DESIGNING SUSTAINABLE LIVESTOCK GRAZING SYSTEMS

Martin Vavra, Tim DelCurto, and Mike McInnis

Introduction

Agricultural production and the use of natural resources have had many vocal critics in recent years. The livestock industry has been challenged, particularly in the western U.S., in regards to its sustainability. The term "sustainability" has been used in several different contexts in recent years. It is one of the popular buzzwords of our time. What exactly do we mean by sustainability? The term really has evolved over time, in regard to application to the western livestock industry. It probably has its roots in the severe winter of 1885-1886 and the drought of 1891-1892. Livestock producers discovered, through disaster, that a free-ranging livestock system would not work in the western U.S. Hay production for winter feeding and fencing for distribution control began with the survivors of this period. However, the unattached public lands of the West continued to be abused. The Taylor Grazing Act of 1934 was championed by the livestock industry and put an end to unrestricted grazing use. Land administered by the Forest Service had already come under restricted use with the passage of the Forest Reserve Act of 1891.

Across the West, livestock production was put in balance with the perceived notion of sustainability: the long-term output of livestock products. The long-term offtake of livestock products did not decay the ability of the land to produce those products. This is how society defined sustainability at that time. While the productive ability of the land to produce commodities is protected under this definition, the integrity of the ecosystem (the interaction of native plants and animals and their environment) may not be. However, this definition is applicable to private lands with the sole purpose of livestock production. On public lands, grazing systems must be designed for multiple use by law (Multiple Use Act 1968).

Today, the term has evolved into a much more complex meaning. Considerable literature exists that attempts to define sustainability (Vavra, 1996). Sustainability may be defined as the overlap between what people collectively want, reflecting social values and economic concerns, and what is ecologically possible in the long term. Sustainability should be looked at, not as an end point, but as a direction or trajectory with certain bounds. Lee (1993) called sustainability a goal, like liberty or equality, not to be reached but a direction that guides constructive change.

The future use of public lands for livestock grazing may hinge on our ability to convince the public that grazing is a sustainable practice. Therefore, in this paper we hope to make the giant leap from this philosophical discussion to some ideas that may help livestock producers move further in the direction of sustainability.

The Range Resource

Given our definition of sustainability, a livestock grazing management system for rangelands must provide economic return for the producer and provide protection for the ecological function of that land. Ecological function includes the maintenance of such diverse entities as watershed health, native plant communities, mammals, birds, and fish.

Forage quality

First, let's take the easy one, economic return to the producer. Most of the West is semiarid. Rainfall is limited and highly variable from one year to the next. The window of opportunity to capture nutrients from the forage base and convert them into pounds of beef or lamb is limited (Figure 1). Forage quality exceeds the animals' (cow/calf or ewe/lamb pair) requirements for only a short period of time during the grazing season, perhaps as short as 90 days. Moving the animals to higher elevation can extend this time period. Forage at cooler, wetter, higher elevations is less mature and more nutritious on a given date than that at lower elevations. However, a general rule of thumb can be applied to the rangelands of the West: 75 percent of the livestock gain usually occurs in the first half of a May-through-September grazing season. Cows or ewes often actually lose weight during the last half, because they are "milking off their back." Calf and lamb weights are marginal or even negative. Changes from traditional management that provide for more efficient livestock production are possible. DelCurto et al. (this publication) discuss livestock management options that, coupled with specialized grazing practices, provide alternatives to conventional management.

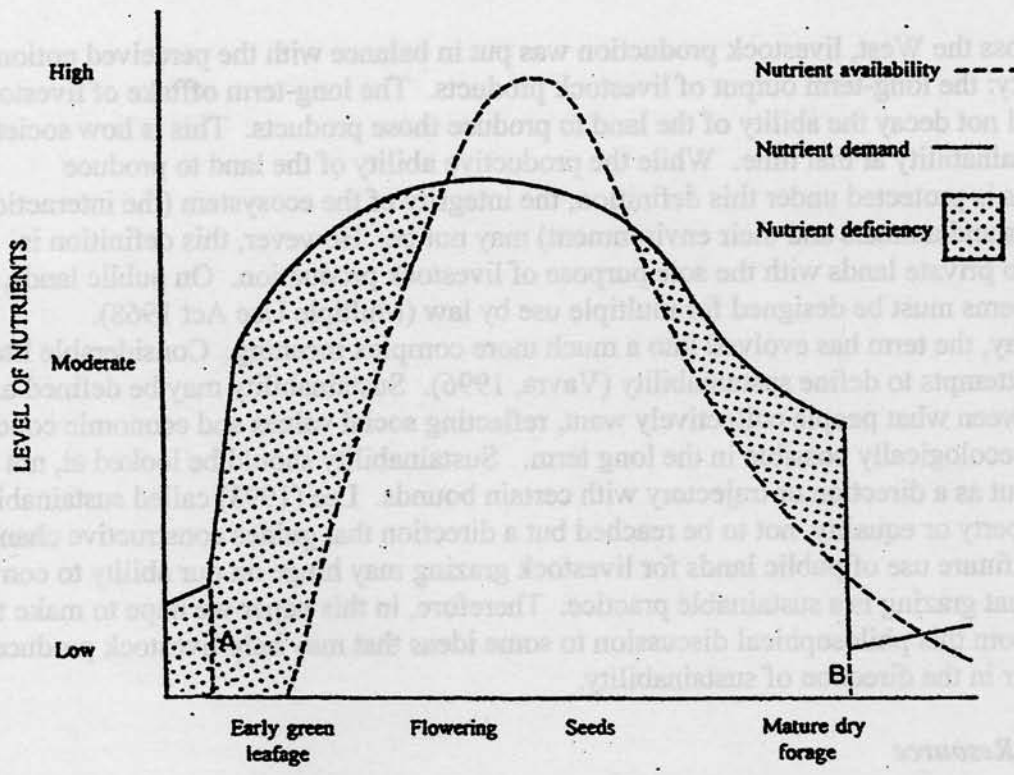

Figure 1. Generalized relationship between nutrients supplied by principal forages in the sagebrush-steppe and nutrients required by a breeding beef cow. Point A represents a hypothetical calving date of March 1, and point B represents a weaning date of October 23 (205 days postpartum). (McInnis and Vavra, 1997).

Grazing Management Considerations

An important factor in optimizing economic returns from grazing is developing the proper stocking rate, the amount of land allocated to each animal unit for the grazing period. Both gain per animal and gain per acre are important aspects in determining stocking rate (Figure 2). Generally, as stocking rate increases, gain per animal declines. This occurs because the highest quality forages are selected first, and, at higher stocking rates, they are removed from the system sooner, leaving forages of less nutrient quality and therefore less gain per animal. However, optimizing gain per animal may mean that animal numbers are too low to be profitable. Likewise, overstocking may lead to light weaning weights and decreased reproductive success, and be equally unprofitable. Stocking rates that optimize gain per acre and gain per animal should also provide adequate vegetation residue to sustain plant welfare and provide litter to the soil.

Optimizing nutrient consumption on rangelands means grazing during the active growth period of plants. Annual grazing during this time period can lead to a decrease in plant vigor and eventually degeneration of the resource. To prevent this, deferment or rest should be built into the grazing system. From May through July, some consideration should be given to incorporating two pastures into the system for use in any one year. Smaller pastures with adequate water sources should aid in optimizing distribution. A third pasture would be rested each year to provide for maintenance of the vigor of the plant communities.

In some areas, late fall or winter grazing may provide an option to feeding harvested forages. Supplementation programs usually are required, because dormant forages seldom meet animal requirements. For a more detailed description of such systems, see DelCurto in this publication.

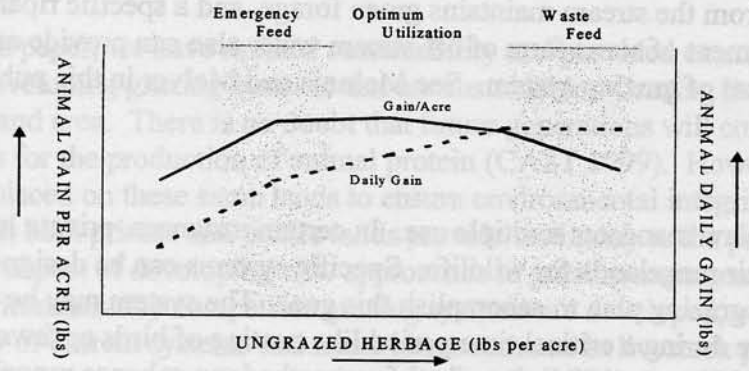

Figure 2. The relationship between daily gain per acre and daily gain per animal, and the amount of ungrazed herbage available. (From Bement, 1969).

Specific Management Systems

In the case of public lands, a sustainable system also means providing for other organisms that share the range. Protection of riparian areas and providing habitat for various wildlife species are common considerations. Generally, grazing systems can be assigned that provide habitat for a diversity of wildlife and other values, and also viable livestock production. In the case of riparian zones, knowledge of the specific needs of the target animals or resources is required. The system then can be designed to meet the needs identified. Following are some specific examples.

Riparian zones

One of the most difficult considerations for approaching sustainability is protection of riparian and aquatic resources. Objectives for maintenance or improvement of riparian vegetation usually include target stubble heights for herbaceous species and minimizing use of riparian woody vegetation. Conventional grazing systems that are in place from May through September commonly develop livestock distribution problems during the latter half of the grazing season. Cattle commonly concentrate in riparian zones at this time of year because of hot temperatures coupled with dry, mature, low nutrient quality upland forage and limited or poor quality upland water. Therefore, pastures containing riparian areas are best grazed when the riparian zone attractiveness is minimal. One option occurs during the first half of the grazing season, when upland forage conditions exceed animal requirements and temperatures are cooler. However, since grasses are being used during the active growth period, some form of rest or deferment has to be built into the system to maintain vigor of these plants. Late fall grazing may work in areas where cold air drainage creates frost pockets in the bottoms. Late winter and early spring grazing on a mix of residual forage and new spring growth also provides opportunities. High water levels from spring run-off may provide protection to residual herbaceous vegetation and woody vegetation along banks. Late summer and fall grazing may work when the floodplain is broad, sub-irrigation from the stream maintains green forage, and a specific riparian pasture can be created. Development of some form of off-stream water also can provide an additional distribution tool regardless of grazing system. See McInnis and McIver in this publication.

Wildlife Considerations

On public lands, law mandates multiple use. In certain instances, private landowners may wish to enhance their rangelands for wildlife. Specific systems can be designed and easily incorporated into a total grazing plan to accomplish this goal. The system may be as simple as deferring use of a pasture during a critical time period like nesting of birds or fawning of pronghorn. Severson and Urness (1994) described four methods to enhance rangelands for wildlife: (1) altering the composition of the vegetation, (2) increasing the productivity of selective species, (3) increasing the nutritive quality of the forage, and (4) increasing diversity of habitat by altering its structure.

Cattle tend to favor grasses in their diet, so pastures grazed by them may be altered if grazing puts physiological stress on those grasses. Forbs and/or shrubs then may increase. Likewise, grasses eventually may dominate a pasture containing a dominant but palatable shrub

component, if the browsing pressure is heavy. In the same way, cattle can be used to improve productivity of shrubs again, by putting physiological pressure on the grasses.

Nutritive quality of grasses can be improved by spring grazing with cattle, followed by removal of those cattle when sufficient soil moisture remains to allow regrowth. This regrowth is commonly of superior nutritive value when compared to ungrazed plants. The regrowth is then available for fall and winter use by wild herbivores. However, forage production is compromised, dependent on soil moisture and resulting regrowth. The Oregon Department of Fish and Wildlife uses such a system in the Bridge Creek Wildlife Management Area to improve winter forage for elk. This system also can be used to provide fall forage for another cattle entry (Hyder & Sneva, 1963).

Improving habitat diversity by altering its structure simply may mean uneven patterns of utilization within a pasture. Removing mature coarse vegetation through grazing or haying and opening up trails through dense wetland vegetation are two other examples. Removing the top layer of coarse vegetation also increases availability of the lower layers that may contain small forbs or newly developed grass shoots. Opening up trails in dense wetland vegetation provides open areas that facilitate passage of waterfowl through that vegetation.

Other Opportunities

Utilizing grazing animals in a sustainable system often means combining an economically efficient grazing system with another objective of land management. Grazing animals have been used as weed control agents. Sheep have been used effectively to control leafy spurge. Winter cattle grazing in sagebrush stands may result in mechanical damage to the brush and prevent some increase in stand density. Winter sheep grazing also may reduce some species of sagebrush. In a prescribed burning program where fine fuel loads are high, grazing may be employed to reduce those fuel levels.

Conclusions

In this paper, we have defined sustainability and provided examples that may furnish insight for developing grazing systems that are sustainable. Grazing livestock use 35 percent of the world's land area. There is no doubt that future generations will continue to depend on grazing lands for the production of animal protein (CAST 1999). However, increased scrutiny also will be placed on these same lands to ensure environmental integrity. The ever-increasing regulations on both private and public lands provide testimony to the previous statement. One very positive aspect of developing new approaches to grazing management exists. At the same time that environmentally compatible grazing systems are developed, we can look critically at the efficiency of current systems and make improvements in livestock production. Utilizing our knowledge of the seasonally changing forage base, alternative forage possibilities, and the changing nutritional needs of livestock, improved livestock production and/or improved efficiency of production should be possible.

Suggested Readings

(Copies can be obtained from EOARC)

Agricultural Experiment Station. 1983. Research in Beef Cattle Nutrition and Management. Oregon State University, Special Report 678. Corvallis, OR.

Bement, R. E. 1969. A Stocking-Rate Guide for Beef Production on Blue-Grama Range. J. Range Manage. 22(2):83-86.

Council for Agricultural Science and Technology (CAST). 1999. Animal Agriculture and Global Food Supply. Task Force Report No. 135.

Eastern Oregon Agricultural Research Center, 1979. Research in Beef Cattle Nutrition and Management. Agricultural Experiment Station, Oregon State University. Special Report 534. Corvallis, OR.

Elmore, Wayne and Boone Kauffman. 1994. Riparian and Watershed Systems: Degradation and Restoration. pp. 212-231. *In*: Ecological Implications of Livestock Herbivory in the West. M. Vavra, W.A. Laycock, and R.D. Pieper (eds). Soc. For Range Manage. Denver, CO.

Hyder, D. N. and Forrest A. Sneva. 1963. Morphological and Physiological Factors Affecting the Grazing Management of Crested Wheatgrass. Crop Science 3:267-271.

Severson, K. and P.J. Urness. 1994. Livestock Grazing: A Tool To Improve Wildlife Habitat. pp. 232-249. *In*: Ecological Implications of Livestock Herbivory in the West. M. Vavra, W.A. Laycock, and R.D. Pieper (eds). Soc. for Range Manage. Denver, CO.

Svejcar, Tony and Martin Vavra. 1985. The Influence of Several Range Improvements on Estimated Carrying Capacity and Potential Beef Production. J. Range Manage. 38(5):395-399.

Svejcar, Tony and Martin Vavra. 1985. Seasonal Forage Production and Quality on Four Native and Improved Plant Communities in Eastern Oregon. Oregon State University Agricultural Experiment Station, Tech. Bulletin 149. Corvallis, OR.

USDI-BLM. 1997. Effective Cattle Management in Riparian Zones: A Field Survey and Literature Review. Riparian Technical Bulletin No. 3. Billings, MT.

Vavra, Martin. 1998. Public Land and Natural Resource Issues Confronting Animal Scientists and Livestock Producers. J. Anim. Sci. 76:2,340-2,345.

Vavra, Martin. 1996. Sustainability of Animal Production Systems: An Ecological Perspective. J. Anim. Sci. 74:1,418-1,423.

Vavra, Martin. 1992. Livestock and Big Game Forage Relationships. Rangelands 14(2):57-59.

Vavra, Martin. 1986. Manipulative Grazing of Plant Communities. pp. 167-178. *In*: Grazing Research at Northern Latitudes. Olafur Gudmundsson (ed). Plenum Publishing Corporation.

Vavra, Martin. 1984. Livestock Production Possibilities on Streamside Meadows. pp. 35-44. *In*: Proceedings of Symposium on Range Watersheds, Riparian Zones and Economics: Interrelationships in Management and Use. Oregon State University, Corvallis, OR.

Vavra, Martin. 1983. Managing Grazing Animal Response to Forestland Vegetation. pp. 43-51. *In*: Proceedings of Symposium on Forestland Grazing. Washington State University Coop. Ext., Pullman, WA.

Vavra, M. and R.L. Phillips. 1979. Diet Quality and Cattle Performance on Forested Rangeland in Northeastern Oregon. *In*: Proceedings, Western Section, American Society of Animal Science.

Vavra, Martin and Dennis P. Sheehy. 1996. Improving Elk Habitat Characteristics with Livestock Grazing. Rangelands 18(5):182-185.

Vavra, Martin, Mitchell J. Willis, and Dennis P. Sheehy. 1999. Livestock-Big Game Relationships: Conflicts and Compatibilities. pp. 130-136. *In*: Grazing Behavior of Livestock and Wildlife. K.L. Launchbaugh, J.C. Mosley, and K.D. Sanders (eds). Idaho Forest, Wildlife, and Range Experiment Station, Station Bulletin 70. Moscow, Idaho.