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Rain on the Range

By Lou Ellen Ruesink, Editor, Texas Water Resources
"It is important to know," according to Fred Smeins, professor of Range Science at Texas A&M University, "something about the quantity arid quality of surface runoff from Texas rangeland.

"The rancher should know that he is losing valuable moisture and nutrients for plant production which ultimately lowers livestock production. On the other hand, the water resource planner, developer, or city manager should know how much water and sediment and what types of pollutants from rangeland to expect downstream in municipal and industrial water supplies."

Since 60 percent of Texas is rangeland, every Texan should be aware of the effect of range management on the state's water resources.

High intensity, short duration thunderstorms account for most of the runoff and erosion from Texas rangelands. The ability of the soil to absorb water is important to effectively utilize that rainfall and to decrease the potential for downstream sedimentation and pollution.

Even though the effects of range management on surface water are more obvious, groundwater sources are also affected. A substantial amount of water from good pastureland will percolate through the soil and collect in underground reservoirs or resurface in natural springs. Evidence of this are the years of range misuse followed by the drying up of many natural springs.

Smeins is interested basically in the water and nutrients lost when runoff occurs and is studying range management methods to prevent loss of the water and nutrients necessary for plant production. He has designed a study to determine how much water and what kinds and amounts of nutrients are lost from pastures with different types of grazing managements and brush control.

He is collecting data at the Sonora Research Station which is located within the Edwards Plateau Land Resource Area. Eighty-acre pastures with different grazing systems have been maintained on the station since 1948. Small watersheds within some of these pastures were also available for Smeins' use. These 6 to 8-acre areas surrounded by small dykes and outfitted with flumes that record runoff quantity have been used by the Agriculture Research Service to measure water yield for the past 15 years.

Sediment Samplers

Funding through the Texas Water Resources Institute allowed the addition of runoff quality analysis. Automatic sediment samplers were added to the existing runoff flumes so that the quality of the runoff could be analyzed. During a runoff event each sampler collects a one-quart sample every 3 minutes as long as there is runoff from the watershed.

Smeins plans to continue his study and feels that his results are not complete at this time. However, preliminary data shows that good grazing management can help to reduce the amount of runoff. This in turn reduces the potential for sediment and nutrient loss and the resultant pollution downstream. The study has also shown that runoff from rangeland, even rangeland in poor condition, is high in quality compared to runoff from cropland or urban areas.

Student Research

In addition to his own study of the runoff from various types of grazed pastureland, Smeins has directed the research of three graduate students in Range Science. These student projects also have been funded partially by the Texas Water Resources Institute.

The nitrogen cycle for specific plants was studied by James George and Bradley Kohls. Nitrogen is significant because it is necessary for plant growth and many biological activities. In a negative sense nitrogen is potentially a major pollutant in the state's drinking water. Amounts and forms of nitrogen in the small range ecosystems were analyzed by the students. These individual projects will help Smeins to evaluate movement of nitrogen from pastures with different types of grazing management and different kinds of vegetation and soils.

Another student, Allan McGinty, studied the effect of different grazing practices on the ability of the soil to absorb water. He concluded that grazing management does greatly influence the infiltration capability of the soil. Infiltration involves the passage of water through the soil surface (intake) and the movement of water through the soil (percolation). Infiltration rate of soil has been defined as the maximum rate at which soil, in a given condition at a given time, can absorb rain.

Effects of Grazing

Trampling by livestock has a direct effect upon the infiltration capacity of soil. Hooves compact the soil and render it less receptive to water intake increasing the potential for

runoff and erosion. Removal of plants by excess grazing also results in less water entering the soil and consequently more lost in runoff.

McGinty conducted his study on three pastures at the Sonora Research Station: two with different grazing systems and one which had been protected from livestock grazing.

Unlike Smeins, McGinty did not have to wait for natural rain on his research plots. He used a mechanical rainmaker called an infiltrometer--a portable tent-like structure with a plexiglas roof holding 2,500 hypodermic needles. "Rain" was forced through the needles onto 3-foot square plots in the sample pastures at a rate of 6 inches per hour. Depth of penetration as well as amount and time of runoff were recorded for each plot.

The soil in the pasture under heavy continuous grazing had an infiltration rate that was significantly lower than the soil in the pasture under a rotation system or in the area protected from livestock. However, McGinty found little difference in the ability of the pastures to absorb precipitation whether not grazed at all or grazed under a rotation system.

Pastures with good vegetation and good soil conditions such as the rotation pasture continued to take in water long after runoff occurred in poorly managed pastures. There was also deeper penetration into the soil of the good condition pastures.

Range Reclamation

Texas scientists such as Smeins have spent three quarters of a century trying to conserve, manage, and reclaim the Texas grasslands.

Back in the late 1800's, native grasses were "stirrup high," and natural springs fed numerous water holes. However, in a very few years overstocking changed much of the range to bare, tired pastures; tall grasses were replaced by short grasses, brush, and weeds. When rain came, it washed the soil away rather than soaking into support plant life.

Reclamation of the worn out range was the subject of a U.S. Department of Agriculture study as early as 1901. Citizens of Abilene were concerned enough to voluntarily construct fences for experimental pastures. The study concluded that the pastures needed periods of systematic rest from grazing to maintain plant vigor and to allow seed production and seedling growth.

This theory has been developed and tested for the past 25 years on the Edwards Plateau by Leo B. Merrill, director of the Sonora Research Station, Texas Agricultural Experiment Station, Texas A&M University System. The research station was established near Sonora in 1916 to improve breeding of Angora goats. However, the experimental goats began to feed heavily on poisonous bitterweed. Fifty years of heavy continuous grazing pressure had removed much of the palatable range forage and encouraged the spread of bitterweed. This was a common problem for much of the ranching country of

Texas, and improvement in range condition was concluded early to be the most effective way to combat bitterweed. Range management research to improve range condition and simultaneously maximize animal production thus became the primary activity at the station.

Different methods of grazing management have been tested at the 3,400-acre research station since 1948. Systems designed to give pastures periodic rest from grazing have not only proven beneficial for land reclamation, but have shown to support as many cattle on the same number of acres as a continuously, heavily grazed pasture.

Even though researchers have shown the economic advantages of rest-rotation grazing and Smeins has now concluded that valuable moisture can be saved by using grazing rotation, he estimates that 75 percent of the Edwards Plateau is continuously grazed, often overgrazed.

Often, because of economic constraints, ranchers simply cannot afford fencing and other improvements needed to rotate herds even though this might in time improve condition of the range resource and produce a greater economic return. Therefore, most pastures are in poor to fair condition and much needed moisture end plant nutrients are lost to surface runoff.

Brush Control

The development of brush control methods is another range improvement program at the Sonora Research Station. Poor condition ranges have many brush and weed species that are unpalatable to animals but utilize soil moisture that could be channelled into more useful forage plants. Removal of these undesirable plants is often a necessary practice to improve and restore rangeland to a higher level of animal production. This alteration of the range vegetation must be done, however, with consideration of its impact on soil conservation and moisture.

Smeins hopes to expand his research at the Sonora Research Station to determine the effects of brush control on the quality and quantity of runoff from rangeland.

Recent national concern over pollution in water resources has encouraged research on sources of pollution. The Water Pollution Control Act Amendments of 1972 (PL92-500) authorized an inventory of all pollution sources in the U.S.--both point and nonpoint. Examples of point sources are municipal and industrial waste treatment outlets. Nonpoint sources include urban storm drainage, erosion, and agricultural runoff.

Smeins' research on yield and quality of range runoff is one of the first comprehensive studies on rangeland in the southwest. McGinty's was the first detailed infiltration study conducted on the Edwards Plateau and one of the few ever conducted on Texas rangeland. They have shown that good grazing practices will in fact reduce runoff and reduce downstream sedimentation and pollution.

Not Enough to Measure

They have encountered problems in conducting these studies in the semi-arid land 325 miles from offices and laboratories on the Texas A&M campus. A student-technician must live at the station to collect samples and maintain equipment; and all samples must be frozen and transported back to the campus for analysis.

Another problem is the infrequency of rainfall in the area. For example, there was not enough rain in the sample pastures to even measure during the entire first year of the project. However, when rainfall does occur it is often intense enough to create serious erosion and runoff problems.

According to Smeins, the best use of rainfall is to keep it on the range. "In general, we should try to keep water and nutrients on the rangeland to maintain productivity of the system. Also, West Texas has a limited supply of water, so we want to keep it as high a quality as possible. What nutrients leave the land will eventually end up as potential downstream pollutants."