

Introduction to the Conservation Effects Assessment Project and the Rangeland Literature Synthesis

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THE CONSERVATION EFFECTS ASSESSMENT PROJECT

The Conservation Effects Assessment Project (CEAP) is a unique, multiagency effort designed to quantify conservation effects and to determine how conservation practices can be most effectively designed and implemented to protect and enhance environmental quality (Duriancik et al. 2008). CEAP was jointly initiated in 2003 by the Natural Resources Conservation Service (NRCS) in partnership with the Agricultural Research Service (ARS) and the National Institute of Food and Agriculture (NIFA) in response to requests from Congress and the Office of Management and Budget for greater accountability to US taxpayers following a near doubling of US Department of Agriculture (USDA) conservation program funding in the 2002 Farm Bill. These funds are allocated to multiple conservation practices through several USDA-sponsored conservation programs, including the Environmental Quality Incentives Program, Wetlands Reserve Program, Wildlife Habitat Incentives Program, Conservation Reserve Program, and NRCS Conservation Technical Assistance Program. This funding increase was concomitant with substantial modifications to

conservation programming that emphasized *environmental quality* of these lands in addition to sustainable agricultural production (Mausbach and Dedrick 2004).

CEAP Goals

The primary goal of CEAP is to strengthen the scientific foundation underpinning conservation programs to protect and enhance environmental

Rangelands represent non-cultivated, non-forested land that is extensively managed with ecological principles. (Photo: David Briske)





Rangelands are comprised of diverse and extensive ecosystems that provide multiple goods and services to society. (Photo: Rick Miller)

quality of managed lands. CEAP is focused on establishing principles to guide cost-effective conservation practices at landscape scales and to achieve multiple environmental quality goals by placing specified conservation practices or combinations of complementary practices at appropriate locations on the landscape to maximize their effectiveness. CEAP is also developing science-based guidance, information, and decision support tools to determine the appropriate practices to be implemented at various locations on the landscape and to provide conservation program managers with a blueprint for delivery of science-based and cost-effective conservation programs (Duriancik et al. 2008).

A secondary goal of CEAP is to establish a framework for assessing and reporting the full suite of ecosystem services impacted by various conservation practices. Ecosystem services represent the benefits that ecological

processes convey to human societies and the natural environment. For example, agricultural lands provide flood and drought mitigation, water and air purification, biodiversity, carbon sequestration, nutrient cycling, and aesthetics and recreation, in addition to the primary agricultural commodities produced. These ecosystem services are often taken for granted and unpriced or underpriced by the marketplace. Research and assessment activities will be integrated within CEAP to provide a scientific foundation for assessing the extent to which ecosystem services are enhanced by conservation practices and programs.

Organization and Approach

The USDA engaged the Soil and Water Conservation Society in 2005 to assemble a panel of university scientists and conservation community leaders to recommend the most effective, proactive, and scientifically credible CEAP activities—thereby ensuring that

CEAP products would have wide utility for diverse stakeholders within the conservation community. CEAP has evolved into an assessment and research initiative directed at determining not only the impacts of conservation practices, but also evaluating procedures to more effectively manage agricultural landscapes in order to address environmental quality goals at local, regional, and national scales (Maresch et al. 2008).

Three principal themes will guide CEAP investments and activities in the future (Maresch et al. 2008):

1. Research addressing effective and efficient implementation of conservation practices and programs to meet environmental goals and enhance environmental quality.
 - Continue and expand CEAP research projects on the effects and benefits of conservation practices for soil and water quality at the watershed and landscape scales.
 - Implement a new research and assessment initiative for grazing lands designed to provide scientific evidence for implementation of conservation practices at the landscape scale.
 - Determine the critical processes and attributes to be measured at the appropriate landscape position for evaluation of environmental benefits.
 - Expand the scope of assessment to include evaluation of a full suite of ecosystem services influenced by conservation practices and programs.
2. Assessment of the environmental impacts of conservation practices for reporting at the regional and national scales.
 - Continue CEAP activities designed to estimate environmental benefits of conservation practices and programs.
 - Develop a framework for reporting impacts of conservation practices and programs in terms of ecosystem services.
 - Identify future conservation requirements and provide information for setting national and regional priorities.

- Expand assessment capabilities to address potential impacts of changes in agricultural land use and policy and define necessary conservation programs to meet new environmental challenges brought about by alternative land use or policy changes.
3. Translation of science into practice by developing a blueprint for integrating scientific knowledge into the conservation planning and protocols for implementation.
 - Communicate research findings and lessons learned about managing agricultural landscapes to a broad audience.
 - Develop strategies for communicating scientific findings and recommendations to farmers, ranchers, and NRCS field office staff describing opportunities to enhance environmental quality.
 - Conduct studies to determine the types of tools and resources field offices require to evaluate and implement conservation practices within landscapes.
 - Conduct studies to demonstrate effective implementation of landscape management and adaptive management to conservation planning, implementation, and monitoring.
 - Develop tools that can be used by NRCS field offices to identify the most appropriate practices to be applied at the most appropriate landscape positions to effectively and efficiently meet local and regional environmental goals.

CEAP has been organized into four national assessments addressing croplands, wetlands, wildlife, and grazing lands—grazing lands are subdivided into rangelands and pasturelands based on distinct climate and management considerations. CEAP also includes several watershed investigations, which are sponsored by ARS, NIFA, and NRCS. These studies provide quantitative science-based outcomes and methodological innovations to support the national assessments. Bibliographies and literature syntheses have been developed for



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TABLE 1. Areas treated by each of the seven major conservation practices addressed in the rangeland synthesis in the west and central regions of the United States during 2004–2008.

Conservation practice	USDA code	Area (ha)
Prescribed grazing	528	31 359 980
Prescribed burning	338	370 821
Brush management	314	1 456 837
Range planting	550	517 301
Riparian herbaceous cover	390	12 352
Upland wildlife habitat management	645	19 165 668
Pest management	595	7 603 070

each of the four national assessments and the watershed assessment; these document the current state of knowledge regarding the effectiveness of conservation practices, provide recommendations to enhance conservation programs, and identify critical knowledge gaps that require further research (Duriancik et al. 2008).

RANGELAND CEAP

Rangeland CEAP was formally initiated in 2006 to evaluate conservation effectiveness on rangelands (166 million hectares) and grazed forest (23 million hectares) that comprise 188 million hectares of the nation’s nonfederal rural land. It emphasizes conservation practices that are routinely applied on rangelands west of the 100th meridian to accomplish multiple management and environmental goals, including maintenance of plant community health, protection of water quality and quantity, reduction of accelerated soil erosion, and promotion of economic stability through rangeland sustainability. Conservation practices are usually not implemented in isolation, but as part of a broader conservation plan that may potentially recommend implementation of multiple practices. Resource management systems represent a combination of conservation practices and resource management actions prescribed to address multiple natural resource concerns that meet or exceed the quality criteria for resource sustainability. It is fully anticipated that some combination of agricultural and environmental benefits arise from implementation of these conservation practices on rangelands, but

quantitative measures of their specific effects on soil, water, animals, plants, and air are required to document the efficacy of these practices and systems.

Organization and Approach

Rangeland CEAP encompasses four interrelated components:

1. *National Assessment.* Evaluation of the effects of conservation management on rangelands across the United States accomplished with a combination of ground-based measurements, remotely sensed data, and hydro-ecological and economic simulation models. This effort is coordinated by the ARS with emphasis on watershed modeling in the Intermountain West (Weltz et al. 2008).
2. *Watershed Assessment Studies.* Quantification of the measureable cumulative effects of conservation practices and enhancement of understanding of the interactions among practices in experimental watersheds. These watersheds occur in both croplands and grazing lands and are intended to provide in-depth assessments that are not possible at the regional scale to evaluate and enhance performance of the national assessment models.
3. *Bibliographies.* Compilation of published literature citations addressing the environmental benefits of conservation practices and programs for grazing lands was completed by the USDA National Agricultural Library in 2006. Dynamic bibliographies using real-time searches in the National Agricultural Library catalog (AGRICOLA) have been assembled (USDA National Agricultural Library 2007).
4. *Literature Synthesis.* Compilation of the current status of knowledge concerning the ecological effectiveness of major conservation practices applied on rangelands by systematically mining the published scientific literature.

Rangeland Synthesis

Rangelands synthesis CEAP has been developed to provide an in-depth assessment of the published experimental information concerning the effectiveness of previously implemented conservation

practices on rangelands. The primary goal is to provide the most definitive assessment of conservation impacts ever conducted within the rangeland profession to serve as an evidence-based benchmark for the efficacy of current conservation practices. This is a necessary and essential step for assessing the benefits of existing conservation practices and determining whether or not current practices require modification in either design or implementation to enhance their effectiveness in future programs. This information, coupled with evidence-based recommendations to enhance conservation programs, and identification of key knowledge gaps in existing information will promote development of novel evidence-based conservation systems that possess the capacity to assess environmental quality and ecosystem

services in addition to traditional agricultural production metrics.

The rangeland literature synthesis was specifically organized around a series of testable questions derived from the stated purposes or outcomes of seven major conservation practices as identified in the NRCS National Conservation Practice Standards. These conservation practices were selected for assessment based on their prominence in the conservation planning environment, the extent and frequency with which they are applied, and the amount of incentive payments allocated to them (Tables 1 and 2). Rigorous literature syntheses established the portion of experimental studies that supported, refuted, or were insufficient to assess the benefits of these conservation practices. Two

TABLE 2. Environmental Quality Incentive Program funds (US dollars) expended on the seven major conservation practices address in the rangeland synthesis by region and state during 1997–2003.

Region	State	Brush management	Prescribed burning	Prescribed grazing	Range planting	Riparian herbaceous cover	Upland wildlife habitat management
West rangeland state							
	Arizona	672 345		1 090 536	134 842		1 650
	California	2 192 285	2 625	110 813	592 108	12 116	20 394
	Colorado	185 295	3 785	3 496 391	70 985		8 936
	Idaho	7 250		29 411	18 868	1 126	527
	Montana			923 457	135 236	148	15 895
	Nevada	35 756	90	770	77 883		214
	New Mexico	3 259 774	21 542	421 262	674 895		188
	Oregon	164 759		83 377	188 088	66	35 790
	Utah	415 038	13 402	18 199	241 036	5 629	1 113
	Washington	563		41 862	96 686		75 547
	Wyoming	145 829	5 145	3 136			108
West total		7 078 894	46 589	6 219 214	2 230 627	19 085	160 362
Central rangeland state							
	Kansas	551 470	33 595	1 321 533	142 215		12
	Nebraska	124 609	2 218	197 443	133 641		21 757
	North Dakota	8 807		1 091 930	203 208		81 976
	Oklahoma	2 215 107	200 046	298 249	174 530		430
	South Dakota	6 376		59 330	100 057		41 820
	Texas	9 297 443	72 136	122 491	1 535 268	25 682	5 290
Central total		12 203 812	307 995	3 090 976	2 288 919	25 682	151 285
Grand total		19 282 706	354 584	9 310 190	4 519 546	44 767	311 647



The recent success of CEAP provides numerous opportunities and challenges to achieve its full potential within the USDA and the broader conservation community.”

additional chapters emphasizing landscape ecology and socioeconomic issues, including ecosystem services, were developed on the basis of their anticipated importance to future conservation programs and planning. These final two chapters were organized to be cross-cutting among all seven conservation practice standards.

Seven major conservation practices and two cross-cutting issues are addressed in the Rangeland CEAP literature synthesis.

- Prescribed Grazing
- Prescribed Burning
- Brush Management
- Range Planting
- Riparian Herbaceous Cover
- Upland Wildlife Habitat Management
- Herbaceous Weed Control
- Landscape Analysis (cross-cutting chapter)
- Socioeconomics and Ecosystem Services (cross-cutting chapter)

A writing team was formed for each of these nine chapters by recruiting team leaders with recognized experience and expertise in the respective subject matter areas and encouraging them to select two to four subject matter specialists with sufficient diversity to address the entire scope of ecological topics under consideration—soils, water, air, plants, and animals—as they relate to the seven major conservation practices. Geographic representation of team members across US rangelands was considered in the selection process to the extent possible. Teams focused on the development of tabular databases comprising quantitative information addressing multiple ecological responses to conservation practices to provide an unprecedented compilation of evidence-based information. Databases were primarily derived from the refereed literature with some quality “grey” literature included at the discretion of the writing teams. Individual chapters underwent rigorous peer review by three recognized experts that were not affiliated with CEAP; reviewer recommendations were provided to the chapter authors for incorporation, and the revised chapters were evaluated by the academic coordinator of Rangeland CEAP. The entire document was evaluated

for relevance and impact by one nonfederal reviewer and one NRCS reviewer prior to publication.

Major sections addressed within each of the synthesis chapters include the following:

- Description of conservation practices and their purported benefits.
- Evidence-based assessment of conservation benefits, including potential tradeoffs and risks of not implementing the practice, and of unintended negative outcomes.
- Recommendations to modify or develop alternative conservation practices to more effectively accomplish the intended purposes.
- Identification of critical knowledge gaps in current information.
- Succinct summary and conclusion of findings for each conservation practice.
- Literature-cited section containing citations within the text, but not those used to support the extensive tabular data. These supporting citations will be made available in a searchable electronic version of this document.

The rangeland literature synthesis is available in both hardcopy and electronic formats. The electronic version will be posted on the NRCS-CEAP, National Agricultural Library, and Society for Range Management Web sites and it will be searchable for both citations and appendices of tabular data specific to each chapter. This document is designed to target multiple audiences, including 1) policy makers (e.g., executive summary), 2) practitioners and students (e.g., general synthesis), and 3) researchers and modelers (e.g., tabular databases and supporting references).

CEAP IMPLEMENTATION AND THE ROAD AHEAD

Design and implementation of conservation practices through use of the best available information and technology is a hallmark of NRCS. The knowledge generated through CEAP-sponsored assessments is critical to continuation of this mission by optimizing the cost-effectiveness of conservation practices and the environmental outcomes



CEAP has created new opportunities to promote rangeland stewardship. (Photo: Rick Miller)

that they support. CEAP has generated new conservation opportunities to manage agricultural landscapes for environmental quality, created diverse and valuable conservation partnerships, and emphasized conservation assessment and planning at the watershed and landscape scales.

Anticipated applications of the information created by CEAP include the following:

- Support further development of grazing lands management and conservation practices within the Soil and Water Resources Conservation Act and National Conservation Program.
- Informing grazing land initiatives in subsequent Farm Bills.
- Advancement of conservation planning tools and program delivery mechanisms for targeted implementation and enhanced adoption.
- Evaluation of mitigation and adaptation strategies associated with climate change, water security challenges, or changes in land use or management.
- Devising inventory and monitoring protocols to better document conservation benefits for both agricultural production and environmental quality.

The recent success of CEAP provides numerous opportunities and challenges to achieve its full potential within the USDA and the broader conservation community. Implementation of CEAP will require reevaluation of procedures concerning conservation planning, greater knowledge transfer among USDA programs, modification of select conservation practices, and additional technology development and transfer. An expanded culture of collaboration among USDA programs and agencies, and several nonfederal partners, has contributed greatly to the transformational influence of CEAP. Continued collaboration is necessary both within USDA programs as well as with the broader conservation and agricultural communities to further capitalize on the knowledge and unprecedented capacity associated with rapidly emerging conservation science to produce the next generation of conservation programs for the 21st century.

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