EXECUTIVE SUMMARY

Soil Carbon Moonshot

Grounding Carbon Storage in Science

MARCH 2022

Carbon180

ABOUT CARBON180

Carbon180 is a climate NGO with a vision to remove legacy carbon emissions from the atmosphere and create a livable climate in which current and future generations can thrive. Based in Washington, DC, we design and champion equitable, science-based policies that bring carbon removal solutions to gigaton scale.

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Investments from the US federal government have shaped the notion of modern farming known across the country. For decades, the agriculture sector benefited from robust public research and investment that once established the US as a global leader and helped the sector navigate economic downturns, global competition, and rapid population growth.

Since the early 2000s, however, public investments in agricultural research have stagnated; meanwhile, the sector faces its greatest challenge yet as extreme weather intensifies existing economic challenges.

American farmers and ranchers are now working on the frontlines of climate change, at once managing huge swaths of land, feeding the country, stewarding our natural resources, and retooling their long-standing practices to build resilience and remain competitive. More than ever, they need support to make informed changes on their land to curb and adapt to climate change and ensure their businesses thrive.

Soil carbon sequestration can be a solution that radically transforms the agriculture sector's relationship to climate change. Experts estimate that globally, soils could store up to 5 billion metric tons of carbon dioxide (CO_2) per year — an amount equal to 13% of global annual greenhouse gas emissions.[1] If we draw down ambient CO_2 and stow it in the soil of our agriculture system, we can turn the very emissions causing drought, yield instability, and labor impacts into a source of economic and environmental benefit. Healthy, carbon-rich soils build resilience to extreme weather and contribute to increased productivity — and across the 915 million acres of US farmland, soil can play an important role as a climate solution.

Despite the potential, there is virtually zero dedicated funding for soil carbon research today and related efforts across the federal government are fragmented. While soil carbon is gaining momentum with policymakers, private companies, and farmers alike, many knowledge gaps remain, and reaching scale will require

1. Paustian, K., Larson, E., Kent, J., Marx, E., & Swan, A. (2019). Soil C Sequestration as a Biological Negative Emission Strategy. *Frontiers in Climate*, 1. https://www.frontiersin.org/articles/10.3389/fclim.2019.00008/full

strategic investments in research. What remains most acutely unknown is the measurement and verification of carbon stored in our soils from acre to acre. For one, few rigorous soil carbon protocols exist, making it difficult to reliably ensure that carbon stays sequestered over long periods of time.[2] Today, farmers are asked to take physical samples from their land and mail them to a lab for carbon analysis — an arduous process, especially for small- and medium-sized farms and those that lack access to additional capital. Existing protocols, to fill in a complete picture of an operation's soil storage potential, often rely on models informed by insufficient source data to predict soil carbon. Measurement aside, soil carbon research to date has neglected to explore the economics and real-world implementation challenges that farmers face and has stopped short of developing best practices for the diversity of regions and operation types that makeup US agriculture, including specialty crop, dryland, livestock, and small-scale operations.[3] If we can advance our understanding of soil carbon — with practices embraced by farmers, tools that accurately measure climate benefits, and incentives grounded in science — the US will be positioned to develop and deploy the next generation of climate solutions for the agriculture sector.

To meet this challenge and scale soil carbon in a science-driven way, we need an ambitious, interdisciplinary, coordinated interagency research program: a Soil Carbon Moonshot (SCM). Only a moonshot program can marshall the necessary resources from across the federal government to pursue ground-breaking research and speed up innovation where solutions may not yet be profitable or scalable. The Soil Carbon Moonshot provides a North Star for agencies, ensuring that efforts are coordinated across the federal government and fill core research gaps to equip policymakers, farmers, and technical assistance providers with the findings necessary to scale soil carbon practices. Moonshot research programs can also be more expansive, investing in emerging technologies and practices that are so far unexplored but could unlock new benefits.

Critically, the Soil Carbon Moonshot offers a path forward for standardized, affordable, and easy-to-use monitoring, reporting, and verification (MRV) of soil carbon to ensure that farmers can maximize and be rewarded for soil carbon storage and that agriculture's climate benefits are tangible. A successful research

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2. Zelikova, J., Chay, F., Freeman, J., & Cullenward, D. (2021). A buyer's guide to soil carbon offsets. CarbonPlan. https://carbonplan.org/research/soil-protocols-explainer

3. Zelikova, J., Amador, G., Suarez, V., Kosar, U., & Burns, E. (2020). *Leading With Soil: Scaling Soil Carbon Storage in Agriculture*. Carbon180 Reports. https://static1.squarespace.com/static/5b9362d89d5abb8c51d474f8/t/5eaa30d12c3a767e64c3845b/1588211922979/LeadingWithSoil_Final+Text.pdf

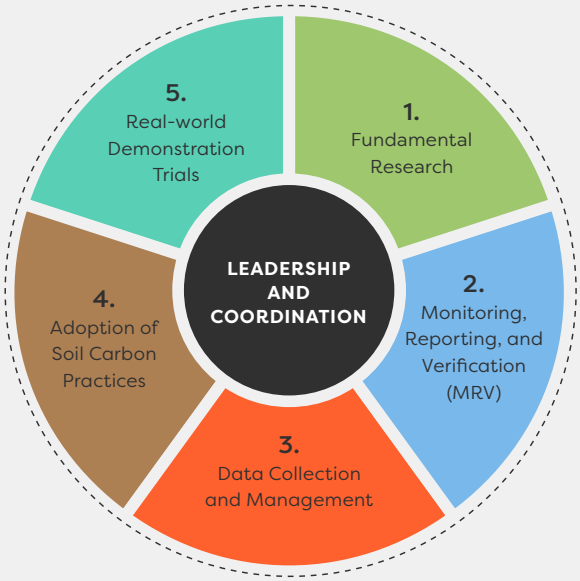
program will also recognize farmers and ranchers are on the frontlines of this work and need assistance in overcoming the socioeconomic and cultural barriers to the widespread adoption of soil carbon practices — an element of this moonshot program that is particularly salient for small-scale and Black, Indigenous, and people of color (BIPOC) producers. Ultimately, the goal is to encourage wide-scale adoption of regionally-appropriate soil carbon practices, position farmers and ranchers to be rewarded for soil carbon storage, and catalyze agriculture's climate-mitigating potential.

To realize this vision, the Soil Carbon Moonshot proposes an interagency, coordinated $2.3 billion investment, centered at the United States Department of Agriculture (USDA), over five years, and across five key categories: (1) fundamental research, (2) MRV, (3) data collection and management, (4) adoption of soil carbon practices, and (5) soil carbon demonstration trials. A program like this can drive a powerful transformation for USDA's approach to climate mitigation.

A research moonshot for soil carbon is both critical and timely given the increasing interest and action in soil carbon sequestration, including voluntary carbon market programs, net-zero climate pledges, unprecedented bipartisan action on climate-smart agriculture, and new programs to support climate-smart agriculture and forestry projects. Outside of the government, environmental nonprofits, commodity groups, and global food businesses have also emphasized the need for improved science around agriculture as a climate solution. Paying for soil carbon storage — whether through carbon markets or dedicated policy incentives — is critical for actualizing soil carbon storage, but foundational science is an urgent prerequisite that deserves further Congressional and administrative attention and investment.

At scale, soil carbon storage is both an economic and environmental answer to the pressures facing our farming system. We need to strategically, robustly, consistently, and specifically invest in soil carbon research before these practices can be scaled acre by acre. A robust and coordinated soil carbon research program reestablishes US leadership in public agriculture R&D and positions our farming system to address our generation's most pressing, complex societal and environmental challenges. The Soil Carbon Moonshot spells out a holistic and multifaceted roadmap to ground soil carbon storage in science, serving the patchwork of farmland across the country, the farmers and ranchers who steward our natural resources, and the soil itself.

Key investment areas for soil carbon



High-level Recommendations

CATEGORIES	RECOMMENDATIONS	FUNDING INCREASE OVER 5 YEARS*
Leadership and Coordination	**1.** Establish an interagency committee to develop a strategy and action plan to advance soil carbon research, education, and technical assistance initiatives across the federal government.	N/A
	2. Establish a dedicated official to lead coordination of soil carbon research efforts within USDA and across other federal agencies.	N/A
Fundamental Research	**3.** Invest in soil carbon dynamics research across programs and agencies.	Climate Hubs (+$25 million) SARE (+$10 million) LTAR (+$25 million) GEO (+$25 million) BER (+$25 million) **Total: $110 million**
	4. Develop advanced cultivars that can enhance carbon uptake and retention.	AFRI (+$100 million) ARS (+$125 million) **Total: $225 million**
	5. Develop, test, and deploy region-specific best practices for increased soil carbon.	Climate Hubs (+$28 million) SARE (+$10 million) LGU (+$30 million) NAC (+$20 million) **Total: $88 million**
	6. Expand support for underexplored soil amendments to forge the next generation of agricultural climate solutions.	ARS (+$250 million) **Total: $250 million**
		TOTAL $673M

* Funding levels adapted from the National Academies of Sciences Negative Emissions Technologies and Reliable Sequestration: A research agenda, Energy Futures Initiatives Clearing the Air report, reviews of existing and analogous program funding, as well as conversations with experts.

High-level Recommendations

CATEGORIES	RECOMMENDATIONS	FUNDING INCREASE OVER 5 YEARS*
Monitoring, Reporting, and Verification	**7.** Audit existing and develop new soil sampling protocols to support data collection efforts.	Climate Hubs (+$6 million) LTAR (+$25 million) **Total: $31 million**
	8. Improve and develop new measurement tools to generate robust soil carbon quantification.	LTAR (+$100 million) AFRI (+$100 million) FFAR (+$100 million) Climate Hubs (+$20 million) SARE (+$25 million) **Total: $345 million**
	9. Advance modeling and predictive tool development to reduce the cost and expand the number of acres with soil carbon MRV.	ARS (+$45 million) NIFA (+$20 million) GEO (+$25 million) ESD (+$25 million) **Total: $115 million**
	10. Assess and verify the effectiveness of soil carbon measurement tools in real-world agricultural contexts.	CTA (+$25 million) **Total: $25 million**
	11. Create decision support tools to empower farmers and ranchers to implement the best soil carbon practices for their unique operations.	NRCS (+$50 million) **Total: $50 million**
		TOTAL $566M
Data Collection and Management	**12.** Launch a national soil carbon monitoring network to map existing soil carbon stocks, uncover the areas with the greatest potential gains, and link agricultural management practices to carbon outcomes.	SCMN (new) (+$300 million) RaCA ($75 million) LTAR (+$200 million) Climate Hubs (+$25 million) **Total: $600 million**
		TOTAL $600M

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High-level Recommendations

CATEGORIES	RECOMMENDATIONS	FUNDING INCREASE OVER 5 YEARS*
Adoption of Soil Carbon Practices	**13.** Investigate the costs and benefits of soil carbon practice adoption to better incentivize wide-scale adoption and maximize soil carbon storage.	ERS (+50 million) **Total: $50 million**
	14. Identify barriers to adoption of soil carbon practices to create the necessary conditions to scale soil carbon storage.	NASS (+$3 million) NRCS (+$3 million) **Total: $6 million**
		TOTAL $56M
Demonstration Trials	**15.** Establish an extensive network of real-world demonstration trials to test and de-risk soil carbon practices across the diversity of US agriculture.	CIG (+$320 million) SARE (+$60 million) **Total: $380 million**
		TOTAL $380M

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