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WATER IN THE SOUTHWEST

Research seeks answer to when, how much, where it goes, what for, and why.

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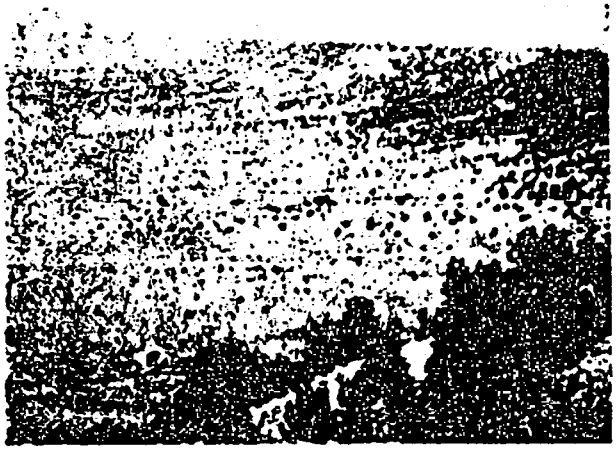

Approximately half a million square miles in the Southwestern United States are in the arid and semiarid climatic zones. The principal use of this vast area is for livestock grazing.

Water yields from the area are generally low and constitute only a small portion of the water supplies for irrigation. On the other hand, a major part of the sediment entering irrigation reservoirs comes from rangeland. During recent years municipal, industrial, and irrigation users have made increasing demands on the limited water resources of the Southwest.

Downstream water users fear that vegetative improvement on rangelands as a result of soil conservation programs may reduce the already pitifully small water yields of these areas. Ranchers operating the land quite naturally are interested in maximum forage production. They feel that any rain falling on the land is theirs to use to their best advantage.

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Pictures, starting at upper left: Black grama and associated grasses on Walnut Gulch experimental watershed . . . much of this brushland was in grass 60 years ago . . . Alamogordo Creek experimental watershed with juniper invading valley floor . . . one of new runoff measuring flumes in Walnut Gulch watershed.

In an effort to provide basic hydrologic data necessary for the intelligent management of these rangelands, the Agricultural Research Service, in cooperation with the Soil Conservation Service and the State agricultural experiment stations, is conducting watershed research in Arizona and New Mexico. The studies were begun by the research division of the SCS in 1953 and have been continued by the ARS since 1954.

Some of the questions which the research studies are designed to answer are:

(1) What are the important runoff-producing characteristics of convectional thundershowers? (2) How much water and sediment are yielded from range watersheds of various sizes under present vegetation and management? (3) How will a range conservation program affect these yields? (4) How much of the runoff water does the channel system lose before water reaches a point of downstream use, and what happens to it?

Two large watersheds have been selected for intensive field study: Walnut Gulch watershed at Tombstone, Ariz., and Alamogordo Creek watershed near Santa Rosa, N. Mex.

The Walnut Gulch watershed includes 60 square miles. In addition to the main watershed, four subwatersheds ranging in size from 0.9 to 43 square miles are gaged. Vegetation is representative of the black gramagrass areas of southern Arizona which have been partially invaded by mixed stands of creosotebush, whitehorn, and tarbush. Comprehensive surveys of soil, vegetation, and range site and condition are essentially complete.

In eastern New Mexico the 67 square mile Alamogordo Creek watershed was selected as representative of the blue gramagrass areas. Vegetation on the level portions of the valley floor consists of blue grama, galleta, and their associates. On the escarpment which rings the valley are found stands of pinon and juniper, which have moved out into the rougher portions of the valley. One measuring flume at the watershed outlet is in operation. Soil and range site and condition surveys are well on their way to completion and detailed sampling of the vegetation is in progress.

One of the unusual features of the hydrology of semiarid lands is the very small area covered by runoff-producing rains. Practically all of the runoff from the watersheds comes in the convectional thundershower season. Recent studies of radar film records indicate that in southern Arizona the average summer thunderstorm diameter is about 1 mile. Several of these small storms may occur more or less simultaneously on one of the large watersheds. Rainfall intensities are typically very high. It is obvious that in order to obtain an accurate picture of the rainfall pattern on a 60 square mile area, a large number of recording raingages are needed. At present time the Walnut Gulch and Alamogordo Creek watersheds have about one gage per square mile. Data from these dense gage networks are yielding important information concerning depth-area-frequency relationships for the unique storm types characteristic of the region.

A distinctive feature of the runoff pattern, which results from the peculiar nature of the runoff-producing storms, is the large channel or transmission loss. Runoff from one or more small thunderstorms on one portion of the watershed may flow through an extensive network of dry channels before reaching the watershed outlet. A significant portion of the runoff water may be absorbed by the coarse textured channel deposits during the flow. Losses as high as 5 acre-feet per mile of channel during a single flow have been estimated on the Walnut Gulch watershed. Whether or not the water lost in the channels ever reaches the permanent ground water table depends on the geology of the area. Preliminary estimates indicate that much of this water is used by the shrubs and trees which flourish along the edge of the channels.

Major problems have been encountered in obtaining accurate flow measurements from the large experimental watersheds. Although the

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This is the fiftieth of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

channels may be dry as much as 99 percent of the time, the runoff that occurs comes as extremely flashy flows. Flow rates commonly rise from zero to several thousand cubic feet per second in 15 or 20 minutes and recede again to zero in 2 or 3 hours. Steep channel gradients, high velocities and heavy concentrations of sediment further complicate the measurement problem. Based on extensive model testing and on early field experience, new measuring flumes have been developed and are being built in order to overcome such difficulties.

Each of the experimental watersheds has 25 to 30 stock watering ponds. Periodic surveys of these ponds will yield information on sediment inflow rates. In addition, water level recorders are being installed on several of the ponds to measure runoff from small areas of various combinations of soil and vegetation. Where bank erosion is a major source of sediment, periodic channel surveys are made.

Runoff and sediment production are being measured from the watersheds under present conditions of vegetation and management. Meanwhile, cooperative studies with individual ranchers on the watersheds are pointing the way toward economic and effective measures for improvements. The relationships that exist between kinds and amounts of native vegetation present and various soil, climatic, and management factors are being studied in order to shed more light on runoff and sediment problems. When an initial period of calibration has been completed, a concerted effort will be made to apply a comprehensive soil conservation program on the ranches comprising the watersheds, and the effect of this program on water and sediment yields will be evaluated.

In addition to the large watersheds on which water and sediment yield are being studied, seven smaller rangeland watersheds have been under measurement for nearly 20 years. Three are located near Albuquerque, N. Mex. and range from 40 to 180 acres. Four in the vicinity of Safford, Ariz. vary from 520 to 760 acres. Although the soil and vegetation inventories on these areas have not been as complete as on the large watersheds, basic rainfall and runoff data from them are producing valuable information for use in the design of stock ponds and for current flood prevention and upstream control programs. Methods have been devised for synthesizing hydrographs for small arid-land watersheds. The shape of the runoff hydrographs from these areas seems to depend only on certain physiographic features of the watershed. This makes it possible to predict the hydrograph shape for similar ungaged watersheds by evaluating these physiographic features from aerial photos and maps or from reconnaissance surveys. Studies are continuing on the effect of soil, vegetation, and preceding rainfall and runoff on the rainfall-runoff relationship.

Small exhibits such as this are appearing in windows, lobbies, and offices throughout the Great Plains to help focus attention on the Great Plains Conservation Program. USDA has sent 750 of the 29 by 45 inch, four-color portable exhibits to SCS offices in the 10-State region where the program is in effect.