

Prepared in cooperation with the U.S. Department of Agriculture's Farm Production and Conservation Business Center and Farm Service Agency

Development of an Online Reporting Format to Facilitate the Inclusion of Ecosystem Services into Conservation Reserve Enhancement Program Reports

Open-File Report 2022–1104

Development of an Online Reporting Format to Facilitate the Inclusion of Ecosystem Services into Conservation Reserve Enhancement Program Reports

By David M. Mushet and Owen P. McKenna

Prepared in cooperation with the U.S. Department of Agriculture's Farm
Production and Conservation Business Center and Farm Service Agency

Open-File Report 2022–1104

**U.S. Department of the Interior
U.S. Geological Survey**

U.S. Geological Survey, Reston, Virginia: 2022

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment—visit <https://www.usgs.gov> or call 1–888–ASK–USGS.

For an overview of USGS information products, including maps, imagery, and publications, visit <https://store.usgs.gov/>.

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Although this information product, for the most part, is in the public domain, it also may contain copyrighted materials as noted in the text. Permission to reproduce copyrighted items must be secured from the copyright owner.

Suggested citation:

Mushet, D.M., and McKenna, O.P., 2022, Development of an online reporting format to facilitate the inclusion of ecosystem services into Conservation Reserve Enhancement Program reports: U.S. Geological Survey Open-File Report 2022–1104, 19 p., <https://doi.org/10.3133/ofr20221104>.

ISSN 2331-1258 (online)

Acknowledgments

We thank the Economic and Policy Analysis staff of the U.S. Department of Agriculture's Farm Production and Conservation Business Center for providing their timely assistance and funding needed to produce this report. We also thank Farm Service Agency staff for providing reviews and suggestions that greatly improved online forms and the format of Conservation Reserve Enhancement Program partner and congressional reports.

Contents

Acknowledgments	iii
Abstract	1
Introduction	1
Development of Online Reporting Form and Guide	2
Online Reporting Form	2
Online Reporting Guide	3
Creating Conservation Reserve Enhancement Program State Partner Reports from Online Submissions	3
Summary Report to Congress	3
Evaluation of 2020 and 2021 Partner Reports	4
Bringing an Ecosystem Services Approach to Conservation Reserve Enhancement Program Reports	4
Use of the Integrated Valuation of Ecosystem Services and Tradeoffs Modeling Framework	5
Potential Data Sources	5
Land Cover Data	5
Habitat	6
Floral Resources	6
Carbon Stocks	6
Water Quality and Water Quantity	7
Quantifying Ecosystem Services into the Future	7
Summary	7
References Cited	8
Appendix 1. Farm Service Agency Notice Implementing Use of Online Reporting Form	10
Appendix 2. A Guide for Completing Conservation Reserve Enhancement Program Annual Reports Using the New Online Reporting Form	11
Appendix 3. Column Headings for Combined Microsoft Excel File	12
Appendix 4. Microsoft Word Mail Merge State Report Template	17
Appendix 5. Draft Text Produced for 2020 Report to Congress	18
Appendix 6. Draft Text Produced for 2021 Report to Congress	19

Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
Length		
mile (mi)	1.609	kilometer (km)
Area		
acre	4,047	square meter (m ²)
acre	0.4047	hectare (ha)
Mass		
ton, short (2,000 lb)	0.9072	metric ton (t)

Supplemental Information

A water year is the period from October 1 to September 30 and is designated by the year in which it ends; for example, water year 2020 was from October 1, 2019, to September 30, 2020.

Abbreviations

CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
FPAC–BC	Farm Production and Conservation Business Center
FSA	Farm Service Agency
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
MS-Excel	Microsoft Excel
MS-Forms	Microsoft Forms
MS-Word	Microsoft Word
NASS	National Agriculture Statistics Service
NBM	National Biogeographic Map
NLCD	National Land Cover Database
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

Development of an Online Reporting Format to Facilitate the Inclusion of Ecosystem Services into Conservation Reserve Enhancement Program Reports

By David M. Mushet and Owen P. McKenna

Abstract

The Conservation Reserve Enhancement Program is a program administered by the U.S. Department of Agriculture's Farm Service Agency. The Secretary of Agriculture is required to submit an annual report to Congress on Conservation Reserve Enhancement Program agreements that, among other things, reports on the progress made towards fulfilling commitments outlined in the agreements. The U.S. Geological Survey developed an online reporting form designed to ensure that consistent information is submitted to the Farm Service Agency from Conservation Reserve Enhancement Program State partners. Combined with the automated importation of text from partner-provided forms to word-processing documents, individual State reports and annual reports to Congress can now be produced efficiently and in a standardized format. Use of a standardized reporting format will also assist the Farm Service Agency in collecting information needed to support ecosystem service quantifications that go beyond the quantifications required from partners to document progress towards meeting the specific purposes and objectives identified in each agreement. Addition of these overarching conservation effect quantifications builds upon past ecosystem services modeling efforts based on the Integrated Valuation of Ecosystem Services and Tradeoffs suite of open-source software models; these offer a spatially explicit means to quantify additional ecosystem services across diverse partners in a consistent manner. Data sources are currently available to provide much of the information needed to run these models and complete simulations that would facilitate the quantification and reporting of the societal values of conservation actions taken under the Conservation Reserve Enhancement Program. It is the aim of this report to provide the information needed to move towards widescale monitoring of the Nation's ecosystem services in a natural accounting framework, similar to the framework used to value financial and human capital.

Introduction

The Conservation Reserve Enhancement Program (CREP) is a program administered by the U.S. Department of Agriculture's (USDA) Farm Service Agency (FSA). The CREP is part of the larger Conservation Reserve Program (CRP), a national program that provides annual rental payments to farmers in exchange for establishing permanent conservation cover on environmentally sensitive lands, effectively removing these lands from crop production. The CRP is the United States' largest conservation program in terms of acres affected and dollars expended. The size and scope of the CRP necessitate broad goals that align with the Nation's core conservation priorities. The CREP brings a more targeted approach to the CRP by leveraging Federal and non-Federal dollars to address specific conservation concerns and priorities at a more local, often State or regional, scale. Although agreements under the CREP also align with national priorities, the more specific and localized nature of the program results in a multitude of goals and objectives across agreements enacted between the USDA and its numerous CREP partners.

The Agricultural Improvement Act of 2018 (Public Law 115-334; also known as the 2018 Farm Bill) requires the Secretary of Agriculture to submit an annual report to Congress that, among other things, reports on progress made towards fulfilling commitments outlined in the CREP agreements. Staff from the Economic and Policy Analysis office of the USDA's Farm Production and Conservation Business Center (FPAC-BC) requested assistance from the U.S. Geological Survey (USGS) in developing a reporting template and online submission mechanism that would assist CREP partners in providing the information needed by the FSA to comply with this congressional mandate. The statutory language in the 2018 Farm Bill states that the annual report to Congress must include information on (1) status of agreements, (2) purposes and objectives of agreements, (3) Federal and eligible partner commitments made under the agreements, and (4) progress made towards fulfilling those commitments.

Reflecting the diverse goals and objectives of individual agreements, annual reports from partnering States have been provided in a wide variety of formats and often did not

provide sufficient information needed to meet congressional reporting requirements. Thus, the FSA asked that the USGS also evaluate the information being collected from partners to identify deficiencies that prevent the accurate reporting of progress towards meeting commitments. Additionally, the FSA sought to identify ways to quantify progress in terms of benefits related to water quantity, water quality, and habitat that are not consistently identified in the purposes and objectives of agreements. The hopes were that these quantifications would bridge across most or all agreements and allow for a more national view of program effects in addition to reporting progress made towards meeting the localized goals specific to each agreement. Adding these overarching conservation effect quantifications to annual CREP reports builds upon past ecosystem services modeling efforts completed through the Integrated Landscape Modeling Partnership that the USGS began with the FSA, Natural Resources Conservation Service, Commodity Credit Corporation, and U.S. Fish and Wildlife Service, an effort that has been ongoing since 2007 (Mushet and Scherff, 2016).

Development of Online Reporting Form and Guide

The online reporting form is designed to ensure that consistent information is submitted to the FSA from each of its CREP State partners. Providing information to the FSA in a consistent manner will assist CREP partners in meeting reporting requirements and the FSA in providing timely reports to Congress of progress made towards meeting the objectives of each CREP agreement. Additionally, a standardized reporting format will assist the FSA in collecting information needed to support ecosystem service quantifications beyond the specific quantifications required from CREP partners to document progress towards meeting the purposes and objectives listed in individual agreements.

Online Reporting Form

Microsoft Forms (MS-Forms) was used to create an online reporting form to be used by CREP State partners when providing annual reports of progress. The form was designed to collect information required to generate individual partner reports and an annual summary report to Congress. After reviewing CREP annual reports from previous years, the USGS created a preliminary draft of the reporting form in early July 2020 to be used by State partners to meet 2020 reporting requirements. A demonstration of the reporting form was provided to key FPAC–BC and FSA staff on July 10, 2020. A revised version of the form addressing concerns identified in the July 10 meeting was created and provided to the FPAC–BC on July 31, 2020. The reporting form was then recreated by the FPAC–BC on USDA computer

systems to address issues that prevented the sharing of forms between the USGS and USDA, which also ensured that information collected would go directly to and be stored on USDA computer systems rather than being routed through the USGS network. On September 3, 2020, the online reporting form passed compliance tests under Section 508 of the Rehabilitation Act of 1973 (29 U.S.C. § 798) completed by the FPAC–BC. On September 4, 2020, a demonstration of the reporting form was provided to the director of the FSA’s Conservation Division, and the reporting form was updated based on feedback received from the director during the meeting.

On September 11, 2020, a notice requiring the use of the online reporting form for 2020 partner reporting of agreement progress was sent to each FSA State office with CREP agreements by the Acting Deputy Administrator of Farm Programs (appendix 1). A followup call with FSA State offices was held on September 22, 2020, to discuss the new online reporting requirement and form and to address any questions and lingering concerns. FSA State offices then sent letters to each State partner providing links to the reporting form, a guide to the form’s use (appendix 2), and a reminder of the need to complete form submissions by December 31, 2020, to meet reporting requirements. The 2020 reporting form initially consisted of a single online form, but it was later divided into five sections because of character limitations discovered within MS-Forms after the report submission process had begun. Reporting forms were completed online for all 32 CREP State agreements and received by the USDA on or before the December 31, 2020, due date.

After a review of the information provided by CREP State partners in their 2020 submissions, the reporting form was revised based on knowledge gained. The primary change made was related to how information on Federal commitments was handled. In 2020, information on Federal commitments was provided to FSA State offices by the FSA national office. State offices then provided this quantitative information directly to the CREP partners within their respective State for entry into the online reporting form; however, review of data submitted by the CREP partners in 2020 revealed that the numbers reported by partners often did not match those originally provided by the FSA national office. To avoid this inconsistency in the data received, all Federal commitment questions were removed from the online reporting form in 2021. After State level information was received from CREP partners, information on Federal commitments was then directly added to the report input data file using data provided directly from the FSA national office, thus eliminating errors or inconsistencies generated by having the data pass through the State offices, to the CREP partners for entry into the online reporting form, and then back to the national level.

In 2021, the character limit in MS-Forms was increased from 16,000 to 200,000 characters. Along with the elimination of Federal commitment fields from the form, this would have allowed use of a single-section form; however, it was decided to retain the five-section format used in 2020 because it allowed partners to work on individual sections of the form

one at a time without the need to complete the entire form in one sitting. A current (2022) limitation of MS-Forms is that forms in progress cannot be saved and returned to for completion at a later time. The ability to work on the report in sections was highlighted as being appreciated in feedback received from CREP State partners after completing the online reporting process in 2020.

Online Reporting Guide

In concert with developing the online reporting form, a guide was prepared to be used by CREP State partners as an aid for completing the online reporting process (appendix 2). This reporting guide contains computer screenshots of each page of the online form that a partner would complete, along with details of the information to be entered into each field of the form. The guide also contains hotlinks to the five sections of the report form (parts 1–5 in the guide) to assist partners as they navigate the online form submission process. The first draft of the reporting guide was provided to the FPAC–BC by the USGS on August 8, 2020. Subsequent drafts were provided and used in demonstrations as development of the reporting form proceeded. This development included splitting the reporting form into five sections in 2020 and removing the need to enter Federal commitment information into the form in 2021. The reporting form guide provides a valuable resource that facilitates the use of the online reporting form. The guide also allows CREP partners to preview information that is collected during the online reporting process so that this information can be obtained beforehand by the CREP partner and be readily available when completing the online reporting process. To encourage this practice, it is recommended in the reporting guide to enter all the needed information into a word-processing document such as Microsoft Word (MS-Word) before starting the online reporting process. Once all needed information has been gathered and entered into a word-processing document, the online reporting form can then be completed by cutting and pasting text from the word-processing document directly into the online reporting form.

After the online reporting form and guide used in 2020 were updated and modified, a webinar was held on October 18, 2021, for the FSA State offices in which detailed instructions were again provided on how to complete the online reporting process using the online reporting form and guide. The webinar was followed by a question-and-answer session with USGS and FPAC–BC developers of the online reporting process.

Creating Conservation Reserve Enhancement Program State Partner Reports from Online Submissions

After information is collected from the CREP State partners using the online reporting form, MS-Word is used to generate individual State reports. The first step to producing the completed State reports is to export the data collected in MS-Forms as five separate Microsoft Excel (MS-Excel) files, one for each of the five sections of the reporting form. The five files are then merged into a single MS-Excel spreadsheet, and additional columns are added to accommodate Federal commitment data. These columns are then populated with the Federal commitment data provided directly from the FSA national office. The final MS-Excel spreadsheet should have 136 columns that match the columns and column headings depicted in appendix 3. Once the combined MS-Excel data file is created, the “Mail Merge” feature of MS-Word is used to harvest data from the combined data file for direct input into State reports. A CREP State report mail merge template (appendix 4) was created and provided to the FPAC–BC for this purpose. By selecting the combined MS-Excel file as the input file and selecting “Edit Individual Documents” under the “Edit & Merge” button in MS-Word, the State reports are generated as a series of documents to which photographs provided by States can be added. This also is the time to review the reports to be sure that the “Mail Merge” process imported data from the MS-Excel file correctly. Each State report can then be saved as a separate MS-Word or Portable Document Format file. Copies of individual State reports are then generally provided to the CREP partners for their individual records.

Summary Report to Congress

Once the combined MS-Excel file has been created and Federal commitment data have been added, creating a summary report for Congress is a straightforward matter of updating acreage, commitment, and progress information provided in the previous year’s report. Summaries of acreages, financial commitments (Federal and non-Federal), and other commitments are obtained by adding sum formulas to the appropriate columns in the combined MS-Excel spreadsheet. Partner progress text is added to the appropriate objectives statement in the report using the cut and paste tool in MS-Word. Drafts of 2020 and 2021 reports generated for Congress are provided in appendixes 5 and 6, respectively. Because the fields of the draft report contain text provided by the State partners, the draft report often contains errors (for example, in-text references to figures in a State report that are not included in the report to Congress). Such errors can be corrected by a careful review. The draft reports then undergo an FSA internal approval process before submission to Congress to meet Farm Bill requirements.

Evaluation of 2020 and 2021 Partner Reports

One of the key takeaways from an evaluation of the reporting information provided by CREP State partners in 2020 and 2021 is the diversity of purposes and objectives among agreements; however, given the specific and localized nature of the CREP, this is not surprising. Most of the agreement purposes were fairly generalized, and some contained water quality, water quantity, and habitat components. For example, the stated purpose of the Colorado Republican River CREP agreement is to “reduce the amount of irrigation water consumptive use, conserve energy, and reduce agricultural chemicals and sediment from entering waters of the State from agricultural lands” and to “enhance aquatic and terrestrial wildlife habitat through establishment of permanent vegetative cover.” By contrast, other agreements have more specific stated purposes and may only contain a single water quality, water quantity, or habitat purpose. For example, the stated purpose of the Washington CREP agreement is to “assist in the recovery of salmon species that have been listed as threatened or endangered species under the Federal Endangered Species Act [Public Law 93–205, 87 Stat. 884].”

Similarly, the objectives stated in CREP agreements varied greatly and ranged in number from a single objective (Louisiana Lower Ouachita River CREP agreement, New Jersey CREP agreement) to 12 objectives (Kansas Upper Arkansas River CREP agreement). Although some objectives were specific and quantifiable (for example, “reduce soil erosion from 751,633 tons per year to 259,395 tons per year, a total reduction of 492,238 tons per year” [Colorado Republican River CREP agreement]), others were too general to allow for a quantification of progress towards meeting the objective (for example, “conserve and improve wildlife habitat” [Idaho Eastern Snake River Plain CREP agreement]) or did not set a specific measurable criterion of success (for example, “increase the acres of wetlands in the watersheds for erosion control, sediment reduction, stormwater retention, and nutrient uptake” [Indiana CREP agreement]). In future agreements, care should be taken to ensure that objectives are specific and include a measurable criterion of success if subsequent quantitative information on a CREP partner’s progress towards meeting that objective is required. Also, when forming objectives, thought should be placed into methods that will be used to measure progress. In many CREP agreements that list specific objectives with quantified targets, quantification of progress towards meeting those objectives was not possible by the CREP partner because methods were not in place to measure progress or methods used did not allow for the separation of effects because of CREP conservation actions from other anthropogenic or environmental effects affecting the variable being measured.

From the progress information reported by CREP partners in 2020 and 2021, it was apparent that the partners that were most successful in reporting progress towards meeting

specific objectives had objectives in which targets were expressed in terms of acreage of specific conservation cover types to be established that would meet conservation goals under the CREP agreement. Thus, if a partner had a goal to reduce sediment loss by X tons and was able to relate an acre or linear mile of a certain conservation cover type or types to sediment losses, then an objective to establish a certain number of acres or linear miles of a specific conservation cover type would provide for an easily quantifiable measure of progress. Additionally, that measure could be related back to the original environmental goal in terms of a reduction in tons of sediment lost. A wide variety of water quality, water quantity, and habitat variables can be related to land cover types in this way, as described in the “Bringing an Ecosystem Services Approach to Conservation Reserve Enhancement Program Reports” section.

Although CREP agreements current in 2020 and 2021 typically have a single overarching purpose and more specific objectives, breaking the purpose down into environmental goals and then listing objectives that would be needed to reach those goals would facilitate linking environmental effects to more readily obtained information on the establishment of conservation practices. Using this format, a goal would be the specific environmental benefit desired, such as reducing nitrate runoff from fields by 100 tons annually in a target drainage basin. The objective would then be the specific conservation action needed to meet the identified goal (for example, establish 1,000 linear miles of conservation practice X along field edges in a target drainage basin). By listing goals describing desired environmental outcomes and objectives that directly relate to on-the-ground and measurable actions taken by partners, the ability to report on progress towards meeting the purpose and goals of an agreement would be greatly improved.

Bringing an Ecosystem Services Approach to Conservation Reserve Enhancement Program Reports

One of the reasons the FPAC–BC teamed with the USGS was due to the long history of the USDA and USGS working together to develop ecosystem services modeling and quantification techniques through their Integrated Landscape Modeling partnership (Mushet and Scherff, 2016). Bringing an ecosystem services approach to CREP reporting was seen as a way to obtain nationally consistent information that would allow FSA’s annual reports to Congress to be expanded to include quantifications of benefits not specifically identified in CREP agreements. A substantial product from this part of the effort was published as a peer-reviewed journal article in the *Journal of Fish and Wildlife Management* (Mushet and others, 2022). Mushet and others (2022) provided a framework for including ecosystem services into conservation assessments. In addition, they described a case study in which multiple

ecosystem services were assessed to quantify the effect of conservation lands within a specific area (Stutsman County, North Dakota). In Mushet and others (2022), online supplemental materials that include information needed to complete model runs are provided. Although specific to the Prairie Pothole Region of the United States, the information provided in the supplemental materials of Mushet and others (2022) serves as a guide to develop similar information facilitating ecosystem assessments in other regions of the United States. As a supplement to information presented in Mushet and others (2022), the following description is provided to assist CREP, FPAC–BC, FSA, and others in adding ecosystem services to quantifications of the multiple benefits provided by conservation programs.

Use of the Integrated Valuation of Ecosystem Services and Tradeoffs Modeling Framework

The Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) is a suite of open-source software models developed by the Natural Capital Project (<https://naturalcapitalproject.stanford.edu/>), a partnership between Stanford University, the Chinese Academy of Sciences, the University of Minnesota, the Stockholm Resilience Centre, The Nature Conservancy, and the World Wildlife Fund. The InVEST models allow for the mapping, quantification, and valuation of ecosystem services provided by the Earth's ecosystems. The spatial-explicit construct of the InVEST models was a primary reason for the use of these models by the Integrated Landscape Modeling partnership (Mushet and Scherff, 2016) for quantification of the services provided by wetland ecosystems and associated conservation programs in the Prairie Pothole Region of North America (for example, see Mushet and others, 2014; Mushet and Roth, 2020). The Integrated Landscape Modeling partnership also used InVEST ecosystem service models in an evaluation of habitat provided for grassland birds by the CRP (Shaffer and others, 2019). The spatially explicit construct of the InVEST models also makes them well suited for quantifying ecosystem services provided by CREP conservation activities.

InVEST models rely on spatially explicit maps of a landscape to map and quantify services such as carbon storage, the provisioning of floral resources for pollinators, the provisioning of habitat for wildlife, storage of flood waters, sediment attenuation, and others. Incorporating a set of these services into evaluations of CREP conservation efforts would greatly expand the set of quantified benefits received by society from the presence of these conservation lands on the landscape. The primary products that are needed to include a set of ecosystem services are a land cover map that identifies the various land-use and conservation practices of an area of interest and information that can relate the effect of the conservation lands to service outputs. For example, wetland restoration can be a conservation action. If the wetlands restored under a conservation program are mapped

and information is available on the role of those wetlands in storing carbon or providing habitat for a species or set of species, then these services can be mapped and quantified. Mushet and Roth (2020) demonstrate how the effect of a conservation program (in this case, the U.S. Fish and Wildlife Service's Wetlands Easement Program) can have an additive effect on multiple ecosystem services, values that are missed if only a limited set of effects is measured. In their case study, Mushet and others (2022) completed a similar assessment at the scale of a single county. These two publications can serve as a guide to assess conservation effects in other regions and for other conservation programs within an ecosystem services framework. The biggest limitation restricting the use of InVEST is often a lack of data needed to populate the models to function across a diverse range of landscape types and management actions; however, data needed to run InVEST models are becoming increasingly available.

Potential Data Sources

The best sources of data to use as model inputs are those that have been measured locally and provide information specific to each location and management action; however, lacking such data does not prevent the use of the models and the quantification of services at a coarser level until site-specific data become available. In the following sections, examples of data sources that can be used to quantify ecosystem services using the InVEST suite of models are provided. Other data sources are available in the InVEST User's Guide at http://releases.naturalcapitalproject.org/invest-userguide/latest/data_sources.html.

Land Cover Data

The two main national-scale datasets used to identify various land cover types across the United States are the National Land Cover Database (NLCD; Homer and others, 2012) and the Cropland Data Layer produced by the USDA National Agriculture Statistics Service (NASS). NLCD data are available from the Multi-Resolution Land Characteristics Consortium at <https://www.mrlc.gov/>, and the Cropland Data Layer is available from the NASS at https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php. Of the two, the Cropland Data Layer provides the most detailed breakdown of land cover types on agricultural lands. Additionally, the Cropland Data Layer is produced annually, whereas the NLCD is produced every 2 to 3 years. Mushet and others (2014), Shaffer and others (2019), and Mushet and Roth (2020) each used the readily available Cropland Data Layer as the primary land cover input into their evaluations of ecosystem services in various parts of the North American Prairie Pothole Region.

One limitation of all currently available land cover data is that cover types are not identified down to the level of specific conservation practices; thus, other spatial information will be needed to identify the conservation cover types used by CREP

partners in a region. However, once these data resources are obtained or developed, quantification of changes in ecosystem services derived from the establishment of these cover types from the implementation of conservation practices can be regularly quantified. A straightforward way to complete these quantifications is by running two sets of scenarios within the InVEST modeling framework, one with the conservation practices in place (typically called the “baseline scenario”) and a second with the practices removed; that is, changed to cropland or another cover type that represents the landscape without the practices in place (typically called the “no-practice” scenario). This methodology is used by the USDA Conservation Effects and Assessment Project to quantify conservation effects (Natural Resources Conservation Service, 2022) and has proven to be widely accepted in quantifications of conservation effects (Potter and others, 2006).

Habitat

InVEST modeling of wildlife habitat requires spatial information on habitats for the species or group of species of interest in addition to spatial information identifying threats to those habitats. As with cover types, these data are most accurate if generated for a specific area using detailed knowledge of species-specific requirements and local threats to habitats. For some species and areas, this information is available (for example, grassland birds in the Prairie Pothole Region [Shaffer and others, 2019], amphibians in the Southern High Plains [Venne and others, 2012]); however, for most species and areas, this information remains to be developed. As an alternative, large-scale mapping data of habitats are available from the USGS Gap Analysis Project (<https://www.usgs.gov/programs/gap-analysis-project/science/species-data-download>) and can be used for areas and species for which localized data are unavailable. However, localized information on habitat threats will still need to come from local expert sources.

Details on using the InVEST model to quantify habitat and other ecosystem services are not provided in this report because the modeling system is constantly being improved, and such details would quickly become outdated if they were provided in this report. The best source for information on using InVEST, or other modeling systems, typically comes from the sources of the model. These details for using InVEST to quantify habitat and other ecosystem services are provided in the InVEST User’s Guide, which is available at <http://releases.naturalcapitalproject.org/invest-userguide/latest/index.html>. However, the case study provided in Mushet and others (2022) serves as an example of how these quantifications can be completed and how, when used in conjunction with information provided in the InVEST User’s Guide to complete the actual model runs, these quantifications can lead to an increased understanding of the benefits provided by conservation actions such as those carried out under the CREP.

Floral Resources

Floral resources that support native pollinators and honeybees are quantifiable using InVEST. Land cover maps typically used in these assessments are the maps provided by the NASS Cropland Data Layer; however, like habitats, coefficients relating the value of various land cover types in terms of providing flowering plants are regionally specific and will likely need to be developed for most areas with CREP agreements using input from regional experts. Despite this limitation, the development of coefficients for use in reporting the effect of the CREP on floral resources is straightforward using methodologies described by Lonsdorf and Davis (2016) and expanded upon by Smith and others (2021).

Carbon Stocks

Local, directly measured field estimates of carbon stocks by management type provide the most accurate quantifications of management effects. Ideally, these data would be stratified into age classes to allow for estimates of gains or losses without a change in land-use type, just age; however, as with most other ecosystem services, these local data are typically not available. To aid with the quantification of carbon stores in the absence of local, directly measured field data, information is provided on several general data sources that can be used until more specific data become available. This generalized information is not definitive and should only serve as a starting point until more accurate data are obtained. Localized data are typically obtained from State, university, literature, nongovernmental, or other sources; however, more generalized global data can be used if nothing specific to the local area or management action is available.

When localized data are absent, estimates of aboveground vegetation, belowground vegetation, dead vegetation, and soil carbon pools by broad land cover types are provided by the Intergovernmental Panel on Climate Change (2006). Estimates of aboveground carbon stocks for natural and plantation forest types are provided in Intergovernmental Panel on Climate Change (2006, tables 4.7, 4.8, and 4.12). Note that these estimates are provided by the Intergovernmental Panel on Climate Change in units of biomass. For use in InVEST, these values need to be converted to mass of elemental carbon. To make the conversion to metric tons of carbon, multiply the biomass estimate by the conversion factor listed in table 4.3 of Intergovernmental Panel on Climate Change (2006). Similar aboveground biomass estimates for agriculture lands with perennial woody biomass (for example, fruit orchards) are provided in Intergovernmental Panel on Climate Change (2006, tables 5.1, 5.2, and 5.3). Other sources for aboveground and belowground biomass estimates are available in Smith and others (2006) for all U.S. forest types and Grace and others (2006) for savanna ecosystems.

Water Quality and Water Quantity

Water quality and quantity variables are diverse, and the effect of various land cover types on each vary greatly across landscapes and conservation actions. For water quality and quantity services, the Integrated Landscape Modeling partnership determined that a process-based model was most useful in determining the effects of conservation actions (Mushet and Scherff, 2016). Use of a process-based approach can be much more time intensive than use of spatial models such as InVEST; however, the resultant data obtained on the effect of various conservation practices on water quality and water quantity services are typically more accurate (Mushet and Scherff, 2016). The process-based model used by the Integrated Landscape Modeling partnership and the Conservation Effects Assessment Project is the Agriculture Policy/Environmental eXtender model (Gassman and others, 2010). When the Agriculture Policy/Environmental eXtender model with baseline and no-practice scenarios is used, the effect of various conservation practices on water quality and quantity variables of interest can be estimated and used to relate acres or linear miles of specific practices (that is, CREP agreement objectives) to environment effects (that is, CREP agreement goals). This modeling work would be labor and cost intensive but would in the end provide information needed to accurately report progress of CREP agreements in a standardized and informative way. Additionally, much of the modeling work needed to obtain this information might already have been completed or can be modified from work already completed by the USDA's Conservation Effects Assessment Project.

Quantifying Ecosystem Services into the Future

In order for the FSA to better prepare national summaries for their reports to Congress, a broader view of ecosystem services is needed than that provided at the localized scale through individual CREP agreements. It is the nature of the CREP that agreements focus on specific conservation concerns at a more local scale than was possible through the CRP. CREP brought the ability to target localized needs and concerns of local and regional partners to the CRP, but the localized, specific nature of the resultant CREP agreements does not translate well to national reporting requirements. A national-scale quantification of ecosystem services is therefore needed. One potential opportunity to develop such a national assessment of ecosystem services is available in the form of the USGS's National Biogeographic Map (NBM). The NBM already contains detailed mapping data of land use, species habitat, and species ranges (see <https://www.usgs.gov/news/technical-announcement/new-species-habitat-distribution-maps-now-support-conservation-planning>). Much like the InVEST modeling system, analytical tools that draw upon

current and future datasets could be developed within the NBM to quantify ecosystem services across the Nation. CREP partners could then complete evaluations of conservation effects by zooming into specific areas or regions of interest and completing baseline and no-effect assessments of conservation actions by adding or removing conservation land types (for example, tree plantings, grass buffers) as appropriate. The differences in ecosystem services provided between the baseline and no-practice scenarios would provide a quantification of conservation effects. A wide variety of ecosystem services could be quantified in this way, including carbon storage soil retention, food production, and, given that species range and habitat maps are already a part of the NBM, wildlife habitat. By developing a single tool with the ability to quantify ecosystem services nationwide, CREP partners would be able to consistently quantify services to meet reporting requirements, and the FSA could draw upon these estimates to meet their reporting requirements to Congress as outlined in the 2018 Farm Bill.

Development of such a national-scale mechanism to quantify ecosystem services has been a long-term goal of the Integrated Landscape Modeling partnership since its development (Euliss and others, 2010). Only since about 2020, with large-scale mapping abilities made possible through the development of cloud-based data storage and cloud-based computing, has a realistic mechanism to meet this vision been realized.

Summary

The Conservation Reserve Enhancement Program is a program administered by the U.S. Department of Agriculture's Farm Service Agency. The Agricultural Improvement Act of 2018 (Public Law 115–334; also known as the 2018 Farm Bill) requires that the Secretary of Agriculture submit an annual report to Congress on Conservation Reserve Enhancement Program agreements that, among other things, reports on the progress made towards fulfilling commitments outlined in the agreements. The U.S. Geological Survey developed an online reporting form designed to ensure that consistent information is submitted to the Farm Service Agency from Conservation Reserve Enhancement Program State partners. Combined with the automated importation of text from partner-provided forms to word-processing documents, individual State reports and annual reports to Congress can now be produced efficiently and in a standardized format. Additionally, use of a standardized reporting format will assist the Farm Service Agency in collecting information needed to support ecosystem service quantifications that go beyond the quantifications required from partners to document progress towards meeting the specific purposes and objectives identified in each agreement. The models within the Integrated Valuation of Ecosystem Services and Tradeoffs suite of open-source software models offer a spatially explicit means to quantify additional

ecosystem services across diverse partners in a consistent manner. Data sources are currently available to provide much of the information needed to run these models and complete simulations that would facilitate the quantification and reporting of the societal values of conservation actions taken under the Conservation Reserve Enhancement Program. The U.S. Geological Survey has the capabilities needed in the form of cloud storage and cloud computing abilities to surpass obstacles that previously limited widescale quantification of ecosystem services across the varied landscapes and the multitude of conservation practices affected and implemented by the U.S. Department of Agriculture. It is the aim of this report to provide the information needed to move towards widescale monitoring of the Nation's ecosystem services in a natural accounting framework, similar to the framework used to value financial and human capital.

References Cited

- Euliss, N.H., Jr., Smith, L.M., Liu, S., Feng, M., Mushet, D.M., Auch, R.F., and Loveland, T.R., 2010, The need for simultaneous evaluation of ecosystem services and land use change: *Environmental Science & Technology*, v. 44, no. 20, p. 7761–7763. [Also available at <https://doi.org/10.1021/es102761c>.]
- Gassman, P.W., Williams, J.R., Wang, X., Saleh, A., Osei, E., Hauck, L.M., Izaurrealde, R.C., and Flowers, J.D., 2010, The Agricultural Policy/Environmental eXtender (APEX) model—An emerging tool for landscape and watershed environmental analyses: *Transactions of the American Society of Agricultural and Biological Engineers*, v. 53, p. 711–740. [Also available at <https://doi.org/10.13031/2013.30078>.]
- Grace, J., San José, J., Meir, P., Miranda, H.S., and Montes, R.A., 2006, Productivity and carbon fluxes of tropical savannas: *Journal of Biogeography*, v. 33, no. 3, p. 387–400. [Also available at <https://doi.org/10.1111/j.1365-2699.2005.01448.x>.]
- Homer, C., Fry, J., and Barnes, C.A., 2012, The National Land Cover Database: U.S. Geological Survey Fact Sheet 2012–3020, 4 p., accessed July 31, 2021, at <https://doi.org/10.3133/fs20123020>.
- Intergovernmental Panel on Climate Change, 2006, 2006 IPCC guidelines for national greenhouse gas inventories—Volume 4—Agriculture, forestry and other land use: Institute for Global Environmental Strategies, Hayama, Kanagawa, Japan, [variously paged]. [Also available at <https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html>.]
- Lonsdorf, E., and Davis, A., 2016, Appendix 5—A geographic information system tool to project managed and wild mees on any landscape, in Mushet, D.M., and Scherff, E.J., eds., *The Integrated Landscape Monitoring partnership—Current status and future directions* (ver. 1.1, December 2016): U.S. Geological Survey Open File Report 2016–1006, p. 43–55, accessed July 31, 2021, at <https://doi.org/10.3133/ofr20161006>.
- Mushet, D.M., Neau, J.L., and Euliss, N.H., Jr., 2014, Modeling effects of conservation grassland losses on amphibian habitat: *Biological Conservation*, v. 174, p. 93–100. [Also available at <https://doi.org/10.1016/j.biocon.2014.04.001>.]
- Mushet, D.M., Post van der Burg, M., and Anteau, M.J., 2022, Assessing conservation and management actions with ecosystem services better communicates conservation value to the public: *Journal of Fish and Wildlife Management*, v. 13, no. 1, p. 306–318. [Also available at <https://doi.org/10.3996/JFWM-21-083>.]
- Mushet, D.M., and Roth, C.L., 2020, Modeling the supporting ecosystem services of depressional wetlands in agricultural landscapes: *Wetlands*, v. 40, p. 1061–1069. [Also available at <https://doi.org/10.1007/s13157-020-01297-2>.]
- Mushet, D.M., and Scherff, E.J., 2016, *The Integrated Landscape Monitoring partnership—Current status and future directions* (ver. 1.1, December 2016): U.S. Geological Survey Open File Report 2016–1006, 59 p., accessed July 31, 2021, at <https://doi.org/10.3133/ofr20161006>.
- Natural Resources Conservation Service, 2022, Cropland National Assessment: Natural Resources Conservation Service web page, accessed May 27, 2022, at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/nra/ceap/na/?cid=nrcs143_014144.
- Potter, S., Wand, S., and King, A., [2006], Modeling structural conservation practices—Cropland component of the Conservation Effects Assessment Project: Temple, Tex., Texas Agri-Life Research Center, 50 p.
- Shaffer, J.A., Roth, C.L., and Mushet, D.M., 2019, Modeling effects of crop production, energy development, and conservation-grassland loss on avian habitat: *PLoS One*, v. 14, no. 1, art. e0198382, 17 p., accessed July 31, 2021, at <https://doi.org/10.1371/journal.pone.0198382>.
- Smith, D., Davis, A.Y., Hitaj, C., Hellerstein, D., Preslicka, A., Kogge, E., Mushet, D.M., and Lonsdorf, E., 2021, The contribution of land cover change to the decline of honey yields in the Northern Great Plains: *Environmental Research Letters*, v. 16, no. 6, art. 064050, 11 p., accessed July 31, 2021, at <https://doi.org/10.1088/1748-9326/abfde8>.

- Smith, J.E., Heath, L.S., Skog, K.E., and Birdsey, R.A., 2006, Methods for calculating forest ecosystem and harvested carbon with standard estimates for forest types of the United States: Newtown Square, Pa., U.S. Department of Agriculture, Forest Service, Northeastern Research Station, General Technical Report NE-343, 216 p. [Also available at <https://doi.org/10.2737/NE-GTR-343>.]
- Venne, L.S., Tsai, J.-S., Cox, S.B., Smith, L.M., and McMurtry, S.T., 2012, Amphibian community richness in cropland and grassland playas in the Southern High Plains, USA: *Wetlands*, v. 32, no. 4, p. 619–629. [Also available at <https://doi.org/10.1007/s13157-012-0305-9>.]

Appendix 1. Farm Service Agency Notice Implementing Use of Online Reporting Form

On September 11, 2020, a notice requiring the use of the online reporting form for 2020 partner reporting of agreement progress was sent to each Farm Service Agency State office with Conservation Reserve Enhancement Program

agreements by the Acting Deputy Administrator of Farm Programs. A copy of this notice is available for download at <https://doi.org/10.3133/ofr20221104>.

Appendix 2. A Guide for Completing Conservation Reserve Enhancement Program Annual Reports Using the New Online Reporting Form

In concert with developing the online reporting form, a guide was prepared to be used by Conservation Reserve Enhancement Program State partners as an aid for completing the online reporting process. This reporting guide contains computer screenshots of each page of the online form that a partner would complete, along with details of the information

to be entered into each field of the form. The guide also contains hotlinks to the five sections of the report form (parts 1–5 in the guide) to assist partners as they navigate the online form submission process. The reporting guide is available for download at <https://doi.org/10.3133/ofr20221104>.

Appendix 3. Column Headings for Combined Microsoft Excel File

After information is collected from the Conservation Reserve Enhancement Program State partners using the online reporting form, Microsoft Word is used to generate individual State reports. The first step to producing the completed State reports is to export the data collected in Microsoft Forms as five separate Microsoft Excel (MS-Excel) files, one for each of the five sections of the reporting form. The five files are then

merged into a single MS-Excel spreadsheet, and additional columns are added to accommodate Federal commitment data. These columns are then populated with the Federal commitment data provided directly from the Farm Service Agency national office. The final MS-Excel spreadsheet should have 136 columns that match the columns and column headings depicted in [table 3.1](#).

Table 3.1. Column headings for the combined Microsoft Excel file.

[CREP, Conservation Reserve Enhancement Program; CRP, Conservation Reserve Program; FSA, Farm Service Agency]

Column letter	Column heading
Column A	State
Column B	CREP name
Column C	CREP agreement name
Column D	Reporting year
Column E	Summary of CREP agreement
Column F	Acreage cap
Column G	Reenrolled acres
Column H	New acres
Column I	Total acres currently enrolled
Column J	Federal CRP rental payments
Column K	Federal signup incentive payments
Column L	Federal practice incentive payments
Column M	Federal cost-share payments
Column N	Other Federal incentive payments
Column O	Total Federal commitments
Column P	Non-Federal financial commitments 2
Column Q	Non-Federal financial commitments 3
Column R	Non-Federal financial commitments directly to CRP participants
Column S	Non-Federal in-kind support 2
Column T	Non-Federal in-kind support directly to CRP participants
Column U	Total non-Federal commitments
Column V	Non-Federal in-kind support 1
Column W	Non-Federal in-kind support 12
Column X	Were there other types of non-Federal in-kind support provided during the reporting year?
Column Y	Non-Federal in-kind support 20
Column Z	Non-Federal in-kind support 22
Column AA	Were there other types of non-Federal in-kind support provided during the reporting year? 2
Column AB	Non-Federal in-kind support 3
Column AC	Non-Federal in-kind support 32
Column AD	Were there other types of non-Federal in-kind support provided during the reporting year? 3
Column AE	Non-Federal in-kind support 4
Column AF	Non-Federal in-kind support 42
Column AG	Were there other types of non-Federal in-kind support provided during the reporting year? 4
Column AH	Non-Federal in-kind support 5
Column AI	Non-Federal in-kind support 52
Column AJ	Other non-Federal commitments or support 2
Column AK	Other non-Federal commitments or support 3
Column AL	Other non-Federal commitments or support directly to CRP participants
Column AM	Goal 1
Column AN	Goal type
Column AO	Progress towards meeting goal 1
Column AP	Difficulties - Goal 1
Column AQ	Are there additional goals associated with this agreement?

14 Development of an Online Reporting Format to Facilitate the Inclusion of Ecosystem Services into CREP Reports

Table 3.1. Column headings for the combined Microsoft Excel file.—Continued

[CREP, Conservation Reserve Enhancement Program; CRP, Conservation Reserve Program; FSA, Farm Service Agency]

Column letter	Column heading
Column AR	Goal 2
Column AS	Goal type2
Column AT	Progress towards meeting goal 2
Column AU	Difficulties - Goal 2
Column AV	Are there additional goals associated with this agreement? 2
Column AW	Goal 3
Column AX	Goal type3
Column AY	Progress towards meeting goal 3
Column AZ	Difficulties - Goal 3
Column BA	Are there additional goals associated with this agreement? 3
Column BB	Goal 4
Column BC	Goal type4
Column BD	Progress towards meeting goal 4
Column BE	Difficulties - Goal 4
Column BF	Are there additional goals associated with this agreement? 4
Column BG	Goal 5
Column BH	Goal type5
Column BI	Progress towards meeting goal 5
Column BJ	Difficulties - Goal 5
Column BK	Are there additional goals associated with this agreement? 5
Column BL	Goal 6
Column BM	Goal type11
Column BN	Progress towards meeting goal 6
Column BO	Difficulties - Goal 6
Column BP	Are there additional goals associated with this agreement? 12
Column BQ	Goal 7
Column BR	Goal type 213
Column BS	Progress towards meeting goal 7
Column BT	Difficulties - Goal 7
Column BU	Are there additional goals associated with this agreement? 214
Column BV	Goal 8
Column BW	Goal type 315
Column BX	Progress towards meeting goal 8
Column BY	Difficulties - Goal 8
Column BZ	Are there additional goals associated with this agreement? 316
Column CA	Goal 9
Column CB	Goal type 417
Column CC	Progress towards meeting goal 9
Column CD	Difficulties - Goal 9
Column CE	Are there additional goals associated with this agreement? 418
Column CF	Goal 10
Column CG	Goal type 519
Column CH	Progress towards meeting goal 10

Table 3.1. Column headings for the combined Microsoft Excel file.—Continued

[CREP, Conservation Reserve Enhancement Program; CRP, Conservation Reserve Program; FSA, Farm Service Agency]

Column letter	Column heading
Column CI	Difficulties - Goal 10
Column CJ	Are there additional goals associated with this agreement? 520
Column CK	Goal 11
Column CL	Goal type 6
Column CM	Progress towards meeting goal 11
Column CN	Difficulties - Goal 11
Column CO	Are there additional goals associated with this agreement? 6
Column CP	Goal 12
Column CQ	Goal type 7
Column CR	Progress towards meeting goal 12
Column CS	Difficulties - Goal 12
Column CT	Are there additional goals associated with this agreement? 7
Column CU	Goal 13
Column CV	Goal type 8
Column CW	Progress towards meeting goal 13
Column CX	Difficulties - Goal 13
Column CY	Are there additional goals associated with this agreement? 8
Column CZ	Goal 14
Column DA	Goal type 9
Column DB	Progress towards meeting goal 14
Column DC	Difficulties - Goal 14
Column DD	Are there additional goals associated with this agreement? 9
Column DE	Goal 15
Column DF	Goal type 10
Column DG	Progress towards meeting goal 15
Column DH	Difficulties - Goal 15
Column DI	Were field reviews of specific acreages completed during the reporting year?
Column DJ	Field review description
Column DK	Field review findings
Column DL	Were field review findings reported to FSA?
Column DM	Outreach activity 1
Column DN	Do you have additional outreach activities?
Column DO	Outreach activity 2
Column DP	Do you have additional outreach activities? 2
Column DQ	Outreach activity 3
Column DR	Do you have additional outreach activities? 3
Column DS	Outreach activity 4
Column DT	Do you have additional outreach activities? 4
Column DU	Outreach activity 5
Column DV	Do you have additional outreach activities? 5
Column DW	Outreach activity 6
Column DX	Success stories
Column DY	Challenges

Table 3.1. Column headings for the combined Microsoft Excel file.—Continued

[CREP, Conservation Reserve Enhancement Program; CRP, Conservation Reserve Program; FSA, Farm Service Agency]

Column letter	Column heading
Column DZ	Future actions
Column EA	Suggestions for improvement
Column EB	Additional information 2
Column EC	Photographs 2
Column ED	Date report completed
Column EE	Contact
Column EF	Contact email

Appendix 4. Microsoft Word Mail Merge State Report Template

Once the combined Microsoft Excel data file is created, the “Mail Merge” feature of Microsoft Word is used to harvest data from the combined data file for direct input into State reports. A Conservation Reserve Enhancement Program State report mail merge template was created and provided to the Farm Production and Conservation Business Center for this purpose. The mail merge template is available

for download at <https://doi.org/10.3133/ofr20221104>. By selecting the combined Microsoft Excel file as the input file and selecting “Edit Individual Documents” under the “Edit & Merge” button in Microsoft Word, the State reports are generated as a series of documents to which photographs provided by States can be added.

Appendix 5. Draft Text Produced for 2020 Report to Congress

A draft of the 2020 Conservation Reserve Enhancement Program report generated for Congress is available for download at <https://doi.org/10.3133/ofr20221104>. Because the fields of the draft report contain text provided by the State partners, the draft report often contains errors (for example, in-text references to figures in a State report that

are not included in the report to Congress). Such errors can be corrected by a careful review. The draft report undergoes a Farm Service Agency internal approval process before submission to Congress to meet requirements stated in the Agricultural Improvement Act of 2018 (Public Law 115–334; also known as the 2018 Farm Bill).

Appendix 6. Draft Text Produced for 2021 Report to Congress

A draft of the 2021 Conservation Reserve Enhancement Program report generated for Congress is available for download at <https://doi.org/10.3133/ofr20221104>. Because the fields of the draft report contain text provided by the State partners, the draft report often contains errors (for example, in-text references to figures in a State report that

are not included in the report to Congress). Such errors can be corrected by a careful review. The draft report undergoes a Farm Service Agency internal approval process before submission to Congress to meet requirements stated in the Agricultural Improvement Act of 2018 (Public Law 115–334; also known as the 2018 Farm Bill).

For more information about this publication, contact:

Director, USGS Northern Prairie Wildlife Research Center
8711 37th Street Southeast
Jamestown, ND 58401
701-253-5500

For additional information, visit: <https://www.usgs.gov/centers/npwrc>

Publishing support provided by the
Rolla and Reston Publishing Service Centers

