American Society of Agronomy • Crop Science Society of America • Soil Science Society of America
5585 Guilford Road, Madison WI 53711-5801 • Tel. 608-273-8080 • Fax 608-273-2021
www.agronomy.org • www.crops.org • www.soils.org

December 21, 2022

Mr. Terry Crosby
Chief, Natural Resources Conservation Service
United States Department of Agriculture
1400 Independence Avenue SW
Washington, DC 20250

Re: Request for Public Input About Implementation of the Inflation Reduction Act Funding
Docket Number: NRCS-2022-0015.

Dear Mr. Crosby:

Thank you for the opportunity to offer comments to the Natural Resources Conservation Service (NRCS) regarding implementation of funding received through the Inflation Reduction Act (IRA) to support climate-smart agriculture and conservation.

The American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA) represent more than 8,000 scientists in academia, industry, and government, as well as 13,000 Certified Crop Advisers (CCA), and 620 Certified Professional Soil Scientists (CPSS). We are the largest coalition of professionals dedicated to the agronomic, crop and soil science disciplines in the United States. As such, we are pleased to offer responses to NRCS's questions that reflect the boots-on-the-ground realities facing producers enrolling and implementing conservation programs. We likewise are pleased to provide input from the scientific community on innovative means to quantify outcomes and tackle these challenges. In short, our perspective reflects both the science and the application of that science in real-world settings.

As the world's population continues to grow, agriculture is being called upon to produce more while using an increasingly scarce supply of soil and fresh water, to steward the land for future generations, and to foster long-term environmental responsibility. On top of this grand challenge, agricultural production is threatened by weather variabilities caused by climate change, which produce conditions that exceed the tolerances of crops and livestock; increase favorable conditions for weeds, pests, and diseases; and increase weather and growing season variability. This will only become more extreme as greenhouse gas emissions continue to accumulate in the atmosphere. By embracing an ***integrated, systems approach*** that considers the delicate balance of relationships between the organisms that compose agricultural ecosystems, farmers are in a unique position to become climate heroes.

The first step toward achieving ecosystem balance is to decrease agriculture's overall footprint. Making changes that reduce greenhouse gas emissions now will make it easier to offset, through sequestration and otherwise, emissions that cannot yet be avoided. The science is clear on which reductions will be necessary, and how they can be achieved, but there is no single solution, no magic bullet. ***Our nation needs are a collection of context-specific practices tailored for each region, each climate, each soil type, and each farming system.***

That is far easier said than done, but we have ideas.

Strategies for water and nutrient management, reducing emissions, sequestering carbon, preventing erosion, reducing stress on plants and animals, protecting germplasm and crop wild relatives, and reducing or repurposing waste must be weighed against their costs and agronomic impact. Every farm is unique; every situation complex. However, with multifaceted communication and outreach, including standardized data collection, trusted technical assistance, and networks of demonstration sites and information sharing, this complexity presents opportunities to maximize a farm's unique potential to reduce agriculture's collective footprint. To meet these needs, we recommend the following priorities for implementing the IRA funding:

1. Invest in Research to Improve Quantification Methods
2. Engage the Private Sector and Private Philanthropy to Leverage IRA Funds
3. Prioritize Practices with Proven Benefits and Support On-Farm Research
4. Coordinate Internal and External Efforts to Improve Program Delivery
5. Leverage Partnerships with Trusted Advisers to Deliver Technical Assistance

1. What systems of quantification should NRCS use to measure the carbon sequestration and carbon dioxide, methane, and nitrous oxide emissions outcomes associated with activities funded through IRA?

Invest in Research to Improve Quantification Methods

Accurately quantifying soil carbon sequestration and greenhouse gas (GHG) emissions is critical to setting and meeting climate goals in agriculture production and conservation. Broad, random sampling using inadequate techniques is counterproductive to understanding the benefits of conservation practices. Further, inherent soil properties and management practices can lead to vastly different outcomes from region to region, so best practices should be developed at state or regional scale. NRCS should avoid using models that apply the same parameters to all regions of the country; instead, models that account for spatial variability at the regional scale should be developed and implemented.

The following recommendations outline current best practices for collecting and quantifying carbon and emissions, but research is needed to reduce uncertainty in these measurements. The NRCS must balance large-scale quantification with detailed sampling that will elucidate actual climate outcomes. NRCS should avoid investing substantial resources into sampling protocols or methods that have not demonstrated the ability to quantify carbon sequestration and GHG emissions. Instead, NRCS should focus on calibrating practices using defined protocols and set up an internal review processes, such as a panel of scientific advisors, to update procedures routinely as new knowledge emerges.

We recommend that the NRCS staff work closely with cooperating partners to collect samples, analyze data, and evaluate outcomes. The National Air Emissions Monitoring Study (NAEMS), supported through the U.S. Environmental Protection Agency (EPA), provides a great example of how university researchers, federal employees, producers, and the private sector can work together to develop scientifically credible methodologies.[1] Land grant universities across the country are already working to tackle these challenges locally and should be seen as an invaluable resource for NRCS.

When possible, field samples should be collected and evaluated in a lab, rather than relying on models based on soil properties and management practices or proxy measurements. Models can be effective if

accurately calibrated and verified by experts and customized to the state or regional scale, but no one model currently exists that provides robust and credible estimates of soil carbon outcomes.

Ultimately, NRCS should work with partners and private industry to develop quick, cost-effective, and tested methods that are appropriate at scale. However, the scientific community currently lacks consensus on the most accurate proxy variable to measure to accurately quantify soil carbon sequestration and climate outcomes. By supporting the development of such metrics, NRCS would not only assure that conservation programs are effective tools for meeting climate goals but would also inform the foundational concepts of private sector carbon and ecosystem services markets and provide long-term value to producers and the environment.

Recommendation: Invest in Aggregation and Synthesis of Existing Data
Numerous small-scale studies on carbon sequestration and carbon dioxide, methane, and nitrous oxide emissions have been previously funded and conducted across the U.S. This data could be leveraged to identify gaps in regional data coverage and allow NRCS to target new data collection efforts to maximize the impact of these funds.

- Given that there are many regional factors that control carbon sequestration and GHG emissions, a meta-analysis of existing data can provide a roadmap for defining regionally-relevant protocols and methods while also identifying gaps in the existing data. The small-scale studies are needed to account for regionally-specific drivers and to ultimately enable large-scale (continental scale) synthesis.
- Many small-scale studies are needed, yet each study is expensive to implement. The vast amount of existing data covering several decades of university and government research related to carbon sequestration and GHG emissions should not be overlooked.
- There are efforts across USDA to create a centralized database (ARS, NRCS, etc). These efforts cover a wide range of data types, including data pertinent to carbon sequestration and GHG emissions. These funds could support efforts specific to compiling current and historic data on carbon sequestration and GHG emissions.

Soil Carbon Sequestration Quantification

Calculating soil carbon stock requires sampling for organic carbon concentration, bulk density, and coarse fragments. Collecting these three measurements to get the accurate carbon stock takes careful planning to balance labor, time, and cost with the number of soil samples needed to get a representative sample.[2] While the following three measurements are generally agreed upon to be credible, they are written below as generalized protocols – more nuance may exist when collecting samples from site to site.

Collecting samples for **soil organic carbon (SOC)** concentration uses the same procedure as soil fertility testing. It means collecting a composite sample to a fixed depth, striving for a representative soil sample that is not impacted by variations in SOC concentration.

- To get a representative sample, combine 10-20 cores from a 15-ft radius circle on homogenous soil (same soil series, slope, management zone, etc) in a bucket, mixing to create a composite.
- For soil fertility testing, taking cores from 0-15 cm depth is sufficient; however, soil carbon samples should be taken from 0-30 cm depth.
- A determination of bulk density is required to arrive at SOC concentration.

Bulk density is the measure of the mass of soil contained in a certain volume. This requires collecting a known volume of soil, then drying the sample to collect the oven-dry mass.[3]

- These soil cores need to be large—you'll need a tool like a slide hammer that you'll pound into the ground or a hydraulic coring machine. Use the largest diameter of soil core you can—the Soil Health Institute uses a 3-inch corer.
- Avoid compacting the soil as you collect the sample.
- Sample when the field is no wetter than field capacity (in fact, slightly drier is ideal).
- Do not sample after recent tillage.
- Collect two depths—one sample from 0-15 cm, and another from 15-30 cm.
- Collect one bulk density sample per composite soil organic carbon concentration sample.

Coarse fragments are particles greater than 2 mm in diameter. If your soil has coarse fragments—but they don't hinder collection of bulk density samples—then taking bulk density cores is good enough to get an accurate measure.

- SHI also recommends considering if taking more cores will improve the accuracy of the coarse fragment estimate.
- But if so many coarse fragments are in your soil that it makes taking bulk density difficult, it's time to try excavation.

Recommendation: Commission the Cooperative Soil Survey to Lead Sampling Efforts

The NRCS soil scientists can critically contribute to soil carbon quantification efforts through the Cooperative Soil Survey. First, we recommend that NRCS measure SOC and soil carbon respiration on samples in storage at the Kellogg Soil Survey Laboratory to establish baseline and reference materials. As baseline values are established regionally in combination with soil data being collected at universities and by private organizations (when possible), the Cooperative Soil Survey staff is equipped to work with university researchers to inform large-scale sampling protocol and model development.

Carbon Dioxide, Methane, and Nitrous Oxide Emissions Quantification

Agriculture is often cited as a primary source of greenhouse gas (GHG) emissions, but crop production and land use account for just over 13% of food-related GHG emissions globally. Altogether, food production in every stage accounts for 26% of global GHG emissions.[4] Global GHG emissions take stock of carbon dioxide (CO2), methane, nitrous oxide, and fluorinated gases. These four primary gases are monitored as climate change indicators, and tracking and decreasing GHG emissions is a major goal for industry, government, and individuals worldwide.[5]

Carbon is a major focus, since it accounts for such a large chunk of global emissions. But nitrous oxide—which is produced when microbes use oxidized nitrogen as an electron acceptor in the soil—is 300 times more potent a greenhouse gas than carbon dioxide.[6] Methane is another GHG by-product of agricultural production, with manure and enteric emissions as its major source. Finally, farms produce emissions as they use energy to operate livestock and farming equipment.

As GHG emissions in agriculture have increasingly received attention, the scientific community has developed standardized protocol for measuring carbon dioxide, methane, and nitrous oxide gas fluxes in from soils.[7] NRCS should use and/or require these protocols for collection of GHG and should preferably work with researchers who are accustomed to collecting these data. While standards have been set for

collecting an individual sample, the research community is still developing best practices for accurately measuring landscape scale greenhouse gas emissions.

Like suggestions for soil carbon sequestration sampling, NRCS should focus GHG sampling efforts on collecting more intensive samples in an organized fashion to calibrate regional models, rather than taking sparse, random samples across sites. Recent findings suggest the following protocol be followed for better understanding emissions:[8,9,10,11]

- Sample as intensively (spatially and temporally) as possible at a single site to capture data on environmental variable, soil properties, and management effects. Broad, random sampling will prohibit scientific rigor and credibility in results.
- Select field soils that have substantial spatial variability based on landscape features and yield heterogeneity to provide a range of soil conditions. Work with scientific/extension contacts to identify the sampling sites.
- Pair emissions data with soil core samples to determine initial carbon balance.
- Use gas flux analyzers to capture data on diurnal patterns, hydrology, fertilizer applications, temperature changes, management impacts. Use permanently installed sensors/probes down to 3 ft depth to measure soil moisture.
- Use in-field analyzers (e.g., Licor Trace Gas Analyzers[12]) to reduce sampling error due to sample collection, handling, and storage.

Recommendation: Facilitate a Panel of Experts to Update GHG Flux Sampling Protocol

In 2014, the Chief Economist's Office worked with public-private partners to develop a protocol for GHG methods and sampling - Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory (usda.gov). These protocols are now out of date and need to be updated by a panel of experts from USDA, universities, and private sector research institutions. We encourage NRCS to use IRA funding to support these updates by convening experts and developing protocol that can be used in academic and practical settings. A new version could as a starting point, use the 2014 document as a template and expand from that to include much of the detailed protocols for sampling, best management, and test beds and other details recommended in the letter. Ultimately, this work is needed to accurately quantify emissions from agricultural production and understand the impacts of conservation practices on climate outcomes.

Recommendation: Fund Joint Research on Carbon-Nitrogen Dynamics and the Impact on GHG Flux

Soils are complex ecosystems with innumerable interactions taking place at any moment. Soil carbon and nitrogen cycles are deeply connected, but the impacts of their interaction on GHG emissions have not been fully addressed because most grants and funding opportunities are focused solely on carbon dioxide and carbon, seldomly including nitrogen, its family of compounds, or even basic C-N reactions. If something We recommend funding opportunities for developing parallel 'test beds' in different climatic zones, major commodity cropping regions of the US, or some other diverse locations such as existing Long Term Ecological Research sites, NEON, NSF's Critical Zone Collaborative Network, or the USDA Climate Hubs using many types of sampling equipment and techniques for comparison between regions. USDA Climate Hubs could provide regional frameworks for these committees with funding from IRA. There is no 'silver bullet' when it comes to soils and the geographic, climatic, geologic, and ecological differences throughout the US, thus, one 'standard' for anything is highly unlikely.

Implementation Needs

Given the challenges we face in agriculture, it is crucial that NRCS work closely with partners at USDA and beyond to implement IRA funding. In the past year, USDA has launched several complementary initiatives, such as the Partnerships for Climate Smart Commodities grant program, and we encourage NRCS to cross coordinate with the Chief Economist, Undersecretary of Research, Extension, and Economics, and others to maximize the effectiveness of data collection and reporting.

Recommendation: Create a Federal Advisory Committee or Consultation Process to Handle Data & Quantification Protocol

USDA should create a formal advisory committee under the Federal Advisory Committee Act (FACA) or an informal consultation process to advise the agency as it collects myriad data from ongoing quantification programs so that it can faithfully carry out the GHG quantification program according to Congress' intent in the Inflation Reduction Act. This advisory committee should include farmers, ranchers, foresters, USDA and university soil, data, agronomic, and environmental scientists, private sector project developers, and agricultural and food supply chain businesses, with representation from minority and underserved producers. The advisory committee should be tasked with ensuring that data and other information collected are useful and help the agency achieve the goals of this program. This committee should assist the agency in developing its quality assurance and quality control (QA/QC) processes so that taxpayer dollars are not wasted on unneeded data collection activities. This Advisory Committee should be run jointly by leadership in NRCS, the REE mission area, and the Office of Chief Economist.

Recommendation: Standardize Measuring, Monitoring, Reporting, and Verification (MMRV) Protocol

New USDA programs that incentivize climate-smart agricultural practices should include best practices for data curation that transfer data with their metadata into safe repositories to maintain data privacy. The repository should ascribe to the FAIR (Findable, Accessible, Interoperable, Reusable) data standard accepted worldwide. Repository funding must also include tools to train and incentivize researchers and students to contribute organized and annotated data, and meta-data specialists for data extraction and upload applications.

Recommendation: Seek Cooperative Agreements to Train Soil Carbon Samplers

In order to develop a more robust understanding of how climate-smart practices impact soil carbon sequestration, we need more data. Specifically, NRCS can help with generating this data through the IRA funding by requiring soil sampling on conservation sites. Because the tests needed to accurately measure soil carbon require delicate sample handling, individuals collecting soil samples must have adequate training. We encourage partnerships with organizations, such as SSSA, to produce a training program for collecting soil carbon sequestration and greenhouse gas emissions samples. Any individual collecting samples, such as NRCS staff, producers, agronomists, or interns, should complete the training program and go through standardized procedures for reporting results.

2. How can NRCS engage the private sector and private philanthropy to leverage the IRA investments, including for systems of quantification?

Engage the Private Sector and Private Philanthropy to Leverage IRA Funds

In the past several years, private industry has made considerable investments into carbon and ecosystem service markets, climate-smart and regenerative agriculture, and conservation. First and foremost, NRCS should seek to complement the work of private industry, rather than duplicating efforts. Additionally, to effectively partner with the private sector, NRCS must make stable, science-based, and economically

proven investments which make partnerships feasible, economical, and sustainable. Finally, the NRCS must ensure that programs and incentives to address climate change in agriculture do not come at the expense of yields, which would be counter-productive to the need for expansion of crop production area and the enormous GHG emissions resulting from it. The NRCS must make a fundamental shift in how they interact with the private sector and build capacity to operate at a speed more aligned with private industry to effectively implement the IRA provisions.

Recommendation: Foster Trust with Stakeholders in the Private Sector

The NRCS must make genuine efforts across the country to foster trust with the private sector. Qualitative studies over the past decade indicate that producers are more likely to adopt conservation practices when they are learning about the programs from a trusted source.[13] Often, these advisers are private crop consultants, retail agronomists, or private lands biologists with locally-based NGOs. Producers may or may not have trusted relationships with local NRCS staff, therefore, it is critical that NRCS staff work alongside private sector advisers to get more conservation on the ground. NRCS staff should be actively engaged with state commodity boards, agriculture associations, and Cooperative Extension. To further build trust, NRCS should create a stakeholder-driven culture when implementing local conservation goals – rather than telling farmers what works in a one-way conversation, they should work with private sector advisers to collect constant feedback from producers and adjust accordingly.[14]

Recommendation: Create Transparency on Best Practices for MMRV and Technical Assistance

In conjunction with the research community and other agencies at USDA, NRCS should use IRA funding to convene a study to determine the current state of best practices for measuring, monitoring, reporting, and verifying soil carbon sequestration and GHG emissions. The study should not be conducted by NRCS scientists alone, but rather in partnership with REE through cooperating agreements with the National Academy of Science, universities, or professional societies (SSSA or ASA). Not only would these best practices be valuable for producers who are interested in adopting climate-smart practices, but they would also provide validation to the work of the private sector and foster innovation. Private sector stakeholders and producers should be assembled to review and guide the study.

Recommendation: Identify Knowledge Gaps with Potential to be Supported by Private Philanthropy

Building upon the former recommendation, there will likely be research and evaluation needed that cannot be covered in the scope of the IRA funding plan. In the absence of federal investments, private philanthropic organizations can support needed research and development to support climate-smart agriculture. Through the IRA implementation, NRCS should develop recommendations for current gaps in knowledge that investments from the private sector could help to bridge. These knowledge gaps should be identified alongside stakeholders at NRCS, other USDA agencies, universities, private research institutions, practicing professionals, professional societies, and producers.

In 2021, a survey of the ASA, CSSA, and SSSA membership revealed that the top areas where we need more information to address climate change are in nutrient management and germplasm or crop improvement. These survey results can be used as a starting point for developing priorities for private philanthropy.[15]

3. How should NRCS target IRA funding to maximize improvements to soil carbon, reductions in nitrogen losses, and the reduction, capture, avoidance, or sequestration of carbon dioxide, methane, or nitrous oxide emissions, associated with agricultural production?

Prioritize Practices with Proven Benefits and Support On-Farm Research

Efforts to address climate mitigation and resilience have broad consensus and support among agriculture, natural resources, and conservation stakeholders. In this moment, NRCS has a window of opportunity to align with this movement and play a role in supporting climate-smart agriculture. To maximize improvements to soil carbon and ecosystem services through the IRA funding, the NRCS must identify their role in the broader agriculture and conservation community and not try to do everything on their own. If the goal of the IRA funding is to get more conservation on the ground, NRCS should remain focused on practice adoption, program awareness, and enrollment and work with external partners to meet other needs. For instance, Cooperative Extension, agricultural retailers, crop advisers, and private lands biologists are often equipped to help a producer understand the agronomic and economic implications of conservation practices – NRCS should rely on these external advisers to guide producers. University and private sector researchers are equipped to collect samples, quantify outputs, and conduct research on best practices – NRCS should rely on these researchers to evaluate program effectiveness.

<u>Recommendation:</u> Significantly Invest in the Research Capabilities of the Land Grant Research Farms and Agriculture Experiment Stations

Each land grant university supports a research farm that is typical of the regions agriculture production capabilities. Some schools manage multiple locations that are placed to represent practices and regional climate. These research farms make an ideal 'test bed' for climate change technologies, advanced farm tools, testing sampling strategies and mitigation approaches. They offer the capability for long-term installation of equipment, practice management and education and outreach programing. We suggest that NRCS consider a direct partnership with land grant institutions and use their research farms as keystone research locations

Continuous Improvement Requires Continuous Monitoring and Evaluation

The private sector is clamoring for science-backed practices and products that facilitate the sequestration of carbon in soil and other ecosystem services. Researchers have found a great number of practices and products that show promise, but too many of these are effective only at a local or regional level. For new ideas that show promise, USDA should facilitate the collaborations and investments necessary to form networked research programs that study a variety of locally appropriate cropping systems, such as agroforestry, and soil amendments, such as locally produced biochar, for carbon storage, water filtration, reduced erosion, and other ecosystem services.

As new practices or products are identified by these projects, there needs to be rapid and continuous communication of new information and practices to the research community, which can verify data and legitimize practices. But the communication must not stop there – also important is to include those who can bring technical assistance directly to producers. USDA should provide on-going opportunities for researchers to collaborate with NRCS, Cooperative Extension, agricultural retailers, and professional agronomists, such as Certified Crop Advisers (CCAs), to establish regional standards, metrics, and testing protocols for climate-smart agricultural practices and their effects.

Recommendation: Expand the Conservation Innovation Grants (CIG) Program through EQIP.
The 2018 Farm Bill authorized USDA's Conservation Innovation Grants program to include on-farm innovation trials that implement conservation practices on working lands. The program was conceived as a partnership between NRCS and private sector partners, who can receive a part of the $25 million available annually to provide technical assistance and incentive payments to offset the risks and perceived risks to producers for trying new approaches. USDA should double funding for this program over the next ten years, focus on climate-smart agriculture practices, and specifically empower trusted, certified advisers, agricultural retailers, and extension to help producers develop climate-smart plans that qualify for the grants. The expansion should also include targets for including smaller and underrepresented producers.

Support Region-Specific Practice Standards with Proven Climate- and Co-Benefits

All aspects of crop production that involve keeping the soil covered, minimizing disturbance, and agronomic management can help sequester carbon and reduce emissions. Specifically, the eight following practices—when carefully applied and tweaked for each farm's cropping system and climate—present areas to cut GHG emissions and improve soil carbon sequestration.[16]

- **Nutrient management:** Changing fertilizer application methods from broadcast to subsurface, reducing rates, and using enhanced efficiency fertilizers. These are all great ways to improve nitrogen use, decrease emissions, and manage carbon sequestration**.** The foundation of nutrient management is the "4 Rs" – right source, right rate, right time, and right place. Using the "4 Rs" can help producers improve nitrogen use, decrease emissions, and manage carbon sequestration.
- **Strip cropping**: Adding and maintaining strips of perennial cover between rows can help increase soil carbon stocks in the field.
- **Forage and biomass planting:** Converting cropland to continuous grass or legume forage/biomass crops can help sequester carbon and prevent emissions associated with tillage. Plus, there are many grass and legumes cultivars that can be used for pasture, hay, or biomass production.
- **Cover cropping:** Keeping the soil continuously covered in seasons when it might otherwise lay bare is a great means of improving soil quality. Cover crops add root biomass, improving soil quality, sequestering carbon, and providing a nitrogen source to the next season's crops.
- **Conservation cover:** Perennial vegetation protects the soil from erosion, improves water infiltration, reduces runoff, and builds soil organic matter.
- **Reduced or no-till:** Decreasing tillage causes less disturbance to the soil, leaving carbon sequestered in the topsoil in place.
- **Perennial grasses:** On marginal lands, where cash crops often underperform, a better option might be planting perennial grasses. These grasses reduce soil erosion, restore carbon stocks, provide feedstock for biofuel and bioproducts, and serve as a mitigation strategy to prevent regional climate change.
- **Technologies:** New technology can enable carbon sequestration. Though we can't get into detail here, see "The Context Network: Global Agriculture Carbon Report" for more information.[17]

Because the scientific community is continuously learning more about the benefits and impacts of various conservation practices,[18] it is important that NRCS works closely with researchers to develop regional practice standards, such as those developed at land-grant universities. A panel of experts should regularly

look over practices and impacts – this can be accomplished through partnership agreements with professional societies and universities – to continually evaluate the co-benefits and drawbacks to various practices.

Recommendation: Prioritize Practices that Promote Landscape Scale Conservation Outcomes
For the purposes of the IRA funding, the NRCS should prioritize practices that have long-term climate benefits, such as taking marginal land out of production and converting to a more permanent perennial vegetation. However, NRCS cannot lose sight of overall soil and water conservation efforts. Practices that reduce erosion, enhance nutrient management, and promote soil health must be implemented on the ground to meet landscape scale conservation needs. ***Soil carbon sequestration and emissions reductions should not be evaluated alone, but rather considered as part of a complex agricultural and conservation system.*** Ultimately, climate-smart practices must also be economically and agronomically feasible for producers.

Recommendation: Enhance Support for Agroforestry within NRCS Conservation Programs
Agroforestry is one of the top land-based climate solutions due to the high carbon sequestration potential of this production system. Through agroforestry, we could sequester 2.2–6.4 billion metric tons of CO2 per year while simultaneously delivering myriad benefits to soil, air, water, and wildlife. However, establishing agroforestry practices requires upfront financial costs that can be prohibitive for producers. Additionally, producers must wait anywhere between three and eight years for trees and shrubs to mature and become harvestable. To sufficiently remove carbon, build resilience, and support biodiversity, agroforestry needs further support and prioritization within NRCS conservation programs.

The five nationally recognized agroforestry practices (windbreaks, riparian buffers, alley cropping, silvopasture, and forest farming) already have NRCS Conservation Practice Standards. However, not all of these practices are available to producers through EQIP and the Conservation Stewardship Program (CSP), in part due to the lack of technical expertise on these practices within NRCS staff. To better support producers in the implementation of agroforestry practices into their operations, NRCS should increase technical capacity and coordinate with the National Agroforestry Center to train field staff on agroforestry practices. NRCS should also consider creating a technical service provider (TSP) certification program to enable wider and faster delivery of technical assistance on agroforestry by on-the-ground stakeholders with in-house expertise.

Additionally, NRCS should provide higher payment rates for agroforestry practices and develop agroforestry bundles under CSP. The agency should also consider creating a separate funding pool for agroforestry under EQIP, as exemplified by the state of Missouri. Furthermore, NRCS should cost-share the full range of equipment and practices needed for mobile grazing and silvopasture as part of the 50% livestock set-aside under EQIP, prioritizing silvopasture and other grazing consistent with agroforestry.

Payment rates for agroforestry practices under federal conservation programs should reflect that these practices have multiple environmental co-benefits, higher upfront costs, a long waiting period until harvest during which producers forgo income. By increasing technical capacity and incentives for agroforestry, NRCS can meaningfully support producers in incorporating high-quality and regionally suitable trees and shrubs into their operations and maximize climate mitigation on working farms, ranches, and forests.

Improve Implementation through Outreach, Innovation, and Training

Adoption of sustainable practices is not only hampered by lack of awareness. Some sustainable practices may benefit agricultural systems in the long-term, but farmers need to earn a profit in the short-term to

stay in business. Incentives are needed that pay farmers directly to off-set short-term financial risks when they engage in sustainable practices that build soil.

Recommendation: Pilot Innovative Financial Incentives
In addition to traditional cost share, or pay for practice, USDA should consider programs that pay for performance. There are two significant reasons for this. First, it is rare that a single practice fully addresses a conservation challenge. Farms that combine multiple conservation practices, which lead to more robust outcomes, should receive higher compensation than single practices alone.

Second, the impacts of climate smart practices can vary greatly depending on where they are implemented. A multi-tier approach should also be considered. Under this scenario, USDA could pay a base rate for implementing practices and provide a premium based on measurable outcomes.

Finally, make investments into resources that will support farmers in the transition period to climate-smart practice adoption. Often, one of the greatest barriers when transitioning to new practices is a lack of equipment. Local NRCS offices should provide access to equipment, such as no-till drills with narrow row spacing, that can be loaned to growers enrolling in conservation programs.

Recommendation: Equip NRCS Staff and Contractors with Continuing Education Opportunities
As best practices continually evolve, it is critical that NRCS staff and external contractors have the opportunity to pursue continuing education and professional development to stay up-to-date. This is particularly important for staff working with producers who do not have experience or education in soil and water conservation. Ideally, these individuals should obtain a certification, such as the Certified Crop Adviser or Certified Professional Soil Scientist designation. Certification would provide several benefits:

- Certified individuals have access to continuing education opportunities through the certifying body.
- Certification often creates trust with producers due to the ethics requirements that CCAs must make recommendations on agronomic principles alone, independent from sales priorities.
- Continuing education would help NRCS innovate more rapidly as scientific knowledge evolves and therefore implement more effective conservation on the ground.
- Certification provides better connections within the profession and with peers across the industry and facilitates more engagement with professionals and farmers.
- Certified professionals outperform non-certified professionals in providing sound agronomic advice, leading to better outcomes for producers.

The NRCS staff working with producers should be provided with the opportunity to attend professional and scientific conferences and to actively engage with external practicing professionals.

4. How should NRCS streamline and improve program delivery to increase efficiencies and expand access to IRA funded programs and projects for producers, particularly underserved producers?

Coordinate Internal and External Efforts to Improve Program Delivery

As climate change exacerbates the pressures on agricultural producers to do even more with fewer inputs, while requiring agile production decisions in the face of changing environments, the pace of information

exchange needs to quicken. To move into the future, collaborations among existing groups should be strengthened, and new, interdisciplinary, and multilevel alliances must be formed. This will accelerate translational research – information flow to and from the farm producers and on-farm advisers – and accelerate dissemination of best practices.

Recommendation: Increase support for and formalize the coordinating and educational role of USDA Climate Hubs and support partnerships with climate centers across federal agencies.
As mentioned throughout these recommendations, it is critical that NRCS works with universities, Cooperative Extension, grower associations, retailers, conservation organizations, and others to meet conservation goals. The USDA Climate Hubs can convene various stakeholders and help to coordinate messaging so that producers are hearing the same concepts from NRCS staff and their trusted, on-farm advisers. The Climate Hubs can also facilitate workshops and field days to bring producers into the same room with researchers, Extension agents, NRCS staff, and other producers to share what's working in their regions.

Recommendation: Increase Staffing at NRCS
Over the past several years, we have continually heard that the NRCS is not equipped with enough staff to provide adequate technical assistance for conservation programs. While NRCS should also rely on external partners to assist in this role, internal staff capacity at NRCS must also increase. NRCS should streamline the hiring process, with more authority granted to NRCS to make hiring decisions. NRCS should also target outreach to underrepresented populations for new hires. Upon being hired, new employees should receive essential soil and water conservation training aligned with their role as well as become acclimated to local agricultural production. We encourage NRCS to work with partners, such as our Societies, to develop the educational content for staff related to soil and water conservation.

Recommendation: Create a Pilot Program for 'Conservation Consultants' to Supplement Technical Assistance Needs
The Technical Service Providers (TSP) program is not adequate in its current form to meet technical assistance needs that cannot be met by internal NRCS staff. As a compromise between hiring full-time staff and the temporary nature of the TSP program, NRCS should pilot a Conservation Consultants program. Conservation Consultants may be based at private organizations or in independent consulting roles. NRCS will create long-term contracts with employers and consultants to provide more stable, long-term technical assistance. The Conservation Consultants would be certified to do a suite of conservation planning support activities, rather than be certified for each activity individually. Finally, Conservation Consultants would receive baseline compensation directly from NRCS in addition to receiving payments for plans written.

5. How can NRCS expand capacity among partners to assist in providing outreach and technical assistance to support the implementation of IRA funding?

Leverage Partnerships with Trusted Advisers to Deliver Technical Assistance

Throughout the nation, agricultural producers are working to improve the economic and environmental sustainability of their operations. Many farmers are eager to share how they doubled their soil carbon over their lifetimes, or how they have now permanently parked their plows. These accomplishments were made possible in part through unbiased information coming from research institutions and federal research agencies. However, if only published in scientific journals, even the most important advances will have little practical impact because these methods of information sharing are not accessible.

Collaborations among universities, federal agencies, producers, and trusted advisers have enabled the access that is needed and produced profound improvements in the nation's soil and environmental health.

Cooperative Extension and USDA's Natural Resource Conservation Service (NRCS) employees work along with certified professional advisers, such as Certified Crop Advisors (CCAs), to bring the latest techniques and technologies to producers. Extension and certified professionals are already trusted resources that producers turn to for advice and assistance, and USDA should leverage these relationships to deliver technical assistance. At the same time when technical assistance is in high demand, the Cooperative Extension system is plagued with outdated infrastructure, reduced budgets, and limited personnel. Certified professionals struggle to navigate the cumbersome and complex process to gain Technical Service Provider (TSP) certification. Further, USDA must facilitate combined training for NRCS staff, TSPs, Cooperative Extension specialists, and CCAs so that all technical advisers are providing farmers with consistent messaging. To deliver state-of-the-art, timely assistance to producers and help them navigate production challenges and conservation opportunities, USDA needs to support an all-hands-on-deck approach among on-farm advisers.

Recommendation: Significantly Invest in the Cooperative Extension System

Many practices that increase carbon sequestration and soil organic matter are already cost-effective, but widespread adoption is hampered by a variety of factors, including awareness. The U.S. Department of Agriculture (USDA) and universities use Extension agents on a county level to deliver knowledge discovered through research to the farmers who can directly apply it on their land, but funding for Extension in real dollars has declined, as has the number of Extension agents available for farmers.[19] Congress should triple the funds for the conservation technical assistance staff at USDA's National Resources Conservation Service (USDA NRCS) and university Extension agents to empower a new Climate Conservation Corps, with NRCS, Certified Crop Advisors, and university Extension employees serving as the boots-on-the-ground to help farmers transition to a new carbon economy. USDA should use a portion of the IRA technical assistance funding to enter into cooperative agreements with Certified Crop Advisors and Cooperative Extension to support this work.

Recommendation: Improve the NRCS Technical Service Provider (TSP) Program

In its current form, the Technical Service Provider (TSP) program is not meeting technical assistance needs and in many cases, does not provide value to the professional working in the TSP role. The application and certification process is complex and tedious, and once someone become a TSP, payments are not adequate, reporting requirements are overly extensive, and renewal requirements cause many TSPs to leave the program. A comprehensive review of the TSP program should be conducted to identify the best ways to move forward, but while NRCS works to implement IRA funding and quickly get more conservation on the ground, we recommend the following immediate changes to the TSP program.

1. ***Accept certification without further requirements to become a TSP.***
   The TSP program should accept the professional certification for what it represents in knowledge and skill if it lines up with an NRCS practice without requiring anything further other than a review of the first plan or project. TSP certification should only be accessible to individuals who have been certified with competencies in conducting various technical assistance tasks. For instance, Certified Crop Advisers and Certified Professional Soil Scientists are qualified to write conservation or nutrient management plans through their certification performance objectives. Certified Foresters are already qualified to write plans related to forest practices. Certified Wetland

Scientists can write plans for wetland installation and restoration. Upon enrolling in the TSP program, NRCS can provide QA/QC on initial plans to provide constructive feedback.

2. ***Host educational content through professional societies and certifying bodies.***
   We continually hear from TSPs that the current AgLearn platform is difficult to access and has outdated educational materials. NRCS should work with professional societies, such as ASA, CSSA, and SSSA, to host the educational content for the TSP program. Our content is regularly updated with the most up-to-date scientific best practices and is easily accessed through our Online Classroom. We have professionals on staff who work exclusively on developing educational content for practicing agronomic and conservation professionals.

3. ***Focus on outcomes rather than specific software requirements.***
   The current protocol for TSPs submitting plans to NRCS is cumbersome and is often required to be done in a different software than the TSP uses routinely. NRCS should focus on outputs of plans, rather than a specific software, to provide TSPs with more flexibility.

4. ***Provide direct payments to the TSP for technical assistance work.***
   Producer-acquired TSP payment rates are paid through Financial Assistance funds which are generally capped at 75-to-90% of the actual costs. This means that either producers must pay the difference to the TSP or the producer-acquired TSPs must discount their rates in order to get work. Additionally, TSP payment rates vary widely between states, even for the same practice in adjacent States.[20] To account for this variability and financial uncertainty, NRCS should adjust payment protocol and provide payments directly to TSPs at a competitive rate, rather than submitting payments through producers.

5. ***Simplify the renewal process to allow automatic renewal if continuing education requirements are met.***
   Certified professionals are dedicated to receiving up-to-date information on scientific best practices and producer needs. Certification programs often require continuing education credits to maintain a certification. For instance, Certified Crop Advisers must complete 40 hours of continuing education every two years covering each of the competency areas of their certification – crop management, nutrient management, soil and water management, integrated pest management, and ethics. NRCS should set renewal requirements aligned with certification programs and allow TSPs to maintain their status automatically upon completing required continuing education courses. NRCS should automatically renew TSPs who maintain their professional certification like CCA or CPSS. The Certification body has more robust and rigid standards to maintain a high level of quality that NRCS can rely on.

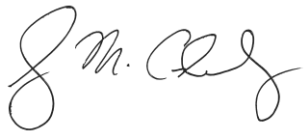
Conclusions

Effectively implementing the priorities outlined by the IRA will take an all-hands-on-deck approach. The NRCS cannot work alone to achieve climate-smart and conservation goals on a scale needed to address climate change and improve resilience. Our scientists and practicing professionals stand ready to assist and encourage NRCS to actively seek cooperating partners. We have made the following recommendations through these comments:

1. Invest in Research to Improve Quantification Methods
2. Engage the Private Sector and Private Philanthropy to Leverage IRA Funds

3. Prioritize Practices with Proven Benefits and Support On-Farm Research
4. Coordinate Internal and External Efforts to Improve Program Delivery
5. Leverage Partnerships with Trusted Advisers to Deliver Technical Assistance

Thank you for the opportunity to provide this feedback. Please let us know if you have any questions at all.



Jim Cudahy
Chief Executive Officer
American Society of Agronomy, Crop Science Society of Agronomy, Soil Science Society of America

---

[1] https://www.epa.gov/afos-air/national-air-emissions-monitoring-study
[2] https://decode6.org/articles/collect-soil-samples-to-calculate-carbon-stock/
[3] https://acsess.onlinelibrary.wiley.com/doi/abs/10.2136/sssabookser5.4.c9
[4] https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-1990-2014
[5] https://www.epa.gov/climate-indicators/greenhouse-gases
[6] https://scied.ucar.edu/learning-zone/how-climate-works/some-greenhouse-gases-are-stronger-others
[7] https://www.usda.gov/sites/default/files/documents/USDATB1939_07072014.pdf
[8] Wendroth, O., V. Vasquez, and C.J. Matocha. 2011. Field experimental approach to bromide leaching as affected by scale-specific rainfall characteristics. Water Resour. Res. 47, W00L03, doi: 10.1029/2011WR010650.
[9] Yang, Y., O. Wendroth, and R.J. Walton. 2013. Field-scale bromide leaching as affected by land use and rain characteristics. Soil Sci. Soc. Am. J. doi:10.2136/sssaj2013.01.0018.
[10] Schwen, A., Y. Yang and O. Wendroth 2013. State-space models describe the spatial variability of bromide leaching controlled by land use, irrigation and pedologic characteristics. Vadose Zone J. doi:10.2136/vzj2012.0196.
[11] Kreba, S.A., M.S. Coyne, R.L. McCulley, and O. Wendroth. 2013. Spatial and temporal patterns of CO2 flux in crop and grass land-use systems. Vadose Zone J. doi:10.2136/vzj2013.01.0005.
[12] https://www.licor.com/env/products/trace_gas/
[13] https://www.tandfonline.com/doi/full/10.1080/08941920.2019.1648710
[14] Amber Saylor Mase, Benjamin M. Gramig, Linda Stalker Prokopy. 2017. Climate change beliefs, risk perceptions, and adaptation behavior among Midwestern U.S. crop farmers. Climate Risk Management. 15: 8-17,
[15] https://www.agronomy.org/files/science-policy/letters/climate-change-survey-one-pager.pdf
[16] https://decode6.org/articles/practices-reduce-emissions-sequester-c/
[17] https://contextnet.com/multiclientreports/
[18] https://www.swcs.org/resources/publications/how-to-build-better-agricultural-conservation-programs-to-protect-water-quality
[19] Wang, SL. 2014. "Cooperative Extension System: Trends and Economic Impacts on U.S. Agriculture". Choices. Quarter 1.
[20] This finding is based on a report to be released in 2023 by the Keith Campbell Foundation for the Environment which evaluated the Technical Service Providers (TSP) program.