United States Department of Agriculture

Natural Resources Conservation Service
Conservation Effects Assessment Project

CEAP Conservation Insight

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National Trends and Resource Concerns in Managing Grazing Land Ecosystem Services

Summary of Findings

- One aspect of CEAP is to build the science base for conservation policy and program development and help farmers and ranchers make informed conservation choices.
- The traditional goods from forage and grazing lands include food, feed, fiber, forest products, milk, and meat.
- The total economic value of forage and grasslands used in livestock animal production is estimated at about $44 billion annually.
- Hay and other conserved and/or stored forage production account for $18 billion of farm income.
- Numerous ecosystem services are provided by forage and grazing lands including reduced soil erosion and improvements in water quality, wildlife habitat, and air quality.
- Sometimes there is little or no direct economic return to the land manager for providing these ecosystem services, yet society is rapidly recognizing the intrinsic values of these important services.

Background

Grasslands and grazing lands constitute more than two-thirds of all agricultural land in the United States and provide several ecosystem goods and services. Increasing and sustaining these ecosystem goods and services (e.g., conserving and protecting soil, water, and air resources) usually requires the investment of public resources.

This Conservation Insight discusses how national trends affect grazed lands, particularly pasture and haylands.

Pasture and Hayland: Extent and Value

According to NRCS, pastureland is "land devoted to the production of indigenous or introduced forage for harvest by grazing, cutting, or both." In contrast with rangeland, pastureland management is relatively intensive and technology-based, commonly using inputs of seeds, fertilizers, and pesticides. Depending upon location, many plant species present may not be native, and pastureland may be periodically renovated or replanted using a variety of techniques. Stocking densities on pastureland generally are higher than on rangelands.

As reported in the 2007 Natural Resources Conservation Service's National Resources Inventory (NRI) land use report, there are 119.8 million acres of pastureland in the United States. From the 2007 Census of Agriculture, 620.2 million acres of land is used for production of hay and other conserved and/or stored forage (except row crops for silage) (NASS, 2009). Pastureland is concentrated in the humid eastern half of the conterminous United States (east of 99° longitude), whereas land for production of hay and other conserved or stored forage is distributed more broadly. In addition, there are about 2.5 million acres of irrigated pastureland in the western U.S. Alaska has 9,900 acres of pastureland and 20,000 acres of hayland. Hawaii has 37,100 acres of pastureland. Puerto Rico has 173,000 acres pastureland.

Of the more than 100 million head of livestock that utilize forage and grazing land in the conterminous United States, about 61 million head are in the eastern half. Approximately 45 percent of these eastern livestock are in the cool-temperate region, 34 percent in the transition zone, and 21 percent in the southeast and subtropical region. Alaska, Hawaii, and Puerto Rico account for about 400,000 head of grazing livestock.

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National Trends in Forage and Grazing Lands

Trends in pasture, rangeland, cropland, and woodland used for grazing indicate that total grazing land decreased by about 268.1

million acres (about 25 percent) from 1945 to 2002. This land use change may reflect a transition to urban, recreational, wildlife, and environmental land uses. One exception to the long-term trend is that permanent pastureland increased by 1.9 million acres in the southeastern U.S., mostly on land previously classified as grazable woodland. In other parts of the United States, grazable woodlands decreased by nearly 58 percent. This long decline in grazable woodland might be explained by fewer and larger farms, greater canopy density of woodland, and greater efficiencies in both livestock and woodland management.

History of Conservation Practices on Pasture and Hayland

Conservation practices developed by the Federal Government and applied to address resource concerns on crop, pasture, and hayland date back to the 1930s; which paralleled the beginning of government agencies such as the USDA Soil Conservation Service, now the USDA NRCS. Some of the early practices recommended for grazing lands included reducing stocking rates on pastureland and rangeland. Also, the theme of "Grassland Agriculture" using permanent vegetation as a conservation practice, using hayland in crop rotations, and applying conservation practices to pastures and hayland emerged about the same time.

Despite several decades of improving management on pasture and haylands through use of conservation practices, significant conservation issues remain and new ones have emerged. There are an estimated 74.1 million acres of pasture and hayland in the United States that would provide greater environmental benefits with application of conservation treatment(s), such as prescribed grazing, pasture/hayland planting, and/or nutrient management (Nelson, 2012). Conservation practices that protect soil and water resources are critical to pasture and hayland management because much of this land is sloping, is classified as marginal for cropland, or is fragile, thus having a small margin for error in management.

Resource Concerns on Pastureland and Hayland

The principal resource concerns addressed in pasture and hayland conservation programs include soil, water, air, plants, animals, and human resources. In addition, efficiency of energy use recently has been added to this list of resource concerns because of the costs of energy and the new role of agriculture in producing renewable energy.

Mismanagement of pasture and hayland can reduce production and profit, and potentially harm the environment. For example, grazing management that exceeds sustainable carrying capacity has been shown to degrade vegetation, increase runoff, impair water quality, reduce farm productivity, and ultimately reduce profitability.

To achieve production goals, the farmer may replant forage stands with better adapted, more productive, or higher quality species and varieties; enhance soil fertility through applications of commercial fertilizer or livestock manure; modify the harvest or grazing management to optimize utilization; or control invasive and destructive weeds and pests. Each of these management interventions has implications regarding the soil, water, air, plant, animal, human, and energy resources in the system. For example, renovating pastures or hayfields via tillage may pose soil erosion risks; poor timing and placement of nutrients from fertilizer or manure may increase runoff or leaching from fields; and intensifying grazing or harvest management may reduce vegetation cover or change the plant community composition. Thus, it is important for land managers to consider correctly using science-based conservation practices as integral parts of their pastureland and hayland management plan to simultaneously achieve production and conservation goals.

In 2010, prescribed grazing (practice standard 528) was applied to a total of 1.58 million acres of pastureland with 41 percent of that area in the southeast, 32 percent in the temperate region, 20 percent in the transition region, and 7 percent in the western states. The forage and biomass planting practice (practice standard 512) was applied predominantly in the temperate region where legumes are in short rotations and suffer from winter injury. Forage harvest management (practice standard 511) was applied mostly in the transition region. The nutrient management practice (practice standard 590) was applied nearly entirely in the southeast and transition regions, perhaps because of the frequent use of poultry litter and other animal manures on pastures in these regions. Future regional CEAP studies intend to focus on environmental results from the application of those, and other, conservation practices.

Emerging Emphasis on Ecosystem Services of Pasture and Hayland

Sometimes there is little or no direct economic return to the land manager for providing these ecosystem services, yet society is

rapidly recognizing the intrinsic values of these important services.

Forage and grasslands have long been recognized for multiple services such as soil conservation, water quality protection, and pleasing aesthetics, among many others. These multiple services are now recognized in the concepts of *ecosystem functions* and *ecosystem services*, which have received much attention. Ecosystem functions are the "habitat, biological, or system properties or processes of ecosystems," whereas ecosystem goods and services include the "benefits human populations derive, directly or indirectly, from ecosystem functions."

Ecosystem goods and services have been classified into four main categories: (1) provisioning services, which include products such as food, fiber, and fuel; (2) supporting services such as primary production and nutrient cycling that enable all other ecosystem services; (3) regulating services such as climate (e.g., drought), and flood regulation; and (4) cultural services, which include intangibles such as aesthetic, spiritual, educational, or recreational experiences. Forage and grazing lands increasingly are expected to provide ecosystem services beyond the traditional provision of food, feed, and fiber.

Table 1 contains a partial list of potential ecosystem functions, goods, and services from pastureland. Forage and livestock production (provisioning services) provide obvious economic benefits from pasture and hayland along with environmental and social dividends (support, regulatory, and cultural services) such as landscape diversity and open space. Fishing and hunting on these lands provide

Table 1. Ecosystem goods and services from pasture and hayland, and their postulated economic, environmental, and social dividends (adapted from Sustainable Rangelands Roundtable, 2008). The categories of "Economic", "Environmental", and "Social/Cultural" are somewhat equivalent to the categories of "Provisioning", "Supporting/ Regulating", and "Cultural" services, respectively, as defined by the Millennium Ecosystem Assessment.

Ecosystem Good or Service	Dividends		
	Economic	**Environmental**	**Social/Cultural**
Forage production for livestock	Sale of feed Hay, forage production	Landscapes for biodiversity Clean air and water Carbon sequestration Soil enrichment from certain plants (e.g., legumes)	Open space Rural communities dependent on forage-livestock systems
Livestock production for humans	Sale of meat and fiber products Farming operations Economic base for rural communities	Recycling of nutrients Landscapes for biodiversity Clean air and water Carbon sequestration Soil enrichment from certain plants (e.g., legumes)	Open space Satisfaction derived from farming as a way of life Serenity of pastoral scenery
Fishing, hunting, bird watching	Sales of licenses, gear, guide services Access rights on private or public lands	Promotion of healthy wildlife populations Maintenance of biodiversity Control of hunted populations	Pleasure derived from outdoor activities Opportunity to observe wildlife
Clean water	Meet needs of domestic, agricultural, and industrial uses Sale of bottled water Income from recreation Human health	Aquatic habitat Drinking water for wildlife Rejuvenation of riparian areas Watershed function	Aesthetics of unpolluted water Pleasure derived from recreation
Biofuel feedstocks	Sale of feedstocks and resultant biofuel products	**(depending on feedstock):** Biodiversity maintenance Soil enrichment Carbon sequestration Greenhouse gas mitigation	Reduced dependence on fossil fuels

revenue through sales of licenses, sporting equipment, and access rights while contributing to healthy wildlife populations. In the future, pasture and hayland may supply biofuel feedstocks leading to net reduction of greenhouse gas emissions and lesser dependence on fossil fuels.

Forage and grazing lands can provide permanent vegetation cover to reduce soil erosion, protect water quality, provide nutrient and energy cycling, and provide an aesthetically pleasing landscape. Grassland systems can also contribute to biodiversity, soil-C storage, and greenhouse gas mitigation. For example, maintaining biodiversity is a desired ecosystem service.

Grasslands can be important reservoirs of plants, insects, and other organisms. Plant species diversity can be managed to improve grassland production and resist weed invasion.

Social pressures, environmental concerns, and regulations will continue challenging farmers and ranchers to manage grazing lands in ways that provide additional ecosystem services. Likewise, federal agencies and researchers are challenged to quantify those ecosystem services. Concurrently, society seeks a greater public role in agricultural practices for production and land management, and a greater degree of government accountability for resources invested in conservation programs.

Adaptive and innovative management is critical to gain desirable ecosystem services from all grazing lands, not just pasture and hayland. A "one size fits all" management strategy is not the solution, as both science and grazing practitioners have consistently shown. Creating policy and adjusting research schema that are sensitive to the adaptive nature of grazing land management is crucial.

It is important that management and conservation measures be cost effective to balance potential tradeoffs in grassland production and the provision of other ecosystem services.

To this end, pasture and hayland management will need to be integrated into all enterprises at the farm scale (cropping systems, rangeland use, wildlife goals, etc.). Collectively, the economic benefits and ecosystem services will need consideration on a farm basis and perhaps even a watershed scale. The latter would require cooperation among land owners/operators in the watershed.

References

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The Conservation Effects Assessment Project (CEAP) is a multi-agency effort to build the science base for conservation policy and program development, and help farmers and ranchers make more informed conservation choices.

The CEAP Grazing Lands national assessment is designed to quantify the environmental effects of conservation practices on U.S. non-Federal grazing lands. The 584 million acres of non-Federal grazing lands in the contiguous 48 states are composed of 409 million acres of rangeland, 119 million acres of pastureland, and 56 million acres of grazed forest land.

Development of CEAP Grazing Lands processes and findings must address a number of unique challenges that are typically not present on croplands at management scales. Grazing lands typically have more diversity in climate (especially precipitation), soils, and topography than does cropland. Management practices and their effects are less precise and less well-defined, making the results of specific studies more difficult to extrapolate. There are three scales of investigation for CEAP Grazing Lands. Ecological sites will be used to stratify assessments at all three levels for the rangeland portion.

This Conservation Insight was developed by Dr. Matt Sanderson, USDA-ARS Northern Great Plains Research Laboratory, Mandan, ND. It is summarized from: Sanderson, M. A., L. Jolley, J. Dobrowolski. 2012. Pastureland and Hayland in the USA: Land Resources, Conservation Practices, and Ecosystem Services. Chapter 1, pp. 25-40. In: C. J. Nelson (ed.) 2012. Conservation Outcomes from Pastureland and Hayland Practices: Assessment, Recommendations, and Knowledge Gaps. Allen Press, Lawrence, KS.

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