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# APPENDIX

## Farmers and Taxpayers Stand to Lose Billions with Elimination of the Conservation Stewardship Program: *CSP's high value farm conservation delivers 4-to-1 return on investment*

The Conservation Stewardship Program (CSP) is one of the most important conservation programs in the United States. CSP is the only working lands program to support comprehensive, whole farm conservation by helping farmers and ranchers to achieve and maintain high levels of stewardship that enable strong productivity while protecting the environment (Lehner and Rosenberg 2018). Funding important practices such as resource conserving crop rotations, management intensive rotational grazing, and establishment of wildlife habitats provides tangible benefits to the environment. Critically, such practices can also deliver increased profits for farmers. Despite the many benefits that CSP provides, it faces significant cuts or even elimination in the 2018 farm bill.

What would the CSP changes proposed in the House and Senate bills mean for taxpayers, farmers, and the environment? To answer this question, we first calculated the return on investment (ROI) of CSP and then estimated the economic impact of various farm bill scenarios. We estimated that the per-dollar ROI for CSP is at least $1.83, but likely meets or exceeds $3.95. Using the likely ROI of $3.95, we estimated that elimination of CSP (as in H.R. 2) could result in losses to taxpayers, farmers, and the environment valued at around $4.7 billion per year. These losses include increased costs for farmers and to the environment, in the form of soil erosion, degraded water quality, and reduced wildlife habitat and biodiversity. In contrast, changes to CSP as in S. 3042 could result in net benefits of $1.3 billion per year or more, due to program improvements that could offset cuts. Based on our analysis, we recommend that Congress keep CSP as a standalone program in the farm bill and maintain its funding. In the future, increasing the CSP budget and acreage would better meet demand and maximize benefits for farmers, taxpayers, and the environment

This appendix details the methodology and core analysis that we used to estimate the return on investment (ROI) and economic impact of various 2018 farm bill scenarios, as reported in the accompanying fact sheet.

## I. BACKGROUND

Given the true costs of current industrial farming practices as well as the known alternatives, solutions are urgently needed to increase adoption of conservation and ecological agriculture (DeLonge et al. 2016; Lehner and Rosenberg 2018). In many cases, regulation-based solutions are not practical. For polluted runoff, for example, the costs and consequences are often manifested far from the source. Because of such challenges, federal policy has focused on voluntary, incentive-based approaches. Existing programs have received positive feedback from farmers, and many farmers have voiced interest in additional federal support to adopt conservation practices (UCS 2018), as many of these can be profitable in the long run but require up-front costs.

In the US, the largest conservation programs are part of the farm bill, where they amount to over $5 billion annually. Much of this funding is dedicated to “working lands”, financially supporting producers to implement practices on acres currently in production, rather than paying farmers to take acres out of production. The EQIP and CSP, introduced in 1996 and 2002, respectively, are the two major such programs, and both are managed through the Natural Resources Conservation Stewardship (NRCS) program. Of these, the CSP is unique in that it takes a holistic approach that targets high-priority areas and concerns. Participating farmers can implement a wide variety of practices, including rotational grazing, cover crops, and crop rotations. Currently, CSP is the largest conservation program in the US, with about 72 million acres enrolled (NSAC 2018a). The program is in high demand, with an estimated acceptance rate of about half of applicants (NSAC 2015), indicating that farmers want, and need, support in adopting conservation practices.

Return on investment (ROI) analyses estimate expected profits resulting from a given investment and help to estimate the efficiency of that investment. Cost-benefit analyses generally provide a similar function, but often account for additional benefits outside of simple profit, frequently including social and environmental benefit. For example, though water quality has monetary value, it often is not considered a cost of or profit from agricultural production. Return on investment analyses of programs that provide such broad benefits (such as CSP) should therefore include their value in “return” estimates. We refer to the following analysis of CSP as an ROI, though for methodological purposes, it is interchangeable with a cost-benefit analysis. For this study, the investment of interest was the total annual cost of CSP to taxpayers, and benefits included returns to farmers, communities, and the environment. Many of the benefits were associated with ecosystem services generated from rectifying environmental externalities caused by current industrial agriculture.

Past analyses have estimated the ROI, or cost-benefit, of several conservation programs. For example, the cost-benefit ratios of EQIP, the Conservation Reserve Program (CRP), and the Wetlands Reserve Program (WRP) were estimated at $1.01, $2.11, and $2.19, respectively (NRCS 2009; Wu and Weber, 2012; Sewell 2014). The goal of the present analysis was to estimate the ROI of CSP, as well as to project larger potential costs associated with major changes to CSP, such as those proposed as part of the 2018 farm bill negotiations.

## II. METHODS

### Estimating CSP costs and benefits

To estimate total CSP costs, we retrieved data for FY2017 from the USDA budget summary (OBPA 2018) (Table 1). We then estimated average cost per acre by dividing total program costs by enrolled acres (NSAC 2017).

**Table 1. Total estimated costs per acre of CSP program in FY2017.**

| | **Value** | **Source** |
|---|---|---|
| **Total budget ($)** | $1,288,000,000 | OBPA 2018 |
| **Total enrolled acres** | 72,000,000 acres | NSAC 2018a |
| **Average $/acre** | $17.89 | |

Benefits were estimated based on a previously published analysis of EQIP (NRCS 2009) and other recent research. Several categories of benefits are targeted by EQIP and were therefore covered in NRCS (2009). These benefit categories include: reduced erosion, grazing land productivity, irrigation water use, air quality, fertilizer use, wildlife habitat, energy use, carbon sequestration, and animal waste management. For the most part, CSP aims to deliver benefits in similar areas to EQIP, making these categories largely relevant to the analysis of CSP, with two exceptions. First, because EQIP can be used for animal waste operations but this is not a focus of CSP, this category was not applicable for the present analysis. In addition, as many practices included in CSP more explicitly targeted water quality concerns, we added water quality as an additional category for this study. We calculated benefits for each benefit category using the methods in NRCS (2009) combined with updated literature values and updated prices, as described below (see Table 2 for brief descriptions).

***Sheet and rill water erosion***. For this category, benefits were accrued both off-site and on-site. Off-site benefits accounted mostly for reductions in public works costs for removing eroded sediment from waterways and recreational benefits (both of which capture some but not all aspects of water quality); on-site benefits considered reduced losses of purchased fertilizers due to reduced erosion rates (NRCS 2009).

To estimate off-site costs, we used a published value per ton of eroded soil ($5.72 per ton after accounting for inflation using a GDP index of 1.16; NRCS 2009, USBEA 2018) as well as updated erosion reduction rates (NRCS 2017a). While the erosion reduction rates used in NRCS (2009) were 8.6 tons per acre per year, those rates were based on large values observed on only the most highly erodible lands (HEL). For this analysis, we used updated erosion reduction rates that we felt better reflected the potential for conservation practices to reduce soil erosion across whole farms. Thus, we incorporated recently reported modeled reductions in both annual sheet and rill erosion (0.86 tons/acre/year) and sediment loss from water erosion (1.74 tons/acre/year).

To estimate on-site costs, we considered the loss of fertilizer costs (NRCS 2009). We updated nutrient loss data (NRCS 2017b) as well as nutrient prices (ERS, 2014), which were converted to 2018 dollars using a GDP index of 1.06 for totals of $0.32 and $ 0.30 per pound of phosphorus and nitrogen, respectively (ERS 2014).

Together, the updated off- and on-site benefits amounted to an estimated $20.42 per acre.

***Increased grazing land productivity.*** The benefit of increased grazing land productivity was calculated as in NRCS (2009), where increased grazing land productivity in response to conservation practices was assumed to improve animal productivity by 1.3 animal unit months (AUM) per acre. The value per AUM was updated from $14.43 to $30 based on recent research (ISU 2018). The overall benefit was calculated as 1.3 AUM times the value per AUM ($30) for a total of $39 per acre per year.

***Irrigation water use***. Benefits for decreased irrigation water use were calculated assuming different costs for irrigation using groundwater versus off-farm water. The most recent Farm and Ranch Irrigation Survey (NASS 2014) indicated that approximately 37.2 million acres are irrigated with groundwater at $54.75 per acre and 14.4 million acres are irrigated with off-farm water sources at $32.95 per acre. Compared to the values used in NRCS (2009), total acres irrigated and costs for both categories have increased. The updated weighted average cost of irrigation across both approaches was $48.65 per acre. As in NRCS (2009) we assumed a 20 percent loss of water for transmission, and an efficiency gain of 5.41 acre-inch as a result of improved practices. For context, the average quantity of water applied through irrigation in 2013 was 19.2 acre-inch per acre (NASS 2014), so 5.41 acre-inch represents a 28% improvement. Using a GDP index of 1.1 to update this to 2018 dollars, the total value of decreased irrigation was calculated as $19.30 per acre per year.

**Table 2. Estimated benefits ($) per acre for addressing a single resource concern through CSP enrollment.** Benefits were based on methods in NRCS (2009) but updated using published research, current prices, and inflation**.** Note that NRCS (2009) also included a category for animal waste management but this category is not applicable to the CSP. On the other hand, the category for water quality was added for this analysis.

| Benefit | 2009 | 2018 | Description and notes |
|---|---|---|---|
| *reduced erosion* | $54.32 | $20.42 | This value considers off-site (public works and recreation costs) and on-site (fertilizer costs) of erosion. Updated erosion reduction rates (CEAP 2017a) account for not all practices taking place in the most vulnerable areas in CSP, as well as declining prices of fertilizers (which were also inflation adjusted from 2014). Total benefit would likely be larger in highly erodible lands and if other related services, such as plant productivity, were included. |
| *Increased grazing land productivity* | $17.25 | $39.00 | This value considers animal productivity improvements from grazing land productivity enhancements. We updated price per animal unit month (AUM) from $14.43 to $30.00 using recent research (ISU 2018). Inclusion of other services, such as reduced land-use conversion, reduced inputs, and influence on other benefits (i.e., additional erosion reductions) would likely result in a higher value. |
| *irrigation water use* | $10.30 | $19.30 | This value accounts for reduced irrigation needs resulting from conservation practices. Since 2009, the proportion of acres irrigated by groundwater and off-farm water changed, and groundwater and off-farm water irrigation costs increased by $25.75 and $14.95, respectively, increasing the average cost of irrigation (NASS 2014). Irrigation costs were also inflation-adjusted from 2012. |
| *fertilizer use* | $17.65 | $13.33 | This value is based on expected reductions in fertilizer applications as a result of improved practices. We updated this value based on declines in fertilizer prices (ERS 2014) and inflation since 2014. Other benefits of reduced fertilizer would likely include productivity, biodiversity, water quality and impact on markets (e.g., fisheries). The impacts of reduced fertilizer use on air and water quality were accounted for separately within those benefit categories. |
| *air quality* | $ 5.71 | $15.08 | This value accounts for estimated benefits from reduced wind erosion and therefore reduced cleaning and maintenance costs, damages to machinery, and some health effects (all using NRCS 2009 methods), as well as reduced fertilizer-related $N_2O$ emissions (additional in this study). We updated previous values using net present valuation with a 7% discount rate. Improved air quality resulting from reduced $N_2O$ was calculated by estimating fertilizer reductions and applying expected rates of loss as $N_2O$ (2%, Houlton et al. 2013) as well as the associated costs ($13.52/kg N; Sobota et al. 2015). This value likely does not fully account for the value of public health, climate regulation, and recreation that would be expected in response to conservation practices targeting air quality (Baro et al. 2014). |

| | | | |
|---|---|---|---|
| *wildlife habitat* | $7.10 | $54.86 | This value was originally based on wildlife viewing and pheasant hunting. We updated the value to add contingent valuation of deer hunter access to land. Values were inflation adjusted from 2007 dollars. The values here are based on an illustrative subset of benefits from improving wildlife habitat, and such values would likely vary substantially depending on location and several other factors. |
| *energy use* | $7.81 | $7.54 | This value estimates the benefit of decreased energy use in response to conservation agriculture, based on known benefits of conservation tillage. We updated expected fuel use reductions (NRCS 2016) as well as diesel fuel prices and state and federal fuel taxes (EIA 2018). Though not included, the influence of fuel reduction on GHG emissions would increase this value. |
| *carbon sequestration* | $0.47 | $3.02 | This value accounts for increased soil carbon sequestration from conservation agriculture and expected climate change mitigation benefits. We increased the C sequestration rate (Franzluebbers 2010) and updated the price of C ($2 to $10 per ton) based on the social cost of C and inflation adjustment from 2007 (EPA 2007). Increases in soil C, which can be higher in select cases (Chambers et al. 2016), tend to also decrease erosion and improve crop resilience to extreme weather and climate change, thus this value is likely an underestimate. |
| *water quality* | - | $23.73 | This category accounts for water quality improvements related to high nutrient levels, which cause eutrophication, dead zones, contaminated drinking water, and other costly impacts (Sobota et al. 2015). Values here are based on estimated costs of eutrophication from N in surface freshwater (Sobota et al., 2015), considering reduced fertilizer inputs (NRCS 2009) and estimated reduced losses of N to waterways (Houlton et al. 2013). These values are similar to estimates from Ma (2011), although other studies suggest this value may be higher (Ma and Swinton 2011; Ma et al. 2012; Mulik 2016). |
| MEAN | $15.08 | **$21.81** | |

***Fertilizer use***. As in NRCS (2009), direct fertilizer use reductions as part of conservation management were estimated based on reductions required for the NRCS Nutrient Management Standard (590), averaged among low, medium, and high adopters. Expected reductions for applications of nitrogen, phosphorus, and potash were 25, 5, and 13 pounds per acre respectively. The prices of each nutrient were updated using recent fertilizer price data (ERS 2014) and translated to 2018 dollars using a GDP index of 1.06. Input reductions were multiplied by prices, for an estimated annual benefit of $13.33 per acre.

***Air quality.*** The benefit value of air quality resulting from conservation practices was partially calculated using NRCS (2009), which accounted for costs including cleaning, maintenance and damage to buildings and equipment as well as health effects due to particulates from wind erosion. In addition to these benefits, we also accounted for the impact of reduced $N_2O$ emissions expected as a result of conservation practices.

The NRCS (2009) air quality benefit value was updated to 2018 dollars using the net present valuation (NPV) method. With a discount rate of 7 percent and a difference of 11 years (the 2009 report used a 2007 value), present value of air quality was estimated at $12.02 per acre per year using the NPV equation: Present value = $FV / (1 + r)^n$.

To add the value of reduced $N_2O$ emissions, we relied on recent literature. Sobota et al. (2015) estimated the median cost of reduced air quality per kilogram of N at $13.52.

Assuming that the N fertilizer reductions due to conservation practices were the same as reported by NRCS (2009) (described in the Fertilizer Use section above; 25 pounds N per acre) and that 2% of applied N is lost to the atmosphere as $N_2O$ (Houlton et al. 2013), the value of air quality from reduced N fertilizer was estimated at $3.07 per acre.

The $12.02 of value from the updated NRCS (2009) methodology combined with the additional $3.07 of value from reduced $N_2O$ equaled a total estimated benefit of $15.08 per acre on air quality. These values are likely an underestimate as we only considered the benefits of reduced particulate matter and $N_2O$ and did not account for other types of air quality concerns (Sobota et al. 2015).

***Wildlife habitat.*** Many practices funded by CSP aim to conserve wildlife habitat, such as Monarch butterfly habitat establishment, conservation cover, riparian forest buffers, herbaceous weed control, and forest management. Though extensive literature on the effects of such practices on wildlife habitat exists (NRCS 2017c), these services are difficult to quantify. The NRCS (2009) methods relied on valuation of just two components of wildlife habitat: improved wildlife viewing and pheasant hunting (Feather et al. 1999), which totaled a benefit of $7.10 per acre in 2007 dollars. Because these only represent a portion of expected benefits, we incorporated additional contingent valuation research that quantifies willingness to pay for services from improved wildlife habitat. Knoche and Lupi (2007) estimated willingness to pay for deer hunting on farms using conservation practices at $39 per acre. Both the $7.10 of previously estimated benefits and the $39 in benefits added in this analysis were converted from 2007 dollars to 2018 dollars using a GDP index of 1.19 (equaling $8.45 and $46.41, respectively) and summed, totaling $54.86 per acre.

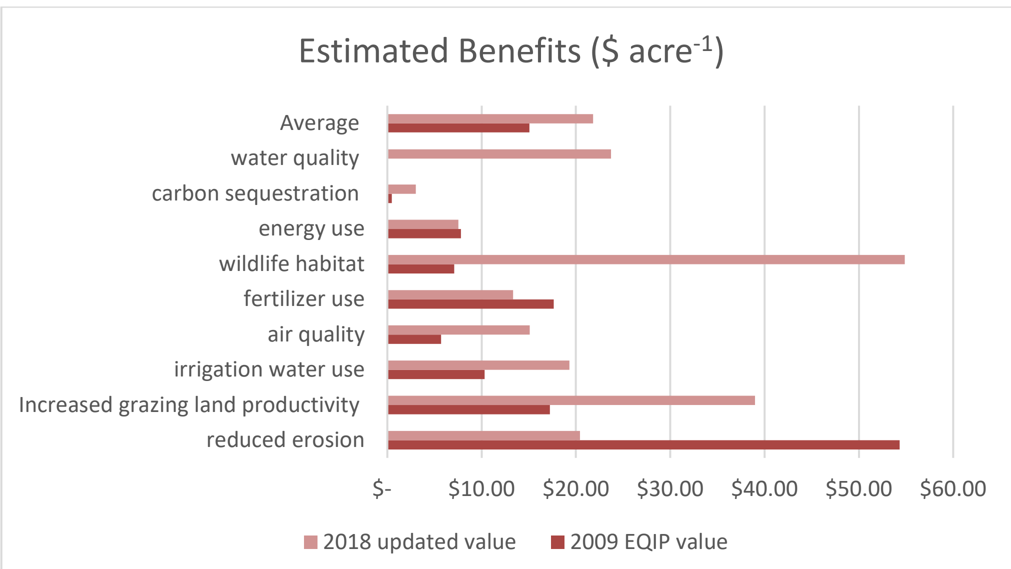
***Energy use.*** The NRCS (2009) methods estimated diesel fuel savings from conservation practices that reduce energy use. For example, transitioning from conventional till to no-till reportedly saves an average of 2.99 gallons of fuel per acre. This value was updated with recent estimates of fuel reductions from several methods of conservation tillage, including continuous no-till, seasonal no-till, and mulching; average reduction across practices totaled 2.81 gallons per acre (NRCS 2016). The cost of diesel fuel and highway taxes were updated with current data (EIA 2018a,b). The $0.54 per gallon for federal and state highway taxes were subtracted from the updated $3.22 per gallon fuel (to account for the reduced cost of fuel for agricultural purposes) and multiplied by the 2.81 gallons fuel per acre saved, totaling a benefit of $7.54 per acre.

***Carbon sequestration.*** The carbon sequestration rates resulting from conservation practices were updated from NRCS (2009) based on recent research. Franzluebbers (2010) quantified carbon sequestration rates of farmland transitions from conventional to conservation tillage, as well as from pasture restoration with perennial species. Across crop and pasture land, carbon sequestration rate averaged 0.261 Mg C per acre per year, which is higher than the 0.233 Mg C per acre per year in NRCS (2009), but lower than estimates of potential sequestration rates in some conditions (Chambers et al. 2016). The value of this additional C was estimated using $36 per ton (in 2007 dollars) for the social cost of carbon ($CO_2$) (EPA 2017), at a discount rate of 3 percent, and updated from 2007 to 2018 dollars using a GDP index of 1.18. This value was translated from $CO_2$ to C for a cost of $11.57 per ton. The cost was multiplied by the average sequestration rate, totaling a benefit of $3.02 per acre.

***Water quality.*** Benefits of improved water quality from conservation practices were estimated based on expected reductions to eutrophication from reduced N-fertilizer inputs. A recent study estimated that each kilogram of N in surface freshwater leads to a median cost of

$16.10 related to eutrophication. To estimate how improved practices could reduce these costs, we assumed that reductions in N fertilizer application were as described in NRCS (2009) (see Fertilizer Use section above; 25 pounds N per acre) and that the fraction of applied N that escapes to waterways is 13% (Houlton et al. 2013). At these rates, the total value of improved water quality from conservation agriculture was estimated at $27.93 per acre. This value was similar to findings from other research. For example, Ma (2011) estimated a value of $21.50 per acre for reducing eutrophication based on consumer willingness to pay and contingent value estimates. Swinton et al. (2015) suggested the value of improved water quality could be even higher, based on increased land values correlated with improved water quality. In addition, the costs we considered in this analysis don't consider all aspects of water quality concerns, such as coastal N loading that affects marine systems (estimated value of $22.22/kg N), groundwater N loading that affects drinking water ($2.44/kg N), and more (Mulik 2016, Sobota et al. 2015). Thus, the benefit value used in this study is likely an underestimate.

**Figure 1. Estimated value of each benefit category considered for CSP based on NRCS (2009).** This figure shows the values of benefits acquired through conservation agriculture according to categories used in NRCS (2009) to assess the value of EQIP. Original values from NRCS (2009) are shown, as well as updated values based on research, prices, and inflation (Table 2).




**Developing representative benefit value scenarios**

CSP is structured such that farmers must be addressing at least two resource concerns to qualify for the program, and they must also address one additional resource concern over a 5-year contract. While the exact benefits achieved will vary by factors such as land use type, region, practices, and more, we developed two benefit scenarios that we believe could be illustrative of average benefits across the full program.

For our **"minimal"** scenario, our goal was to project a conservative but still realistic benefit value. For this scenario we estimated the value only of benefits arising from meeting one additional resource concern, as required following enrollment in CSP. However, we also assumed that the value of this single accomplishment was 50% greater than it would have been if it had been achieved independently of pre-existing stewardship levels. We estimated a 50% increase in the expected value of addressing the new resource concern based on research indicating that stacking conservation practices onto existing conservation practices produces relatively higher levels of value (Robertson et al. 2014; Christianson et al. 2018).

For our **"likely"** scenario, we estimated the combined value of benefits attained from meeting three resource concerns over the course of the contract (two prior to enrollment, as well as one additional over the course of enrollment). We calculated the sum of the resource concerns with the three lowest values and the sum of the resource concerns with the three highest values to represent the maximum and minimum possible values of addressing three concerns. We used the average of these maximum and minimum cases as the estimated benefit value for this scenario.

**Estimating costs and benefits of farm bill policy outcomes**

We considered several possible policy outcomes based on proposed changes to conservation programs as part of the 2018 farm bill (NSAC 2018b). Because CSP contracts are made for five years, active contracts will still fulfill their contract length, regardless of changes made to the program in the 2018 farm bill. For this analysis, we assumed that all changes to CSP took place immediately, rather than over time as contracts expire. Therefore, estimated costs resulting from the policy outcomes below represent an annual average rather than the cost in any specific year.

**Policy Outcome 1*: CSP eliminated (as in House bill*)**. In this case, we annualized proposed budget cuts and assumed that all net cuts ($860 million per year) were from the current CSP budget, such that benefits were lost at the CSP ROI rate. Given that some of the CSP budget was not fully eliminated but was instead rolled into EQIP, we assumed that those funds ($1288 million - $860 million = $428 million) would still provide benefits but at the rate previously estimated for EQIP (NRCS 2009).

**Policy Outcome 2: *CSP reduced (as in Senate bill).*** Cuts to CSP proposed in S. 3042 total $1 billion over 10 years. We assumed an annualized cut of $100 million per year. In this case, we assumed that all benefits were lost at the CSP ROI rate. S. 3042 also proposes structural changes that emphasize high-value environmental benefits, but these proposed improvements were not considered in this scenario.

**Policy Outcome 3: *CSP reduced but improved (as in Senate bill).*** In this case, we consider the lost benefits from reducing CSP by the proposed amount (as in Policy Outcome 2). However, we also considered two possible outcomes based on proposed improvements to the program, which would prioritize high-value practices such as resource conserving crop rotations, cover crops, and managed grazing. These improvements could lead to a higher ROI, thus we estimated alternate policy outcomes based on two different assumptions:
(a) assuming a 10% increase to the CSP ROI estimated in our "likely" scenario,
(b) assuming a slightly higher increase to the CSP ROI estimated in our "likely" scenario. For this estimate, we increased the "likely" scenario ROI by one standard deviation (equal to a 33% increase to the CSP ROI estimated in our "likely" scenario.

**RESULTS**

We estimated that the average cost per acre for CSP, including all program expenses and considering all enrolled acres (72 million), is approximately $17.89. In terms of benefits, we estimated that the value of addressing a single targeted resource concern averages around

$17.49 based on previous cost-benefit analysis methods (NRCS 2009). However, when the values of benefits were updated based on new knowledge, current costs, and inflation, we estimated that the average benefit of addressing a single targeted resource concern is $21.81. Given that CSP requires that at least three benefits must be realized over the course of the contract, the value of CSP is likely much higher. When we assumed that the value of CSP includes the value of meeting three resource concerns, we estimated a benefit ranging from at least $23.89 to up to $117.59.

Based on the range of potential benefits, we estimated that the ROI from CSP is likely between $1.22 and $6.57 (Table 3). For this analysis, we considered cost and benefit outcomes of two different ROI scenarios: a "minimal" scenario with an ROI of $1.83, and a more "likely" scenario of $3.95. Our "likely" scenario is higher than ROIs estimated for other conservation programs (180% higher than CRP and 391% higher than EQIP) (Table 4).

**Table 3. Estimated ROI of CSP ($/acre) calculated assuming an average cost of $17.89/acre.** Benefits are estimated based on CSP requirement to implement practices to meet a new resource concern and to meet a minimum of three resource concerns by program completion. ROI values used for "Minimal" and "Likely" scenarios are identified.

| | **Single Resource Concern (Added Value)** | **Three Resource Concerns (Total Value)** |
|---|---:|---:|
| Limited value | $1.22[1] | $1.34[2] |
| Higher value | **$1.83 ("Minimal")[3]** | $6.57[4] |
| Average | $1.53 | **$3.95 ("Likely")** |

[1] Considers the value of addressing one resource concern only, assuming the average value of all targeted resource concerns (Table 2)
[2]Considers value of addressing three resource concerns, but conservatively assumes the three least valuable concerns were addressed.
[3]Accounts for only the added value of addressing a new resource concern, but also considers the synergistic effects of adding practices to pre-existing practices through a holistic management approach (50% additional value; Christianson et al. 2018).
[4] Considers the value of addressing three resource concerns, but optimistically assumes the three most valuable resource concerns were addressed.

**Table 4: Comparative return on investment of major conservation programs.** Note that the referenced ROIs were completed with different methodologies and at different times, thus these estimates may not be directly comparable.

| **Program** | **Cost** | **Benefit** | **ROI (Source)** |
|---|---|---|---|
| CRP | $1.7 billion | $3.5 billion | $2.19 (Wu & Weber 2012) |
| EQIP | $2.08 billion | $2.09 billion | $1.01 (NRCS 2009) |
| CSP [1] | $1.29 billion ($17.89 $acre^{-1}$) | $21.81 $acre^{-1}$ | $1.83-3.95 (present study) |

[1] For this study, we were only able to estimate benefits per acre rather than total benefits.

We projected possible costs and benefits of farm bill outcomes based on the 2018 farm bill negotiations (Table 5). Assuming the "likely" ROI for CSP of $3.95, we estimate that adopting the H.R.2, which eliminates CSP and only rolls some of its funding into EQIP, would result in lost benefits of $4.7 billion per year. This outcome would mean increased costs to farmers, and increased environmental degradation such as soil erosion, decreased water quality, lost wildlife habitat and biodiversity, and increased pollution due to fertilizer and pesticide use. In contrast, adopting S. 3042 could result in an estimated benefit increase of $1.3 billion per year. Though this bill proposes marginal funding cuts to CSP, improvements in the program are estimated to increase benefits enough to offset the benefits lost to funding cuts. Note that even assuming a more "minimal" ROI for CSP ($1.83), H.R.2 would likely lead to over $1.9 billion of lost benefits whereas the Senate bill would be expected to lead to only relatively small losses (<$0.2 billion per year) to more moderate gains ($53 million to $1.2 billion per year).

**Table 5: Potential outcomes of farm bill changes to the CSP.** Potential outcomes are based on calculations assuming an ROI of (I) "likely" ROI ($3.95), or (II) "minimal" ROI ($1.83). Policy outcomes considered include (1) H.R.2 adopted (2) S. 3042 adopted without proposed improvements (3a) S. 3042 adopted with cuts and program improvements (related to resource conserving crop rotations, cover crop, and managed grazing) that increase ROI by 10%, and (3b) S. 3042 adopted with cuts and program improvements that increase ROI by 33%.

| | Change to Benefits | ROI | Change in ROI |
|---|---|---|---|
| ***I. "Likely" ROI ($3.95)*** | | | |
| **1: House** [1] | $ - 4,661,000,048.13 | $1.01 | $ - 2.94 |
| **2: Senate cuts** | $ - 395,440,997.53 | $3.95 | $- |
| **3a: Senate cuts + improvements** | $113,887,007.29 | $4.35 | $0.40 |
| **3b: Senate cuts + improvements** | $1,291,274,228.81 | $5.26 | $1.31 |
| ***II. "Minimal" ROI ($1.83)*** | | | |
| **1: House** [1] | $ - 1,923,111,728.26 | $1.01 | $ - 0.82 |
| **2: Senate cuts** | $ - 182,872,028.59 | $1.83 | $- |
| **3a: Senate cuts + improvements** | $52,667,144.23 | $2.01 | $0.18 |
| **3b: Senate cuts + improvements** | $1,162,558,124.22 | $2.91 | $1.09 |

[1] In H.R.2, CSP is eliminated, but 33% of its funding will be rolled into EQIP. Estimate includes forgone benefits at the CSP "likely" ROI and the forgone benefits of the 33% transferred funding at the EQIP ROI ($1.01).

### Uncertainties

It is important to note that this analysis contains several uncertainties. In this study, we did not determine the actual costs or benefits of specific practices implemented through CSP. Costs are based on average cost per acre determined by total acres enrolled and total program costs. Benefits are estimated based on the average value of achieving benefits within key categories targeted by CSP. In practice, specific program costs and benefits range widely based on several factors, including location, climate, farm size, and more. In this analysis, we also consider only one year of costs and one year of benefits. We did not project benefits of practices that are likely to endure for multiple years, and the longer-term estimation of ROI to farmers is also outside the scope of this analysis. Costs and benefits estimated by other reports (NRCS 2009; Wu and Weber 2012) are also estimates and rely on differing methodologies, time-scales, and available data. Therefore, the ROI estimated by this analysis for CSP may not be directly comparable to estimates for other conservation programs.

***Paige Stanley, M.S.*** *is a doctoral candidate at the University of California at Berkeley and was an agroecology intern at UCS while working on this project.* ***Marcia DeLonge, Ph.D.,*** *is a senior scientist in the UCS Food and Environment Program.*

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