

Part 645 – National Range and Pasture Handbook

Subpart A – Grazing Land Resources

645.0101 General Information

A. Extent

- (1) The two major global terrestrial land types are rangeland and forestland. Rangeland includes natural grasslands, savannas, shrublands, many deserts, tundra, alpine communities, marshes, and meadows. About 35 percent of the land area in the world is grasslands and woodlands, 21 percent sparse and barren lands, 28 percent forest and woodlands, and 12 percent farmland (see table A-1). Estimates of rangeland throughout the world vary. Summaries by Lund (2007) show a rangeland as 18–80 percent of the landscape. The differences are based on land surface, ice-free land surface, ground surveys and inventories, remote sensing, and soil maps. Heitschmidt and Stuth (1991) estimate that rangelands occupy 47 percent of the world's land area; Mannetje (2002) estimates 50 percent.

Table A-1. Global extent of land use categories (Food and Agriculture Organization (FAO) 2011). Global land area = (32.6 billion acres; 13.2 billion hectares)

Terrestrial Land Cover Types	Acres billion (hectares)	% of Land Area
Grasslands and Woodlands	11.4 (4.6)	35
Forest	9.1 (3.7)	28
Sparsely Vegetated (Barren Lands)	6.9 (2.8)	21
Cultivated lands	4 (1.6)	12
Settlement and Infrastructure	0.37 (0.15)	1.2
Inland Water	0.59 (0.24)	2

- (2) Land use and land cover are often related, but they have different contexts among land management agencies. The Economic Research Service states that “Land use involves an element of human activity and reflects human decisions about how land will be used. Land cover refers to the vegetative characteristics or manmade constructions on the land's surface. Land use is generally determined by surveys based on field observations or enumeration, while land cover is generally determined using remote sensing techniques or interpretation of aerial photography” (ERS 2019). Figure A-1 shows the distribution of the world's rangelands based on land cover. Table A-2 summarizes land use and cover data for Federal and non-Federal land in the United States.
- (3) Federal lands managed by federal agencies such as the Bureau of Land Management (BLM), U.S. Forest Service (USFS), National Park Service (NPS), National Wildlife Refuge System managed by the U.S. Fish and Wildlife Service (FWS), Army Corp of Engineers, and U.S. military bases amount to about 26.0 percent (about one-quarter) of U.S. lands (Figure A-2). Almost half (48.6 percent) of the 13 Western States are Federal lands.

Figure A-1. Rangeland (land cover) of the world. Information & Education (I&E) and Remote Sensing & GIS committees of the Society for Range Management (SRM).

https://www.webpages.uidaho.edu/what-is-range/rangelands_map.htm

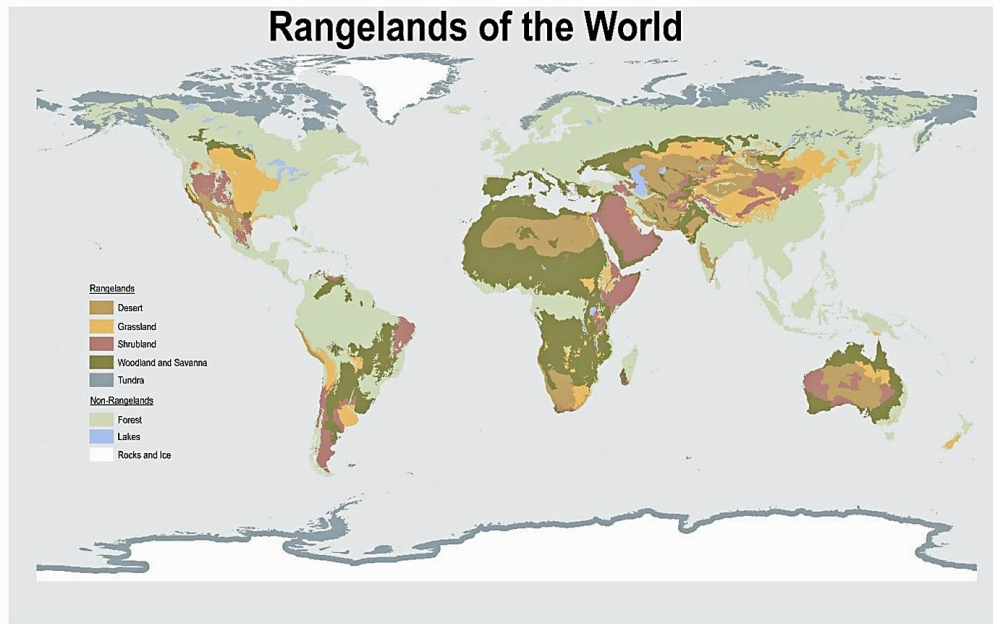


Figure A-2. Federal lands in the United States.

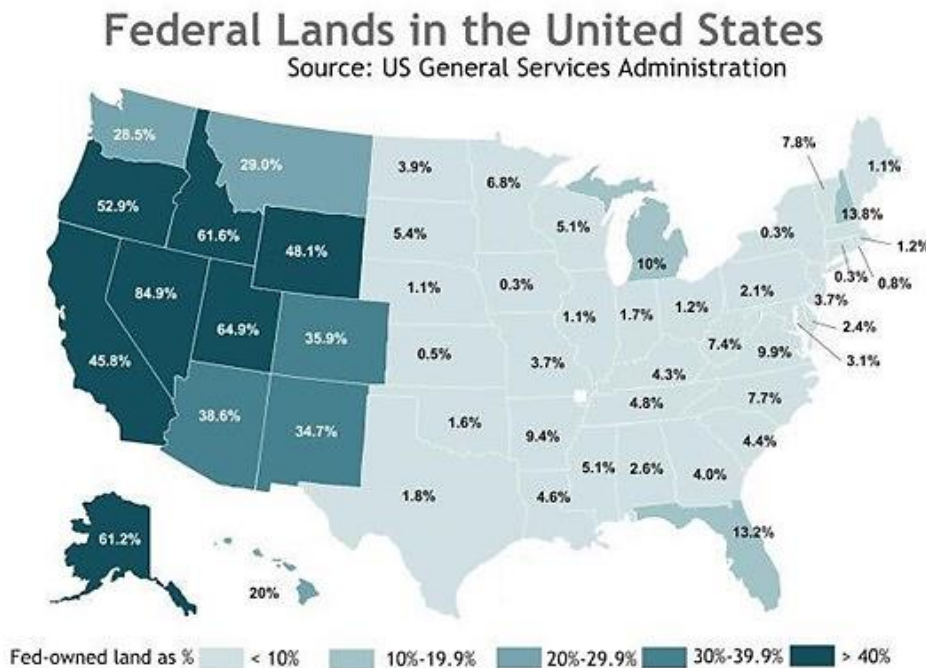


Table A-2. Land use and land cover estimates for the United States, by source (millions of acres) (ERS 2019).

Land Use Categories	USFS ¹ (all forest land)	BLM ¹ (area managed by BLM)	NASS ¹ (land in farms)	Census Bureau ¹ (urban areas)	ERS ¹ (all land uses)	NRCS ² (all non- Federal land)	USGS ³ (all land and water cover)	BLM ³ (area managed by BLM)
Forest/woodland	751	11	75	--	671	409	600	69
—Forest in timber use	N/A	11	46	--	544	N/A	N/A	N/A
—Forest in grazed uses	N/A	N/A	29	--	127	N/A	N/A	N/A
Permanent								
pasture/range	--	158	409	--	614	529	995	174
Range	--	--	--	--	--	406	--	--
Pasture	--	--	--	--	--	121	--	--
Cropland	--	--	406	--	408	390	311	--
Urban areas	--	--	--	68	61	112*	102	--
Rural parks, wilderness areas	--	2	--	--	252	--	--	--
Rural transportation	--	--	--	--	26	*	--	--
Other	--	85	32	--	232	504	373	13
Total area included in estimates	751	256	922	68	2,264	1,944	2,381	256
Total U.S. land area: 2,264 million acres (source: Census Bureau)								
Total U.S. land and water area: 2,381 million acres (source: USGS)								
Year estimates were derived	2007	2007	2007	2010	2007	2007	2006**	2007
Number of U.S. States included	50	26#	50	50	50	49*	50	26#

¹ Land use.² Hybrid land use/land cover.³ Land cover.

* NRCS combines Urban areas and Rural Transportation into a Developed Land category. NRCS estimates exclude AK.

** USGS data are from 2006, except AK and HI estimates are from 2001.

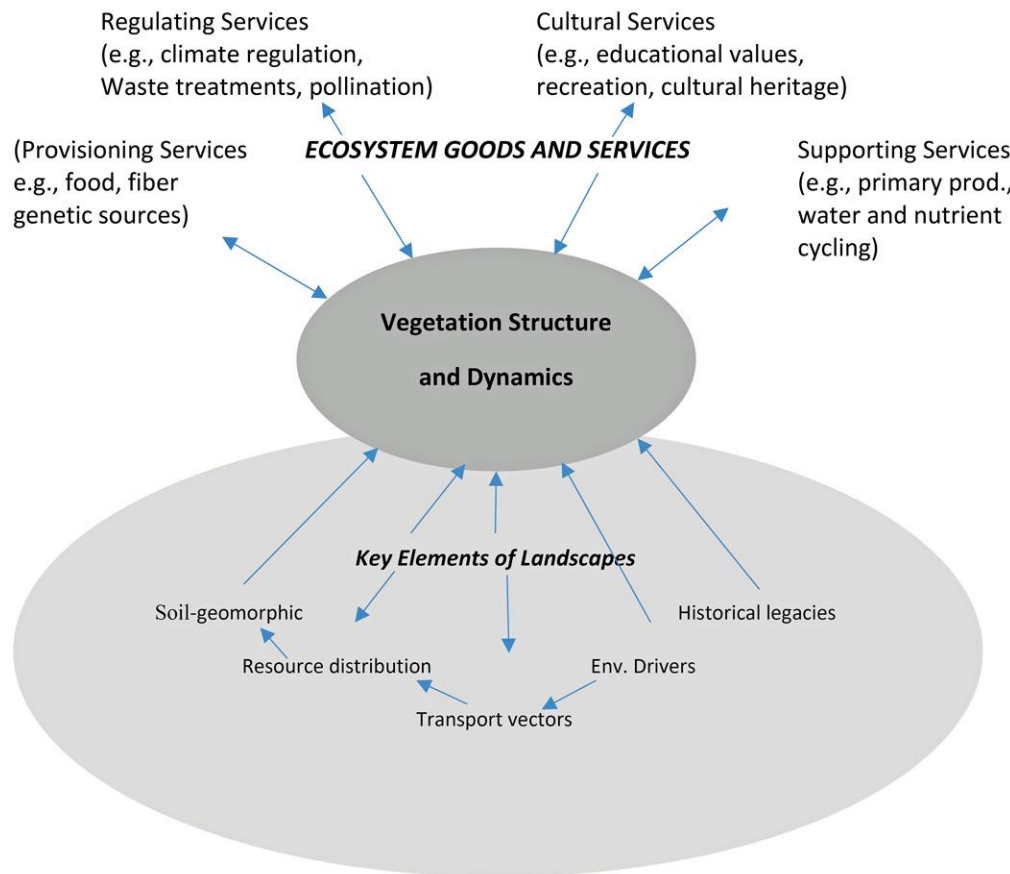
N/A = Not Applicable.

= BLM estimates exclude States that do not contain surface acres managed by BLM.

B. Rangeland Uses and Benefits

- (1) Rangelands throughout the world are and will continue to be affected by increasing world population (projected to increase by 40 percent by 2050), especially for food and fiber production and other ecosystem services (Holechek 2013). The outcomes and future issues in the years ahead for rangeland managers will include geopolitical stresses, increasing pressure to produce food and fiber, financial pressures (higher interest rates, higher production costs), and biological and environmental risks (impacts of climate variability). Survivability mechanisms for rangeland producers include low risk approaches to livestock production that involves conservative stocking, use of highly adapted livestock, and application of behavioral knowledge of livestock to efficiently use forage resources (Holechek 2013).
- (2) Rangelands provide many goods and services, and USDA is committed to providing conservation technical assistance to private land users and others in addressing the various ecosystem goods and services (EGS) that may be available (figure A-3).

Figure A-3. Interacting elements of rangeland landscapes that determine vegetation structure and dynamics with resulting effects on ecosystem goods and services: (1) historical legacies of past climate, disturbances, and human activities, (2) environmental drivers, (3) transport vectors, such as the run-on and runoff of water associated with site hydrologic dynamics, (4) redistribution of resources, such as soil, nutrients, and seeds, and (5) the soil-geomorphic template (after Alcamo et al. 2003; Peters et al. 2006; Havstad et al. 2007).



Rangeland plant communities are multivariate in nature. They are unique because of plants, soils, hydrology, climate, and management response mechanisms. Rangeland plant communities produce a unique set of benefits and services. Basic categorical EGS uses are:

- (i) Rangeland watersheds and their supply of freshwater for domestic, municipal, industrial, and commercial uses
- (ii) Origin and maintenance of soils and their buffering capacity
- (iii) Livestock products
- (iv) Wildlife habitat
- (v) Pollen source
- (vi) Flood protection
- (vii) Scenery
- (viii) Recreation and tourism
- (ix) Wood products
- (x) Industrial products
- (xi) Minerals

- (xii) Ecological continuity
- (xiii) Plant diversity and genetics
- (xiv) Aesthetic, cultural and spiritual renewal
- (3) In summary, public and private rangeland resources provide a wide variety of EGS. Additionally, spiritual values are vital to the well-being of ranching operations, surrounding communities, and the nation as a whole. Society is placing multiple demands on the nation's natural resources, and it is extremely important that NRCS be able to provide resource data and technical assistance at local and national levels.
- (4) Rangelands are in constant jeopardy, either from misuse or conversion to other uses. Holechek et al. (2004) and Holechek (2013) states that in the next 100 years, up to 40 percent of U.S. rangelands could be converted and lost to other uses. Land-use shifts from grazing use to urbanization will be much greater in areas of more rapid population increases and associated appreciating land values. Projections supporting forage demand suggest that changes in land use will decrease the amount of land available for grazing to a greater extent in the Pacific Coast and Rocky Mountains, compared to the North or South Assessment Regions (Mitchell 2000).
- (5) As society attempts to satisfy multiple demands with limited resources, many ranching and farming operations seek to expand operations for multiple goods and services beyond traditional cattle production. Some diversified enterprises may include the following:
 - (i) Management to enhance wildlife abundance and diversity for fishing, hunting and non-hunting activities
 - (ii) Maintaining habitat for rare plants
 - (iii) Accommodating nature enthusiasts, bird watchers, and amateur botanists.
- (6) Planning, evaluation, and communication are necessary steps (consult conservation planning steps) prior to initiating any new rangeland EGS-based enterprises.

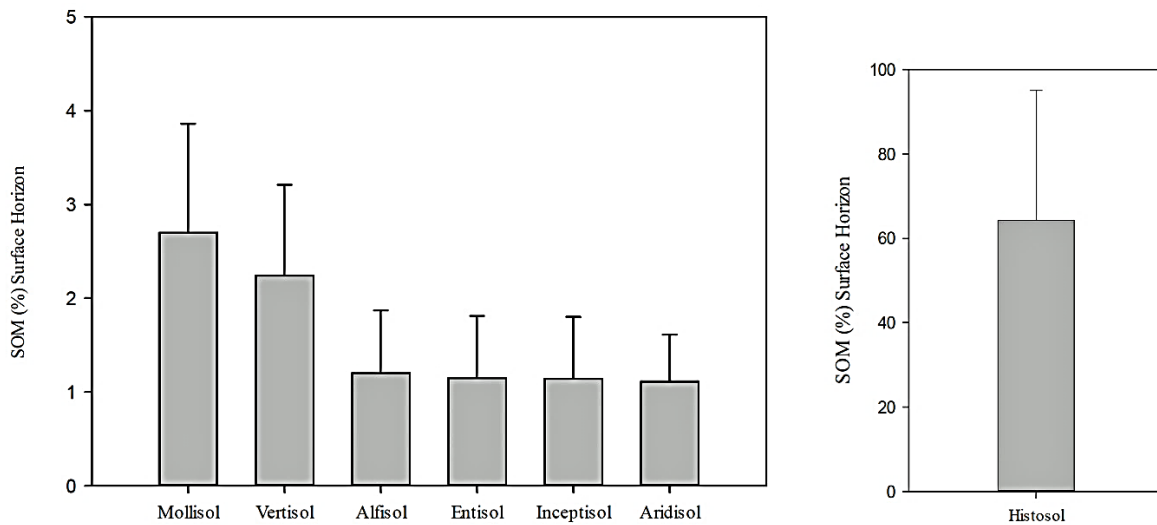
645.0102 Grazing Land Definitions

A. Rangeland

- (1) Rangeland is a land cover or use composed of grasses, grass-like plants, forbs, shrubs, and trees that is typically unsuited to cultivation because of physical limitations such as low and erratic precipitation, rough topography, poor drainage, or cold temperatures. Rangeland can include the following:
 - (i) natural lands that have not been cultivated and consist of a historic complement of adapted plant species; and
 - (ii) natural (go-back lands, old-field) or converted revegetated lands that are managed like native vegetation. Note: The USDA-NRCS rangeland Natural Resources Inventory (NRI) includes this designation in their definition of rangeland. In assessing rangeland conditions and health, keeping these designations separate would provide for more detailed information about rangeland trends and health.
- (2) Converted rangelands can include lands seeded to native species, and/or introduced hardy and persistent plant species (grasses, grass-like plants, forbs, shrubs, and trees). However, previously cultivated rangelands that have been reseeded to native or introduced adapted species do not truly represent both soil and plant dynamics of the historic native plant community. The ecological state may be classified as “converted” in ecological site state-and-transition models. Natural grasslands, prairies, savannas, chaparral, shrublands, pinyon-juniper (depending on tree stature and canopy closure, see forestland definition below), steppes, many deserts, tundra, alpine communities, marshes and meadows are classified as rangeland. Rangelands provide numerous products and services (see above)

and are a primary source of forage for livestock and for wildlife. Rangelands may be harvested by haying equipment and for seed production.

- (3) Rangeland comprises over two-thirds of the Nation's watershed area (FAO 1990) and provides a significant part of its water supply. The increasing importance of water has added a new dimension in range management strategies. In the Southwestern and Western United States, rangeland watersheds are the source of most surface water flow and aquifer recharge. Management on these lands can have a positive or negative effect on plant cover and compositional change, which ultimately influences water quality and quantity.
- (4) Rangelands have diverse physical characteristics due to climate, soil, topography, and physiography. Physical properties determine types and amounts of vegetation, productivity, and types and carrying capacity of livestock and wildlife.
 - (i) Rangelands are also important pools of soil organic carbon stored in soil and vegetation (figure A-4). On a global basis, 9.1 billion ac (3.7 billion ha) of rangeland stores about 20–25 percent of the total global terrestrial carbon (306–330 Petagrams of organic carbon and 470–550 Petagrams of inorganic carbon) (A petagram (Pg) is a unit of mass equal to 10^{15} grams) (Batjes 1996; Kimble et al. 2001). On rangelands, carbon sequestration dynamics are quite complex, and estimation of rates and amounts are systematically more difficult than cultivated croplands (Schuman et al. 2002). This is because rangelands have more heterogeneous soil characteristics, wide daily temperature fluctuations, intermittent precipitation, and diverse vegetation life and growth forms (productivity, root-shoot ratios, herbivore use, and imposed disturbance and management practices).
 - (ii) Globally, forests ($1.2\text{--}1.4\text{ Pg Carbon yr}^{-1}$) and cropland ($0.4\text{--}1.2\text{ Pg Carbon yr}^{-1}$) have the largest potentials for sequestering carbon, although grazing lands (range and pasturelands) can contribute up to 10 percent of the overall terrestrial sink capacity. On a global perspective, rangelands occupy about half of the world's land area, 10 percent of the terrestrial biomass, and 10–30 percent of the soil organic carbon (Schlesinger 1997). An average estimate of globally sequestered soil carbon on rangelands is $0.5\text{ Pg Carbon yr}^{-1}$ (Schlesinger 1997; Scurlock and Hall 1998). Table A-3 shows global and U.S. potential carbon storage for varied terrestrial biomes.

Figure A-4. Average soil organic matter content for selected soil orders on rangeland. (Spaeth 2020).**Table A-3.** Yearly potential carbon storage in terrestrial biomes (United States and globally) (Spaeth, 2020). A petagram (Pg) is a unit of mass equal to 10^{15} grams.

Land Use Activities	United States (Pg yr ⁻¹)	Globally (Pg yr ⁻¹)
Afforestation, agroforestry, natural forest succession, peatlands		1.2–1.4
Natural forest plantings (plantations)		0.2–0.5
Improved forest management USFS National Forest System	0.0317–0.0500	0.08
Rangelands improved management	0.0054–0.0160	
Pastureland grazing management	0.0046–0.0190	
Pastureland fertility management	0.0015–0.0031	
Pastureland manure management	0.0036–0.0090	
Pastureland improved species	0.0008–0.0023	
Total grazing land intensification and improvement	0.0160–0.0504 (avg. 0.033)	0.3–0.5
Desertification control		0.2–0.7
Management of salic soils		0.3–0.7
Cropland conservation and cultural practices	0.1440–0.4320 (avg. 0.2880)	0.4–1.85
Total potential	0.2000–0.4800	2.55–4.96 (avg. 3.8)

B. Pastureland

Pastureland, often called improved pasture or tame pasture, is a land use where introduced or domesticated (tame) and/or native forage species mixtures are established through seeding, sprigging, etc. that can be grazed and/or intermittently hayed or deferred for environmental purposes. Various degrees of management inputs may be applied, such as fertilization, liming,

overseeding with grasses and legumes, mowing, remedial tillage, and irrigation. Pasture vegetation can consist of grasses, legumes, other forbs, shrubs, trees, or mixtures of plant life forms. Croplands seeded to temporary cover crops that are grazed are not typically classified as pasture. Holding pens, corrals, and loafing lots in or near barns, dairy facilities, etc. are not classified as pasture. Pasturelands can provide benefits other than forage for livestock such as wildlife habitat and use, watershed sources, zones for reducing runoff and erosion control, recreational, and aesthetic purposes.

C. Other Grazing Lands

Most grazing lands are considered either range or pasture, but grazing lands also include grazed forest lands, grazed croplands, and haylands. These other land use types make up an additional 106 million acres of privately-owned grazing lands, or about 17 percent of the total U.S. grazing lands.

- (i) Naturalized pasture is cleared, converted, past cultivation, and “old-field” or “go-back land.” It is forestland and cropland that primarily contain introduced species that are largely adapted and have become established without agronomic and cultural inputs, persist under the current conditions of the local environment, and are stable over long time periods. Naturalized pasture is different from rangeland in that rangeland includes the following:
 - Natural lands that have not been cultivated and consist of a historic complement of adapted plant species.
 - Natural (go-back lands, old-field) or converted revegetated lands that are managed like native vegetation. Naturalized pasture, some rangelands that have been disturbed, and old-field or go-back lands have overlapping concepts and grey areas. A guideline to differentiate naturalized pasture from rangeland (as defined from part 2 of the rangeland definition above) can be based on the type of plants that currently occupy the site (e.g., early seral species, tropical plant species, or predominantly cool season forage grasses that have become naturalized without seeding or other establishment methods).
 - Some forest lands may persist as naturalized pasture after disturbance; however, over time, they naturally revert back to a forest-dominated plant community unless practices are applied to keep it in a herbaceous state. If the forest site has not been cultivated in the past, the retrogression could eventually resemble the forest reference state. If the forestland has had a history of cultivation, then the reverted site would be described in a converted forest state.
- (ii) Cultural hayland: A land use subcategory of cropland managed for the production of forage crops that are culturally established and typically machine-harvested. These crops may be grasses, legumes, or a mixture of both. Croplands seeded to annual forage species that are harvested by grazing, are hayed, or are ensiled are not classified as hayland. Some uncultivated native stands of grasses and forbs are hayed and are classified as rangeland.
- (iii) Forestland: “For the purpose of developing ecological site descriptions, a spatially defined site where the historic climax plant community was dominated by a 25 percent overstory canopy of trees, as determined by crown perimeter-vertical projection (USDA NRCS 2010).”

Forestland, grazed: A land use category that includes forest land that is grazed and managed, using range or pasture management principles and practices that maintain soil and surface stability, hydrologic function, and biotic integrity.

645.0103 References

- A. Alcamo, J., et al. 2003. Ecosystems and human well-being: a framework for assessment. Island Press, Washington, D.C., USA.
- B. Batjes, N.H. 1996. Total carbon and nitrogen in the soils of the world. *European Journal of Soil Science* 47: 151–163.
- C. Food and Agriculture Organization. 2011. The state of the world's land and water resources for food and agriculture. Managing systems at risk, summary report. Rome, Italy.
- D. Economic Research Service. 2019. Land Use and Land Cover Estimates for the United States. <https://www.ers.usda.gov/about-ers/partnerships/strengthening-statistics-through-the-icars/land-use-and-land-cover-estimates-for-the-united-states/#m>.
- E. Havstad, K.M., D.P. Peters, R. Skaggs, J. Brown, B. Bestelmeyer, E. Fredrickson, J. Herrick, and J. Wright. 2007. Ecological services to and from rangelands of the United States. *Ecological Economics* 64: 261–268.
- F. Heitschmidt, R.K., and J.W. Stuth. 1991. Grazing management: an ecological perspective (No. 633.202 G7).
- G. Holechek, J.P.R., and R.D. Pieper, and C. Herbel. 2004. Range Management. Principles and Practices 5th ed. Upper Saddle River, NJ: Pearson.
- I. Holechek, J.P. 2013. Global trends in population, energy use and climate: implications for policy development, rangeland management and rangeland users. *The Rangeland Journal* 35:117–129.
- J. Kimble, J.M., R. Follett, and R. Lal. 2001. The characteristics and extent of U.S. grazing lands. In: Follett, R.F., Kimble, J.M., Lal, R. (eds.), *The Potential of U.S. Grazing Lands to Sequester Carbon and Mitigate the Greenhouse Effect*. CRC Press, Boca Raton FL, USA.
- K. Lund, H.G. 2007. Accounting for the world's rangelands. *Rangelands* 29: 3–10.
- L. Mannetje, L. 2002. Global issues of rangeland management 8p. Available at: <http://www.date.hu/acta-agraria/2002-08i/mannetje.pdf>.
- M. Mitchell, J.E. 2000. Rangeland resource trends in the United States: A technical document supporting the 2000 USDA Forest Service RPA Assessment. Gen. Tech. Rep. RMRS-GTR-68. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 84 p.
- N. Peters, D.P.C., B.T. Bestelmeyer, J.E. Herrick, E.L. Fredrickson, H.C. Monger, H.C., and K.M. Havstad. 2006. Disentangling complex landscapes: new insights to forecasting arid and semiarid system dynamics. *Bioscience* 56: 491–501.
- O. Schlesinger, W.H. 1997. Biogeochemistry: An Analysis of Global Change. 2nd edition. San Diego: Academic Press 558 p.

- P. Schuman, G.E., H.H. Janzen, and J.E. Herrick. 2002. Soil carbon dynamics and potential carbon sequestration by rangelands. *Environmental Pollution* 116: 391–396.
- Q. Scurlock, J.M.O., and D.O. Hall. 1998. The global carbon sink: a grassland perspective. *Global Change Biology* 4: 229–233.
- R. Spaeth, K.E. 2020. Soil health on the farm, ranch, and in the garden. New York: Springer.
- S. Steinfeld, H., C. de Haan, and H. Blackburn. 1997. Livestock environment interactions: issues and options. Report of a study sponsored by the Commission of the European Communities, the World Bank, and the governments of Denmark, France, Germany, The Netherlands, United Kingdom and United States of America. London, UK: World Bank/FAO. 56 p.
- T. USDA NRCS. 2010. National forestry manual. September 2010. Washington, D.C.