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March 3, 2021

The Honorable David Scott
Chair, Agriculture Committee
U.S. House of Representatives
Washington, DC 20515

The Honorable G.T. Thompson
Ranking Member, Agriculture Committee
U.S. House of Representatives
Washington, DC 20515

RE: Climate Change and the U.S. Agriculture and Forestry Sectors, Outside Witness Testimony

Dear Chair Scott and Ranking Member Thompson:

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, 12,500 Certified Crop Advisers (CCA), and 781 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.

The House Agriculture Committee's timely hearing on Climate Change demonstrates what the Societies also know – that agriculture and forestry are the linchpins of America's fight against climate change. Agricultural and forest soils have the potential to sequester enough carbon to make America carbon neutral, if not a carbon sink. American agriculture represents about ten percent of the country's greenhouse gas emissions, and agriculture accounts for nearly twenty-five percent of emissions globally.[1] It does not need to be this way. Farmed soils have between 25 and 75 percent less carbon than undisturbed soils, which means that agriculture has the potential to be a significant carbon sink,[2] providing as much as 0.2 Gt CO_2 equivalents per year by 2050.[3] American farmers can become globally recognized climate heroes by sequestering more than a fifth of U.S. carbon emissions, all without interfering with food production.[4] Forest activities, such as reforestation, improved forest management, and reduced deforestation have the potential for even greater carbon sequestration. The technical potential for carbon uptake by forest measures is estimated to be from 0.5 to 1.5 Gt CO_2 equivalents per year by 2050. Forest managers and agroforestry producers along with farmers and rangers are poised to deliver enormous emissions reductions and offsets from elsewhere in the economy.

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[1] https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions, https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data#Sector

[2] Lal, Rattan. "Managing soils and ecosystems for mitigating anthropogenic carbon emissions and advancing global food security." *BioScience* 60.9 (2010): 708-721.

[3] E. Larson, et al. "Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report." Princeton University, Princeton, NJ. December 15, 2020.

[4] Fargione, Joseph E., et al. "Natural climate solutions for the United States." Science advances 4.11 (2018): eaat1869.

Rural Americans have a strong voice in Congress through this Committee, but the fact that many rural Americans see environmental protection as destructive to their very livelihoods and way of life is an existential liability for the planet. We urge the Committee to quickly implement science-based policies that curb and mitigate climate change's effects while empowering producers with new tools, new sources of income, and the pride that comes from global recognition of their efforts.

Put carbon into soil

Carbon-rich farms are healthy farms

Sequestering carbon on farmland is critical to maintaining a healthy planet for generations to come. Sustainable agriculture that focuses on a broad, systems approach that returns carbon to the soil and builds soil organic matter has the double effect of pulling carbon out of the atmosphere and building healthier soils.[5] Soils with more organic matter absorb and retain more moisture, reducing the need for irrigation and increasing a farm's resilience to the damage associated with droughts or flooding.[6] More specifically, farms with high soil organic matter require fewer additional fertilizers and can produce healthier crops and higher yields.[7]

Awareness of best practices is key

Practices to sequester carbon include: no or low tillage; cover crops; diverse crop rotations, sometimes including grazing animals; land applications of manure, biosolids or urban compost; and precision agriculture.[8] These techniques are based in science, but widespread adoption in the United States is hampered by a variety of factors, one of which is 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 to farmers. Congress should triple the funds for conservation technical assistance 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.

Make sure techniques are cost-effective

Concern over potential extra costs associated with switching to new, unfamiliar systems can be alleviated by USDA programs. For example, USDA could be funded to develop a cloud-based cover crop support tool that is easy to use, freely available nationally, and locally specific. The tool would give detailed recommendations for which crops to plant, seeding rates, and more. It would also provide long-term economic data for transitions to demonstrate a producer's likely return on investment, and, given adherence to its recommendations, USDA could offer loans that cover extra costs and potential lost income for the first five years to promote implementation. Once a transition is achieved, USDA could reduce insurance rates for the farm's now less risky, more resilient system. Crop insurance subsidies that are more generous and flexible to producers engaging in sustainable practices will encourage these

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[5] Lal, Rattan. "Enhancing crop yields in the developing countries through restoration of the soil organic carbon pool in agricultural lands." *Land Degradation & Development* 17.2 (2006): 197-209.

[6] Basche, Andrea. "Turning Soils Into Sponges: How Farmers Can Fight Floods and Droughts." *UCS, editor Washington, DC* (2017): 1-18.

[7] Lal, Rattan. "Soil carbon sequestration impacts on global climate change and food security." *science* 304.5677 (2004): 1623-1627.

[8] Montgomery, D. R. (2017). *Growing a revolution: bringing our soil back to life*. WW Norton & Company.

practices and, subsequently, reduce risk.[9] So as not to disadvantage producers who have already made investments in cover crops, for farmers who have already have a five-year or longer history of successful cover crop management experience, insurance premiums can be reduced to offset a portion of their investment and to not leave these pioneering early adopters behind. Important to note, these interventions become exponentially more effective with access to broadband, making rural connectivity a key driver to enabling sustainable practices.

Carbon markets require scientific legitimacy
Congress should consider policies that facilitate ecosystem services markets for producers to earn money directly from sequestering carbon, reducing emissions, preventing erosion, enhancing water quality, and improving the viability of carbon land sinks in both agricultural and forested lands. Such a market needs to be created *and maintained* with the most up-to-date science. Science is always moving forward – new information is constantly discovered, but this must not impede a market from forming now, nor should such a market be prevented from incorporating new findings as they come. Investments in ecosystems science, which includes, for example, soil science, agronomy, forestry, and data science working together, will inform a trusted market that accurately measures and values ecosystem services. Importantly, a lack of science underpinning such a market will greatly degrade trust in its value. This would lead not only to the system's demise but it could also doom future plans to pay producers for ecosystem services, even if subsequent ideas are defensible.

Hundreds of millions of dollars per year in soil and forestry research are needed over the next decade to establish ecosystem health benchmarks so that best practices can be developed for producers over wide geographic ranges. There are proven means of management-based soil carbon sequestration,[10,11,12] but which practices have the largest impact, and where these practices can be optimized, is essential information for valuing ecosystem credits. Also necessary are rapid soil tests that validate these benchmarks. USDA's National Institute of Food and Agriculture (NIFA) should carve out funding for research on soil and forest health and the sustainable, systems-based approaches that return carbon to the soil and build soil organic matter. Congress should fully fund AgARDA with a mandate to invest in high-risk and complex, systems-level research for improving carbon land sinks.

Invest in Conservation
Expand conservation programs like the Conservation Reserve Program (CRP) and the Environmental Quality Incentives Program (EQIP)
Congress has decided that for some lands, the ecological impacts of farming outweigh the potential economic benefit to the producer. The Conservation Reserve Program (CRP) is an option Congress gives producers that pays them to take this land out of production and to restore forests and grasslands. But producers may decide that the potential profit made by planting crops could outweigh the CRP payments, compelling producers to plant on land better suited to conservation. Congress should adjust CRP guidelines to incentivize conservation under a variety of economic circumstances. The guidelines

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[9] Pan, William L., et al. "Integrating Historic Agronomic and Policy Lessons with New Technologies to Drive Farmer Decisions for Farm and Climate: The Case of Inland Pacific Northwestern US." *Frontiers in Environmental Science* 5 (2017): 76.
[10] Poeplau, Christopher, and Axel Don. "Carbon sequestration in agricultural soils via cultivation of cover crops–A meta-analysis." *Agriculture, Ecosystems & Environment* 200 (2015): 33-41.
[11] Luo, Zhongkui, Enli Wang, and Osbert J. Sun. "Can no-tillage stimulate carbon sequestration in agricultural soils? A meta-analysis of paired experiments." *Agriculture, ecosystems & environment* 139.1-2 (2010): 224-231.
[12] McDaniel, M. D., L. K. Tiemann, and A. S. Grandy. "Does agricultural crop diversity enhance soil microbial biomass and organic matter dynamics? A meta-analysis." *Ecological Applications* 24.3 (2014): 560-570.

should also be amended to focus primarily on the marginal lands the program was intended to protect, while lands better suited to production should be channeled to the Environmental Quality Incentives Program (EQIP). EQIP is an excellent way to provide funding for conservation practices on working lands, but it is oversubscribed. Congress should allocate more funding for this program.

Water and irrigation research helps producers and preserves natural ecosystems
Agriculture accounts for approximately 80 percent of freshwater use in the United States[13] because irrigation can double or even triple grain yields in managed agriculture.[14] But even as irrigation helps producers grow more food on less land, extreme weather events and increased development put pressure on freshwater resources. Research on improved regional irrigation strategies and on crops that require less water is key. This research has the combined benefit of helping producers withstand droughts and floods while preserving more freshwater for natural ecosystems and human consumption.[15]

Diverse crops and markets make resilient farms
As new weather patterns change which crops producers can grow, science needs to step in with new options to keep farms resilient. Research is needed to help current commodity crops adapt, but producers and their lands will benefit from a new generation of climate-resilient crops that are better at carbon sequestration and nitrogen use efficiency and more tolerant of droughts and floods. USDA can partner with universities and industry to breed these desperately needed crops. AQUAmax corn and perennial grain crops, for example, are promising new options. Research and partnerships to produce these crops rely on the USDA National Plant Germplasm System and USDA gene banks, which preserve and develop plant genetic resources, such as seeds.[16,17] The genetic resources contained in USDA gene banks will be utilized more intensively, both for adapting existing crops and for introducing new crop species or crop uses to changing and more variable environments.

Crop diversification will require expanded markets and market diversification, enabling producers to weather crop price fluctuations, and diverse crop rotations are a tenant of a soil health-centered agriculture – a win-win for both producers and climate.[18] Agronomic research should widen to include a multitude of crops, agroecoforestry, and the investments needed in economics, marketing, and outreach to prepare for commercial production and expand their markets. Perennial crops, such as perennial grain crops, for example, have the potential to sequester carbon year after year while saving

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[13] https://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use/

[14] Kukal, Meetpal, and Suat Irmak. "Irrigation-limited yield gaps: trends and variability in the United States post-1950." *Environmental Research Communications* (2019).

[15] Basche, Andrea D., and Marcia S. DeLonge. "Comparing infiltration rates in soils managed with conventional and alternative farming methods: a meta-analysis." *BioRxiv* (2019): 603696.

[16] Gepts P (2006) Plant genetic resources conservation and utilization: The accomplishments and future of a societal insurance policy. Crop Science 46:2278-2292 doi: 10.2135/cropsci2006.03.0169gas

[17] Byrne PF, Volk GM, Gardner C, Gore MA, Simon PW, Smith S (2018) Sustaining the future of plant breeding: the critical role of the USDA-ARS National Plant Germplasm System. Crop Science 58:451-468 doi: 10.2135/cropsci2017.05.0303

[18] Pan, William L., et al. "Integrating Historic Agronomic and Policy Lessons with New Technologies to Drive Farmer Decisions for Farm and Climate: The Case of Inland Pacific Northwestern US." *Frontiers in Environmental Science* 5 (2017): 76.

producers money in seeds and planting and enhancing biodiversity[19], but market infrastructure is key to ensuring profitability at comparable levels to current commodities.

Expand on-farm energy production through biofuel systems
Biofuels play an important role in meeting global energy demands, but many crops traditionally used for bioethanol production, such as corn (maize), sugarcane, and sugar beets, are more valuable as food and feed sources. Because the priorities of energy and food are in constant competition, these types of biofuel crops will not be able to meet rising global energy demands. Instead, investments are needed to research and deploy biofuel systems that use agricultural residues and food waste while promoting sustainable land use.[20]

Nitrogen management research benefits the planet and the producer's bottom line
The use of industrially produced nitrogen fertilizers on farms has saved billions from starvation and substantially reduced the amount of land that would have been cleared for agriculture. But applied nitrogen that a crop does not use immediately can lead to contaminated waterways, causing "dead zones" and "do not drink" water advisories. Excess nitrogen in the soil also converts to the potent greenhouse gas nitrous oxide,[21,22] which causes three hundred times more global warming than carbon dioxide.

Researchers are discovering new ways to reduce nitrogen applications without compromising yields. Precision agriculture, for example, is a promising technology powered by artificial intelligence that requires rural broadband for high-speed wireless connectivity. It combines best practices with on-farm data and digitally enabled equipment so that fertilizers can be applied according to variabilities across a field. This represents a major paradigm shift from managing an entire field the same way. Meanwhile, management techniques take advantage of rotations with crops that produce, or "fix," their own nitrogen from the air, and a recent discovery of nitrogen fixation in a corn (maize) landrace represents a huge potential for reducing nitrogen applications worldwide[23], should researchers harness its potential in commercial varieties.

Research and Extension Are Vital
Agricultural producers need healthy soils that sequester carbon, resist flooding, and retain moisture; they need Extension experts and Certified Crop Advisors who can rapidly bring them up to speed on the latest best practices; they need cost-effective policies that incentivize conservation and follow the latest science; and they need resilient crops and robust markets for them. Each of these needs can be met with increased investments in Extension and agricultural and forestry research on soil and ecosystem health, agricultural and forestry best practices, and a diversity of crops. Resilient, sustainable farms, forests, and ranches of the future must be our legacy.

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[19] Glover, Jerry D., et al. "Increased food and ecosystem security via perennial grains." *Science* 328.5986 (2010): 1638-1639.
[20] Gupta, Anubhuti, and Jay Prakash Verma. "Sustainable bio-ethanol production from agro-residues: a review." *Renewable and sustainable energy reviews* 41 (2015): 550-567.
[21] Canfield, Donald E., Alexander N. Glazer, and Paul G. Falkowski. "The evolution and future of Earth's nitrogen cycle." *science* 330.6001 (2010): 192-196.
[22] Snyder, C. S., et al. "Agriculture: sustainable crop and animal production to help mitigate nitrous oxide emissions." *Current Opinion in Environmental Sustainability* 9 (2014): 46-54.
[23] Van Deynze, Allen, et al. "Nitrogen fixation in a landrace of maize is supported by a mucilage-associated diazotrophic microbiota." *PLoS biology* 16.8 (2018): e2006352.

Thank you for your consideration. For additional information or to learn more about the ASA, CSSA, and SSSA please contact Karl Anderson, Director of Government Relations, kanderson@sciencesocieties.org or 202-408-5382. We look forward to hearing from the Committee on how our membership's expertise can help farmers become climate heroes.

Cc: Members of the House Agriculture Committee