilizer applied) up front.

Risk assessment. We can determine the risk of low yield by calculating and graphing a distribution of lower confidence limits at various alpha-levels for the mean corn yield of both the ‘Typical’ and ‘Reduced’ rates and when considering all site results in aggregate.^[36]

Soil health measurements. Dr. Marshall McDaniel (ISU Agronomy) and his lab team will assess soil nitrate and soil carbon mineralization (aka CO₂-C burst) as an in-kind contribution at 12 on-farm research sites per year in both Year 1 and Year 2.

PFI staff provide support throughout the entire on-farm research process. Staff help farmers with questions about the experimental design and in-field measurements and protocols. Staff perform statistical analysis (ANOVA, t-test, LSD) and interpretation of the results and, with the farmers involved, write findings in research reports that are published and made freely available on our website.

The de-risk payment for each field involved in on-farm research trials will amount to \$125/ac for up to 8 acres (\$1,000 total). This payment serves to cover (de-risk) potential revenue loss/yield loss resulting from a farmer reducing their N fertilizer rate by 50 lb N/ac; roughly, the payment covers a yield reduction of 25 bu/ac when assuming a corn price of \$5/ac (for reference, in April 2021 the most recent (Feb. 2021) average cash corn price reported by ISU Extension and Outreach was \$4.87/bu^[34]). While we do not necessarily assume a yield loss, we are realistic and do recognize the risk to farmers from reducing N rates.

OBJ. 2: Increase awareness, knowledge, adoption and support of soil health management systems. PFI will increase awareness and access to information about soil health management systems both among farmers and the general public.

- **Grower Meetings and Presentations:** PFI will organize field days, webinars, conference sessions, shared learning calls, virtual meet-ups and other educational opportunities for growers, leveraging PFI's 30+ year track record of increasing practice adoption through farmer-to-farmer and on-farm information sharing. From evaluations in recent years, 70% of attendees report they consider adopting changes to their farms as a result of attending events and presentations.
- **Communication:** PFI will communicate updates and results through our membership network using the following communications tools: magazines, newsletters, blog posts and website accessible reports. PFI will also conduct outreach in the form of news releases and articles published in agriculture media. Estimated audience reach will be 650,000 (see section x. for more detail on media reach).
- **Docu-series:** PFI has been ramping up capacity to produce higher-quality video work. Previously released in-depth how-to videos on cover crop and small grains production, like our 12-part series, [Rotationally Raised](#) (2016-2017), and our 10-part series, [Organic Weed Control](#) (2019), have been successful. To produce PFI's first feature film, [Livestock on the Land](#) (2021), we built a video production and storytelling apparatus. We will now pivot to tell the story of the farmers who are cover crop and soil health pioneers in a two-part docu-series, *Taming Winter* (partially funded by a grant from EPA; estimated launch is Summer 2023). PFI's most valuable asset is its people and that is what the docu-series will focus on. Knowledge generated from the on-farm trials in this project, and the people who generated the knowledge, will bolster the content of the docu-series. Our target audience will be clear – farmers and farm families.
- **Smart Directory:** Once operational (funded by a grant from EPA; estimated launch is January 2023), the hotline's underlying directory will enable PFI staff to use keywords from inquiries to search through years of PFI member data and make matches. Inquiries may include phone calls, texts or emails from farmers, agronomists, ag retailers, ag consultants, etc. Matched farmer-members will be contacted to respond to the inquiry

within a short period of time (e.g. 24 hours). As matched farmer-members answer inquiries, the directory will become “smarter” using a feedback script that logs the number and type of inquiries they receive. We are developing this directory because years of feedback we have received underscores the fact that farmers want to hear from other farmers. We will deepen our bench by involving the farmer research participants in this project to help them share their knowledge gained from the on-farm trials with others.

- **Share Project Results with Conservation Community:** PFI will present results of this project at a conference or workshop, a public webinar and a fact sheet geared towards other conservation and natural resource professionals and groups.

iv. Project outcomes and benefits

Short-term

Forty on-farm research trials conducted in soil health management systems will show that in 75% of cases, reducing N fertilizer rate by 50 lb N/ac will result in no corn yield loss. In those cases, results will demonstrate improvements to ROI by approximately \$17 to \$20 per acre (assuming an N fertilizer cost of \$0.34/lb N on Apr. 28, 2021^[35]).

A result of coordinating 40 on-farm research trials on soil health management systems will be a cohort of empowered farmers who generated and shared knowledge with other farmers. On-farm research participants, event attendees and recipients of outreach activities will gain an understanding of the effectiveness, utility, affordability, and usability of soil health practices. Farmers will gain increased technical and economic knowledge of the planning, design, and implementation of soil health practices. Relevant information on how to overcome obstacles and address potential issues with soil health practices will be generated and shared with farmers at events, online, and through various other types of outreach. The principal short-term outcomes achieved through this project will be change in knowledge about soil health management system benefits, how to reduced N fertilizer successfully, and the economic return of doing so, as well increases in the volume and strength of participants’ farmer-networks.

Mid-term

The mid-term outcomes of this project will include actual changes made to farm practices based on the knowledge generated and shared in this project. Based on our previous evaluation data of on-farm research and farmer-to-farmer education we anticipate that 75% of research participants and 40% of educational event attendees will adopt N fertilizer reduction as a result of engagement with on-farm research and farmer-to-farmer education respectively. As farmers implement changes, they will stay connected to their PFI support network – increasing their interest and confidence in soil health practices. This project will also likely strengthen the relationship between PFI and organizations such as the Soil Health Institute, and academic researchers investigating soil health, resulting in more effective efforts and transfer of knowledge.

Long-term

The outreach and technical materials funded by this project may continue to be used to educate and share information with farmers and landowners well beyond the period of performance for this particular project. Furthermore, this project's efforts to build social capital and community support for soil health management systems will result in an acceleration in the adoption of soil health practices over the long-term, which will have tangible benefits for soil health, water quality and greenhouse gas emissions as well as financial benefits for the farmer. Ultimately, we wish to build a vibrant community of curious and creative farmers taking a scientific approach to improving their farms. These farmers will be leaders among their farming peers whose work contributes to the field of agricultural research, resulting in more profitable, diverse and environmentally sound farms.

v. Geographic location and size of project or project area

Project activities will occur statewide throughout Iowa. PFI's on-farm research trials and outreach activities have historically gained attention from all over the state and from all over the Midwest. Specific locations and venues of on-farm trials and outreach activities are yet to be determined. Trials will be equally distributed among the four largest landform regions across Iowa (Des Moines Lobe; Iowan Surface; Northwest Iowa Plains; Southern Iowa Drift Plain).^[23] On-farm research strip trials will comprise approximately 16-20 acres at each farm.

vi. EQIP-eligible producer participation

Practical Farmers of Iowa's entire philosophy centers on the direct participation and leadership of its farmer-members. We estimate at least 20 EQIP-eligible producers (6 have already been identified) will be involved in the activities funded by this project. PFI has offered over 1,500 on-farm research opportunities for farmers for 34 years. We will recruit remaining participants through several channels: direct contact with members; email discussion lists; e-newsletters; announcements at events. On-farm research trials and outreach activities will be hosted and led by producers. Farmers will be asked to speak at workshops or field days as part of the project. Communications and outreach media pieces will heavily feature member stories and experiences. Furthermore, producers will be the primary target audience for all of this project's activities.

vii. Project deliverables/products

Table 3: Project Deliverables		
On-Farm Research	Activity	Technical Deliverable to Evaluate Performance
Trials	PFI coordinates forty (40) on-farm research trials, 20 in Year 1 and 20 in Year 2. Results will be statistically analyzed and interpreted by PFI staff.	Trials will be implemented by at least 20 farmers (we anticipate some repeat farmers). Reports of research findings will be co-written by staff and farmers and made publicly available on PFI's website.

Outreach and Education	Activity	Technical Deliverable to Evaluate Performance
Grower Meetings	PFI will organize learning opportunities for farmers to meet in person to learn about soil health management systems.	We will deliver a combination of three (3) events (field days, gatherings and farmer-to-farmer networking events) annually in Year 2 and Year 3 (6 total).
Presentations	PFI will organize opportunities for farmers or the occasional soil health expert to present about their knowledge of and experience with soil health management systems.	We will deliver a combination of six (6) presentations (conference sessions, webinars, learning calls and other opportunities) annually in Year 2 and Year 3 (12 total).
Communication	PFI communicates with networks and to broader agricultural media continually about soil health management systems.	We will publish a combination of three (3) magazine articles, e-newsletters, blog posts and social media posts annually in Year 2 and Year 3 (6 total). We will earn stories in mainstream outlets via press releases and relationships with journalists. PFI reaches more than 650,000 impressions.
Docu-series	PFI produces a binge-worthy Netflix model of video content directed at farmers and farm families.	Information and knowledge generated from the on-farm trials in this project will bolster the content of a two-part docu-series <i>Taming Winter</i> designed to tell the story of the farmers who are cover crop and soil health pioneers. We anticipate the docu-series to launch in Year 2 (Summer 2023).
Smart Directory	PFI connects farmers with questions to farmers with answers on soil health management systems using directory and hotline service.	The farmer research participants in this project will participate in the directory and hotline in order to help them share their knowledge gained from the on-farm trials with others. We anticipate the directory and hotline to be operational in Year 2 (January 2023).
Project Results are Shared with Conservation Community	PFI will share activities and outcomes of the project with wider conservation community and the general public.	PFI will present about this project at a conference or workshop by Year 3; PFI will produce a fact sheet about the project and at the end of the project PFI will conduct a webinar to present final results of the project publicly.

Evaluation	Activity	Technical Deliverable to Evaluate Performance
Evaluation	Summary report of on-farm research experience evaluations outlining knowledge gained and potential changes made to operation.	90% of on-farm research participants report a gain in knowledge and 75% consider reducing N-rate on their farms.
Evaluation	Summary report of outreach evaluations (when applicable), detailing knowledge and network-building outcomes.	75% of those engaged report a gain in knowledge; 80% report an increased sense of community; and 40% consider making changes (reducing N-rate) on their farms.
Reporting	Activity	Technical Deliverable to Evaluate Performance
Reporting	Any and all required reports.	PFI submits semi-annual and final reports on time and supplemental narratives, as necessary, to explain and support requests for reimbursement.

viii. Project action plan and timeline

On-farm research trials

- Fall 2021 to Winter 2022
 - Recruit farmer participants from across Iowa for year 1 trials.
- Spring 2022 to Fall 2022
 - Farmers implement strip trials.
 - Dr. McDaniel's lab collects and analyzes soil samples from trial locations.
 - PFI staff are in touch with farmer-participants about progress on a routine basis.
- Fall 2022 to Winter 2023
 - PFI staff analyze and interpret strip trial results.
 - Results shared by and discussed with farmers at PFI's Cooperators' Meeting.
 - PFI staff write and publish research report on year 1 findings.
 - Recruit farmer participants from across Iowa for year 2 trials.
- Spring 2023 to Fall 2023
 - Farmers implement strip trials.
 - Dr. McDaniel's lab collects and analyzes soil samples from trial locations.
 - PFI staff are in touch with farmer-participants about progress on a routine basis.
- Fall 2023 to Winter 2024
 - PFI staff analyze and interpret strip trial results.
 - Results shared by and discussed with farmers at PFI's Cooperators' Meeting.
 - PFI staff write and publish research report on year 2 findings.
- Spring 2024 to Fall 2024
 - PFI staff synthesize and report on results from year 1 and year 2.

Grower meetings and educational opportunities

- Fall 2022 to Winter 2023
 - Plan and execute conference sessions, webinars and virtual meet-ups.
- Spring 2023 to Fall 2023
 - Plan and execute field days, small gatherings, meetings and webinars.
- Fall 2023 to Winter 2024
 - Plan and execute conference sessions, webinars and virtual meet-ups.
 - Connect farmers with questions to farmers with answers using smart directory and hotline service.
- Spring 2024 to Fall 2024
 - Plan and execute field days, small gatherings, meetings and webinars.
 - Connect farmers with questions to farmers with answers using smart directory and hotline service.

Communications and media

- Fall 2021 to Fall 2022
 - PFI staff will record interviews and footage of farmers to portray in two-part docu-series, *Taming Winter* (estimated launch is Summer 2023).
- Fall 2022 to Fall 2024
 - PFI staff will produce a combination of magazine articles, e-newsletters, blog posts and social media posts and for several outlets and venues throughout the project.
- Spring 2023 to Fall 2024
 - PFI staff connect farmers with farmers using directory and hotline in order to help them share their knowledge gained from the on-farm trials with others.

Interim and final reporting

- Spring 2022; 2023; 2024
 - Submit semi-annual report
- Fall 2022; 2023
 - Submit semi-annual report
- Winter 2024
 - Submit final report

ix. Project management

PFI will manage all deliverables and project activities. Project will be overseen by the Research and Field Crops Director, Stefan Gailans, who has served at PFI for 9 years and in that time has overseen more than 600 on-farm trials. In order to plan and track project activities, the Research and Field Crops Director will be in frequent contact with the Research Coordinator, Communications and Marketing Director, the Finance and Benefits Director, the Strategic Initiatives Director, and the Executive Director. The Research Director and Research Coordinator meet at least twice per week; the others meet at least once per month. The Research Director and Research Coordinator are in routine contact through the year with farmers who

conduct on-farm research and who participate in events and outreach. PFI will also continue to leverage our farmer leaders for guidance on programming and educational opportunities.

x. Technology transfer

Peer-to-peer sharing is integral to PFI's farmer-to-farmer network model. Exchanging ideas and strategies during field days or while planning on-farm research trials has been at the core of PFI's purpose since inception 30+ years ago. PFI will organize field days, webinars, conference sessions, shared learning calls, virtual meet-ups and other educational opportunities where growers can meet and interact on soil health topics. PFI will also disseminate farmer stories and experiences by publishing blogs, articles in agricultural media, press releases and research reports. Our work is featured extensively in the Farm Progress family of publications across the country (*Corn and Soybean Digest*, *Wallaces Farmer*, *Delta Farm Press*, *Southeast Farm Press*, etc.) about every other week throughout the year. In 2020, PFI was featured 813 times in 387 media outlets across North America. Our work was featured in print and online outlets that reached an audience of over 650,000 people (though some of those circulations likely have overlap). In addition to in-person events and publications, PFI has a robust and growing website, array of email discussion lists and online social media presence made even more relevant in socially distanced and virtual world. PFI's most active and largest discussion list is 'field crops' with 706 members, others range from 300-500 members. Our e-newsletters collectively reach nearly 8,000 subscribers. We have more than 20,000 followers on our Facebook, Twitter, Instagram and YouTube channels combined as of Apr. 20, 2021; and in 2020, our website had 421,932 pageviews. We anticipate our YouTube channel will gain 4,800 new subscribers, 750,000 views and 105,000 hours of watch time thanks to the docu-series, *Taming Winter*. The eventual hotline directory will build in efficiencies that accelerate internal connections. It will also allow PFI staff to mobilize members for more media and outreach requests. Connecting farming voices to external outreach opportunities offers exposure to broader audiences and builds momentum towards wider public understanding of agriculture's role on the landscape to protect natural resources and improve soil health.

xi. Project evaluation

PFI recently overhauled its evaluation plan to accurately measure impact. Project evaluation at PFI follows a standard protocol regardless of the activity type (research trial, field day, cost share, etc.). The approach is conducted in three to four phases that allow us to capture program reach and short-term, medium-term and long-term outcomes.

To evaluate program reach, at the start of any activity we ask participants to provide their contact information, some demographic information (farming/not, years of farming experience, etc.), how they heard about the activity and their motivation for participating. This information allows us to understand the number and type of participants we are engaging, as well as how to continue to engage them (and others like them) in PFI's activities and farmer-network to meet their interests and needs.

To evaluate short-term outcomes, we follow up with a survey at the time of completion of the activity (at the end of the research trial, end of the field day, etc.). This survey captures the immediate impacts we hope to have with PFI programming: increase in curiosity, increase in knowledge, increase in community/network, and intention to make changes.

To evaluate medium-term outcomes from our events specifically, we deploy an annual November-December survey to participants who attended events in Dec-Oct of the previous year. This survey captures the effects of our programming on the farmers' business and well-being after they've left our events. Questions in this evaluation focus on: implemented changes to farm practice (did they follow through on their intention to change immediately after the event?); what practices they implemented; how many acres had practices implemented; whether they are now meeting more of their farming goals; whether they have improved their well-being; and if they are still connected with the network they created through PFI participation. This mid-term survey is combined with the short-term outcome survey for specific programs such as cost-share or on-farm research. This is because the immediate "short-term" evaluation surveys occur at the end of the implementation or action on farm (usually three to 12 months after their participation in the activity began), so the evaluation for both the short-term and medium-term outcomes are best collected in one survey at the time of activity completion.

To evaluate long-term outcomes, PFI employs a three-year member survey along with evaluating publicly available data. This assessment focuses on the parameters of PFI's vision statement: healthy soil, Iowa-grown food, clean air, clean water, resilient farms and vibrant communities. Healthy soil, clean air, and clean water are calculated referencing the number of acres and practices reported by members in their medium-term and long-term outcomes surveys, using NRCS models, the Fieldprint® Calculator, actual lab data from Iowa Soybean Association tile monitoring program and published research, such as the Iowa Nutrient Reduction Strategy. Iowa-grown food, resilient farms, and vibrant communities are ascertained through a combination of questions on these topics in the long-term outcomes survey (change in sales of Iowa-grown food products, increase in spending locally in their communities, meeting business viability goals, etc.), along with public tax and ag census data reporting the number and longevity of farm businesses in Iowa and money flowing through rural communities.

This evaluation plan will be deployed to evaluate the research trials, farmer-to-farmer meetings, and other deliverables involved in this project.

xii. Graphics

N/A

xiii. References

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