

WRITTEN TESTIMONY for hearing on “Title II Conservation Programs: Exploring Climate Smart Practices”  
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Chairwoman Spanberger and Ranking Member LaMalfa, my name is Dr. Keith Paustian; I’m a Professor at Colorado State University, Department of Soil and Crop Sciences. I do research and teaching on soil ecology and biogeochemistry related to agriculture and climate. Thank you for allowing me the opportunity to speak at your hearing today.

Agriculture, both in the US and Globally, is facing several challenges, while being called upon to deliver more and more products and services to an increasing global population. Agriculture is a significant source of GHGs, accounting for about 10% of total US emissions<sup>1</sup> and 14% of global emissions<sup>2</sup>. However, agricultural soils can also be a carbon sink, removing carbon dioxide from the atmosphere and converting it into soil organic matter that improves soil fertility and soil health.

The key determinants for reducing soil GHG emissions, sequestering carbon and improving soil health are the agronomic practices employed by the farmer. Many so-called conventional practices -- including use of continuous annual crops, heavy tillage, extended bare-fallow periods and cultivation of marginal lands -- have, over time, significantly depleted soil carbon stocks. However, we can reverse much of those historic carbon losses by adopting a variety of conservation practices including reduced and no-tillage, cover crops, more diverse crop rotations, field buffers, agroforestry, and other practices<sup>3</sup>. These management practices lead to more carbon dioxide being taken up by plants and converted to organic matter stored in the soil and with less soil disturbance, which also helps to maintain more of that added organic matter.

In addition to sequestering carbon, many of these practices help to “tighten” nutrient cycles, reducing leaching losses that contaminate ground and surface waters and reducing emissions of nitrous oxide – another GHG – from soils. In addition, soils rich in organic matter are also more resilient to both flooding and drought conditions, which reduces yield loss due to extreme climate events.

While these conservation management practices are seeing increasing use in the US, there’s massive room for additional adoption – for example, cover crops are still only planted on less than 5% of our annual cropland. USDA conservation programs such as EQIP, the Conservation Stewardship Program (CSP), the Conservation Reserve Program (CRP) and others have been key to introducing appropriate conservation practices to producers across the country and to encourage adoption through cost-sharing, direct payments and technical assistance. Although many conservation practices can pay for themselves in the long run by

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<sup>1</sup> <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>

<sup>2</sup> <https://www.ipcc.ch/report/ar5/syr/>

<sup>3</sup> Paustian, K., J. Lehmann, S. Ogle, D. Reay, G.P. Robertson & P. Smith. 2016. Climate smart soils. *Nature* 532:49-57.

improving soil function and yield stability, there are numerous barriers to adoption. Farming is inherently risky and farmers tend to be risk averse. Thus, the support payments and technical training and outreach from these USDA programs help to mitigate risk while farmers transition to these new practices.

One of the activities that my research team at Colorado State University has been involved in with USDA over the past 12 years has been the development of the COMET-Farm system. COMET-Farm<sup>4</sup> is an on-line tool that farmers, ranchers, crop consultants, NRCS field staff and others can use to do a full carbon and GHG inventory of their operation and explore implementing different conservation management practices to estimate how much they could increase carbon sequestration and reduce other greenhouse gas emissions. The tool is free and available for any one that has an internet connection. The tool implements USDA's Entity Scale Greenhouse Gas Inventory Methods which were developed by top experts from government, academia and industry, overseen by USDA's Office of Energy and Environmental Policy and first published in 2014<sup>5</sup>. We've also developed a related tool called COMET-Planner<sup>6</sup> that gives a quick overview at the regional scale of the impacts of implementing NRCS-prescribed conservation practices on carbon sequestration and GHG reductions. The COMET tools are currently being used by 10s of thousands of users, including federal agencies, state governments, NGOs, companies, consultants, extension personnel, students, as well as individual farmers and ranchers (see attached Appendix A of current COMET users.)

To bring about truly transformative changes on the nation's agricultural lands will require continued support from federal and state governments but also increased participation and investment from the private sector. Over the past couple of years there's been growing interest from major companies towards investing in carbon drawdown approaches, including soil carbon sequestration, to help meet corporate carbon neutrality and sustainability goals. In addition, many agriculturally-related industries are striving to develop low carbon food and fiber products.

To increase the confidence and willingness of the private sector to invest in soil carbon solutions, and to design optimal public policy, we need to improve our abilities to cost-effectively measure and monitor carbon sequestration and greenhouse gas reduction in the agricultural sector and reduce uncertainties in our estimates. While we have many excellent long-term field experiments documenting the performance of conservation practices, as well as highly capable models and tools such as COMET-Farm, there are a number of research and development initiatives that could significantly improve our capabilities. A number of these R&D priorities have been documented in a 2019 study by the National Academy of Sciences<sup>7</sup> on so-called negative emission technologies, including soil carbon sequestration. I will just mention a couple of them here.

One is the need for a national system for on-farm measurements of soil carbon stock changes over time. The National Resources Inventory (NRI) system is managed by USDA and provides a statistical sampling of farms

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<sup>4</sup> <https://comet-farm.com/>

<sup>5</sup> [https://www.usda.gov/sites/default/files/documents/USDATB1939\\_07072014.pdf](https://www.usda.gov/sites/default/files/documents/USDATB1939_07072014.pdf)

<sup>6</sup> <http://comet-planner.com/>

<sup>7</sup> <https://www.nationalacademies.org/our-work/developing-a-research-agenda-for-carbon-dioxide-removal-and-reliable-sequestration>

that tell us what management practices (such as crop rotations, irrigation, fertilizer use, etc.) are being used but there are **no** on-the-ground measurements of, for example, soil carbon stocks. If USDA chose a few thousand NRI points on which to measure soil C stocks every 7-8 years, we would be able to build up a record of soil C stocks changes over time. Our forest inventory system provides this type of information on biomass C changes; we need something similar for our soils.

We also need capabilities for field performance testing of new technologies, such as new crop varieties, new soil amendments and new practices that aren't currently included in long-term field experiments. Typically assessing the impact of new practices or crop types on soil carbon sequestration can take a decade or more; we need systems to assess capabilities of new technologies much more rapidly.

Finally, there's a growing scientific consensus that improved quantification systems can be achieved by more fully integrating multiple data sources, including ground-based measurements and monitoring networks, remote sensing, crowd-sourced data on management activities and dynamic models<sup>8</sup>. Further R & D investments in developing an integrated soils information system can yield major improvements in the next few years.

In summary, USDA Title II programs have been instrumental in promoting the adoption of conservation practices that can yield significant climate benefits along with promoting healthier soils and ecosystems. Good tools exist now to advance and expand policies to promote climate-smart agriculture. Further improvements in quantification technologies can help increase engagement by the private sector to take these improved agricultural conservation practices to scale.

Thank you. I'll be happy to take any questions.

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<sup>8</sup> Paustian, K., et al. 2019. Quantifying carbon for agricultural soil management: from the current status toward a global soil information system. *Carbon Management* 10:567-587.

Appendix A. Report to USDA/NRCS, March 2021, Summary of COMET-Farm and COMET-Planner users

## COMET-Tools Outreach Report

03/12/2021

### COMET-Farm

Year	Total Users	Annual Sessions
2015		3,769
2016	140	4,201
2017	407	2,497
2018	777	3,273
2019	901	2,500
2020	4,181	12,342
2021 (as of 3/12/2021)	1,345	3,111

### COMET-Planner

Year	Total Sessions
2016	4,582
2017	7,985
2018	10,029
2019	8,564
2020	5,626
2021 (as of 3/12/2021)	679*
Lifetime	37,460

\*Excluding an anomaly of 1,121 users on 2/1/2021

### User Support via Help Desk:

Year	Sessions	People	Hours	Solution Article Views
2016	37	54	35.2	-
2017	26	40	21.7	-
2018	38	26	11.5	-
2019	74	104	67.8	-
2020	377	398	321.5	413
2021 (as of (3/12/21)	92	59	16	284

### YouTube Training Video Views

Video	Views
Assessing Animal Ag (Dairy)	170
Using Shape Files in COMET-Farm	107
Assessing Agroforestry	123
Assessing Croplands	449
Assessing Croplands (Rice)	89
Assessing Forestry	96
Introduction to COMET-Energy	131
COMET-Planner video (2015)	2250
COMET-Planner video (2017)	1157
New Drag and Drop Feature	46
COMET-Farm & COMET-Planner Introduction *New Channel*	136
Creating a COMET-Farm Account *New Channel*	27
Navigating COMET-Farm *New Channel*	29
Carbon Farm Planning Using COMET-Farm	231
New Animal Ag Accounting (flexible baseline, defining herds, herd copy)	19

### Outreach to Date

Federal, State, Regional and Local Government	
USDA Agricultural Research Service	State of Hawaii
USDA Farm Services Agency	San Miguel County, Colorado
California Department of Food and Agriculture	Boulder County, Colorado City of
California Air Resources Board Resource	Boulder, Colorado LaPlata County, Colorado
Conservation Districts throughout California	Summit County, Utah Johnson County, KS
WHATCOM Conservation District, Washington State	Sierra Resource Conservation District
Wilkin Soil and Water Conservation District, Minnesota	NRCS- Annapolis, MD; Walhalla, SC; McMinnville, OR; Washington, D.C.; Connecticut; Madison, WI; Columbia, MO;
Department of Agriculture, Forestry & Fisheries (S. Africa)	Colorado Energy Office
California Air Resources Board	Boulder County (Colorado) Parks and Open Space
New Mexico Department of Agriculture	Alameda County Resource Conservation District

<b>Federal, State, Regional and Local Government (cont.)</b>	
Indiana Department of Agriculture	Tualatin Soil and Water Conservation District
Wisconsin Land + Water	Napa Resource Conservation District

<b>Higher Education</b>	
Colorado State University	University of Northern Colorado
Bard College	University of Wyoming
North Dakota State University	University of Hawaii
University of Maryland	University of Vermont
Western Colorado University	Oklahoma State University
University of Guelph	Yale University
Rutgers University	Northern Arizona University
Georgia Institute of Technology	University of California Composting Education Program
Nueta Hidatsa Sahnish College- North Dakota	

<b>NGO's</b>	
The Marin Carbon Project	Carbon Cycle Institute
Environmental Defense Fund	Chesapeake Bay Foundation
The Nature Conservancy	American Farmland Trust
Climate Action Reserve	American Carbon Registry
Verra (formerly Verified Carbon Standard-VCS)	Innovation Center for U.S. Dairy
Solano Land Trust	Colorado Carbon Fund
The Pinhead Institute	Ducks Unlimited
Sustainable Tompkins	Soil Health Institute
National Corn Growers	Soil Health Partnership
Straus Family Farm	Project Together
Clear Frontier Ag Management	Shelburne Farms
Fish Friendly Farming	Energy District
Carbon 180	California Land Stewardship Institute
Sunflower City	

<b>Agricultural Industry Organizations</b>	
California Farm Bureau	California Almond Growers Rocky
Mountain Farmers Union Hawaii	Agriculture Research Center
Australian Department of Environment and Water	



Businesses	
Ben & Jerry's	Pure Strategies
Fibershed & The North Face	NORI Indigo
Ag Coca Cola	Agrisoma
Unilever	Monsanto
Strauss Dairy	Stemple Creek Ranch
Native Energy	Mad Agriculture
Cargrill	NORI
Sustainable environmental Consultants	Upstream
Watershed Climate	Nutrient
Indigo Agriculture	Microsoft Azure
Logiag	Boston Consulting Group
GD Associates	PIF California
Anthesis Group	SBC Global
Handsome Brook Farms	Post Holdings
Land O' Lakes	Wheat Sheaf Group
Blue Skye	Simplot
First Earth	Jackson Family Wines
Mondelez International	Keystone Pacific/Wild Rose LLC
Lozensky Farms	Active Renewals
Wheat Sheaf Group	Gould Family Farms
Anuvia	Agrocares
FoodTBS	Solution TF
KWS Berlin GmbH	Frontier Farmland
TeamAg Inc.	Stonyfield Organic
Arcor Group	Quivira Coalition
Polytechnique Montreal	Heffernan Consulting, Inc. Home & Farm Consulting
Caterpillar	McKinsey & Company
CiBO Technologies	Casella Waste Systems
SMARTFARM	Pipestone Nutrition
Hudson Carbon	Growell Consulting
Kloberdanz Consulting	Sofies Environmental Consulting
Locus Agriculture Solutions	Florida Crystal Corporation
McKinsey & Company	Philosopher's Farm
Alltech- Quality Animal Nutrition, Health and Feed Supplements	Blockware Technologies (Canada)
Levi's Indigenous Fruit Enterprises	Soletrac Electric Tractors
Treasury Wine Estates	Biome Makers
Team Ag Inc	Royal Dairy
Mountain View Acres Farm & Orchard	Ag Grow Tech
Kytech Consultant	Hem Mills
Smart Farmer (Thailand)	Net Zero Carbon Buildings
Frogs Leap Winery	Pifer's Land Management
Triple Crown Consulting	African Data Technologies





<b>Businesses (cont.)</b>	
Carbon Credits Group	Fresh Del Monte
Pekrul Engineering	LandFund Partners
Sesenta (South Africa)	Farmer's Business Network
Deveron	Cedar Valley Farms
EMBRAPA (Brazil)	Farmer's Edge
North Iowa Agronomy Partners	Dari Gold

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