

# Livestock Grazing Impacts on Watersheds

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What impact does livestock grazing have on rangeland watersheds? Range scientists with the Texas Agricultural Experiment Station are conducting long-term research in the Edwards Plateau and Rolling Plains of Texas to find the answer.

Livestock grazing affects watershed properties by altering plant cover and by the physical action of their hooves. Reductions in the vegetation cover may: (a) increase the impact of raindrops, (b) decrease soil organic matter and soil aggregates, (c) increase surface soil crusts, and (d) decrease water infiltration rates. These effects may cause increased runoff, reduced soil water content, and increased erosion.

Grazing impacts will vary naturally from area to area and over time due to the normal variability of climate, vegetation, intensity and duration of livestock use. Few studies have attempted to account for these natural variations. Documentation of the intensity and duration of livestock grazing has been poor or completely ignored in most studies. Only for the ponderosa pine/bunchgrass and Great Plains rangelands do we have a sufficient data base for evaluation of the hydrologic impacts of proper livestock grazing.

The literature is filled with examples of the adverse impact of heavy or abusive grazing on watersheds. However, few research projects have studied seasonal or long-term hydrologic impacts of grazing systems or proper vegetation management. The impact of livestock vegetation on watershed parameters has, in recent years, become a national resource management issue. Often the information used is based on emotion or misinterpreted data.

## Heavy Grazing Or No Grazing

Grazing, whether by insects or livestock, has an impact on watersheds. The goal of range management is to harvest the forage resource in such a manner as to keep the impacts consistent with sustaining the total resource base of rangelands. The question should not be, "Should rangeland be grazed?", but "How can we better manage the grazing animal to minimize its impacts?" Most livestock grazing studies have compared the impacts of heavy grazing with no grazing. These studies tend to indicate that heavy grazing is a viable management objective or that livestock grazing is the same as heavy grazing; however, no such oversimplification is justified. It has been recognized for 70 years that heavy continuous grazing accelerates erosion and runoff. The literature is filled with examples of the adverse impacts of overgrazing on watersheds. In 1958 Love wrote, "There is a large

body of information leading to the conclusion that heavy grazing has had bad hydrologic consequences. It is doubtful that more investigations are needed to emphasize this conclusion." For the most part, grazing exclusion and heavy continuous grazing are questioned as management objectives. Scientists, however, need to study the extremes for the same reasons that ecologists study successional and climax vegetation—to develop sound management practices.

## Light or Moderate Grazing

Available information on the hydrologic impacts of light or moderate grazing intensity strongly suggest there are few hydrologic differences between pastures continuously grazed lightly or moderately. Some studies have failed to show a difference in soil loss, infiltration rates, or soil bulk density among light, moderate, and ungrazed pastures. Watershed research data strongly suggest that watershed condition can be maintained or improved under moderate grazing intensity.

## Grazing Systems

Much interest has been generated by grazing systems and their potentials. Little information is available, however, to support many of the claims concerning grazing systems impacts on watersheds. Gifford and Hawkins (1976) found



Livestock grazing—Southern Great Plains range watershed.



Livestock grazing—high elevation range watersheds (photo by U.S. Forest Service).

no published evidence to show that any single grazing system consistently or significantly increased plant and litter cover on watersheds.

Most of the information on the impacts of grazing systems on watershed characteristics comes from studies conducted in the Rolling Plains and Edwards Plateau of Texas. Results of these studies indicate that pasture grazed under a four-pasture three-herd deferred-rotation system were hydrologically similar to those of livestock exclosures. Pastures grazed under a high intensity, low frequency grazing system (eight-pasture one herd with 17-day graze and 119-day rest) were better or similar hydrologically to moderate continuously grazed pastures. Conversely, short duration pastures (14-pastures one herd with a 4-day grazed and 50-day rest), stocked at double the recommended rate, was similar hydrologically to heavy continuous grazing (McCalla 1982). The hydrologic parameters responded favorably during average or above average precipitation years; however, during droughts the short duration system rapidly displayed adverse impacts on infiltration rates, sediment loss, grass cover, grass standing crop, surface roughness and soil aggregates. After 2 years of above average precipitation, hydrologic parameters of the short duration pasture have not recovered from the 1980 drought. Results of this research strongly suggest that if most of the additional carrying capacity with a short duration grazing system can not be picked up by increased livestock distribution as a result of fencing and water development, then extreme caution should be used in adjusting stocking rates upward.

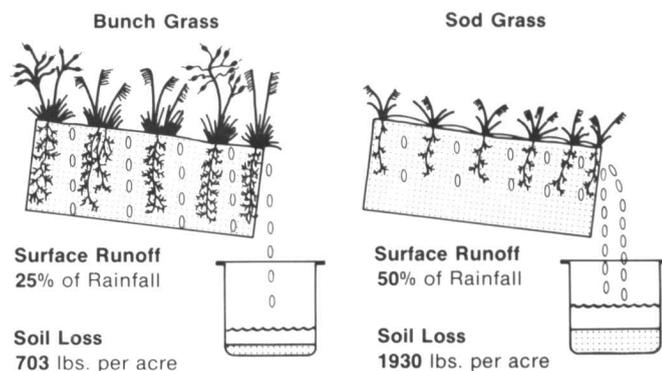
#### Bunchgrasses or Sodgrasses

Bunchgrass-dominated areas are consistently characterized by: (1) higher infiltration rates, (2) lower sediment production, (3) more total vegetation cover, grass standing crop, and mulch accumulation (4) higher soil organic matter

content and aggregate stability, (5) a rougher soil surface, (6) less bare ground, and (7) lower bulk density, than sodgrass-dominated areas. Based on 4 years of data from the Sonora Research Station in Texas, runoff from sodgrass dominated areas was twice that of bunchgrass-dominated areas. Thus, less water infiltrated sodgrass soils and is available for plant growth. Almost three times more soil was lost from sodgrass areas than from bunchgrass areas. A decrease in bunchgrasses, regardless of the cause, will eventually result in a lower hydrologic condition of the site. Livestock grazing potentially has the greatest impact on

#### EFFECT OF TYPE OF GRASS ON RUNOFF AND EROSION

(4 inches of rain in 30 minutes)



Average runoff and soil loss from bunchgrass and sodgrass dominated areas, Sonora Research Station, Texas. Based on 4 inches of simulated rainfall in 30 minutes, applied 22 times over a 4-year period.

bunchgrasses. They are usually the better forage species and are generally more sensitive to abuse than low-growing sodgrasses. It was only in the bunchgrass-dominated sites at the Texas Experimental Ranch in the Rolling Plains of Texas, that grazing treatments were hydrologically different. Heavy grazing at the Sonora Research Station in the Edwards Plateau of Texas eliminated the positive influence of bunchgrasses on watershed characteristics after 22 months. Short duration grazing, stocked at double the recommended stocking rate, significantly reduced the bunchgrasses.

Bunchgrasses are easily destroyed by overstocking and should be monitored closely when: (1) stocking rates are changed, (2) new grazing systems are initiated, or (3) during drought.

### Soil Crusts

A crust commonly developed at the surface of rangeland soils differs considerably from that of the underlying material. It is characterized by a high bulk density, few large pores, platy structure, stratification, and orientation of the different sized materials. The layer or crust is often harder than the rest of the soil, has low infiltration rate and is a prime factor causing runoff and erosion. It often becomes hard enough to prevent seedling emergence. Soil crusting is commonly associated with low organic matter, high silt content, and low aggregate stability (Blackburn 1975, Wood et al. 1978).

One suggested way to improve crusted rangeland soils is to concentrate a herd of cattle on the affected area for a very short time (2 to 3 days) to churn up the soil surface (OTA 1982). Livestock trampling may incorporate mulch into the surface soil or act as an aid to seedling emergence in a similar way a cultipacker is used on agricultural and to break up crusts over emerging seedlings. This "churned" soil, however, will not remain beyond the first rainstorm nor will infiltration rates be increased. The impact of falling raindrops, a

few minutes into a storm, effectively destroys the modified surface. Soils that are susceptible to crusting are poorly aggregated; soil particles are easily detached by raindrop impact and flow together when saturated.

To modify the negative influence of soil crusts, livestock grazing systems must address the causes of crusting, mainly low organic matter and poor aggregate stability. Livestock grazing systems that promote plant and mulch cover will modify soil crusts the most.

### Water Quality

The major pollutant from rangeland watersheds is sediment. Moderate continuous grazing or grazing systems should reduce sediment losses to a minimum from most watersheds. However, if watersheds have been severely overgrazed, instituting moderate continuous grazing or a specialized grazing system, may not reduce sediment losses. Bacteria or nutrients as potential pollutants from livestock grazing do not appear to be a problem on areas other than riparian zones.

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