

# **Policy Incentives for Soil Health Practices: A Comparative Analysis of Potential Federal Soil Health Policies**

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Prepared for Mad Agriculture

Final Report: May 18, 2020

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## 1. Executive Summary

Unsustainable agricultural practices and climate change have set a trajectory towards poor long-term soil health, costing American farmers billions in economic productivity loss and generating millions of tons of greenhouse gas emissions. Farmers, conservationists, legislators, and agricultural experts have touted regenerative agriculture, a set of ecologically informed agricultural practices, as an economic, political, social, and environmental solution to this problem. Soil health practices are known to improve economic benefits for farmers by cutting costs and improving the resilience of their farms and can generate environmental benefits critical for mitigating climate change.

This report considers five potential federal soil health policies which would pay farmers to adopt soil health practices in order to identify the most promising pathway for widespread adoption of soil health practices. These are 1) existing federal incentives, 2) tax credits for soil carbon sequestration, 3) crop insurance rebates for cover cropping, 4) generalized grants for soil health practices, and 5) agricultural carbon markets. Each of those policies is modeled on an existing state system or on proposed legislation. The primary objective is to identify which policies would best promote the adoption of soil health practices in order to generate economic benefits for farmers and sequester carbon in soil.

These policies are compared on the basis of four evaluation criteria: effectiveness, equity, efficiency, and political feasibility. Effectiveness represents the potential for each policy to promote the uptake of soil health practices by looking at eligibility, ease of access, and payout to farmers. Equity represents how each policy is expected to affect marginalized farmers specifically, including those on smaller farms and without access to capital. Efficiency represents the administrative efficiency of each program, as well as the environmental benefits of the soil health policies it promotes. Political feasibility represents whether or not a policy is likely to garner bipartisan support and support from key stakeholder groups.

Each policy is scored by criterion to generate a weighted score, identifying how well it is expected to perform overall. **The policy alternative *Grants for Soil Health Practices* is recommended** as the strongest soil health policy that will promote soil health adoption throughout the United States. This policy allows farmers to use the practices that make the most sense for their land, finances farmers when implementing soil health practices rather than after the fact and has the potential to particularly aid smaller and minority farmers.

## 2. Introduction and Problem Statement

In the U.S., nearly 40% of all land is farmland.<sup>1</sup> While agricultural intensification technologies like chemical fertilizers, pesticides, and new equipment have increased yields per acre dramatically, progress has come at great cost. For every calorie of food produced, 12 calories of fossil fuel are burned, and agricultural soils have lost as much as 60% of their original organic carbon content.<sup>2</sup> In some areas, such as the Central Valley in California, farms have soil with only 0.2% of the original organic carbon content.<sup>3</sup> This is alarming: high organic soil carbon content is an indicator of both soil health as well as the soil's ability to act as a carbon sink storing atmospheric greenhouse gas emissions (GHGs). The USDA National Resources Conservation Service defines soil health or soil quality as “continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.”<sup>4</sup> Improving soil health therefore carries the joint benefits of improved agricultural productivity, farmer livelihoods, and food security, as well as providing a unique opportunity to mitigate the impacts of climate change through the storage of GHGs.

Soils are the largest terrestrial carbon pool, holding approximately 2500 petagrams of carbon.<sup>5</sup> Healthy soils can function as a carbon sink, meaning they sequester more carbon than they emit. The 2019 IPCC report estimates that the land sector could sequester up to 30% of global carbon emissions.<sup>6</sup>

Practices to promote soil health, such as cover cropping, reduced or no-tillage, conservation cover, and nutrient management, can generate broad environmental and economic benefits to farmers and society. From a climate standpoint, soil health practices reduce GHGs through both carbon sequestration and by minimizing practices that generate carbon dioxide, nitrous oxide, and methane emissions. Beyond carbon sequestration, additional environmental benefits include reduced soil erosion and nutrient leaching, increased drought resilience and water quality, ecological diversity, and habitat security for beneficial insects and pollinators.<sup>7</sup> For more on the co-benefits of soil health, see Appendix A.

These environmental benefits can increase economic profits for farmers by directly or indirectly increasing agricultural productivity and lowering costs. Additionally, soil health practices generate

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<sup>1</sup> USDA NASS, “Farms and Farmland: Numbers, Acreage, Ownership, and Use.”

<sup>2</sup> Canning, Rehkamp, and Waters, “The Role of Fossil Fuels in the U.S. Food System and the American Diet.”

<sup>3</sup> Guzman, “Interview Correspondence.”

<sup>4</sup> Soil Survey Staff, “Natural Resources Conservation Service, United States Department of Agriculture.”

<sup>5</sup> Kane, “Carbon Sequestration Potential on Agricultural Lands: A Review of Current Science and Available Practices In Association with: National Sustainable Agriculture Coalition Breakthrough Strategies and Solutions, LLC.”

<sup>6</sup> Arneeth et al., “Framing and Context.”

<sup>7</sup> Carlisle, “Factors Influencing Farmer Adoption of Soil Health Practices in the United States: A Narrative Review.”

economic benefits through increased soil productivity and crop yields; weed suppression; reduced fertilizer, labor, and diesel costs; and improved nutrient cycling.<sup>8</sup>

Poor soil health currently costs the U.S. \$85.1 billion annually through agricultural productivity losses, greenhouse gas emissions, loss of biodiversity, eutrophication, contamination, and decreased resilience.<sup>9</sup> This is linked with another crisis: farming is not profitable for the majority of farmers. Since 2012, net farm income has decreased by 49 percent, and the farm sector's debt-to-income ratio is the highest it has been since the mid-1980s.<sup>10</sup>

Farmers adopting soil health and carbon sequestration practices stimulates agricultural productivity, increases farm profitability, and generates environmental benefits critical for mitigating climate change. One case study found done on Okuye Farms, CA saw a \$76,155 total net income increase and \$657 increase per acre from the introduction of soil health practices. Agricultural soils—cropland and grazing land—have the potential to sequester between 58 and 168 teragrams/megatons of carbon per year.<sup>11</sup>

Despite the environmental and economic benefits from soil health practices, a persistent adoption gap exists. The main barriers to adoption are a lack of knowledge and experience about soil health practices, a lack of funds and technical expertise to implement and maintain soil health practices, differences in perspectives about soil health practices, and imperfect market and governmental incentives.<sup>12</sup> Additionally, benefits are more significant in the medium to long term, which can disincentivize farmers without secure land tenure, such as renters.<sup>13</sup>

There are no models that accurately predict farmer adoption of soil health programs; therefore, an effective federal policy should allow for flexibility and locally-specific adoption strategies across diverse regions and farming communities.<sup>14</sup> As soil health practices have combined economic and environmental benefits, policies intended to incentivize soil health adoption represent a promising window for bipartisan cooperation.

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<sup>8</sup> Carlisle.

<sup>9</sup> Doane et al., "ReThink Soil : A Roadmap for Collective Action to Secure the Conservation and Economic Benefits of Healthy Soils."

<sup>10</sup> USDA ERS, "2020 Farm Sector Forecast."

<sup>11</sup> Chambers, Lal, and Paustian, "Soil Carbon Sequestration Potential of US Croplands and Grasslands: Implementing the 4 per Thousand Initiative."

<sup>12</sup> Carlisle, "Factors Influencing Farmer Adoption of Soil Health Practices in the United States: A Narrative Review."

<sup>13</sup> Carlisle.

<sup>14</sup> Carlisle.

**The principle objective of soil health policy is to increase adoption of soil health practices.**

To garner political support and foster widespread and sustainable adoption, adequate federal policies must prioritize strong economic support for farmers and reward farming practices that present the greatest potential for climate benefits.

**Therefore, the essential objectives of a successful soil health policy are:**

1. Continuation and expanded uptake of soil health practices
2. Improved economic outcomes for farmers
3. Increased carbon sequestration and other environmental/climate benefits.

### **3. Potential federal soil health policies**

This policy analysis assesses the federal policy landscape by comparing existing federal incentive programs (the Status Quo) with four policy alternatives. These policy alternatives are each represented by a model program or bill to ensure operational feasibility, as listed in Table 1 below. Each policy is projected at a national scale but is based on a particular model which may be at the state level. To extrapolate the effects of each policy at a federal level, we have considered only the fundamentals of each, namely the funding mechanism and eligible farm practices, and ignored secondary specifications (i.e. funding for technical assistance), as those specifications would likely change at the federal context.

*Table 1 - Five policy mechanisms and their representative policies*

<b>Policy Alternative</b>	<b>Model Policy</b>
Existing Federal Incentives / Status quo	2018 Farm Bill
Tax credits for soil health practices	Natural Carbon Sequestration Tax Credit
Crop Insurance Rebate	Iowa Cover Crop Insurance Demonstration Project
Generalized grants for soil health practices	California Healthy Soils Program
Agricultural carbon markets	Ecosystem Services Market Consortium (ESMC)

### 3.1 Existing Federal Incentives

Soil health quality in the U.S. has been degrading for decades.<sup>15</sup> To assess the current status quo of soil health policies, we consider the 2018 farm bill and its implications for soil health. The farm bill is only a small percent of the total U.S. budget, but spending on conservation has decreased. The main policy proposals in the farm bill include standard soil health testing protocols, discounts on crop insurance, and ensuring land exiting the Conservation Reserve Program (CRP), which pays farmers to take land out of production, enters regenerative production.<sup>16</sup> The primary programs that incentive soil health practices run by NRCS are Environmental Quality Incentive Program, Conservation Technical Assistance Program, Regional Conservation Partnership Program, Conservation Stewardship Program, and Conservation Reserve Program.

However, utilization is limited. Currently, only 3.6% of croplands in the US receive funds to implement practices that promote soil quality under these five NRCS programs. Appendix B includes more detailed information about these programs.

### 3.2 Tax Credits for Soil Health Practices

To evaluate tax credits for soil health practices, Senator Michael Bennet's [Natural Sequestration Tax Credit](#) draft legislation is used as a model (the Bennet bill).<sup>17</sup> The Bennet bill expands the 45Q tax carbon sequestration credit, currently available to energy sector companies, to farmers and ranchers on agricultural soils, forests and wetlands. It proposes creating a 45T tax credit: a quantification credit that establishes a 30% tax credit for the cost of quantifying baseline and annual carbon sequestration levels; and an outcomes-based tax credit that creates credits per ton of carbon sequestered. The pay rate would be the same as the 45Q tax credit rate, which is currently \$20 per ton of carbon dioxide equivalent (CO<sub>2e</sub>) sequestered, increasing to \$50 in stages by 2026. The bill would also require USDA to establish a reporting and verification accreditation system and outline a process to transfer the tax credit to other taxpayers to account for businesses that do not have tax liability.<sup>18</sup>

It is also important to note that Bennet's draft legislation is the result of conversations with producers and rural communities from all parts of Colorado in the past two years.

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<sup>15</sup> Harrigan and Charney, "Impact of 2018 Farm Bill Provisions on Soil Health."

<sup>16</sup> USDA Farm Service Agency, "Conservation Reserve Program Fact Sheet."

<sup>17</sup> Bennet, "Natural Carbon Sequestration Tax Credit - 45T Discussion Draft."

<sup>18</sup> Donovan, "Fact Sheet - The Natural Carbon Sequestration Tax Credit."

### 3.3 Crop Insurance Rebate

This policy is based on the [Iowa Cover Crop Crop Insurance Demonstration Project](#), a program launched in 2019 in which farmers may receive a \$5/acre discount on federal crop insurance for each acre of spring-planted crops they treat with a fall-planted cover crop. Farmers in this program may not harvest cover crops for grain but can graze or harvest forage. Farmers may be required to provide documentation including seed bills, seeding method, and timing to confirm fields applied were seeded with cover crops. There is no limit on the number of acres enrolled, although acres must not be enrolled in another cover crop incentive program.

The Iowa program is funding-limited; discounts are awarded until funding for the program runs out. However, this analysis will operate under the assumption that a similar federal policy would not be funding-limited: nationally, any participants who qualify would be allowed to enroll so as not to arbitrarily create caps on uptake and benefit estimates.

Such a program would be integrated with the existing crop insurance federal authority, giving it a clear implementation structure. However, this program would necessarily be limited in access, as only those farmers eligible for crop insurance would be able to benefit from a discount on crop insurance. While most traditional field crops (including wheat, corn, and soy) are eligible for crop insurance, only about half of specialty crop acres are covered with crop insurance.<sup>19</sup>

### 3.4 Generalized Grants for Soil Health Practices

This policy is based on the [California Healthy Soils Program Incentives Program](#), a program launched in 2017 which awards grants to farmers to implement soil health practices according to a specific valuation of many different practices, usually covering the average implementation cost. Farmers are encouraged to implement multiple practices, and the program is very flexible, with no limit on the number of acres enrolled or practices applied, although there is a total grant cap of \$75,000. The program also includes funding for annual soil tests; while the funding is not tied to soil outcomes, the hope is that collecting soil health data will provide data for further soil health research.

A federal policy based on the HSP Incentives Program might modify the funding amounts to be more applicable to a nationwide farmer population. To account for this change in contexts, one funding amount has been modified: it is assumed that a nationwide grants program would have a lower payment rate for cover cropping, as the current HSP payout rate (~\$130/acre) is substantially higher than the nationwide average cost of implementing cover cropping (\$50/acre). Thus the payment rate

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<sup>19</sup> Rosa and Johnson, “Federal Crop Insurance: Specialty Crops.”

for this analysis is adjusted to \$55/acre to align with the other HSP payment rates, which slightly exceed the average cost of each practice.

This policy could be implemented through a new federal grants program, or through a significant expansion of existing grants programs like EQIP or CSP, discussed under Existing Incentives. However, a grants program as extensive as the California Healthy Soils Program would be such an immense expansion that this policy requires separate analysis from Existing Incentives.

### **3.5 Agricultural Carbon Markets**

Carbon markets use private markets to pay farmers to sequester carbon through soil health practices. These solutions include private companies working to create agricultural carbon markets, such as Indigo Agriculture, Nori, and the [Ecosystem Market Services Consortium \(ESMC\)](#).

These programs use a “science-based, standards-based, verified and certified program” to quantify changes in ecosystem services.<sup>20</sup> These benefits are then monetized and sold as ecosystem service credits. These market solutions depend on asset quantification, and rely on the development of accurate, cost-effective, and scalable methods to quantify the impact of agricultural management systems on soil carbon, net greenhouse gases, water quality, and water quantity. ESCM’s first three-year pilot was launched in 2019 in the Southern Great Plains on rangeland and farmland in Texas and Oklahoma. This initial pilot partnered with participants of the Land Stewardship Program of the Noble Research Institute, involving 12 operations covering over 40,000 acres. It is anticipated that the first sale of soil carbon credits from this pilot will occur in the spring of 2020.

For any market-based mechanism, pricing and measuring carbon or other metrics is paramount. Once a price has been set, these solutions are intended to be self-maintaining. ESCM is specifically seeking to launch a fully functioning national scale ecosystem services market conceived and designed to sell carbon and water quality and quantity credits for the agricultural sector by 2022.

## **4. Analytic Methodology**

### **4.1 Criteria Overview**

**In order to compare these policies, we evaluated each of them along four criteria: effectiveness, equity, efficiency, and political feasibility.** These criteria are split into seven sub-criteria in total. For each sub-criterion, we relatively scored each policy (from 1-lowest to 5-highest).

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<sup>20</sup> Ecosystem Services Market, “Ecosystem Services Market Consortium.”

These policies were scored using quantitative metrics where possible, and when such metrics were not available, we scored them based on available information as described.

We assign each of the sub-criteria a weight, representing how significant we think the factors represented by that sub-criterion are for a successful soil health policy. Our criteria and weights are outlined in Table 2.

*Table 2 - Description and weighting of evaluation criteria*

<b>Criteria</b>	Weight (total = 1.0)
<p><b>Effectiveness Overall</b>  <i>How well does this policy promote uptake of soil health practices?</i>            Together, the three effectiveness criteria evaluate how many farmers will use soil health practices under a given policy. The effectiveness criteria drive our analysis, as they measure each policy's impact against our primary objective: increasing uptake of soil health practices for farmers.</p>	(0.45)
<p><b>Estimated Average Benefit To Farmers, per Acre</b>  <i>Will this policy pay farmers well?</i>            This criterion evaluates how much money farmers are likely to receive from a given policy. Greater farmer benefits will result in dramatically greater uptake, leading to more carbon sequestration and more farmers aided, so this criterion is weighted heavily at 0.2.</p>	0.2
<p><b>Eligibility</b>  <i>Are most farmers eligible for this policy?</i>            This criterion evaluates how many farmers are likely to be eligible for a given policy. Total uptake and adoption of soil health practices is limited by this factor. However, total eligibility does not vary widely among the different policies, so this criterion receives a smaller weight of 0.05.</p>	0.05
<p><b>Ease of Access</b>  <i>Is this policy easy for farmers to access and implement?</i>            This criterion evaluates barriers to farmer access, including: complexity of access, complexity of implementation, reliance on subsidiary programs, existence of similar programs, financial investment required from farmers, and similarity to demonstration projects. This is a crucial aspect of engagement and uptake, so it is weighted heavily at 0.2.</p>	0.2

<b>Criteria</b>	Weight (total = 1.0)
<p><b>Equity</b>  <i>Is this program accessible to marginalized and smaller farmers?</i>  This criterion evaluates how the distribution of benefits and costs varies across farmer demographics. We are interested in the scalability of the benefit to farmers and the distribution of returns on investments. We define the following principle indicators to evaluate equity against: the distribution of estimated average benefit to farms based on both farm size, tenure arrangement, gender, and race. Any good soil health program should create economic opportunity for marginalized and disadvantaged farmers. This factor thus gets a 0.1 weighting.</p>	0.15
<p><b>Efficiency Overall</b>  <i>Does this program spend money only on program aspects that will have the outcomes we desire?</i>  These criteria evaluate whether this policy promotes soil health practices that sequester large amounts of carbon, and whether or not the policy has high administrative costs to the government. We use an atypical definition of efficiency here, and our primary goal with these criteria is to answer: for farmers impacted by each policy, what are the estimated climate benefits, and how do those compare against the estimated implementation costs? Thus, our measure of efficiency is a slightly altered benefit/cost analysis.</p>	(0.2)
<p><b>Estimated Magnitude of Climate Benefit, per Acre</b>  <i>Does this policy lead to carbon sequestration in soils?</i>  This criterion evaluates the estimated amount of carbon sequestered as a result of adopting the policy: estimated average eCO<sub>2</sub> (carbon dioxide equivalent) sequestered per acre over the estimated number of operations that will implement soil health practices as a result of the policy. This criterion is important but not crucial to the primary goal, receiving a 0.15 weighting.</p>	0.15
<p><b>Administrative Efficiency</b>  <i>Is this policy straightforward and cost-effective to implement?</i>  This criterion evaluates the administrative efficiency of a program. Hurdles to efficiency may slow down implementation and delivery of programs, particularly in the short term. A more efficient soil health policy will use funding to invest in farmers rather than for</p>	0.05

Criteria	Weight (total = 1.0)
administrative necessities. However, this criterion is not directly related to the analysis goals and so receives a 0.05 weighting.	
<p><b>Political Feasibility</b>  <i>Is this policy likely to garner broad political support?</i>  This criterion evaluates political support for a given policy by examining support in Congress, positions of relevant interest groups, and the political power of relevant stakeholders. Political feasibility is crucial to passing and implementing any program, so it is weighted heavily at 0.2.</p>	0.2

**4.2 Estimating the Ratios of Adopted Practices**

Of the five programs we analyze, four incentivize a mix of soil health practices. Tax credits and carbon markets pay in proportion to carbon sequestered, while grants pay for practice adoption costs, and existing federal incentives promote various practices at different rates. In these circumstances, a mix of adopted practices is estimated in order to obtain average magnitudes of economic and soil health benefits.

To simplify the analysis without sacrificing specificity, it is assumed that farmers are only using the most common practices: no-till or reduced-till, nutrient management (including both reduction in nitrogen fertilizer application and switch to compost), crop rotation, and cover cropping.

- |   |
|---|
| <p><i>Common practices:</i></p> <ul style="list-style-type: none"> <li>A. No till</li> <li>B. Reduced till</li> <li>C. Nutrient management (reduction in nitrogen fertilizer application)</li> <li>D. Nutrient management (switch to compost)</li> <li>E. Crop rotation</li> <li>F. Cover cropping</li> </ul> |
|---|

Rather than attempt to estimate the number of farmers who will use each possible combination of these practices, we assume that each farmer will use only one of the above practices, or one of three common combinations: all practices (no-till, composting, crop rotation, and cover cropping); crop rotation, no-till, and cover cropping; and no-till and cover cropping. That creates a list of nine possible practices.

*Common combinations:*

- G. All practices (no-till, composting, crop rotation, and cover cropping)
- H. Crop rotation, no till, cover cropping
- I. No till and cover cropping

From these practices, baseline USDA data is used to estimate the ratio of practices which farmers are likely to uptake.<sup>21</sup> The agricultural census does not specify how many farmers are using multiple practices. Based on the available data, it is estimated that between 10% and 50% of those who use organic fertilizer are using every practice; between 10% and 30% of those using cover crops are also using no-till and crop rotation; and between 10% and 40% of those using cover crops are also using no-till but not crop rotation. These uncertainties are propagated throughout further calculations to present a range of possible outcomes.

The federal program will likely incentivize an increase in adoption of these practices overall, but a *larger* increase in adoption of the less common practices (cover crops and organic fertilizer) and a particularly large increase in the adoption of combinations of practices. A range of possibilities is considered, from unchanged ratios of practices to an optimistic scenario in which use of the less common practices increases relatively fourfold, and the use of combinations of practices increases relatively eightfold. The results of these calculations are illustrated in the following figure, and further detailed in Appendix C.

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<sup>21</sup> USDA ERS, “Nutrient Management”; USDA, “Census of Agriculture.”

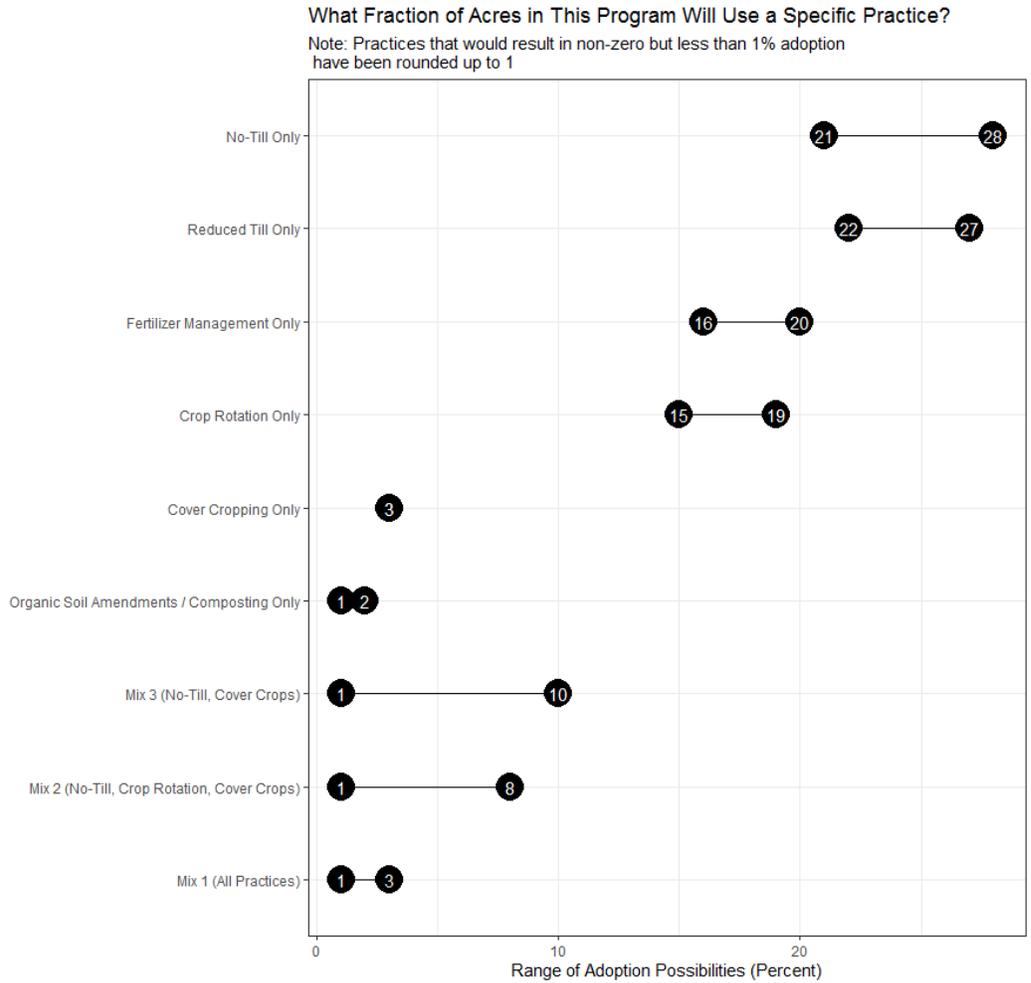


Figure 1 - Adoption Rates by Specific Practices

This range of ratios is used to calculate both net carbon sequestration and payouts for those policies that incentivize multiple practices.

## 5. Effectiveness

### 5.1 Estimated Average Benefit to Farmers

Many soil health practices are worthwhile investments, and farmers can often recover the investment they put into soil health practices after several years due to increased productivity and reduced costs on their land. However, many soil health practices are expensive and technically complex, and require both a large initial financial investment and a change of behavior. Farmers are much more likely to use soil health policies when they can identify a clear and certain economic benefit. The average benefit to farmers is investigated as a critical aspect of the effectiveness of any soil health policy; programs which

pay farmers well are likely to have much greater uptake and lead to larger increases in soil health practice use.

To calculate the average benefit to farmers, we first estimate which practices farmers are likely to use, following the calculation in 4.2 Estimating the Ratios of Adopted Practices. Since grants pays by practice, these calculations can be used to identify an average payout per acre.

*Calculating Payouts: Grants*

Calculate for each practice:

**fraction of acres using that practice × payout per acre for that practice**

then, add together for each practice to get a

**sum of payout per acre per practice = total average payout per acre**

Tax Credits and Carbon Markets pay in proportion to measured carbon sequestered. The estimate of which practices farmers are likely to use forms the basis for an estimated average carbon sequestration per acre. The result is multiplied by the payout rate of the policy to get an average payout per acre.

*Calculating Payouts: Tax Credits and Carbon Markets*

Calculate for each practice:

**fraction of acres using that practice ×  
carbon sequestration per acre for that practice**

then, add that together for each practice to get a

**sum of carbon sequestration per acre per practice =  
total average carbon sequestered per acre**

then, multiply by the payout rate

**total average carbon sequestered per acre ×  
payout rate per ton of carbon sequestered =  
total average payout per acre**

An average economic benefit for Existing Incentives was not calculated. Current programs can have payout rates as high as \$75/ac/yr for practices like cover cropping, but funding is extremely limited, and only a small fraction of farmers who are in principle eligible for funds through existing programs are actually able to access those funds.<sup>22</sup> It would be difficult to calculate a meaningful average rate

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<sup>22</sup> Sustainable Agriculture Research & Education, “When Incentive Payments Are Received for Cover Crop Use.”

across a large number of programs and different eligible populations. However, it is clear that the limitations on current incentives have caused them to be ineffective at increasing the use of soil health practices, and so we score this program lowest.

The results of our calculations are summarized in the following table (see Appendix C for more detail on these calculations):

*Table 3 - Summary of Economic Calculations*

<b>Program</b>	<b>Economic Benefit (Estimated Payout, Dollars per Acre per year)</b>	<b>Score: Economic Benefit</b>
<b>Grants</b>	\$32.40 - \$57.58	5
<b>Tax Credits (2026)</b>	\$13.03 - \$22.20	4
<b>Carbon Markets</b>	\$5.21 - \$8.88	3
<b>Crop Insurance Discounts</b>	\$5	2
<b>Limited Incentives</b>	----	1

## 5.2 Eligibility

### 5.2.1 Overview

Regardless of how attractive a program is, only farmers who have the potential to uptake a program will do so. Programs restricted to certain practice types or farmers will have lower uptake than those that are accessible to all farmers. By looking at three factors, we can score each program's relative base of eligible farmers:

- (1) Could any farmer in principle access this program?
- (2) Does this program give farmers the flexibility to use whichever soil health practices are most appropriate for their land?
- (3) Are there limits to the funding for this program?

### 5.2.2 Analysis

One program, Tax Credits, has universal eligibility and applicability. Any farmer or rancher would be able to receive tax credits based on soil carbon sequestration, and they would be able to use any soil health practices.

Two programs, Grants and Existing Incentives, have universal eligibility but limited funding. In the case of Existing Incentives, total funding is capped, leading to significantly lowered access. In the case of Grants, funding is capped on an individual level, meaning the largest operations are limited in their access to these funds. These programs do allow for any soil health practice.

One program, Crop Insurance Discounts, has multiple restrictions on access. Only farmers who receive crop insurance are eligible for this program in the first place. And this policy only supports one practice, fall-planted cover crops. Farmers who cannot use cover crops will not be able to access this policy.

One program, Carbon Markets, has practicality restrictions on eligibility. Because Carbon Markets is not a federally administered program, access to markets may be regional or based on certain crops and farm types as it develops. However, in principle Carbon Markets could have universal eligibility.

Based on these variations in eligibility, we produce the following scorings:

*Table 4 - Effectiveness Eligibility Scoring*

<b>Program</b>	<b>Score: Eligibility</b>
<b>Tax Credits</b>	5
<b>Grants</b>	4
<b>Carbon Markets</b>	3
<b>Crop Insurance Discounts</b>	2
<b>Existing Incentives</b>	1

## **5.3 Ease of Access**

### **5.3.1 Overview**

An effective soil health policy should be easy for farmers to access. A simple program which integrates with existing farmer behaviors is likely to have broader uptake, especially in the short term. Ease of access has many different dimensions, including complexity of implementation, reliance on subsidiary programs, existence of similar programs, a clear federal agency for oversight, and similarity to demonstration projects.

A core driver in ease of access is the existence of technical assistance, and government effort, to enroll farm operators in these programs. Every program analyzed here needs funding allocated to technical assistance programs, but any technical assistance program will need to be specially tailored to the program it assisted. The existence and success of such technical assistance programs are independent from the benefits of the programs themselves. Given the importance of technical assistance, we consider this an essential part of any policy package. As such, unless a program explicitly lacks a technical assistance component, technical assistance ultimately has little impact on our relative scoring.

Another potential estimate of uptake rates which we do not examine is uptake rates in states that have implemented similar programs. A national bill has a fundamentally different potential uptake profile with a more heterogeneous farming population, and small differences in marketing and technical assistance will make large differences in uptake. Because of this, we believe that uptake rates in states with existing programs are *not* perfect proxies for national uptake rates.

### **5.3.2 Analysis**

Ease of access is highest for Crop Insurance Discounts, a straightforward program that integrates smoothly with farmer's existing engagement with federal programs. Some of the programs in Existing Federal Incentives are comparatively easy to access, so that program also receives a high score here.

The Grants program has several conflicting advantages and disadvantages for uptake. It covers a broad range of practices, so almost any farmer can find a benefit. While some of the practices it covers are technically difficult, farmers can begin by applying for practices within their capacity. However, awareness of the programs is limited, and a high level of grant-writing expertise is needed to be able to access the funds. These aspects slow uptake. In California, for example, while this program is generous and covers the full cost of many soil health practices, many farmers do not know about the program or do not have the capacity to enroll in it.

Both the Tax Credits and Carbon Markets programs have major barriers to uptake. Primarily, both of these programs pay out years after practices are implemented once sequestered carbon can be measured in the soil. This means farmers must commit their own investments into soil health practices long before they are likely to see financial benefits. While the Tax Credits program provides a 30% credit on spending on soil health practices, and the Carbon Markets program is likely to provide financing for uptake, those will provide further administrative and capacity-based barriers to uptake and are not sufficient substitutes for faster payment.

Additionally, both of these programs require soil testing, an expensive and technically complex practice which is likely to seriously limit uptake (for more on the complexities of soil health testing and research, see Appendix D). Between these programs, we believe that Tax Credits is slightly more attractive, as it is similar to federal programs that farmers may already be enrolled in and is fundamentally national, while Carbon Markets may be difficult to operate on a national level until it has had time to grow.

This produces the following scoring of these programs.

*Table 5 - Effectiveness Ease of Access Scoring*

<b>Program</b>	<b>Score: Ease of Access</b>
<b>Crop Insurance Discounts</b>	5
<b>Existing Incentives</b>	4
<b>Grants</b>	3
<b>Tax Credits</b>	2
<b>Carbon Markets</b>	1

## **6. Equity**

In considering equity this analysis examines how the distribution of benefits and costs varies across farmer demographics. Specifically, the scalability of the benefit to farmers and the distribution of returns on investments are analyzed. The following principle indicators are defined to evaluate equity against the distribution of estimated average benefit to farms based on farm size, tenure arrangement, gender, and race. Soil health policy has the opportunity to help marginalized and disadvantaged farmers; equity should be prioritized to achieve this end.

Small farms are more likely to be owned by the operator, more likely to have female or non-white operators, and more likely to have a lower net income. Small farms are also more likely to use cover crops, and organic fertilizer, while medium to large farms are more likely to use no-till or reduced till (see Appendix E for a breakdown of practice use by farm size and other equity breakdowns). Given these characteristics, we are primarily interested in understanding how distributional outcomes differ between policies.

## 6.1 Status Quo

Around 30% of principal farm operators are socially disadvantaged farmers or ranchers (meaning they identify as female or part of a racial or ethnic minority group), 17% of principal farm operators are new and beginning farmers (meaning they have operated the farm for less than 10 years) and 7% of principal farm operators are limited resource (meaning for the past two years their farm made less than \$180,000 and their current-year income is below the national poverty level).<sup>23,24</sup>

On average, socially disadvantaged farmers are underrepresented in NRCS programs funding soil health practices, with only 9.5% of contracts going to this farmer type though they comprise 30% of principal farm operators.<sup>25</sup> New and beginning farmers are well-served by NRCS programs, with 27.1% of total program contracts going to these farmers, who comprise 17% of principal farm operators. Limited resource farmers were underrepresented in NRCS programs, with only 2.1% of contracts, who comprise 7% of principal farm operators. (See Appendix F for program totals breakdown). Therefore, this program receives a **scoring of 3**.

## 6.2 Tax Credits

This program pays for tons of carbon equivalent and provides a 30% tax rebate for investments in monitoring to assess soil carbon sequestration. This program does not provide support for farmers to invest in or maintain soil health practices, and it may take several years for soil carbon levels to build sufficiently to receive payment. Therefore, this program will most likely benefit larger farms with

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<sup>23</sup> The percent of farms with SDFR as principal operators (30%), rather than percent of all producers (41%), was used to compare with NRCS programs since program data is by race/gender/ethnicity of the principal operator.

<sup>24</sup> Key, “Beginning, Limited Resource, Socially Disadvantaged and Female Farmers.”

<sup>25</sup> Program data from three NRCS soil health programs, Environmental Quality Incentives Program (EQIP), (Regional Conservation Partnership Program (RCPP), and Conservation Stewardship Program (CSP) was examined to determine what percent of contracts were given to socially disadvantaged, limited resource, and beginning farmers compared to the total percentage of these farmer types in 2019. These data include all contracts from the program, not just soil health specific contracts, but provides insight into how these programs are serving disadvantaged groups. Two related programs, the Conservation Technical Assistance and the Conservation Reserve Program, were excluded because they do not have contract data at the farm operator level. Farmers may access multiple programs, so averages may be skewed upwards.

secure land tenure who can afford the fixed costs of infrastructure improvements and on-going maintenance costs. It will be challenging for small farms and renters to be able to invest in the necessary infrastructure and soil monitoring to access program benefits. As socially-disadvantaged, limited-resource, and new and beginning farmers tend to be small farmers, this program will likely be difficult to access for these programs. Therefore, this program receives a **scoring of 3**.

### **6.3 Crop Insurance Discounts**

Federal crop insurance primarily covers commodity crops, such as wheat, corn, and soybeans. About one-half of acres planted with specialty crops have some type of federal insurance, though federal insurance is only offered for some types of specialty crops.<sup>26</sup> Thus, many farmers are not even eligible to receive discounts, even if they implement soil health practices on land in specialty crops. Smaller farms and farms with non-white and/or female operators are more likely to grow specialty crops. Therefore, this program is likely not very accessible to socially-disadvantaged farmers.

However, among the population of farmers who do farm crop insurance eligible land, the equity effects of this program are somewhat difficult to estimate. Cover crops are most popular on smaller farms, so a subsidy for cover crops would likely be a large boon to smaller farmers. However, cover crops are also expensive, and this program does not cover implementation costs, which means that farmers who would like to participate in this program will nonetheless need access to some additional capital. That capital may be more accessible for larger farms--who have a larger and more expensive acreage to cover-- and may be less accessible for marginalized or very low-income farmers. Given these limitations, this program receives a **scoring of 2**.

### **6.4 Grants for Soil Health Practices**

As implemented in California, the program specially devotes extra funds for priority populations, defined as low-income communities and households, and communities that experience disproportionate environmental degradation and public health conditions.<sup>27</sup> This program pays by practice rather than by amount of carbon sequestered and has the highest payment rate. The \$75,000 grant cap makes this program less accessible to large farms who may not be able to receive funding for all of their acres. This program also has technical assistance funding for local and regional partners to

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<sup>26</sup> *Specialty crops* refers to “fruits and vegetables, tree nuts, dried fruits, and horticulture and nursery crops (including floriculture)” [7 U.S.C. §1621 note]; Rosa and Johnson, “Federal Crop Insurance: Specialty Crops.”

<sup>27</sup> “Disadvantaged communities are defined by CalEPA as the top 25 percent of communities experiencing disproportionate amounts of pollution, environmental degradation, and socioeconomic and public health conditions according to OEHHA’s CalEnviroScreen tool.”; California Department of Food and Agriculture, “2020 Healthy Soils Program Incentives Program Questions and Answers (Q&A).”

assist with receiving funds and implementing practices. This program is accessible to small farmers and low-income farmers, suggesting it may also be more accessible for socially-disadvantaged farmers who tend to have smaller farms and less farm income. Because of the potentially massive upside of a Grants program with adequate technical assistance funding to be accessible by many, this program is given a **rating of 5**.

### 6.5 Carbon Markets

Similar to the tax credit program, the upfront infrastructure costs and on-going maintenance costs are not paid for by carbon markets, which pay per ton of carbon sequestered. Additionally, farmers must pay for soil carbon monitoring to quantify carbon sequestration. It may take several years for sufficient carbon to accrue in order to receive payments. The reliance of carbon markets on intensive soil health testing and measurement means that payoffs from these markets may be delayed, and the measurement requirements may be too onerous and expensive for small farms to implement. This policy therefore requires farmers to have access to capital to invest in the costs of implementing, maintaining, and measuring soil health practices in order to receive payments several years later. Therefore, this program is primarily accessible to large farms and farms with secure land tenure who are able to access the capital needed to make investments in soil health. Large farms will also be able to better spread fixed costs across acreage. As this program is primarily accessible to large farms, it likely excludes socially-disadvantaged and low-resource farmers. This program receives a **scoring of 1**.

### 6.6 Scoring

*Table 6 - Equity Scoring*

<b>Program</b>	<b>Score: Equity</b>
<b>Grants</b>	5
<b>Tax Credits</b>	3*
<b>Existing Incentives</b>	3*
<b>Crop Insurance Discounts</b>	2
<b>Carbon Markets</b>	1

*\*Because a Grants policy would have more opportunities to address equity issues than any of the other policy, we chose to represent the tie between Tax Credits and Existing Incentives at a score of 3 rather than 4, to more accurately represent the large gap in equity implications between those policies and Grants.*

## 7. Efficiency

These criteria evaluate whether this policy promotes soil health practices that sequester large amounts of carbon, and whether or not the policy has high administrative costs to the government. An atypical definition of efficiency was developed for this project to address the following: for farmers impacted by each policy, what are the estimated climate benefits, and how do those compare against the estimated implementation costs? While not a comprehensive benefit-cost analysis, this approach provides similar, more specific insights for this project.

### 7.1 Estimated Magnitude of Climate Benefit, per acre

The estimate of climate benefit was quantified in tons of eCO<sub>2</sub>/ac/y (mass of carbon dioxide equivalent<sup>28</sup> sequestered per acre of land per year). The soil health practices that are most common and likely to be subsidized by the policy alternatives were compiled and assessed to determine their respective climate benefits. These practices and their associated climate benefit were calculated based on data published in the COMET-Planner Report, prepared by the United States Department of Agriculture and Colorado State University. Since carbon sequestration potential can vary greatly by climate conditions, each soil health practice was assessed separately for dry/arid climate and moist/humid climate scenarios. These estimates represent an average magnitude of carbon sequestered in each scenario and are not reflective of any particular plot of land. The table of soil practices and their respective climate benefit estimates is listed in Appendix G.

The calculation of estimated magnitude of climate benefit for each policy is similar to the calculation of economic benefit described in 5.1 Estimated Average Benefit to Farmers; the estimated mix of practices are used in combination with the carbon sequestration of each practice to calculate the climate benefit of each practice. Note that this is the average climate benefit on acres treated as a result of the program, not on all acres of farmland. Three programs (Tax Credits, Grants, and Carbon Markets) incentive uptake of the same practices, and thus are tied.

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<sup>28</sup> eCO<sub>2</sub> or equivalent carbon dioxide is a common unit of measurement that incorporates the global warming impacts of multiple greenhouse gases into a uniform magnitude. In this analysis, several soil health practices sequester carbon dioxide as well as methane and nitrous oxide. Impacts from each of these gases is captured in the metric eCO<sub>2</sub>.

Table 7 - Efficiency Climate Benefit Scoring

<b>Program</b>	<b>Climate Benefit (Estimated Carbon Sequestered, tons of CO2 per acre per year)</b>	<b>Score: Climate Benefit</b>
<b>Tax Credits</b>	0.26 - 0.45	5 (tie)
<b>Grants</b>	0.26 - 0.45	5 (tie)
<b>Carbon Markets</b>	0.26 - 0.45	5 (tie)
<b>Crop Insurance Discounts</b>	0.35	4
<b>Limited Incentives</b>	0.26 - 0.27	3

## 7.2 Administrative Efficiency

Hurdles to efficiency may slow down implementation and delivery of programs, particularly in the short term. Less efficient programs also divert funds for administrative aspects of these policies rather than investing in farmers, and certain policies may require more administrative work on the part of the government to process applications and disburse funds. This criterion seeks to specifically compare policies along their administrative costs to the government, as opposed to Ease of Access which incorporates administrative costs for farmers.

Two programs, Crop Insurance Discounts and Existing Incentives, have minimal administrative costs, requiring little surveillance, testing, or complex processing. Existing Incentives is the winner here, as there is no additional implementation cost whatsoever; these policies already exist, and administrative costs are comparatively low.

Grants has a middle administrative cost. As a large grants program is comparable to a dramatic expansion of some existing incentives programs, it may be straightforward for the federal government to implement. However, the grants program would be complex and require processing of complex applications, assistance to farmers with uptake, and difficult maintenance and confirmation. With grants, we estimate that the largest barrier is getting enrolled in the program. Once enrolled, assistance to farmers along with maintenance and confirmation represent substantial and essential costs of any program.

Tax Credits require soil testing, which is very expensive, and will require substantial advertising and technical assistance. Carbon Markets requires not only soil testing and technical assistance, but the country-wide expansion of a market program requiring individual connections between companies and farmers. These programs thus have lower scores, with Carbon Markets having the lowest.

*Table 8 - Administrative Efficiency Scoring*

<b>Program</b>	<b>Score: Administrative Efficiency</b>
<b>Limited Incentives</b>	5
<b>Crop Insurance Discounts</b>	4
<b>Grants</b>	3
<b>Tax Credits</b>	2
<b>Carbon Markets</b>	1

## **8. Political Feasibility**

### **8.1 Overview**

This criterion describes the political feasibility of each proposed policy. In traditional definitions political feasibility can describe the capacity a given policy has in gathering political consensus from various stakeholders and its capacity in mitigating potential political conflicts between stakeholders. This policy project is examining multiple policy alternatives that have already been implemented by different states and that have already demonstrated varying political feasibility capacity. A goal of this project is to quantify the capacity the policy alternatives have in becoming potential bills that can pass federally. Therefore, for the purposes of this project, political feasibility has been defined as the capacity of a policy alternative to gather bipartisan support to pass Congress and gather a signature from the presiding President.

In policy scholarship, there is widespread acknowledgement about the role of institutions, political power, and stakeholder group preferences in the process of policy making. These elements affect the political feasibility of proposed policies, meaning that they influence the likelihood that a policy proposal will be passed or implemented by the target socio-political body, in this case Congress. In this context, this comparative analysis will use relevant institutions (Congress/Agricultural Lobbying) and stakeholder groups (business/farmer associations, taxpayers/voters) as points of reference when

measuring the political feasibility of tax credits for measured soil carbon, discounts on crop insurance for cover cropping, generalized grants for soil health practices, and agricultural carbon markets. Additionally, the relevant institutions and stakeholder groups examined for each policy alternative will differ due to the comparative analysis use of implemented programs in different states. For example, institutions of relevance and stakeholder groups vary from state to state with state specific associations, farming communities, and companies. However, Congress will still serve as a particularly significant institution in the political feasibility analysis for all policies examined. Furthermore, federal political and corporate representatives will still serve as significant stakeholders for all policy options in the political feasibility analysis. Therefore, this study explores the preferences of industry, relevant stakeholders, and representatives at the federal level.

## **8.2 Existing Federal Incentives**

For the political feasibility of the Status Quo this analysis pays particularly close attention to the 2018 Farm Bill. This is because this bill most likely resembles the kind of policies that will continue to pass in Congress if none of the other policy alternatives in this analysis are absorbed by future farm bills or if none of the policy alternatives besides the status quo become stand-alone legislation.

The 2018 Farm Bill is the first farm bill enacted within a year in the last 30 years of Congress.<sup>29</sup> This was likely due to the massive pressure farmers and ranchers put on Congress following steep declines in commodity prices as a result of the ongoing federal administration's trade wars with China.<sup>30</sup> The Senate passed its final conference report of the bill with a vote of 87 to 13. The House of Representatives passed its final conference report of the bill with a vote of 369 to 47. Additionally, it is important to note that the bill initially passed on June 21st, 2018 with a 213 to 211 very slight majority with all 191 democrats voting against it. Since 2018, democrats now have a majority in the House of Representatives.

Moving forward, it is likely that Congress will continue to act with a sense of urgency with passing future farm bills if trade wars remain ongoing. The existence of these trade wars will continue to pose a threat to small to medium sized farms that rely heavily on their commodity prices. Depending on the results of the 2020 elections, the trade wars can stop depending on transitioning federal government agencies. Regardless, the dominating presence of democrats in the House of Representatives makes it more politically feasible to include more generous soil health practice funds and programs in the next

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<sup>29</sup> American Farm Bureau Federation, "Who Supported the Farm Bill."

<sup>30</sup> Stein, "Congress Just Passed an \$867 Billion Farm Bill. Here's What's in It."

farm bill (in addition to the status quo) as these are priorities for many stakeholders of these representatives.<sup>31</sup> The Status Quo gets a political feasibility **score of 4**.

### **8.3 Tax Credits**

Due to the stakeholder groups and the bipartisan nature of those involved in the formation of the draft legislation and its desire to promote economic equity for farmers and ranchers by providing additional financial relief, this is a policy that has strong implementation and political feasibility potential. Since there is already an existing tax relief program implemented for the energy sector (45Q), USDA and other agencies involved have infrastructure that they can rely on for the success of this program. But since the reporting and verification accreditation system does not currently exist, this could pose as an uptake and implementation feasibility challenge. The lack of reporting and verification systems also poses a political feasibility challenge as lawmakers will need to negotiate on specifics and processes for these complex systems. Finally, the draft bill has been introduced using energy sector tax relief as a point of comparison with the agriculture sector. The Bennet office calls it unjust for the energy sector to get tax relief while farmers and ranchers do not for carbon sequestration work. Although not likely to spur much opposition, this could antagonize industry or motivate pushback. Therefore, this policy gets a **score of 2** for political feasibility.

### **8.4 Crop Insurance Discounts**

Congress created the modern-day crop insurance system through the Federal Crop Insurance Corporation ([FCIC](#)).<sup>32</sup> It has been funding it since 1938. Representatives intended for the federal Crop Insurance system to prevent *ad hoc* disaster legislation and to prevent taxpayers from having to cover the full costs of agricultural disasters. Congress has not had to pass any ad hoc crop disaster bills over the past several years including 2011 and 2012 where the country had some of the worst weather years. By comparison, 42 emergency disaster bills in agriculture cost taxpayers \$70 billion from 1989 to 2012, according to the Congressional Research Service.<sup>33</sup>

Considering the significant congressional funding history of the FCIC and the success of the federal program has had with saving taxpayers money, it is likely that programs like Iowa Crop Insurance Demonstration Project (ICIDP) will continue gathering bipartisan support. Furthermore, subsidiaries of relevant national stakeholder groups such as the Iowa Farm Bureau, Conservation Districts of Iowa, Iowa Agricultural Water Alliance, the Agribusiness Association of Iowa, Iowa Soybean Association,

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<sup>31</sup> Food Policy Action, “An Eater’s Guide to Congress.”

<sup>32</sup> USDA RMA, “History of the Crop Insurance Program.”

<sup>33</sup> Chite, “Emergency Funding for Agriculture : A Brief History of Supplemental Appropriations, FY1989-FY2009.”

Iowa Corn Growers Association, and the Iowa Cattlemen's Association are already partners with the ICIPD.<sup>34</sup> Considering these business organizations' desires to lobby on behalf of economically beneficial policies for farmers and conservation organizations' desires to incentivize climate friendly agricultural practices, future federal bills of this kind will continue to have strong stakeholder support. Finally, it is not likely large agricultural companies will oppose such policies, and it is more likely that they would also try to benefit from the crop insurance programs if the opportunities presented themselves because of their profit motive. Therefore, this program gets a **score of 4** for political feasibility.

### **8.5 Grants for Soil Health Practices**

Although funding for farmer support remains friendly in Congress, and further funding for a mixed practice grants would make strong talking points for the reelection campaigns of representatives with significant farming industries and constituents, the ineffectiveness of implementation in states like California poses a political feasibility challenge. As previously mentioned, the success of such a program will likely depend on the formation of larger bureaucratic bodies, possibly new ones dedicated to technical assistance and outreach, and additional funding. It is possible that such a program will face opposition from fiscal conservatives in Congress wanting to conserve taxpayer money or libertarian and like-minded representatives wanting to reduce the size of government.

For states with significant agricultural economies like California, programs like healthy soils are politically feasible where there is strong interest from state representatives and state stakeholder groups to fund climate friendly agricultural projects and support farming communities from diverse and even opposing political factions. Stakeholders and representatives in smaller states with smaller economies and with less financial resources will likely have a harder time gathering support for such generous projects from taxpayers.

Such a program will likely have support from relevant national stakeholder groups like the Farm Bureau, the Cattlemen's Association, the National Association of Conservation Districts, among others. Theoretically, it is possible the support of these interest groups can sway the preferences of representatives over taxpayer sentiments. It is also possible fiscal conservatives would support such a program to increase their reelection chances with significant farming constituencies despite further funding bureaucracies. It would not make sense for representatives to oppose their constituents even if they felt morally compelled to restrict the size of government.

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<sup>34</sup> Iowa Department of Agriculture and Land Stewardship, "Clean Water Iowa Partners."

Ultimately, a mixed practice program with significant economic and climate benefits is more likely to pass federally than not keeping in mind stakeholder groups, representative preferences, and taxpayer preferences. The only other potential opposition mixed practice grant programs could have is from large agriculture companies that may view statewide soil health programs as a threat to their landscape dominance. Nonetheless, many large companies, particularly in California such as the Wonderful Company, are also experimenting with sustainability practices and using them for positive marketing.<sup>35</sup> It is more likely that similar companies will try to take advantage of such programs to increase their bottom line rather than to oppose them. Therefore, this program receives a **score of 3** for political feasibility.

## **8.6 Carbon Markets**

Legislators and non-governmental organizations have touted market solutions for reduced carbon emissions such as the ESMC as a non-political solution for reducing greenhouse gas emissions. As suggested in the report, ESMC pilot programs have already started in the States of Texas and Oklahoma. These types of programs have been expanding without legislation in Congress. For this reason, the policy alternative does not require bipartisan political support in the same way the other alternatives in report do to pass federal legislation as it is constructed with private entities. Therefore, since it does not require political negotiations for bipartisanship nor political push by relevant stakeholders to pass a federal bill in Congress, this alternative is theoretically the most politically feasible in this report. However, it is important to note that it is controversial outside of political legislation.

Even though it does not require legislation, the alternative will still receive pressure from environmental organizations and small to medium sized farmers and organizations that want to advocate for climate benefits and the economic bottom line for small to medium sized farmers. This is because carbon markets often contain loopholes that allow polluters to continue offset emissions with few incentives to stop.<sup>36</sup> Additionally, offset projects in carbon markets also tend to benefit large-scale farms the most.<sup>37</sup> This systemically would disadvantage already disadvantaged small to medium-sized farmers to corporate farms and entities.

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<sup>35</sup> The Wonderful Company, “Doing Well by Doing Good: 2017 Corporate Social Responsibility Report.”

<sup>36</sup> Schmidt, “Carbon Offsets: Growing Pains in a Growing Market.”

<sup>37</sup> Pramono and Sukiman, “Small Farmers Victims of Forest Carbon Trading.”

Therefore, although in this report’s definition of political feasibility, this is the most politically feasible policy alternative with a **score of 5**, it is important to note the politically controversial nature of this policy outside of its likelihood for bipartisan legislation.

### 8.7 Scoring

The political feasibility scorings for each policy are summarized in the table below.

*Table 9 - Political Feasibility Scoring*

<b>Program</b>	<b>Score: Political Feasibility</b>
<b>Carbon Markets</b>	5
<b>Existing Incentives</b>	4
<b>Crop Insurance Discounts</b>	4
<b>Grants</b>	3
<b>Tax Credits</b>	2

## 9. Comparison and Recommendation

The following table indicates scores for the policies across each of the criteria, multiplied by their respective weights to produce a final score.

*Table 10 – Policy Scoring Summary and Comparison*

	<b>Weight</b>	<b>Existing Incentives</b>	<b>Tax Credits</b>	<b>Crop Insurance Discounts</b>	<b>Grants</b>	<b>Carbon Markets</b>
<b>Effectiveness: Economic Benefit to Farmers</b>	0.2	1	4	2	5	3

	<b>Weight</b>	<b>Existing Incentives</b>	<b>Tax Credits</b>	<b>Crop Insurance Discounts</b>	<b>Grants</b>	<b>Carbon Markets</b>
<b>Effectiveness: Eligibility</b>	0.05	1	5	2	4	3
<b>Effectiveness: Ease of Access</b>	0.2	4	2	5	3	1
<b>Equity</b>	0.15	3 (tie)	3 (tie)	2	5	1
<b>Efficiency: Climate Benefit</b>	0.15	3	5 (tie)	4	5 (tie)	5 (tie)
<b>Efficiency: Administrative Efficiency</b>	0.05	5	2	4	3	1
<b>Political Feasibility</b>	0.2	4 (tie)	2	4 (tie)	3	5
<b>Total Score</b>	1.0	3.0	3.15	3.4	3.85	2.9

**9.1 Recommendation: Grants for Soil Health Practices**

Based on the above comparison, it is recommended that the federal government adopt a grants-based policy to promote soil health. This policy has a variety of strengths and few weaknesses. By covering costs for practice implementation rather than reimbursing or paying farmers after the fact, this policy allows farmers to begin using soil health practices without significant up-front investment or risk. The Grants policy also incentivizes each farmer to use the practices which make the most sense for their own land, leading to efficient scenarios with high economic and environmental benefits.

The primary flaws of the Grants program are its administrative complexity, both for farmers and for the government, as well as its political feasibility. While the Grants program does not require soil testing, which poses financial and technical barriers for farmers, it does require farmers to identify in

advance which practices they wish to use and navigate a fairly complex application in order to receive funding. Similarly, the federal government needs to manage highly specific and individualized applications and disbursements for many farmers. However, this level of complexity is believed necessary to gain the broad accessibility, flexibility, and financial viability of the Grants program; a simpler program simply would not have as many economic and environmental benefits.

As discussed in Section 8.5 Grants for Soil Health Practices, we believe that the Grants program is politically viable. Key interest groups are likely to be open to such a program, and the program resembles existing conservation programs, albeit at a substantially larger scale. Opposition is most likely to come from fiscal conservatives, but this policy's potential to attract support from rural populations is likely to help overcome such barriers. This policy may be slightly less politically viable than simpler programs like Crop Insurance Discounts, but this is not considered a substantial risk.

## **9.2 Tradeoffs and the Benefits of Other Policies**

Crop Insurance Discounts receives a fairly high score as well in our analysis. This policy has almost opposite strengths and weaknesses from Grants. This policy has promising simplicity, both for farmers and for the government, and the straightforward access path for farmers through crop insurance. However, this policy only incentivizes one type of practice, cover cropping, and is only accessible to farmers who are eligible for crop insurance. This policy also does not pay well enough to offset the cost of cover cropping, meaning farmers who participate will need to invest their own funds. These flaws may overwhelm the attractive simplicity and accessibility of this policy.

For these reasons, this policy is not recommended. A policy operating through crop insurance could be made more effective by broadening the number of practices it incentivizes and through offering a larger rebate. However, if substantially more practices are included, this policy may lose the administrative simplicity that makes it attractive. Similarly, no matter how broad it becomes, it still would only be accessible for a smaller pool of farmers who use crop insurance, excluding many specialty crop farmers.

Tax Credits also received a lower score. However, the administrative and financial burdens provided by soil test mandates make this policy much less attractive. While the effort to pay in proportion to measurable benefits is commendable, it is likely not worth the substantial additional cost of widespread soil testing. If soil test technology develops substantially and soil testing becomes much cheaper and more technically accessible, this policy may become more viable on a larger scale.

Existing Incentives received a low score. While many existing programs might be effective in theory, in practice they are underfunded and do not have a broad impact. However, note that an effective Grants

program might look somewhat similar to a dramatically expanded EQIP. Successes and failures of existing federal programs also carry much information for an effective soil health policy.

Carbon Markets also receives a low score. An agricultural carbon market would face many challenges, including requiring quantification of soil carbon, complex enrollment, issues with regional access, and inaccessibility to disadvantaged farmers. A large carbon market would not likely provide the benefits desired from a national soil health policy.

### **9.3 General Recommendations**

This analysis focuses on choosing between mechanisms by which to financially incentivize farmers to uptake soil health practices. However, an effective soil health policy must include substantially more than financial incentives. Regardless of whether or not any of these policies are implemented, it is recommended that any soil health policy should consider incorporating the following practices:

**Substantial Outreach:** Successful programs have often been limited in their impact simply because many farmers do not know about them, do not know farmers who have used them, or do not fully trust suggestions and information coming from outside their communities. Effective funding directly to farmers must be supported by sustained and devoted outreach efforts, aimed at making farmers and farmer communities aware of the opportunities provided by soil health and the existence of profitable funding. Any program, at the bare minimum, should give grants to farmer organizations and nonprofits to support outreach and education around soil health funding opportunities.

**Technical Assistance:** Farmers who are enthusiastic about implementing soil health practices may still need training and assistance to implement them effectively. Any federal soil health program must also provide technical assistance for practice uptake, likely through federally provided resources and funding for local nonprofit farmer assistance organizations.

**Awareness of Regional and Crop Variations:** The analysis of average payouts to farmers does not take account of the substantial variations in regional applicability of various soil health practices, regional variations in which practices sequester the most carbon, or regional differences in crops and agricultural practices. A successful soil health policy must be careful to make sure that farmers all over the country will be able to benefit from the policy, and that farmers in a variety of environments will be incentivized to take up the soil health practices most applicable for their land and their crops. This issue would be most pronounced with a carbon-payments based policy like Tax Credits or Carbon Markets, where climatic variations in baseline soil carbon and the effectiveness of various policies would create different financial outcomes for farmers in different climates. Yet even a flexible policy like Grants must carefully account for regional and climatic variation in farmer needs and practices.

**Flexibility:** Soil health practices have substantial, proven benefits. As research continues, the general understanding of which practices are the most beneficial and which metrics or outcomes should be prioritized will be further developed. Farmers will learn more about how their yields change when implementing these practices and will continue to build practical and technical knowledge about these practices. Any soil health policy will not be immediately perfect; it may overvalue certain practices and undervalue others, or use a flawed carbon measurement technique, or create administrative barriers that render the program inaccessible. To succeed at expanding the use of soil health practices and benefiting from the immense potential for carbon sequestration, public health, and ecosystem restoration provided by these practices, any soil health policy must be flexible and update its guidelines and payment rates regularly, in line with current technical knowledge and science.

## 10. Future Work

This report included a basic analysis of many of the major aspects of any soil health program. However, soil health is a complex and interdisciplinary subject, and there is room for substantially more analysis in order to recommend a successful soil health policy. The following section outlines some suggestions for future work to help develop these findings.

**Region-Specific Analysis:** This analysis combined average use of practices and carbon sequestered by practices across regions to arrive at estimates for the effectiveness and efficiency of each policy. However, use of these practices, as well as their potential to sequester carbon, varies by climate, soil type, and crop type. A more specific analysis of which practices are used in which regions, and how a given policy might affect farmers in one region versus another, could be useful for evaluating these policies. Some of the necessary data to begin such an analysis may be found in the Agricultural Census.

**Uptake Estimates and Benefit: Cost Estimates:** This analysis compared likely relative uptake rates without estimating exactly how many farmers would uptake a certain practice. Specific large-scale economic projections about a soil health policy, such as total cost to the government, total carbon sequestered, and total payout to farmers, would require such an estimate. While such an estimate would be difficult to calculate with any degree of precision, due to the numerous different factors affecting uptake, it may be possible in a few years to use existing soil health policies as case studies to make estimates about uptake rates in different conditions. The estimate of uptake rates can be refined by drawing from currently ongoing work done by Jessica Chiartas at the California Soil Resources Lab on surveying farmers about the feasibility of implementing soil health practices. Such an estimate would allow an analysis like this to be more specific about the total benefits and total costs of different policies.

**Political Strategy and Implementation Strategy:** This analysis focused on the general impact of these policies, only partially discussing how best to get them to pass Congress or ensure their effective implementation. A more specific analysis of political messaging could be useful, and work with focus groups or stakeholder groups might identify paths for coalition-building and political organizing. Similarly, analysis of the implementation of existing soil health programs, as well as federal farm conservation programs like EQIP, CRP, and CSP, comparing them to a potential federal soil health program, might lead to an implementation strategy which could be used to help draft a federal bill.

**Greater Variation in Policies:** This analysis matched each funding mechanism with a particular model policy. However, a grants program does not have function like the California Healthy Soils Program: for example, a grants program could pay in proportion to estimates of how much carbon will be sequestered rather than by offsetting implementation costs. A soil health policy functioning through crop insurance would not necessarily be similar to the Iowa Cover Crop Crop Insurance Demonstration Project: rebate scales could vary based on different crop types and practices. A future analysis could compare different potential ways to implement a single funding mechanism to each other or compare different implementations across a broad array of different policies, potentially identifying a variety of options with different costs and benefits.

## 11. Conclusion

Poor soil health currently costs the United States billions in agricultural productivity losses, greenhouse gas emissions, loss of biodiversity, eutrophication, contamination, and decreased soil resilience.<sup>38</sup> Poor soil health is also linked with net farm income decreases and negative debt-to-income ratios for farmers. Soil is the country's largest carbon sink, and healthy soil practices stimulate agricultural productivity, increase farm profitability, and generate environmental benefits critical for mitigating climate change.

Despite their environmental and economic benefits, there is a consistent adoption gap for soil health practices throughout the United States. This policy analysis examined which major soil health policy is best positioned to promote widespread soil health practices that prioritize strong economic support for farmers and reward farming practices that present the greatest potential for climate benefits.

The analysis assessed the federal policy landscape by comparing existing federal incentive programs (the Status Quo) to four policy alternatives. These policy alternatives are each represented by a model program or bill. The comparative policy alternatives were tax credits for soil health practices, crop

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<sup>38</sup> Doane et al., "ReThink Soil : A Roadmap for Collective Action, to Secure the Conservation and Economic Benefits of Healthy Soils."

insurance rebate, generalized grants for soil health practices, and agricultural carbon markets. The model policies for these were Natural Carbon Sequestration Tax Credit, Iowa Cover Crop Insurance Demonstration Project, California Healthy Soils Program, and Ecosystem Services Market Consortium (ESMC), respectively.

After comparing these policy alternatives based on the criteria effectiveness, equity, political feasibility, and efficiency, and based on our weighted scoring system, Grants for Soil Health Practices was recommended to be emulated by future federal bills and as the strongest policy to promote soil health adoption throughout the United States.

As global climate change continues to negatively impact farming communities throughout the country, and as unsustainable agricultural practices exacerbate the problem of climate change, it is critical that political and economic leadership in the United States engage in innovative and sustainable solutions to these problems. Although soil health practices regenerative agriculture is not the only solution to our growing economic and climate crisis, it is a powerful instrument for positive change with multiple benefits beyond economic benefits for farmers and climate change mitigation. This report aims to contribute to the broader conversation of how to solve these major issues.

## **Acknowledgements**

*We wish to thank the following people for their insights, contributions, and support for this report:*

**Miguel Alatorre**, Low-income Rural Communities Advocate at Greenaction for Health and Environmental Justice

**Rudy Arredondo**, Farmer, President and CEO, National Latino Farmers & Ranchers Trade Association

**Reyes Barboza Jr.**, Rural Development Specialist, Former Director of Operations at the LEAP Institute, Inc. (Green Raiteros)

**Dr. Mia Bird**, Visiting Assistant Professor at the UC Berkeley Goldman School of Public Policy

**Dr. Jessica Chiartas**, California Soil Resource Lab, Scow Microbial Ecology Lab at the University of California, Davis

**Araceli de Corona**, Farm Labor Contractor & Farmworker at Araceli de Corona Farm Labor Contractor Inc.

**Caroline Grunewald**, Food & Agriculture Analyst at the Breakthrough Institute

**Aidee Guzman**, PhD Candidate, Department of Environmental Science, Policy & Management at the University of California, Berkeley

**Rey Leon**, Mayor at the City of Huron, CA and Executive Director at the San Joaquin Valley Latino Environmental Advancement & Policy Institute

**Miguel Lopez**, Board Trustee at the Merced City School District and Project Manager at the Office of Community & Economic Development at Fresno State

**Max Neumeyer**, Director of Policy at Mad Agriculture

**Daniel Peñaloza**, Councilmember at the City of Porterville, CA and Water Leadership Strategist at the Community Water Center

**Brian Shobe**, Associate Policy Director at the California Climate & Agriculture Network

**Alex Smith**, Food & Agriculture analyst at the Breakthrough Institute

**Dave Warner**, Rural Community Development Manager at Self-Help Enterprises

**Antonio Ybarra**, Farmer, Community Program Specialist at the United States Department of Agriculture

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## Appendices

### Appendix A: Co-Benefits for Soil Health Adoption

Co-Benefits for Soil Health Adoption (in addition to main climate and economic benefits)	
Promotes Public Health	General use of toxic chemicals in conventional farming and exposure to pesticides in surrounding communities poses multiple public health risks. <sup>39</sup> For example, an estimated 200,000 people die each year due to acute poisoning from pesticides. And even when not in direct exposure, people can still be impacted by chemical residue in water and food. Soil health Adoption promotes the reduction, and in some cases, the non-use of pesticides through soil health focused practices.
Promotes Environmental Resilience	Soil health practices like cover crops and crop rotation protect local biodiversity by strengthening natural environments for soil organisms. Soil health adoption also reduces the use of harmful chemicals like pesticides that reduce pest populations that often upset natural predator and prey food chains in surrounding ecosystems.
Can Support Underrepresented Farmers	Soil Health programs like California Healthy Soils provide a unique entry point for new and beginning farmers who are more likely to be people of color, immigrants, and women. <sup>40</sup> Future federal bills, grants, and loans intended to promote soil health as mitigation for climate change will similarly provide new entry points for populations underrepresented in farming.

<sup>39</sup> Nicolopoulou-Stamati et al., “Chemical Pesticides and Human Health: The Urgent Need for a New Concept in Agriculture.”

<sup>40</sup> Ahearn and Newton, “Beginning Farmers and Ranchers: A Report from the Economic Research Service.”

Promotes Water Conservation	Healthier soils can hold more water, increase farm resilience to droughts and floods, and increase water infiltration. <sup>41</sup> Soil health adoption also reduces chemical impact on water quality, helping to protect and restore clean water in nearby streams, rivers, and lakes. <sup>42</sup>
Promotes Soil Conservation	Cover cropping among other soil health practices promote living roots in the soils that provide ecosystems with energy to build organic matter and cycle nutrients. This keeps the soil ecosystem from losing nutrients to aquifers and waterways. Cover cropping and crop rotation also increase biodiversity in soils which strengthens soil capacity to break down pollutants.

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<sup>41</sup> USDA NRCS, “Effects on Soil Water Holding Capacity and Soil Water Retention Resulting from Soil Health Management Practices Implementation.”

<sup>42</sup> USDA NRCS.

## **Appendix B: The 2018 Farm Bill and Current Soil Health Policies**

The 2018 farm bill modified many existing conservation-practice-funding programs and added a few new ones under existing umbrellas, related to incentivizing soil health and soil restoration practices. This bill modified four existing programs: the Conservation Stewardship Program (CSP), Conservation Innovation Grants (CIG), and the Conservation Reserve Program (CRP). The CSP was modified to “enhance soil health to the greatest extent possible,” and increase payment rates for cover cropping, resource conserving crop rotations, and advanced grazing systems. The CIG was modified to \$10 million / year dedicated to soil health demonstration trials. The CRP was changed to make it easier to enroll in CSP when a CRP contract ends, increasing farmers’ ability to implement conservation practices on working lands as the CRP contract ends.

The 2018 farm bill also added new incentives for soil health conservation practices. New incentives under CSP authorize payments above 100% of practice costs and income forgone for some soil health improving practices. Cover crop activities may get 125% of determined annual payment and resource-conserving crop rotations / advanced grazing management may get 150%. The bill also provided new funding assistance within the Environmental Quality Incentives Program (EQIP) and CSP for soil tests and soil remediation; notable for urban producers with potential site contamination as well as financial and technical assistance for planning soil health improvement programs.

This bill also created two new programs Soil Health and Income Protection Program (SHIPP) and the Grassland Conservation Initiative. SHIPP allows farmers to enter 3-5 year contracts to place their least productive land into a CRP contract, receiving up to 50% of the normal CRP rate with the goal of incentivizing taking the most degraded soils out of production. The Grassland Conservation Initiative is part of CSP, and is a one-time enrollment option for a 5yr contract to protect and conserve grazing land, while addressing one “priority resource concern.”

In addition, the 2018 farm bill increased access to soil health support for beginning, socially disadvantaged, and veteran producers. The bill increased the cap on many programs for advanced payments (from 50% cap to up to 75%) for limited resources, socially disadvantaged, beginning, and veteran farmers and ranchers. It also provided incentives for CRP landowners to sell or lease their expiring CRP land to such a producer, and increased funding for CRP TIP (transition incentives program) from \$33m to \$50m over 5 years.

The 2018 farm bill mandates the collection of data capturing soil health outcomes. The bill directed the USDA to compile, maintain, and publicize a database of conservation practices and their impacts, and follow up with recommendations. The USDA has been directed to issue a report identifying all

available USDA conservation practice datasets and their impacts on profitability, including crop yield and soil health.

This bill modified some crop insurance provisions to address loopholes related to cover crops and crop insurance. Soil health was also added as a research purpose and priority area to some farm-bill backed research initiatives, and funding increased (OREI, AFRI, BRDI). The 2018 farm bill did not provide much funding for outreach or technical assistance.

**How Many Land Acres are Treated By at Least One Practice that Promotes Soil Health?**

<b>Program</b>	<b>Acres Treated</b>	<b>Percent of All US Farmland</b>
Environmental Quality Incentive Act	3,347,390 <sup>43</sup>	0.37%
Conservation Technical Assistance Program	5,517,597 <sup>44</sup>	0.61%
Regional Conservation Partnership Program	378,826 <sup>45</sup>	0.042%
Conservation Stewardship Program	3,622,049 <sup>46</sup>	0.4%
Conservation Reserve Program	20,000,000 <sup>47</sup>	2.2%

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<sup>43</sup> USDA NRCS, “NRCS Conservation Programs: Environmental Quality Incentives Program (EQIP).”

<sup>44</sup> USDA NRCS, “NRCS Conservation Programs: Conservation Technical Assistance (CTA).”

<sup>45</sup> USDA NRCS, “NRCS Conservation Programs: Regional Conservation Partnership Program (RCPP).”

<sup>46</sup> USDA NRCS, “NRCS Conservation Programs: Conservation Stewardship Program (CSP).”

<sup>47</sup> USDA Farm Service Agency, “Conservation Reserve Program Fact Sheet.”

## Appendix C: Tables of Calculations

The following table displays sub-steps in our calculations for estimating the ratios of adopted practices (Figure 1), effectiveness (average economic benefit to farmers per acre, Table 3), and efficiency (average climate sequestered per acre, Table 7).

The first column below names the individual practices and mixes of practices that we assume any one land may be applying.

The second column lists the current percentages of land using those practices. We do not have data for how much land is using multiple practices. Our upper bound for this number is the land using the least common practice in each mix; for example, no more land than is using cover cropping can be using Mix 3, which is no-till and cover cropping. We show in column 2 our estimates for what fraction of land using the least common practice in each mix is in fact using the whole mix.

We believe that a soil health program is likely to increase the use of all of these practices, but to especially increase the use of the costly, less common, but more effective practices (soil amendments and cover crops), and especially increase the use of multiple practices on the same land (mixes 1, 2, and 3). Column 3 shows a range of uptake factors, which represent increase in relative uptake due to this increase. For example, an uptake factor of 1-4 means that we expect this practice to be 1 to 4 times more common, relative to other practices, under a federal soil health program.

These uptake factors are then combined with the current percents calculated in column 2 to estimate how many acres of land in the program will use those practices. This is shown in Column 4.

The estimate of how much land under this federal program would use each practice allows us to calculate average economic and environmental benefits. We calculate average carbon sequestered by using these ratios with the carbon sequestration estimates from Appendix G (generating Table 7). We calculate economic benefit following the process described in section 5, using payment-per-carbon ratios with the carbon sequestration estimates for the Tax Credits and Carbon Markets programs, and using the payout rates by practice in Column 5 below for the Grants program.

<b>Practice</b>	<b>Current Percent of Land Using<sup>48</sup></b>	<b>Uptake Factor</b>	<b>Fraction of Farmers In Program Estimated to Use This Practice (Low Mix / High Mix scenario)</b>	<b>Grants Payout Rate by Practice</b>
<b>No-Till</b>	11.6	1	0.28/0.21	\$30.18
<b>Reduced-Till</b>	10.9	1	0.27/0.22	\$32.06
<b>Improved Nitrogen Fertilizer Management</b>	8.0	1	0.20/0.16	\$14.26
<b>Replacing Synthetic Fertilizer with Soil Amendments</b>	0.4	1-4	0.01/0.02	\$250.00 <sup>49</sup>
<b>Conservation Crop Rotation</b>	8.0	1	0.19/0.15	\$35.98
<b>Cover Crops</b>	1.7	1-4	0.03/0.03	\$55.00 <sup>50</sup>
<b>Mixes</b>	<b>Ratio of Farmers using Least Common Practice in Mix assumed to be using Mix</b>			
<b>Mix 1: No-Till, Soil</b>	0.1-0.5	1-8	<0.01/0.03	\$371.16

<sup>48</sup> Based on data from USDA Census; USDA ERS, “Nutrient Management.”

<sup>49</sup> This is an estimate: CHSP pays \$50 per ton of compost, not by land area. Application rates for compost per acre can vary widely; we use 5 tons per acre as a rough average. However, despite this large and variable number, use of this difficult and still costly practice is likely to be very small; variation in this number does not dramatically affect further outcomes.

<sup>50</sup> This number is adjusted from a CHSP rate of ~\$100-140/acre to account for cheaper access to cover cropping on the national scale.

<b>Practice</b>	<b>Current Percent of Land Using<sup>48</sup></b>	<b>Uptake Factor</b>	<b>Fraction of Farmers In Program Estimated to Use This Practice (Low Mix / High Mix scenario)</b>	<b>Grants Payout Rate by Practice</b>
<b>Amendments, Crop Rotation, Cover Crops</b>				
<b>Mix 2: No-Till, Crop Rotation, Cover Crops</b>	0.1-0.3	1-8	<0.01/0.08	\$121.16
<b>Mix 3: No-Till, Cover Crops</b>	0.1-0.4	1-8	<0.01/0.11	\$85.18

## Appendix D: Soil Health Testing and Research

Soil health cannot be determined by measuring only crop yield, water quality, or any other single outcome. Since there is no single measure for soil health, it is evaluated based on a suite of indicators. These indicators include physical, chemical, and biological properties. Soil health is impacted by contamination (natural and industrial), conservation (wind & water erosion), productivity (cash crops & forage). To help implement widely-applicable, consistent measures of soil health, the Soil Health Institute recommends 19 national soil health measurements.

Some measurements and metrics may be in direct conflict with another. For example, increased organic matter and ammonium levels in the soil (two metrics of soil health) have also been shown to increase production of nitrous oxide, a greenhouse gas.<sup>51</sup> Furthermore, some common practices like installing hedgerows to increase friendliness to pollinators have long been known to be positively correlated with soil health, but only recently have scientists been able to concretely make statements about how these practices relate to soil health.<sup>52</sup> A key question to consider is: how do measurement based policies interact with these types of measurements/metrics?

While standardizing measurements and metrics and engaging in data pooling between producer-groups is helping establish a set of key indicators, benchmarking broad inventory goals/funding mechanisms to these metrics risks compromising indicator use for site or application-specific problem solving.<sup>53</sup> Since farm health issues can be extremely heterogeneous based on region or locality, metrics must be easily adapted to fit these local and regional contexts. These metrics also often attempt to capture change over time, which will likely ignore or fail to capture efforts or practices made by farmers already engaged in responsible soil health practices. On this point, the population of farmers already engaged in these practices is rather small, but when designing a policy a critical consideration must be whether or not the policy disproportionately rewards farms with a history of neglecting soil health who are only engaged in marginal practices. Finally, these metrics tend to be biased towards larger agricultural operations that have the connections and resources to engage in comprehensive, robust soil health testing.

Soil quality across a specific farm may vary greatly, making it challenging to obtain representative samples. A significant number of samples from across a plot of land taken at a specified depth are

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<sup>51</sup> Bergstrom, Tenuta, and Beauchamp, "Increase in Nitrous Oxide Production in Soil Induced by Ammonium and Organic Carbon."

<sup>52</sup> Holden et al., "The Role of Hedgerows in Soil Functioning within Agricultural Landscapes."

<sup>53</sup> Wander et al., "Developments in Agricultural Soil Quality and Health: Reflections by the Research Committee on Soil Organic Matter Management."

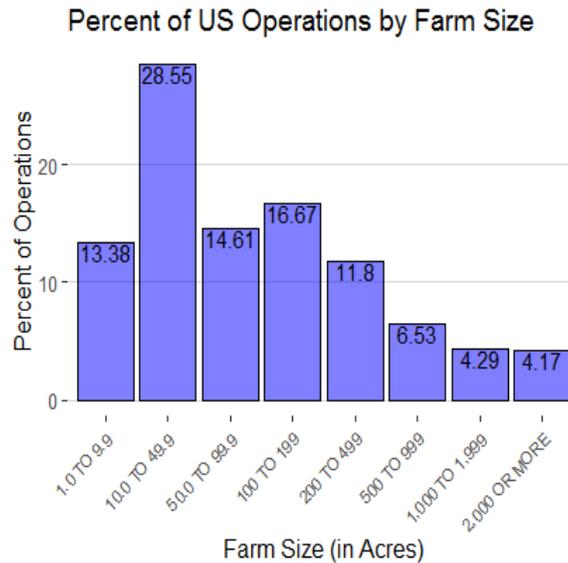
needed to assess soil health. Furthermore, some practices known to impact long-term farm health, carbon sequestration, and crop yields do not have direct relationships to soil health indicators.

Given these challenges around measuring soil health, soil health research, development, and deployment (RD&D) plays an important role. However, the exact role that soil health RD&D plays, and the nature of soil health RD&D is unique. RD&D around soil health practices is different from traditional scientific research in other technological and scientific areas. First, many soil health practices are already accepted as widely beneficial. One of the main challenges is how to increase adoption of soil health practices, rather than how to develop new soil health practices. Second, any soil health RD&D requires significant community engagement. Soil health RD&D cannot occur from a lab, separate from farmers, but must directly engage farmers to quantify the impact of specific practices and build on existing knowledge. Thus, one of the fundamental challenges around soil health RD&D is the challenge of linking researchers and funds with specific farmers. University based programs such as Extension do a decent job of filling this need.

## Appendix E: Demographics of Disadvantaged Farmers

### Farm Size: Acreage and Income

Currently, 57% of U.S. farms are less than 100 acres. Forty-five percent of farmland is in small family farms, defined as farms with less than \$250,000 in gross cash farm income.<sup>54</sup> Farms with women and/or people of color as the principle operators tend to be smaller in terms of acreage and have less revenue.<sup>55</sup>



*Figure 1: Percent of US Operations by Farm Size. Source: US National Agricultural Census, 2017*

### Farm Tenure

Sixty-one percent of farmland, which includes both cropland and pasture, is farmed by the landowner.<sup>56</sup> While 39% of farmland is rented, more than half of cropland is rented. Rental activity is concentrated in grain production areas, like rice, corn, soybeans, and wheat.<sup>57</sup> Small family farmers are

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<sup>54</sup> MacDonald, “Small Farms, Big Differences.”

<sup>55</sup> Key, “Beginning, Limited Resource, Socially Disadvantaged and Female Farmers.”

<sup>56</sup> Callahan, “Farmland Ownership and Tenure.”

<sup>57</sup> Callahan.

more likely to own all of the land they farm.<sup>58</sup> Seventeen percent of farmers are new and beginning farmers, meaning they have operated a farm for less than 10 years.<sup>59</sup>

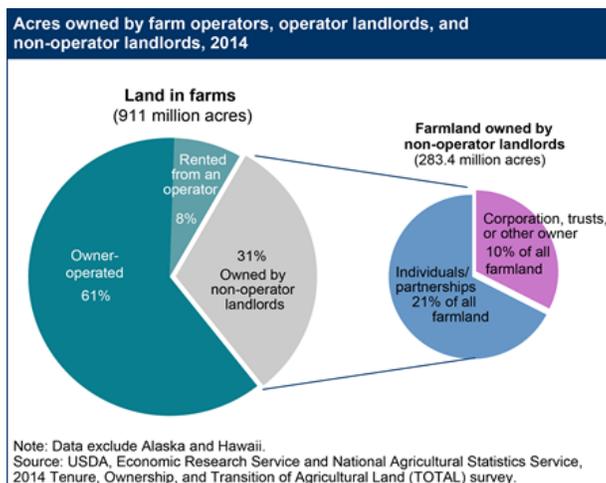


Figure 2: Distribution of Farm Ownership Structures

## Gender

There are several different ways to look at the breakdown of gender in farms. Women account for about 36% of all producers. While 56% of farms have female producers, just 13% of farms have women as the principle operators.<sup>60</sup> Though most beginning farmers are white males, female farmers are more likely to be beginning farmers.<sup>61</sup> ERS reports “women were principal operators of 19% of beginning farms, versus 11% of established farms. Women were principal operators of 27% of limited resource farms compared with 11.5% of non-limited resource farms.”<sup>62</sup>

<sup>58</sup> Callahan.

<sup>59</sup> Ahearn and Newton, “Beginning Farmers and Ranchers: A Report from the Economic Research Service.”

<sup>60</sup> Key, “Beginning, Limited Resource, Socially Disadvantaged and Female Farmers”; USDA, “Census of Agriculture.”

<sup>61</sup> Ahearn and Newton, “Beginning Farmers and Ranchers: A Report from the Economic Research Service.”

<sup>62</sup> Key, “Beginning, Limited Resource, Socially Disadvantaged and Female Farmers.”

## Race

Ninety-seven percent of farms have white operators and 93% of all producers are white.<sup>63</sup> About 3.3% of all producers are Hispanic, 1.7% are American Indian or Native Alaskan, 1.5% are black or African American, and .7% are Asian. Though most beginning farmers are white males, non-white farmers are more likely to be beginning farmers.<sup>64</sup> White farmers sold 1.25 of 1.3 billion total worth of agricultural products sold directly to consumers in 2012.<sup>65</sup> Commercial farmers are 97 percent white and 98 percent male.

<b>Race</b>	<b>Percent of All Producers</b>
Hispanic	3.3%
American Indian or Alaska Native	1.722%
Black or African American	1.452%
Asian	0.704%
White	92.82%

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<sup>63</sup> USDA, "Census of Agriculture."

<sup>64</sup> Ahearn and Newton, "Beginning Farmers and Ranchers: A Report from the Economic Research Service."

<sup>65</sup> USDA, "Census of Agriculture."

## Appendix F: NRCS Program Contracts Awarded to Disadvantaged Farmers, 2019

	<b>EQIP</b>	<b>RCPP</b>	<b>CSP</b>	<b>Program Totals</b>	
<b>Socially Disadvantaged Farmers (# of contracts)</b>	4,214	85	374	4,673	
<b>Total Program Contracts</b>	41,471	2,241	5,692	49,404	<b>% of SDFR Operators (All Farms)</b>
<b>Percent of SDFR contracts out of total</b>	10%	3.79%	6.57%	<b>9.46%</b>	<b>30%</b>
<b>New and Beginning Farmers (# of contracts)</b>	11,575	496	1,318	13,389	
<b>Total Program Contracts</b>	41,471	2,241	5,692	49,404	<b>% of N/BF Operators (All Farms)</b>
<b>Percent of N/BF contracts out of total</b>	27.90%	22.10%	23.20%	<b>27.10%</b>	<b>17%</b>
<b>Limited Resource Farmers</b>	931	29	89	1049	
<b>Total Program Contracts</b>	41,471	2,241	5,692	49,404	<b>% of LR Operators (All Farms)</b>
<b>Percent of LRF contracts out of total</b>	2.24%	1.29%	1.56%	<b>2.12%</b>	<b>7%</b>

\*Data are not available for CTA as the program funds technical assistance rather than direct payments to farmers.

\*\*CRP data are not included as this program pays farmers to take land out of production, rather than incorporate soil health practices.

## Appendix G: Comet Planner Data on Carbon Sequestration

The following values are based on data from the COMET-Planner, published by Colorado State University, Natural Resources Conservation Service and USDA.

<b>Practice</b>	<b>Carbon Sequestered: Dry/Semiarid Climates (tons of CO<sub>2</sub>e/ac/y)</b>	<b>Carbon Sequestered: Moist/Humid Climates (tons of CO<sub>2</sub>e/ac/y)</b>
<b>Conventional Tillage to No-Till</b>	0.39	0.34
<b>Conventional Tillage to Reduced Till</b>	0.19	0.22
<b>Nutrient Management - Improved Nitrogen Fertilizer Management</b>	0.04	0.12
<b>Nutrient Management - Replacing Synthetic Nitrogen Fertilizer with Soil Amendments</b>	1.10	1.93
<b>Conservation Crop Rotation</b>	0.29	0.24
<b>Cover Crops</b>	0.29	0.41