OPPORTUNITIES TO ADDRESS CLIMATE CHANGE IN THE FARM BILL

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The Emmett Environmental Law and Policy Clinic at Harvard Law School is directed by Wendy B. Jacobs and is dedicated to addressing major environmental issues in the United States and abroad and to providing its students an opportunity to do meaningful, hands-on environmental legal and policy work. Students and clinic staff work on issues such as climate change, pollution reduction, water protection, smart growth, citizen science, and energy justice.

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EXECUTIVE SUMMARY

This paper summarizes the Emmett Environmental Law and Policy Clinic's (the "Clinic") proposals for how to address climate change in the Farm Bill, both during the current authorization process and in the future.[1] We provide recommendations for both climate mitigation strategies to reduce greenhouse gas (GHG) emissions and increase carbon sequestration from agriculture, and climate adaptation strategies to increase the resiliency of farms to the impacts of a changing climate.

The Farm Bill, which affects nearly every aspect of agriculture and forestry in the United States, presents an important opportunity for climate change action. Agricultural practices were responsible for about eight percent of U.S. GHG emissions in 2015, even when agriculture-related fuel combustion and land use changes are excluded.[2] Agriculture is also vulnerable to the impacts of climate change, including rising temperatures, changes in rainfall and pest migration patterns, extreme weather events, and drought.

However, farmers and ranchers can adopt practices that enhance their resilience to these impacts while also reducing GHG emissions, and increasing carbon sequestration. Many of these practices improve the long-term productivity and profitability of farms. Indeed, farmers are already adopting practices such as cover cropping, crop diversification, conservation tillage, and agroforestry, that reduce emissions or sequester carbon in the soil and in woody biomass while also improving productivity and resilience on their land.

Our team examined a range of options for driving climate adaptation and mitigation in the Farm Bill. We summarize these options, organized by Farm Bill title, below in Table 4. We then developed a set of metrics that we used to prioritize among the many options available: the potential magnitude of the climate impact; the existence of co-benefits, equity and fairness; scalability of the proposals; enforceability and administrability; and feasibility. Based on these criteria, we identified three recommendations that best fit our metrics for reform:

1 This work was undertaken as part of the Farm Bill Law Enterprise (FBLE), a group of law school clinics, research programs, and faculty who are working to promote a Farm Bill that reflects a thoughtful consideration of the long-term needs of our society, including economic opportunity and stability, public health and nutrition, public resources stewardship, and fair access and equal protection. *See* http://www.farmbilllaw.org. This paper, however, is independent of FBLE and does not necessarily represent its views.

2 EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015*, at ES-21 (2017) [hereinafter EPA, *Inventory*], https://perma.cc/HQ9B-BJYP.

- **Recommendation 1**: Incorporate resilience measures into crop insurance and conservation compliance to better manage on-farm climate risks under Titles II and XI.
- **Recommendation 2**: Ensure the best available science and research—including the outcome of pilot programs—are incorporated into Farm Bill programs; support dissemination of downscaled climate data through USDA regional offices and land grant universities to develop agricultural climate mitigation and adaptation capacity under Title VII.
- **Recommendation 3**: Advance manure management collection and storage methods, as well as biogas development under Title IX to mitigate GHG contributions from livestock.

The next Farm Bill offers an important opportunity to better manage the risks of climate change on farms, forests, and ranches by supporting resilience practices that also offer GHG reductions. We hope that sharing our work will help policymakers and industry actors at the local, state, and federal level address climate change impacts on agricultural lands.

INTRODUCTION

This paper provides background information on the complex relationship between climate change and agriculture and proposes a suite of practices that could be incorporated into the next Farm Bill to improve on-farm efforts to adapt to and mitigate climate impacts. It is organized into four main sections. First, we provide background on the Farm Bill and the ways that the U.S. agricultural system contributes to GHG emissions. Next, we provide an overview of opportunities for on-farm mitigation and adaptation. Many of the practices we recommend can reduce on-farm emissions and build a more resilient agricultural system. Third, we identify a set of metrics that we used to assess potential proposals. Finally, we summarize how climate practices can be incorporated across titles and highlight three particularly promising options.

BACKGROUND

A. Agricultural Sources of GHG Emissions

Greenhouse gases trap heat in the atmosphere and contribute to increases in global temperatures. Although this a natural process, rising GHG emissions since the industrial revolution have increased atmospheric greenhouse gases to levels never before recorded. Agriculture, including raising crops and animals as well as resulting land use changes and farm equipment usage, is primarily a source of three GHGs: methane (CH_4), nitrous oxide (N_2O), and carbon dioxide (CO_2) (see Table 1).[3]

3 EPA, *Inventory*, *supra* note 2, at 5-1.

Table 1. GHG Profiles[4]

GHG	Description	Characteristics
Carbon Dioxide (CO_2)	• Cycles through reserves in environment, including on land, in oceans, and in the atmosphere[5] • Primary GHG emitted by human activities[6]	• Global Warming Potential[7] (GWP): 1 • Persists in the atmosphere: Variable • Atmospheric Increase Since 1750: 43% • Proportion of US Emissions (2014): 81%
Methane (CH_4)	• Results from oxygen-free decay of organic matter • Second most significant GHG from human activities[8]	• Global Warming Potential (GWP): 25 • Persists in atmosphere: 12 years • Atmospheric Increase Since 1750: 160% • Proportion of US Emissions (2014): 11%
Nitrous Oxide (N_2O)	• Naturally present in atmosphere and other sources, including soil[9] • Release into the atmosphere is influenced by soil management practices	• Global Warming Potential (GWP): 298 • Persists in atmosphere: 114 years[10] • Atmospheric Increase Since 1750: 21% • Proportion of US Emissions (2014): 6%

Globally, emissions from food systems are responsible for nearly a third of all GHG emissions.[11] Domestically, EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks* divides up agriculture-related emissions into different categories. N_2O and CH_4 emissions are categorized as

4 EPA, *Overview of Greenhouse Gas Emissions* [hereinafter EPA, *Overview*], https://perma.cc/7WS6-JXQY. The two to three percent of emissions unaccounted for are fluorinated gases which are synthesized during industrial processes. *Id.*

5 EPA, Inventory, supra note 2, at 1-6.

6 Id. at ES-7.

7 Global warming potential is a measure of how much energy the emissions of 1 ton of a gas will absorb relative to the emissions of 1 ton of CO2. See U.S. Envtl. Prot. Agency, Understanding Global Warming Potentials, https://perma.cc/DTQ7-DA7T.

8 EPA, Summary Report: Global Anthropogenic Non-CO2 Greenhouse Gas Emissions: 1990–2030, at 2 (2012) [hereinafter EPA, Summary Report], https://perma.cc/AT8S-XRPA.

9 EPA, Inventory, supra note 2, at 5-20.

10 Id. at 1-9.

11 Natasha Gilbert, *One-third of our Greenhouse Gas Emissions Come from Agriculture*, Nature (Oct. 31, 2012), https://perma.cc/2GF7-ASMM.

"Agricultural," and accounted for 8.3 percent of total greenhouse gas emissions in the United States in 2014.[12] In 2014, agricultural N_2O emissions were 336 million metric tons of carbon dioxide equivalent (MMT CO_2 Eq.); these emissions were caused primarily by soil management such as the use of synthetic fertilizers, tillage, and organic soil amendments.[13] Manure management and biomass burning also contribute to N_2O emissions. Agricultural CH_4 emissions were 238 MMT CO_2 Eq. and resulted from enteric fermentation during ruminant digestion (164 MMT CO_2 Eq.), manure management (61 MMT CO_2 Eq.), and the wetland cultivation of rice (12 MMT CO_2 Eq.)[14]

CO_2 emissions from agriculture-related land use changes and equipment usage are accounted for in the "Land Use, Land-Use Change, and Forestry" and the "Energy" categories, respectively, of the Inventory. Estimates of total food system emissions, which include the CO_2 emissions from energy use and transportation, increase the agricultural industry's proportion of U.S. GHG emissions to between 19% and 29%.[15]

B. Impacts of Climate Change on U.S. Agriculture

Climate change is also anticipated to have significant adverse effects on agriculture in the United States. It will lead to an increase in extreme heat and drought as well as heavy precipitation events, which can cause soil erosion.[16] A lack of prolonged periods of cold during the winter can be harmful to some perennial crops, such as fruit and nut trees.[17] Climate change may also increase the impacts of weeds, pests, and diseases.[18] All of these changes will shift the geographic locations in which particular crops can be grown, requiring farmers to adjust their practices. Some areas that are currently farmed may become unsuitable for agriculture, while other areas that are not currently farmed may become suitable. On the whole, climate change is expected to reduce the yields of major crops and farm profits, while increasing annual variations in production.[19]

12 EPA, *Inventory*, *supra* note 2, at 5-1.

13 *Id.*

14 *Id.*

15 Research Program on Climate Change, Agriculture, and Food Safety, *Food Emissions*, https://perma.cc/YYL8-YSPM.

16 Jerry Hatfield, et al., *Agriculture*, *in* Climate Change Impacts in the United States: The Third National Climate Assessment (J.M. Melillo, et al. eds. 2014), at 150, 159, 161.

17 *Id.* at 156.

18 *Id.* at 158.

19 *Id.* at 152.

STRATEGIES FOR MANAGING CLIMATE RISK THROUGH MITIGATION AND ADAPTATION

Given that agriculture both causes GHG emissions and will suffer significant harms from climate change, it is appropriate to consider how climate change can be incorporated across the titles of the Farm Bill. The anticipated reauthorization in 2018 can play a critical role in addressing climate change in the United States by promoting practices that encourage mitigation and adaptation practices on farms. Even if not adopted in 2018, our recommendations will also be relevant to future reauthorizations.

Adopting new agricultural practices can be challenging, especially for small farmers or operations without access to large amounts of capital or information about adaptation opportunities. However, doing so will not only help U.S. farmers and ranchers to confront shifting seasons, more severe storm events, new pests, drought, and other challenges,[20] it will also reduce the Farm Bill's fiscal burden on taxpayers.[21] Fortunately, farmers and ranchers are already adopting strategies that not only reduce emissions or sequester carbon in the soil, but also have the important co-benefits of improving productivity and resilience.[22]

A. Mitigation Measures

Farmers and ranchers can mitigate GHG emissions by offsetting current emissions, sequestering carbon, and/or preventing future emissions.[23] Table 2 describes some relevant strategies and the practices to achieve them.

First, farmers and ranchers can reduce their GHG emissions in a number of ways. Practices such as conservation tillage reduce soil disturbance, and prevent some erosion, which can lower

20 *See* USDA, *USDA Agriculture Climate Change Adaptation Plan* 9 (2014) [hereinafter USDA, *Adaptation Plan*], https://perma.cc/8SM9-5NDX; Louise Jackson & Susan Ellsworth, *Scope of Agricultural Adaptation in the United States: The Need for Agricultural Adaptation*, *in* The State of Adaptation in the United States 42 (Lara Hansen et al., eds. 2013), https://perma.cc/HS57-K35T.

21 For example, a recent report from the Office of Management and Budget and the Council of Economic Advisers estimates that the annual cost of the crop insurance program will increase by $4 billion per year in 2080 as a result of the impacts of climate change. OMB & CEA, *Climate Change: The Fiscal Risks Facing the Federal Government* 6 (Nov. 2016), https://perma.cc/4Y22-P85V; *see also* USDA, *Adaptation Plan*, *supra* note 20, at 9.

22 USDA, *Climate Change and Agriculture in the United States: Effects and Adaptation* 126–27 (2013) [hereinafter USDA, *Effects and Adaptation*], https://perma.cc/QW8T-Y4RL.

23 Michael McLeod et al., *Cost-Effectiveness of Greenhouse Gas Mitigation Measures for Agriculture: A Literature Review*, OECD Food, Agriculture and Fisheries Papers, No. 89, at 26 (2015).

soil carbon loss. Precision agriculture strategies can reduce fertilizer inputs on cropland, which in turn reduces GHG emissions from fertilizer production and application.[24] Reincorporating livestock manure onto cropland as well as improved management of liquid manure using anaerobic digesters or other on-farm technology can reduce methane emissions from livestock waste by capturing it rather than emitting it.[25]

Second, farmers and ranchers can sequester additional carbon through on-farm practices. Soil carbon can be increased by incorporating cover crops—including legumes—into crop rotations, reducing tillage, and agroforestry practices.[26] In addition, planting perennial crops or incorporating trees into farms through alley cropping, hedgerows, and riparian forest buffers can lead to long-term sequestration of carbon in woody biomass.

Finally, farmers and ranchers can take steps to avoid future emissions. The most critical way to avoid new on-farm emissions is to avoid land conversion, which releases carbon that was previously sequestered in the soil and in woody biomass.

24 Peter Lehner & Nathan Rosenberg, *Legal Pathways to Carbon-Neutral Agriculture*, 47 Envtl. L. Rep. 10,845, 10,849 (2017).

25 *Id.* at 19–21.

26 For a more detailed review of how carbon sequestration can be increased in agriculture, see Daniel Kane, Nat'l Sustainable Agric. Coal., *Carbon Sequestration Potential on Agricultural Lands: A Review of Current Science and Available Practices* (2015), https://perma.cc/R4WA-2PPK.

Table 2. Sample practices for agricultural greenhouse gas mitigation[27]

Mitigation Strategy	Potential Benefit	Sample On-Farm Practices
Mitigating Current Emissions	Farms may be able to alter existing farming and grazing practices to lower GHG emissions.	• Use appropriate fertilizer amount and type, at the right time, in the right place. • Implement conservation tillage • Improve efficiency of irrigation • Adopt precision agriculture methods • Reduce methane emissions through better manure management
Sequestering Carbon	Farms may be able to improve sequestration by increasing soil carbon, preventing the loss of soil, or increasing woody biomass production.	• Return more organic matter (i.e. plant residues) to soil • Minimize soil disturbance • Plant cover crops between rotations • Extend crop rotations • Include legume rotations • Adopt agroforestry and other practices that enhance woody biomass and perennials
Preventing Future Emissions	Farms may be able to limit new cultivation on site or choose not to cultivate higher-emitting soils.	• Prevent land use conversion or expansion of agriculture on marginal lands • Avoid draining organic soils

B. Adaptation Measures

Adaptation to a changing climate will require farmers, foresters, and ranchers to prepare for and respond to new risks, including extreme weather events, changing growing seasons, and different pests and plant diseases. Table 3 provides an overview of the range of practices that farmers can undertake to adapt to climate change.

27 *Adapted from* Pete Smith et al., *Greenhouse Gas Mitigation in Agriculture*, 363 Philosophical Transactions of the Royal Society B, 789 (2008).

To make farming operations more resilient, farmers can enhance soil health, which will make agricultural systems better able to withstand extreme weather, drought, and erosion due to high winds or flooding.[28] Strategies for enhancing soil health include adjusting production inputs, the timing of planting and adding soil amendments, cover cropping, conservation tillage or no-till agriculture, new crop species, and diversified crop rotations.[29]

In addition to improving soil health, farmers can take a variety of other steps to make their farms more resilient to other climate risks. For example, to prepare for flooding, heavy rainfall, and other risks, farmers can implement resilient farm landscapes that include buffer strips and the return of marginal cropland to native vegetation. To prepare for new pests and diseases, farmers can diversify their crop selection and alter crop rotations. To adjust to changing seasons and a warming climate, farmers can plant different crops; crop scientists can also develop more heat- and drought-resistant crop varieties. Resilience planning is also important on the community level, as rural communities can ensure that new infrastructure investments supported by the Farm Bill, such as rural water and energy systems, are resilient to climate change effects.

28 Alexandra Bot & José Benites, Food & Agric. Org. Of the United Nations, *FAO Soils Bulletin 80, The Importance of Soil Organic Matter: Key to Drought-Resistant Soil and Sustained Food and Production* 19 (2005), https://perma.cc/6VE8-6KG7.

29 USDA, *Effects and Adaptation*, *supra* note 22, at 123; *see also* Nat'l Sustainable Agric. Coal., *Climate Change and Agriculture Recommendations for Farm Bill Conservation Program Implementation* 2 (2014), https://perma.cc/2JKC-AXSY.

Table 3. Sample practices for agricultural adaptation to climate change[30]

Adaptation Strategy	Potential Benefit	Sample On-Farm Practices
Soil Management	Healthier soils better withstand extreme weather events, drought, and other climate-related events.	• Use diversified crops and improved crop varieties • Extend and adapt crop rotations • Include cover crops between rotations • Include legumes in crop rotations • Reduce intensity of cropping • Restore degraded or drained soils • Adopt conservation tillage
Nutrient Management	Improved nutrient management contributes to healthier soils. Additional benefits, such as reduced run-off into water bodies.	• Adjust nutrient application rates • Adopt more precise nutrient application • Reduce nutrient application where possible • Consider transitioning cropland to organic practices[31] • Use crop residue and other organic soil amendments

30 Please note that while these practices may generally lead to better resilience on farms, adaptation practices are highly region-specific.

31 There may be tradeoffs between the benefits of organic practices on nutrient management and the amount of cropland and tillage necessary for the same yield.

Landscape Management	Farms can better withstand extreme events, such as floods, and build soils on retired cropland. Additional benefits, such as reduced run-off into water bodies.	• Employ buffer strips to reduce cropland nutrient loss • Use riparian buffers to reduce nutrient loss and protect water bodies • Return some cropland to native vegetation, such as grassland • Convert drained cropland back to wetlands • Incentivize community-level climate resilience infrastructure investments, such as rural water systems
Water Management	Farms can build better soil and protect water resources, especially in areas facing drought.	• Use more targeted, efficient irrigation practices, including precision agriculture methods • Use cover cropping to reduce evapotranspiration • For wetland rice production, adjust timing of flooding and keep soil dry during off season
Grazing Management	Ranches can build more stable grazing land soil that may better withstand climate change risks such as extreme weather events.	• Optimize grazing intensity • Manage grazing lands to reduce fire risk • Establish or maintain deep-rooted grasses and legumes on grazing lands
Agroforestry	Farms can develop diversified agricultural systems to sequester carbon and reduce soil erosion.	• Plant trees on agricultural lands

C. Opportunities for mitigation and adaptation to work together

Importantly, many on-farm practices can help with both climate adaptation and mitigation.[32] For example, improving soil health not only mitigates climate change, it also makes farms more resilient and better able to withstand the shifting and at times extreme conditions of a changing climate. Efficient fertilizer application will reduce GHG emissions while enhancing soil resilience. Similarly, cover cropping, diversified crops, and other practices that stabilize the soil will reduce GHG emissions from the soil while building soil health. It is important to note that the efficiency of these on-farm practices will vary by region, impacting the ways they can and should be implemented.[33]

Mitigation and adaptation strategies for agricultural systems often require long-term planning to strengthen "climate-sensitive assets"—such as soil and water—over time and in changing conditions.[34] The development of better region-specific data regarding the adoption of conservation practices is needed for this long-term planning to be successful. From those baseline data, regional efforts will be of critical importance in identifying mitigation opportunities, developing strategic adaptation planning, and implementing enhanced soil and livestock management practices.[35]

32 USDA, *Effects and Adaptation*, *supra* note 22, at 126–27.

33 For example, in the Central Valley of California, an adaptation plan that included integrated changes in crop mix and altered irrigation, fertilization, and tillage practices, was found to be most effective for managing climate risk. *Id.* Along with the USDA Climate Hubs, the following organizations have undertaken projects related to regional agricultural adaptation research and planning: California Healthy Soils Initiative; Wisconsin Initiative on Climate Change Impacts; Southeast Florida Regional Climate Change Compact; The Mid-Atlantic Water Program; U.S. Midwest Field Research Network for Climate Adaptation.

34 *Id.* at 126.

35 *Id.*

METRICS FOR PRIORITIZING REFORM PROPOSALS

As the summary above indicates, there are many actions that can promote climate change mitigation or adaptation in agriculture. In addition, changes can be made to every Title of the Farm Bill that would promote one or more of these mitigation and adaptation strategies. Given this complexity, the uncertainties associated with quantitative estimates of the mitigation potential of different strategies, and the qualitative differences between mitigation and adaptation as goals, we developed a range of qualitative metrics that we used to analyze potential reforms. In particular, we considered:

- ***Potential magnitude of climate impact:*** Priority was given to proposals that had proven climate benefits, did not require significant additional research, and targeted the largest sources of agricultural GHG emissions.
- ***Co-benefits:*** Priority was given to proposals that could increase resiliency or economic benefits of farms.
- ***Equity:*** Priority was given to programs that could benefit both small and large farms in all regions.
- ***Scalability:*** Priority was given to proposals that seemed replicable and applicable to farms across the country or where Climate Hubs could facilitate regional diversity.
- ***Enforceability/Administrability:*** Priority was given to proposals that could be tied in with or build upon existing requirements or programs in the Farm Bill.
- ***Feasibility:*** Feasibility considerations included ease of implementation technically, economically, and politically. Because any legislative change will need to be passed in Congress, political feasibility was determined to be one of the most important considerations. Accordingly, we prioritized proposals that seemed, based on stakeholder engagement, suitable for the next Farm Bill, given competing interests for funding and stakeholder sentiment towards climate action.

We have included an analysis of these metrics throughout our recommendations. However, this analysis should be considered as only a first step. While we have attempted to target the largest sources of GHG emissions, more detailed proposals will be required before there can be precise estimates of their potential for emission reductions. The USDA's COMET-Farm, an online farm and ranch GHG accounting tool, can facilitate this effort.[36] Similarly, determining

36 *See* COMET-Farm, https://perma.cc/4GR3-DHJH.

the economic feasibility of specific reform proposals has been difficult because of taxpayer subsidization, the uncertainty of how appropriations may be allocated, and the varying degrees of stringency that reforms could encompass (e.g. mandate vs. incentive). Finally, while previous Farm Bill reauthorizations can serve as a guide, the ongoing transitions at U.S. federal agencies engaged in Farm Bill programs will likely have impacts on the political feasibility of proposals, which cannot be appropriately assessed at this time. For these reasons, we recommend that any stakeholder utilizing this work anticipate conducting additional research to measure the climate impact of proposals, outline the benefits and co-benefits for farmers and the public, articulate the administrability of the program, and gather stakeholder input and support for proposals.

PATHWAYS FOR ADDRESSING CLIMATE CHANGE IN THE FARM BILL

To determine how we could reform the Farm Bill to better address climate change, we first categorized the range of mitigation and adaptation practices identified in Tables 2 and 3, above, in terms of their potential applicability to the Farm Bill. We then examined how these practices mapped onto the current titles in the Farm Bill. Finally, we assessed how the upcoming Farm Bill could better incentivize these actions across titles, with an eye toward win-win practices with both mitigation and adaptation benefits. Appendix 1 presents a graphic representation of the range of policy mechanisms we considered.

Table 4 contains the range of possibilities we identified for addressing climate mitigation and adaptation by title. To fully assess the impact of each of these policy options—and their interaction with other policies and programs—will require additional research and outreach to stakeholders affected. We discuss in more detail below a set of recommendations, indicated by bold font in this table, that best fit our metrics.

Table 4. Options for Addressing Climate Change by Farm Bill Title

Title	Recommendations
I: Commodity Programs	• Incentivize improving soil health through improved soil management practices, such as cover cropping. • Incentivize improved manure and water management.
II: Conservation	• **Establish conservation compliance requirements for building soil health for climate-ready agriculture.** • Improve conservation compliance enforcement. • Lengthen or make permanent conservation easements.
III: Trade	• Promote international food aid export of more fruits and vegetables, especially legumes. • Export lower quantities of high-emission crops and commodities.
IV: Nutrition	• Leverage government purchasing power for local and sustainable foods and specialty crop purchasing. • Promote the purchasing of more fruits and vegetables, especially legumes, to replace calories from meat, wheat, corn, soy, and rice.

V: Credit	• Offer preferential terms for good soil management practices.
VI: Rural Development	• Incentivize community-level climate resilient infrastructure investments, such as rural water systems. • Give preference to grants and loan applications for clean energy technology, including equipment that could be shared through community cooperatives, such as anaerobic digesters for biogas production.
VII: Research	• **Fund climate change research outreach, tool development, and science synthesis through land grant universities.** • Promote research into climate-resilient crop development.
VIII: Forestry	• Incentivize and provide technical assistance for long-term forest management for private forests. • Adopt agroforestry and other practices that enhance carbon sequestration through woody biomass.
IX: Energy	• **Pursue strategies to decrease methane emissions, including biogas, ethanol, and other on-farm renewable energy.**
X: Horticulture and Organic Agriculture	• Incentivize improving soil health through improved soil management practices, such as cover cropping. • Incentivize improved manure and water management. • Incentivize transitions to organic farming. • Provide greater funding and government purchasing support to specialty crops.
XI: Crop Insurance	• **Reform crop insurance to incentivize climate risk management and eliminate disincentives for adopting climate-friendly practices.** • **Tie crop insurance to new conservation compliance provisions for building soil health for climate ready agriculture.**
XII: Miscellaneous	• Support efforts to address food waste across food system. • Support small and beginning farmers' transition to organic agriculture or to on-farm clean energy options.

All of these areas for reform have the potential to advance climate-ready agricultural practices through the Farm Bill. Many of these areas for reform also have wide-ranging benefits beyond climate change mitigation or adaptation, such as enhancing on-farm productivity and more efficiently using taxpayer dollars. We elected to focus on three recommendations we judged to be particularly important based on the metrics we established (see Section IV).

- **Recommendation 1**: Incorporate climate measures into crop insurance and conservation compliance to better manage on-farm climate risks under Title II (Conservation) and Title XI (Crop Insurance).
- **Recommendation 2:** Ensure the best available science and research—including the outcome of pilot programs—are incorporated into Farm Bill programs; support dissemination of downscaled climate data through USDA regional offices and land grant universities to develop agricultural climate mitigation and adaptation capacity under Title VII.
- **Recommendation 3:** Advance manure management collection and storage methods, as well as biogas development under Title IX to mitigate GHG contributions from livestock.

Recommendation 1: Incorporate Climate into Crop Insurance and Conservation Compliance

a. Reform crop insurance to incentivize climate risk management and eliminate disincentives for adopting climate-friendly practices

The crop insurance program in Title XI of the Farm Bill makes government-subsidized crop insurance available to producers who purchase a policy covering losses in yield, crop revenue, or whole farm revenue. Farmers can select and combine several types of crop insurance policies: catastrophic coverage, "buy-up" coverage, and a supplemental coverage option for selected crops. USDA's Risk Management Agency (RMA) sets insurance premium subsidy rates and develops specific contracts,[37] working with 18 insurance companies to administer the program.[38]

Crop insurance is deeply subsidized by the federal government and it represents the single largest

37 USDA, *About the Risk Management Agency*, https://perma.cc/N49E-KQ3H.

38 Dennis A. Shields, Cong. Research Serv., *Crop Insurance Provisions in the 2014 Farm Bill* 3 (2015).

federal outlay in the farm safety net.[39] On average, taxpayers cover 62 percent of crop insurance premiums.[40] The insurance companies' losses are reinsured by USDA, and the government also reimburses their administrative and operating costs.[41] The Congressional Budget Office anticipates that this program will cost taxpayers over $40 billion from 2016 to 2020.[42]

These subsidies disproportionately benefit large farms: while only about 15 percent of farms use crop insurance, insured farms account for 70 percent of U.S. cropland.[43] Small farmers struggle to utilize crop insurance because of the high administrative burden and challenges of insuring specialty crops.[44] In addition to clear equity concerns involving access to crop insurance, this situation is problematic from a climate perspective because larger farms are more likely to grow monocultures, which are more vulnerable to pests and extreme weather events and can degrade soil health. Indeed, just four crops—corn, cotton, soybeans, and wheat—make up about 70 percent of total acres enrolled in crop insurance.[45]

The current loss coverage policies in the crop insurance program can discourage farmers from proactively reducing their risks by taking steps to enhance soil health and resilience. Because farmers with crop insurance are protected against losses incurred from the kinds of impacts likely to increase with climate change, farmers may not be properly incentivized to respond to

39 *Id*.

40 *Id*.

41 Dennis Shields, Cong. Research Serv., *Federal Crop Insurance: Background* 2 (2015).

42 Cong. Budget Office, *March 2016 Baseline for Farm Programs* (2016), https://perma.cc/896T-TUJ9; *see also* Heritage Found., *Addressing Risk in Agriculture* (2016).

43 USDA, *Structure and Finances of U.S. Farms: Family Farm Report, 2014 Edition* 32–33 (2014), https://perma.cc/S9YP-P6CY.

44 Generally, the more diverse or specialized crops and livestock a farmer produces, the harder it is to obtain insurance. These policies are not designed to support small producers and the policies are administratively complex and burdensome for small farmers, with high premiums for small farmers. On the one hand, if small farmers used yield-based or revenue-based insurance policies, they would need to purchase insurance for each crop, which requires producing a significant volume of each single crop to justify the paperwork and setting up a contracted purchase price from a processor. On the other hand, whole farm insurance policies are based on average adjusted gross revenue of the farm, regardless of the variety of products the farmer grows. This type of policy is more appropriate for diversified farmers, but may still be too cumbersome for small farms to participate. *See* Jeff Schahczenski, Nat'l Sustainable Agric. Info. Serv., *Crop Insurance Options for Specialty, Diversified, and Organic Farmers* (2012), https://perma.cc/64P6-CTRC; Nat'l Sustainable Agric. Coal., *Have Access Improvements to the Federal Crop Insurance Program Gone Far Enough?,* NSAC's Blog (July 28, 2016), https://perma.cc/PT37-RNNL.

45 Shields, *Federal Crop Insurance: Background*, *supra* note 41, at 1.

the changing conditions.[46] Some environmental organizations have even raised concerns that in response to the crop insurance transfer of risk, some farmers may be more willing to engage in unsustainable practices, such as aggressive expansion, irresponsible management, and use of marginal land.[47] In addition, farmers may make planting decisions based on the insurance program incentives rather than market-based signals.[48] In these ways, crop insurance can push farmers towards practices that pose risks to both their operations and taxpayer obligations.[49] It is therefore important that the crop insurance program better align farmers' risk management incentives with the real and growing risks they face from climate change.

One way to achieve this objective is through incentivizing or requiring farmers to undertake actions to improve soil management and promote soil health. Some specific changes to the crop insurance program that could promote these practices include:

- Incorporating climate projections to account for changing growing seasons and planting dates.
- Providing insurance premium rebates for farmers who voluntarily undertake beneficial practices.
- Incentivizing improved soil management practices, diversified crops, and manure management.
- Adjusting the length of policies to better reflect the value added from changes that improve long-term soil health.
- Writing soil health requirements into insurance policies.

More generally, changes to the crop insurance program that reduce the magnitude of the subsidy offered to farmers, such as setting a dollar-per-acre cap, could reduce the moral hazard that current policies create.[50] The methodology used to set premiums could also be adjusted to be based more on the projected frequency and intensity of events such as droughts and floods rather

46 Linda Prokopy et al., *Farmers and Climate Change: A Cross-National Comparison of Beliefs and Risk Perceptions in High-Income Countries*, 56 Envtl. Mgmt. 492, 497 (2015).

47 Bruce Babcock, Environmental Working Group, *Cutting Waste in the Crop Insurance Program* 10 (2013).

48 *Id*.

49 C. O'Connor, NRDC Issue Paper 13-04-A, *Soil Matters: How the Federal Crop Insurance Program Could Be Reformed to Encourage Low-risk Farming Methods with High-reward Environmental Outcomes* (2013).

50 *See, e.g.*, Heritage Found., *Addressing Risk in Agriculture* (2016).

than on backward-looking data. RMA has started to incorporate climate-related risk metrics into annual rates by weighting recent loss experience more heavily, thereby more accurately reflecting the risks that growers face. However, it is important to consider future risks from a changing climate as well.

In addition, elements of the crop insurance program that act as disincentives to climate-friendly farming practices should be removed or updated to account for the growing climate risks farmers face. For example, RMA has guidelines in place about the termination of cover crops, because of concerns that these crops will scavenge water from the commodity crops.[51] This requirement can act as a disincentive to farmers' adoption of cover cropping, a practice that builds the soil and reduces runoff in the non-growing season.[52] The next Farm Bill could specify that there should be no specific termination requirements for cover crops.

Insurance policies may also serve to incentivize some environmentally harmful practices, such as early and excess fertilizer application and cultivation of environmentally sensitive land.[53] Because early application maximizes crops' uptake of nitrogen, it can increase yield in the short term, but it contributes to N_2O emissions, unhealthy soils that become less able to fix nitrogen and must rely increasingly on fertilizer, and polluted runoff. In addition, synthetic fertilizers, which are made from non-renewable materials, including petroleum and potash, are produced at a huge energy cost.[54] These changes could be complemented by an increase in the length of insurance policies, as discussed above, because insurance companies would benefit from the longer-term improvements in soil health.

51 Nat'l Sustainable Agric. Coal., *10 Ways USDA Can Address Climate Change in 2016*, NSAC's Blog (Dec. 30, 2015), https://perma.cc/L5AZ-NAF5.

52 *See* Practical Farmers of Iowa, *Cover Crops*, https://perma.cc/7GHL-NVXQ.

53 USDA's Economic Research Service found that "[l]ands brought into or retained in cultivation due to these crop insurance subsidy increases are, on average, less productive, more vulnerable to erosion . . . then cultivated cropland overall. Based on nutrient application data, these lands are also associated with higher levels of potential nutrient losses per acre." USDA Economic Research Service, *Report Summary: Environmental Effects of Agricultural Land Use Change* (Aug. 2006); *see also* Daniel Sumner & Carl Zulauf, *The Conservation Crossroads in Agriculture: Insight from Leading Economists. Economic and Environmental Effects of Agricultural Insurance Programs*, *in* The Council on Food, Agricultural and Resource Economics (2012).

54 *See* Stephanie Ogburn, *The Dark Side of Nitrogen*, Grist (Feb. 5, 2010), https://perma.cc/9J6E-ZD9J ("About one percent of the world's annual energy consumption is used to produce ammonia, most of which becomes nitrogen fertilizer.").

b. Tie crop insurance to a new conservation compliance provision for building soil health for climate ready agriculture

Currently, in order to qualify for crop insurance, farmers must satisfy two conservation compliance requirements, the Wetland Conservation ("Swampbuster") and Highly Erodible Land Conservation ("Sodbuster") provisions.[55] These provisions ensure, respectively, that farmers do not convert a wetland or plant crops on highly erodible land or a previously converted wetland.[56] While these current conservation requirements are beneficial in addressing some climate impacts, adding a conservation compliance requirement directly targeted at climate-related practices would improve upon them.

With 70% of farmland in the crop insurance program, changes in conservation compliance through the next Farm Bill or through RMA's policies can drive big climate change benefits. Under Title II, Congress could create an additional conservation compliance requirement for climate-friendly agricultural practices, which could either be required to obtain crop insurance or could make farmers eligible for rebates. The types of on-farm practices that could mitigate risk and enhance climate resilience include more precise irrigation and fertilizer application, reduced tillage of the soil, cover cropping, altering crop rotations, and building buffer strips and riparian buffers..[57]

In addition, enforcement gaps have limited the success of the existing conservation compliance requirements. To make the mechanism effective, it will be important to establish simple and effective enforcement, for example by using remote sensing, and to ensure that Natural Resources Conservation Service (NRCS) offices have sufficient resources to carry out enforcement efforts.

These proposals could produce significant climate benefits from increasing soil health, in terms of both mitigation and adaptation. Reform of the crop insurance and conservation titles could also help address some of the equity issues that currently exist between small and large farms. Existing USDA programs, described in the next section, could help with scalability and administrability. Finally, in terms of feasibility, while any change may be difficult, our stakeholder engagement indicated that farmers are open to programs that target soil health, given the potential economic benefits for their farms. While the actual on-farm impacts will vary based on how the program is designed and constructed, building more resilient, healthy soil can help improve environmental

55 Sodbuster, 16 U.S.C. § 3811 *et seq*.; Swampbuster, 16 U.S.C. § 3821 *et seq.*

56 *See* Nat. Res. Conservation Serv., USDA, *Conservation Compliance Provisions, https://perma.cc/6V9X-URBP*.

57 *Id.* at 7.

outcomes and decrease the risk of crop loss.[58]

Recommendation 2: Ensure that the Best Available Science and Research Guide Farm Bill Programs

The effectiveness of agricultural practices that promote climate change mitigation and adaptation often varies based on the local climate, soil types, and crops. For example, the benefits of many of the on-farm practices that improve soil health, including more precise irrigation and fertilizer application, reduced tillage of the soil, and altering crop rotations, vary by region and soil type. In some areas, no-till methods may be infeasible; farmers who try to implement no-till in these areas would likely continue to till to some degree or after a short period of time, resulting in quick reversal of the achieved carbon sequestration benefits. Furthermore, the technical specificity of choosing among these practices and correctly implementing them requires guidance at a local level. Therefore, to incorporate climate-ready practices into conservation compliance or crop insurance, the USDA would need to account for this regional variability.

To address these types of knowledge gaps and to provide technical assistance to states and farmers, USDA has created a range of programs, including Climate Hubs, which were established at public land-grant universities in 2014.[59] The Hubs deliver science-based knowledge, practical information, and program support for farmers to engage in "climate-informed decision-making" by farmers.[60]

Increasing funding in the 2018 Farm Bill in Title VII, the Research title, could solidify and expand USDA's ability to administer and scale climate research and outreach efforts across all regions of the country. Additionally, creating systems to collect and analyze regional data on pilot programs and ensure best practices are adopted could assist long-term efforts to incorporate climate policies into Farm Bill programs.[61] For these reasons we recommend additional funding for climate research and monitoring, especially focused on regional resilience.

58 O'Connor, *Soil Matters*, *supra* note 49, at 7.

59 USDA Climate Hubs, *Mission and Vision*, https://perma.cc/T46E-CSBT.

60 *Id.*

61 The existing ARS LTAR system, which conducts longterm sustainability research, could be used to inform the regional best practices communicated in outreach efforts. *See* Agric. Research Serv., USDA, *Long-Term Agroecosystem Research (LTAR) Network*, https://perma.cc/6XRT-FBTC.

Recommendation 3: Address the Significant GHG Contributions of Livestock Management

Improving livestock management, especially manure management, is a significant opportunity for mitigating emissions of methane and achieving several co-benefits for the public and farmers. There is currently very little regulation of livestock manure management. Manure is sometimes stored—uncovered—in a single collection site, which causes the methane to be released directly into the atmosphere. In addition to being a major GHG emissions source, it can cause a range of considerable environmental harms.[62]

a. Require improved manure management, including the covering of lagoons

First, the upcoming Farm Bill could address manure management collection and storage methods. Practices can be improved through actions such as allowing livestock to roam,[63] covering manure lagoons, flaring the methane produced, or producing biogas for use. Simply covering a manure lagoon results in significant decreases in methane emissions, as well as decreased odors. Flaring is the combustion of methane, which yields water and carbon dioxide. Although flaring still emits GHGs, carbon dioxide is a less potent GHG than methane.

The Farm Bill could promote these practices either through incentives or mandates in the Conservation or Crop Insurance titles. For example, the Farm Bill could mandate or incentivize farmers with a threshold number of cattle, swine, or poultry to cover manure and flare the produced methane to be eligible for crop insurance. Such a mandate would have the greatest impact at Concentrated Animal Feeding Operations (CAFOs), which may also be better able to bear the high capital costs associated with biogas production.

62 For example, manure management practices can create a public nuisance for which neighbors have little recourse. In addition, runoff from agriculture is not adequately regulated under the Clean Water Act and results in pollution to the nation's waterways. Every year a hypoxic zone, also called a dead zone, develops where the Mississippi River dumps pollution from Midwest livestock and fertilizers into the Gulf of Mexico. *See* Kyle Weldon & Elizabeth Rumley, Nat'l Agric. L. Ctr., *States' Right to Farm Statutes*, https://perma.cc/Y8XA-KUBR; Ada Carr, *This Year's Gulf of Mexico "Dead Zone" Will Be the Size of Connecticut, Researchers Say*, Weather.com (Jun. 15, 2016), https://perma.cc/36ZZ-NKY9.

63 Farms where the cattle range freely do not release as much methane to the atmosphere because the less consolidated manure is more likely to be absorbed into the soil rather than anaerobically digested to produce methane.

b. Pursue strategies to decrease methane emissions, including biogas and other on-farm renewable energy production

Second, the Energy Title could incentivize on-farm biogas. Farms can use many different substrates to produce biogas, including animal excrements (such as from cattle, swine, poultry,[64] and horse), food waste, milling by-products, and catch crops (such as clover grass on farms without livestock).[65] Farmers can realize substantial savings from biogas production, including through substituting biogas for other energy sources, through substituting digestate[66] for commercial fertilizers,[67] and by avoiding disposal and treatment of substrates (such as for waste-water treatment). Farmers may also be able to sell carbon offsets.[68] In addition, farmers producing biogas can avoid some of the worst problems with animal agriculture: farmers must do something with the manure, and its storage can produce strong odors,[69] unhealthy conditions for workers and families,[70] and pollution through runoff in the worst scenarios.[71]

Farmers have two main options for biogas use: (1) generation of electricity for on-site use or sale

64 Using poultry manure as a substrate can be difficult because feathers and poultry litter can clog anaerobic digesters. *See* Donald L. Van Dyne & J. Alan Weber, Special Article, *Biogas Production from Animal Manures: What Is the Potential?*, Industrial Uses/IUS-4 20, 22 (Dec. 1994).

65 SustainGas, Sustainable Biogas Production: A Handbook for Organic Farmers 38 (2013), https://perma.cc/8354-G3A4.

66 Digestate is the solid that is left over after biogas has been produced. Digestate can be sold or used on farm as fertilizer. It smells better than manure, is free of harmful bacteria, and contains nitrogen in a form that is more bioavailable for crops.

67 40 organic farms in Germany, in a region without livestock, have found it worthwhile to cooperate in supplying and transporting clover grass up to 50 km to an AD because the digestate provides them with a flexible organic fertilizer. *See* SustainGas, *supra* note 66, at 28. They find that the digestate leads to higher quality for their food crops. *Id.* "Biogas has to serve food production via improved nutrient supply," one farmer says. *Id.*

68 If farmers can show that they have reduced their methane emissions, they may be able to sell the carbon offsets in exchanges such as the California GHG cap and trade market. *See* Cal. Air Resources Bd., Compliance Offset Protocol, Livestock Projects: Capturing and Destroying Methane from Manure Management Systems (2014), https://perma.cc/68EF-2SB9.

69 The odor-reducing benefits are viewed as especially desirable for poultry and swine farms.

70 Biogas plants dispose of waste and sewage, making conditions healthier. Not only does the anaerobic digestion process remove pathogens, but because biogas production requires collecting manure at a central location, some unhygienic conditions are avoided. *See* Julia Bramley, et al., Tufts Department of Urban & Environmental Policy & Planning, Agricultural Biogas in the United States: A Market Assessment 122 (2011), https://perma.cc/Z4ER-S4SD.

71 Livestock manure generated at cattle yards and dairy farms can contaminate surface and ground water through runoff. Anaerobic digestion sanitizes the manure to a large extent, decreasing the risk of water contamination. *Id.*

to the grid; and (2) direct use of biogas locally, either on-site or nearby.[72] Using the biogas to fuel a generator to produce electricity is considered the most profitable use for most farms.[73] Another use is to upgrade the biogas, then called biomethane, to be injected into the national natural gas pipeline network as a substitute for extracted natural gas.

Because farmers could benefit financially from on-farm use or the sale of biogas, the Farm Bill should continue and expand funding for the Rural Energy for America Program, which offers cost-sharing grants and loans for renewable energy improvements.[74] However, these programs are most likely to benefit large farms because anaerobic digesters are expensive and require a large and constant supply of substrate to produce a return on investment. We therefore suggest the Farm Bill also fund pilot programs to assist small farm communities to form cooperatives so that they are also able to utilize this technology and participate in the grant or loan program.

Even with the available grants and loans, farmers are still taking a substantial financial risk. USDA or land-grant universities should actively help communities or cooperatives with the planning and application process. Large farms or cooperatives who are unable or unwilling to operate and maintain anaerobic digesters themselves could hire a company to lease the equipment and manage the biogas production process.[75] USDA Rural Development Agencies could be a valuable liaison between biogas management companies and farmers.

CAFOs could be part of a voluntary program or be required to use anaerobic digesters due to their greater contribution to climate change and other environmental harms. Because CAFOs are responsible for high levels of greenhouse gas emissions and because anaerobic digesters are economically feasible for large operations, there is reason to consider the benefits that could be achieved by requiring these practices for large CAFOs in the Farm Bill.

Livestock management is a critical area for addressing climate impacts, and biogas has the potential to be a win-win for farmers willing to invest in alternative energy production.

72 EPA, AgSTAR Handbook: A Manual for Developing Biogas Systems at Commercial Farms in the United States 2-5 (K.F. Roos et al. eds. 2d ed. 2004).

73 *Id.* at. 3-1. For most farms, electricity comprises 70% to 100% of energy use. *Id.*

74 USDA, *Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Loans & Grants*, https://perma.cc/5LE3-2QRF.

75 This model is frequently used for wind energy production. *See* Agric. Research Serv., USDA, *Wind and Sun and Farm-Based Energy Sources*, Agric. Res., Aug. 2006, https://perma.cc/ZBJ9-R74Q.

CONCLUSIONS

The U.S. agricultural system must evolve to mitigate climate change and adapt to the effects of a changing climate. Opportunities for climate change mitigation and adaptation exist across the Farm Bill, from bolstering climate resilient infrastructure in the Rural Development title to incentivizing sustainable forest management in the Forestry title. Taking action on climate measures in the next Farm Bill reauthorization will help farmers better plan for changing conditions, protect taxpayers from increasing risks, and assist the United States in meeting its global climate commitments. We strongly recommend that the next Farm Bill incorporate climate risk management provisions and that state and local actors consider ways they can support these efforts moving forward. We hope this white paper can help support stakeholders engaged in this work.