ORGANIC FARMING RESEARCH FOUNDATION

Fostering the improvement and widespread adoption of organic farming.

Organic Farming Research Foundation
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June 19, 2020

Dear Members of the Senate Democrats' Special Committee on the Climate Crisis,

We deeply appreciate the opportunity to provide input from the viewpoint of farmers, ranchers, and rural communities regarding the impacts of climate change on livelihoods, producer innovations to mitigate and adapt to climate, and the tools and policies needed to meet the challenges.

The Organic Farming Research Foundation (OFRF, https://ofrf.org) is a nationwide nongovernmental organization whose mission is to promote and expand successful implementation of organic production systems through research, education, and policy advocacy. OFRF awards small grants to producers and researchers to explore and develop innovative approaches to organic production, and has published a series of practical guidebooks on Soil Health and Organic Farming, Risk Management, and Climate Resilience, based on an extensive review of USDA funded organic agricultural research (2002-present). In addition, OFRF conducts surveys of organic and transitioning-organic producers every five years to identify current and emerging research priorities, most recently summarized in the 2016 National Organic Research Agenda (NORA). All of these reports are available at https://ofrf.org/research/reports/.

It is from this perspective, and on behalf of the nation's organic farmers and ranchers, that OFRF submits the following comments to the Senate Democrats' Special Committee on the Climate Crisis.

General Comments:

As a Represented Member of the National Sustainable Agriculture Coalition (NSAC), OFRF fully supports the comments and recommendations submitted to the Senate SCCC by NSAC, especially the following:

- Establish climate change mitigation and adaptation in agriculture as a department-wide USDA priority across agencies and programs.
- Make climate change a leading Resource Concern in USDA Natural Resources Conservation Service (NRCS) programs; enhance program content, financial incentives, and technical assistance accordingly.
- Increase research investment in organic production systems with emphasis on climate mitigation and resilience.
- Support widespread adoption of advanced grazing management systems in livestock production, and phase-out year-round animal confinement operations.

- Increase investment in development of regionally adapted, stress-resilient, public crop cultivars and livestock breeds suited to organic and other climate-friendly production systems.
- Emphasize whole-farm systems and site-specific approaches, rather than single-practice or “one-size-fits-all” prescriptions.
- Take effective measures to protect the nation’s three million farm workers and food system workers from the compounding impacts of climate change and COVID-19, including increasing heat stress, pesticide exposure, and other health and occupational hazards.
- Ensure that farmers and communities of color and other historically underserved constituencies are fully engaged in resilience innovations and gain full access to and benefit from relevant USDA conservation and other programs.

We also want to highlight the unique potential of organic farming and ranching systems to build agricultural and community resilience and contribute to climate mitigation, as well as a few unique challenges that organic producers face. Thus, we offer the following additional comments in response to several of the questions posed by the Committee.

Question 1. What challenges do you face from weather extremes? What would it take for your community to be prepared for more severe storms, droughts, wildfires and flooding? What additional tools would be valuable as you work to plan for future weather extremes and to ensure your community is prepared to make it through disaster events?

In our 2015 national survey and listening sessions of nearly 2,000 organic farmers, soil health and fertility remained organic producers’ top research need (rated “high priority” by 74% of respondents), and climate change emerged as a high or medium research priority for 75% of respondents (Jerkins and Ory, 2016). Many cited increasing challenges related to excessive rainfall, drought, erratic temperature swings, and disrupted fruiting patterns in tree crops. Some farmer quotes include:

- “Climate change is about to put me out of business. 2011 was too wet, 2012 too dry, 2013 and 2014 too wet and 2015 on track to be too wet. Plus devastating extreme cold temps in Jan 2014 and Feb 2105. How can I, as the manager, and the beef cattle deal with it?”
- “Irrigation is not truly sustainable, and especially with challenges due to climate change we need better practices that improve our water capture, retention, and cycling.”
- “We need better ways to manage weeds and new insects. How to cope with them? Old diseases showing up more often due to climate change.”
- “Climate change has drastically affected our pistachio production due to insufficient chilling hours. We need trials and research to help this growing industry survive these new challenges.”
- “Sadly, I think climate change is going to catch up with all of us: it is getting hard to produce crops that have been routine to me over the decades.”

Since the publication of this report, additional extreme weather events across the U.S., including drought-sparked wildfires and irrigation restrictions in the West, record flooding in the Midwest in 2019, intense landfalling hurricanes, and a record wet 2018 in the mid-Atlantic followed by a late summer "flash-drought" in 2019 have continued to elevate the urgency of climate change as an agricultural production concern and research priority.

The organic agricultural production method emphasizes healthy, living soil as the foundation for a successful farming or ranching operation, and utilizes natural, biological processes to provide for crop nutrition and crop protection from diseases and other stresses. Organic practices that build soil organic matter and maintain a vibrant, diverse community of soil life contribute to the net removal of carbon dioxide CO_2) from the atmosphere via plant photosynthesis and ultimately, conversion into *stable soil organic carbon* (carbon sequestration). The use of organic and natural mineral sources of fertility in lieu of synthetic soluble fertilizers reduces the amount of nitrous oxide (N_2O, a powerful greenhouse gas with 300 times the global warming potential of CO2) emitted from organically managed soils compared to conventionally fertilized soils. In addition, by avoiding the use of synthetic pesticides and fertilizers, organic producers protect the soil life, including soil organisms that play vital roles in carbon sequestration and efficient nitrogen (N) cycling that further reduces N_2O emissions (Klein, 2019).

Our review of research into organic agriculture indicates that widespread adoption of state-of-the-art sustainable organic practices could render U.S. agriculture climate-neutral through carbon sequestration and reductions in other GHG emissions (Schonbeck et al., 2018). However, organic producers face some challenges that require further research and development of practical tools and methods to fully realize the climate mitigating potential of their operations. These include:

- Without herbicides, organic farmers rely on some tillage and cultivation to manage weeds and cover crops in annual crop rotations. Tillage can release some soil organic carbon as CO_2, harm some beneficial soil organisms, and increase risk of soil erosion. Farmers and researchers have made important progress toward organic reduced-till systems that minimize these impacts, yet more research and practical innovation is needed to develop production systems that protect soil life from both chemical and physical disturbance.
- Organic nutrient sources are more challenging to manage in a way that precisely matches crop nutrient needs. Unlike soluble fertilizer N, the N in organic amendments requires biological processes to become available to crops, and timing can be tricky. Increasing the use rates of compost and manure to ensure sufficient N for organic crop production can lead to excessive soil phosphorus (P) levels, which can suppress mycorrhizal fungi that play vital roles in C sequestration, nutrient cycling, and soil health. Again, research advances and on-farm innovation have made progress toward better organic nutrient management, yet much more needs to be done.

Organic farms and ranches that integrate multiple soil health practices with diversified crop rotations and production systems also show greater resilience to droughts and other weather extremes. This is reflected in greater *yield stability* that minimizes losses in "bad" years (see figure 1B below, in our response to questions 3 and 4a). One key factor in this resilience is the improved physical properties of organically managed soils, which allow heavy rainfalls to infiltrate more easily into the soil (less runoff, erosion, and flooding), and retain a greater reserve of plant-available moisture during dry spells. These properties, combined with the improved nutrient cycling and reduced plant disease pressure in healthy, living soils will play vital roles in helping farms and rural communities withstand the impacts of ongoing and future climate changes.

Recent studies indicate that many farmers are responding to climate changes by modifying their crop rotations and by increasing the use of fertilizer and/or irrigation to maintain crop yield in the face of increasingly extreme and erratic weather. However, increasing inputs can have maladaptive regional consequences, such as increased nutrient runoff and N_2O emissions, and depletion of groundwater resources (Crane-Droesch et al., 2019; IPCC, 2019). In contrast, organic and sustainable producers aim to build agricultural resilience by reducing reliance on off-farm inputs, and are now applying this approach to reducing risks related to climate change (Lengnick, 2018).

Organic producers depend on healthy living soil to "weather the storm" to a greater extent than non-organic farmers, who can resort to synthetic fertilizers and crop protection chemicals when pests or other production problems arise.While the organic approach enhances both climate mitigation and resilience, it is not invulnerable, because climate change itself can complicate efforts to improve and maintain soil health in several ways:

- Higher temperatures can accelerate the loss of soil organic carbon and make it more difficult to maintain soil organic matter levels and sequester carbon.
- Heavier rains and sharper swings from wet to dry aggravate soil compaction and surface crusting, and can leach out nutrients.
- Changing climate conditions can alter the species composition and functions of the soil life, as well as crop performance and adaptation to locale. This will necessitate continual adaptation in soil management and crop and cultivar selection by all producers.

Thus, an urgent and long-term research need exists to develop practical, site- and region-specific tools and strategies to maintain soil health, stabilize crop production, and enhance farm, ranch, and community resilience in the face of ongoing climate disruptions. Conducting this research within the parameters of USDA organic rules will further enhance the capacity of organic producers to stay in the business of providing healthful food to their customers and to become a more effective part of climate solutions.

In addition, this research will benefit *all* producers and the U.S. agricultural and food system as a whole. Many conservation-minded non-organic producers are adopting selected organic tools, practices, and inputs, in order to reduce the direct and environmental costs of their operations and enhance long term economic viability, and will continue to do so as they join nationwide endeavors to prepare for and help combat climate change.

Question 2: What are the most important reasons for acting to improve resiliency and slow the impacts of changes to climate? How would you describe the risks and local impacts of inaction?

Producers and rural communities need to act *promptly* to ensure that the flooding, droughts, temperature extremes, and other impacts of climate change do not drive farmers and ranchers out of business, crash rural economies, damage or destroy community infrastructure, and threaten public health and safety. While individual farmers can make important contributions to resilience and climate mitigation through adoption of best organic and conservation practices, they cannot do it alone. Governmental policies that support sustainable and organic agriculture, and effective climate mitigation and adaptation are essential at the federal, state, and local levels.

Resource conservation, climate mitigation, and resilience-building strategies must be applied at a regional scale. For example, an organic farm surrounded by other farms that do not optimize resilience through best practices for soil conservation, soil health, nutrient management, and integrated pest management could be severely impacted by runoff, and unintended exposure to agrochemicals not allowed in organic production, as well as increased risks of pest and disease outbreaks. Non-optimum land management practices that do not maintain healthy soils and vigorous living cover by native vegetation and useful, non-invasive cultivated plants miss an opportunity for region-wide carbon sequestration and GHG mitigation. An organic or conservation-agriculture farm surrounded by clearcuts, clean-tilled fields, or otherwise poorly managed land areas may also experience a deterioration in local microclimate that makes successful, resilient, and climate-mitigating production more difficult to achieve.

Without regional conservation and resilience measures, surface and groundwater may become contaminated, thus compromising irrigation water quality and drinking water safety; and risks of damage from flooding, gully erosion, siltation, and "dust bowl" events will increase. As weather extremes become more intense with climate change, these impacts will likely worsen. In conclusion, farms, whether organic or non-organic, can thrive only in the context of healthy landscapes and regional ecosystems, as well as some degree of climate stability.

Question 3: Are there existing tools for farmers, ranchers and communities such as those at the U.S. Department of Agriculture in their Natural Resources Conservation Service or Farm Service Agency that would help your area be more resilient? Are there ways those tools could be expanded or changed to address the challenges land managers face in keeping our working lands and agricultural operations productive and profitable in the face of changes in local and large-scale weather patterns and growing conditions?

Question 4a: What are the most promising opportunities for land managers to benefit from climate action that are based on tools, such as conservation practices, that are currently in use?

The practice of organic farming, codified since 2002 in the USDA National Organic Program (NOP) Standards, offers a vital tool in our nation's effort to prepare our farms, ranches, and rural communities to withstand the impacts of climate change and to contribute to efforts to national and global efforts to reduce GHG emissions and stabilize the climate. The NOP Rule (USDA, NOP, undated) defines organic production as follows:

> *" A production system that is managed in accordance with the [Organic Foods Production] Act [of 1990] … to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity."*

The NOP soil fertility and crop nutrient management practice standard requires:

> *"[T]illage and cultivation practices that maintain or improve the physical, chemical, and biological condition of soil and minimize soil erosion. [M]anage cropnutrients and soil fertility through rotations, cover crops, and the application of plant and animal materials."*

The NOP crop rotation practice standard requires:

> *"[C]rop rotation including but not limited to sod, cover crops, green manure crops, and catch crops that … maintain or improve soil organic matter content, provide for pest management … manage deficient or excess plant nutrients, and provide erosion control."*

In addition, more and more organic and other conservation-minded producers are implementing five key soil health management principles widely promoted by NRCS and innovative producers:

- Keep the soil covered
- Maintain living roots as much of the year as practical
- Maximize crop and enterprise diversity to build soil biodiversity
- Minimize soil disturbance – tillage, chemicals, overgrazing, invasive species
- Integrate crop and livestock production with rotational grazing

Together, the NOP standards and the five soil health principles provide an excellent roadmap toward agricultural resilience and climate mitigation during production. Specifically:

- The site specific approach of organic farming ensures that a given suite of practices best addresses local conditions and local climate-related challenges.
- Organic nutrient sources and non-use of synthetic agrochemicals protects soil organisms that play central roles in carbon sequestration, GHG reduction, and long term soil health and resilience.
- Diverse rotations that include cover crops and maintain year round cover and living roots can protect the soil, sequester carbon during the off-season, and improve water relations for drought and flood resilience.
- Research has shown that adding one or more new crops to a low-diversity rotation (such as corn-soy, commonly seen in the Midwest) improves soil health and enhances carbon sequestration (McDaniel et al., 2014; Tiemann et al, 2015; Wander et al., 1994). A recent meta-analysis of 11 long term trials in the U.S. showed that diversifying crop rotations can substantially improve system resilience, as indicated by 28% higher corn yields and greatly reduced corn yield losses during drought years (Bowles et al., 2020).
- Enterprise diversity improves economic resilience; for example, an adverse weather event that destroys one crop is less likely to drive a farm to bankruptcy if several other enterprises come through the event unscathed.

Cover cropping is an especially important practice for enhancing resilience and maintaining soil organic carbon in annual cropping systems such as vegetables, corn, soybeans, wheat, and cotton. This has been illustrated especially in the Mediterranean climates of California and parts of the Pacific Northwest, where most of the region's rainfall comes during the winter months, while most crop production takes place during the summer, when hot, rainless conditions necessitate regular irrigation, especially for vegetables, strawberries, and other specialty crops. This region has been severely impacted by climate changes, including an historic drought during

2014-16, followed by an unusually wet winter in 2017, and more rounds of drought since then.

In central California, NRCS scientist Dr. Zahinger Kabir documented the dramatic benefits of planting a winter cereal grain cover crop after vegetable harvest. The cover cropped field easily absorbed a 2-inch rainfall in February, 2017, while an adjacent fallow field became flooded (Figure 1A). Prolonged flooding compromises soil life and soil health, and causes a burst of GHG emissions including methane (CH_4, about 25 times as potent as CO_2) and N_2O.

In an organic farming systems study in Salinas, CA, simply growing a winter cover crop after fall broccoli harvest recovered sufficient leftover nitrogen (N) to sustain high spring lettuce yields, while winter fallow allowed the N to leach and denitrify (releasing N_2O), and led to sharp yield reductions and sometimes a complete failure of the lettuce crop (Brennan, 2018). In no-till cotton production in the South Carolina coastal plain, a winter rye cover crop sequestered significant additional carbon, relieved subsurface compaction, enhanced plant-available moisture, and boosted cotton yield by 30% or more (Marshall et al., 2016).

Yet, not all organic producers currently use cover crops, and only a small (though gradually increasing) minority of conventional row crop farmers use cover crops. This is largely because adopting this practice requires new management skills, careful selection of the best cover crop varieties for the locale, and up-front costs, while direct financial benefits and resilience (yield stability) may take three to ten years to accrue (USDA SARE, 2019). Thus, additional technical and financial assistance through USDA programming may be needed to encourage adoption of this valuable practice and thus build agricultural and regional resilience to climate change.

However, organic agriculture is a whole system comprised of multiple individual components that work together, and has much greater climate mitigation and resilience potential than any single practice such as cover crops, no-till, or non-use of synthetic chemicals. For example, organic crop rotations that integrate winter cover crops, diverse rotation, reduced tillage, and organic amendments improved soil moisture retention and sustained crops through two drought years in the Rodale Long Term Farming Systems trials (Figure 1B). In a sandy coastal plain soil in South Carolina, an organic corn-soy-wheat rotation with winter cover crops and other organic practices boosted soil organic carbon, improved soil health, and sustained top yields without applying P or potassium (K) and with half the recommended N (again helping to minimize N2O emissions) (Kloot, 2018).

When the 2014-16 drought restricted irrigation water allotments for farmers in the Central Valley of California, organic producer Scott Park and researchers at UC Davis found that an organic system of diversified rotation, winter cover crops, reduced till, and organic amendments supported full tomato yields on greatly reduced irrigation (Gaudin, 2018).

These examples show the potential of integrated sustainable production systems such as organic agriculture as defined in the USDA National Organic Standards, to enhance both climate resilience and climate mitigation in agricultural production.

A **B**

Figure 1. A. Adjacent fields (same soil type) in winter cover crop *vs* fallow in Woodland, CA the day after a two-inch rainfall in February, 2017. The cover cropped soil easily absorbed the water (left) while the fallow field ponded badly (right). B. In the Rodale Farming Systems Trials in Kutztown, PL, corn grown in the organic system (left) withstood droughts in 1995 and 2012, and yielded 31% more than conventional corn (right).

Question 4b: What new tools and strategies have the most potential for improving resiliency and sequestering carbon?

A continued federal investment in research and development of best organic and sustainable farming strategies to build climate resilience, mitigate agricultural GHG emissions, and sequester carbon sequestration in biomass is urgently needed to help all producers meet the climate challenge. Some top priorities include:

- *Continue and expand plant breeding efforts leading to the development of climate-resilient, public cultivars for organic systems*. When organic and other growers gain access to field crop, vegetable, fruit, forage, and cover crop cultivars that perform well in climate-friendly production systems such as organic minimum-till, resist diseases and pests, outcompete weeds, utilize nutrients and moisture efficiently, and can sustain production through drought, excessive rain, and other weather extremes, their operations will gain resilience to the impacts of climate change, sequester more carbon, and minimize GHG emissions.
- *Increase research investment in organic management of perennial-based production systems,* including orchard, vineyard, alley cropping, agroforestry, permaculture, and silvopasture. These systems have much greater potential to sequester carbon in soil and plant biomass (often more than one ton per acre annually) than the best-managed annual cropping systems managed either organically or through conservation agriculture (about 500 lb per acre annually) (Feliciano et al., 2018; Schonbeck et al., 2018). Historically, the vast majority of OREI and ORG funded projects have addressed annual crops, including corn, soybean, cereal grains, and vegetables. More information on organic management of perennial production systems will help realize this carbon sequestration potential.
- *Continue and expand efforts to develop practical means for organic producers to minimize soil disturbance (tillage) and maximize cover crop biomass and carbon sequestration while maintaining economically viable yields.* A growing number of

cultivation tools and techniques have become available to producers that show promise for providing sufficient weed control and seedbed preparation with minimal losses of soil organic carbon and soil life. Additional research and development is needed to develop practical tools and methods that can be widely adopted.

- *Continue and expand research into the roles of soil and plant root microbiomes in nutrient cycling, plant disease suppression, soil physical properties, and other functions of a healthy soil.* This research topic includes the interaction between crop genetics (cultivar) and soil biotic community in modulating the efficacy of plant-microbe partnerships such as mycorrhizal fungal-root associations. Practical outcomes that point the way to optimum management of the soil life will benefit all farming systems, and will contribute to resilience, mitigation of N_2O, and carbon sequestration (Schonbeck et al., 2019).
- *Expand research and development of sustainable and economically viable organic livestock production systems and crop-livestock integrated systems, with an emphasis on regionally-adapted advanced grazing management systems.* Organic animal agriculture research should prioritize development of new livestock and poultry breeds that are suited to pasture-based organic production systems, and effective, NOP compatible livestock health and welfare management practices, such as alternatives to conventional parasiticides.
- *Conduct sociological and economic analysis, and design educational, extension, and outreach strategies to address and overcome socioeconomic, logistical, market-related, and policy barriers to adoption of practices known to enhance agricultural resilience and help slow climate change.* Leading examples include cover cropping and diversified crop rotation; which, in study after study, yield significant and sometimes dramatic benefits to soil health and resilience—yet are still adopted by only a minority of U.S. producers. For example, vast acreages of the nation's breadbasket (Corn Belt) remain in a corn-soy-winter fallow rotation despite its costs in soil erosion, declining soil health, flooding, and nutrient-polluted drinking water—problems that have grown worse as climate changes cause greater weather extremes.

One challenge that organic producers face is that organic crop yields average 20% lower than the same crops grown with modern conventional practices, which cuts into their bottom line and makes it more difficult to reduce environmental costs per unit production. This differential reflects the historically low investment of agricultural research dollars in organic production practices compared to conventional systems (Ponisio et al., 2014). Federal funding for organic research investment was virtually zero until the USDA opened the ORG program in 2002 and the OREI in 2004. While these programs now receive a total of $26 million per year, USDA investment in organic research across all programs remains between 1 and 2% of the total USDA research investment of about $3.6 billion per year, lagging far behind the current market share of organic products in the U.S. (about 6%).

The lack of organic research may have had its most serious impacts in the area of plant breeding, as illustrated by the following quotes:
"Further, many comparisons between organic and conventional agriculture use modern crop varieties selected for their ability to produce under high-input (conventional) systems. Such varieties are known to lack important traits needed for productivity in low-input systems,

potentially biasing towards finding lower yields in organic versus conventional comparisons. By contrast, few modern varieties have yet been developed to produce high yields under organic conditions; generating such breeds would be an important first step towards reducing yield gaps when they occur." (Ponisio et al., 2014).

"Cultivars are most productive under the conditions for which they were bred ... [C]ultivars bred under conventional management – aided by synthetic fertilizer, herbicides and pesticides – will likely not be as productive under organic management." (Hultengren et al, 2016)

We appreciate that the 2018 Farm Bill has increased OREI funding to $50 million per year in permanent baseline mandatory funding as of 2023, and we urge Congress and the USDA to continue expanding the total USDA organic research investment to be at least commensurate with the organic market share of 6%,or about $220 million per year. Given the tremendous potential of organic systems to contribute to resilience and climate mitigation, increasing USDA organic research funding to above this level, with a particular emphasis on development of climate-resilient crop cultivars and livestock breeds for organic systems, is warranted.

Question 4c: What are the key barriers to adoption of these practices? Are there solutions you would recommend prioritizing?

In addition to the issues discussed above, some barriers to adoption of organic and sustainable practices to help address the climate crisis include:

- A steep learning curve and initial risks and costs associated with undertaking a transition to organic production.
- In the case of cover cropping, a lack of practical knowledge and information, including best cover crop species, varieties, and management practices for a given locale or region, considering soils, climate including local climate change trends, and production systems.
- Adoption of soil health management systems and practices entail up-front costs, while the benefits to farmer bottom line and environment accrue gradually over several or many consecutive seasons of implementation.
- Our current food and agricultural system includes deterrents to farm biodiversity and enterprise diversity. The dominant livestock production systems and human food industry (processed foods) heavily emphasize corn, soy, and wheat; and most farm bill commodity and crop insurance programs are designed for these and a few other commodities.

In addition to the recommendations outlined above, some solutions include:

- Increase promotion, outreach, and funding for NRCS working lands conservation programs. Ensure that payments for relevant conservation practices are sufficient to defray initial costs and enable farmers to adopt cover cropping, farm diversification, perennial conservation and production plantings, and advanced livestock grazing systems, as well as certified organic practices.
- Increase NRCS funding and staffing for technical assistance, including online venues for as long as the coronavirus pandemic necessitates physical distancing, and in person when these restrictions can be safely eased or removed. Emphasize assistance in soil health

management, climate mitigation and adaptation at the farm, watershed, and regional levels.

- Strengthen Extension, education, and outreach efforts to help producers and rural communities adopt the climate resilience, carbon sequestration, and GHG mitigation strategies and practices that have been proven effective through research to date.
- Facilitate the development and delivery of new practical strategies based on emerging research findings. Include a strong Extension/education/outreach component in USDA research programs, with a priority on delivery of new information that will help farmers and communities address the climate crisis.

Thank you again for the opportunity to provide input to the Senate Special Committee on the Climate Crisis.

Sincerely,

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