Watershed Management

good practices required for the optimum production of forage and water yields demonstrated by results of long term study

R. H. Burgy and A. F. Pillsbury

Manipulation of vegetation—as a form of management of brush covered watersheds—has shown promise as a means of increasing seasonal runoff.

Between 10 and 20 million acres of California's foothill and intermediate elevation watershed vegetation is principally brush. These lands are becoming increasingly important as water producing areas. Management of watersheds for production of water may vary from control of land use to physical modification of the vegetation cover.

Programs of vegetation management to convert from brush to desirable forage species are being actively pursued particularly on those areas most adaptable as livestock ranges. Such programs are of dual benefit through improvement of ranges and increased water yields.

Heavy brush species are usually deep rooted and use all of the moisture available in the soil profile. Further, such vegetation has an extremely dense canopy which results in a high interception loss. Both of these factors are important.

Grasses tend to root less deeply and they become dormant at an earlier date in the season, This results in a smaller use of moisture with a consequent carryover of moisture storage to the next season. The interception of rainfall is less by grass than by brush, as it permits a greater part of the rain to reach the soil.

Soils have fixed capacities to store moisture. When winter rainfall exceeds 15″–20″, a soil's field capacity is nearly always satisfied. With a grass cover, more water becomes available for runoff—either directly or by retarded subsurface drainage—to lower elevations.

Hydrologic Studies

Long term studies of the hydrologic effects of brush-grass conversions have shown increased yields of runoff water except in the drier climates. Plot tests and small watershed studies have been set up to measure rainfall and runoff throughout complete cycles of treatment. In addition, the effects of such treatments on soil erosion and vegetative succession are being measured.

Watershed installations are being operated in Shasta, Tehama, Mendocino, Placer, Mariposa, Madera, Tulare and Riverside counties. Generally the stations consist of paired watersheds with gaging stations, erosion collectors and precipitation stations. They are operated to collect data from watersheds of one acre to 4,000 acres in size. Six of these watersheds have been converted from brush to grass thus far, the remainder being under pretreatment calibration.

Water Saved

The studies indicate that savings of water can be accomplished in most of these regions. In some cases increases of runoff have exceeded an equivalent of 1″–2″ depth of water over the entire watershed. Vegetative type, soils, climate, precipitation and other factors influence the magnitudes of the effects. Upon completion of a cycle of revegetation—which takes approximately three seasons of growth to become stable—erosion has been effectively reduced over that which occurs normally under brush cover.

Concluded on page 38

Left—**Diamond Range, Tehama County, watershed after felling trees in preparation for burning of vegetation.** ***Right***—**After removal of woody vegetation, range grasses have replaced the tree types.**

DISTRICTS

Continued from page 6

The experience of the two water conservation districts in Santa Clara County illustrates the role of the public district in dealing with conflicts of this type. The Santa Clara Valley Water Conservation District was organized in 1929 after two attempts to use alternative boundaries. The South Santa Clara Valley Water Conservation District was created in 1938. This southern district was unable to execute its program until the original area within the district was enlarged in 1951 from 18,000 acres to 34,900 acres. In both cases difficulties were encountered in reaching agreement on the incidence of benefits.

One of the primary purposes of the district was to encompass within its boundaries the interests which were to be benefited from the collective action so that the costs of executing the action could fall upon these benefited interests. However, the anticipated benefits from the early water management proposals were not distributed uniformly to all ground-water users.

Santa Clara County contains two distinct ground-water basins, one sloping north toward San Francisco Bay while the other slopes toward the Pajaro River in the south. The small Coyote Valley connects the larger northern and southern basins. Water users in Coyote Valley were reluctant to join the district because they feared detention dams and stream flow diversion would lessen the ample volume of influent seepage of water from the stream to their portion of the ground-water reservoir and that the management of the poorly drained areas would become more difficult. In addition, water spreading at a lower elevation in either district would have been of no benefit. Consequently, Coyote Valley was omitted from inclusion in the two original districts. In fact, the Central Santa Clara Valley Water Conservation District was formed to protest a water-right application by the northern district. With the failure of this action, Coyote Valley was annexed to the Santa Clara Valley Water Conservation District in 1952 and the original plan was adjusted to provide benefit to the area.

The district procedure provided for local interests to register their approval or disapproval with respect to the proposed plan. In these instances the lack of coincidence of district and basin boundaries was a factor leading to conflict and contributing to delay in the initiation of effective ground-water management.

The method of assessing project costs is one of the terms of organization which is frequently a source of conflict with respect to ground-water management. These conflicts of interest center around the question of whether the distribution of costs reflects a reasonable relationship to the distribution of benefits. In the case of the attempt to establish a ground water management organization in Santa Clara County, agreement was not reached concerning the method for raising revenue until four methods had been considered: *1*, a tax upon each parcel of land proportionate to the project benefits assessed to it; *2*, a tax upon the quantity of water pumped from each well; *3*, an assessment upon the value of the land and improvements; and *4*, taxing the land—exclusive of improvements—which was the method that finally won general agreement and was incorporated into enabling legislation of 1929.

The role of the district in these conflicts of interest was to provide the means for reaching a decision in a situation of conflict and to have the authority to collect the required revenue. The election procedure and informal interest group committee were used to settle these conflicting interests. The authority of these districts to collect revenues was never seriously questioned although the ability to issue bonds and the size of bond issues did become questions of electoral conflict.

The district form provides a flexible management tool for determining the incidence of project costs or, to put it differently, of pricing the services rendered. Because of this flexibility, revenue or pricing schemes may be used to fit local ground-water management problems so that there is a coincidence of the incidence of project benefits and costs or that a reasonable relationship exists between them.

The ability of the district to associate costs with benefits should not be confused with the incidence of expenditure. In fact, the largest expenditures of the water conservation districts in Santa Clara County were made to construct detention dams outside of the district. This would suggest that, if a particular watershed management practice in the area above the reservoirs were measurably beneficial to the district program, the incidence of expenditure could be made to fall upon the landowners above the dam while the incidence of cost and of benefit would be within the district or could be partially shared by the district. For example, the district could enter into contractual arrangements with the watershed landowners and pay them to follow agreed-upon practices.

Stephen C. Smith is Associate Specialist in Agricultural Economics, University of California, Berkeley.

Foregoing article is based on Giannini Foundation Paper No. 152, "Problems in the Use of the Public District for Ground-Water Management" by the same author

EFFICIENCY

Continued from page 26

ately brought to the laboratory, weighed and dried for 24 hours at 230°F to determine moisture percentage on a dry basis.

About 43″ of water were applied to the test plot during the season by seven irrigations with the individual amounts varying from 5″–8″ at an average of about 6″. The soil moisture extraction during the period of the seven irrigations in 9′ of the soil profile was 36″. The 7″ difference between the 36″ and the 43″ applied can be attributed to deep percolation below the root zone.

The water application efficiency or amount of water retained in the root zone divided by the amount applied was 84%. This is a high efficiency, as should be expected with an irrigation system wherein large flows of water are contained in relatively small areas. The total amount of water consumed from the time that leaves appeared on the trees, in the middle of March, until the time they were shed, around the first of November, was nearly 44″. The 8″ difference between total water consumed and water furnished by irrigation is attributable to winter rains. Of the total water consumed 23% was extracted from the top foot of soil; 63% extracted from the top 5′; and 87% from the top 7′.

Jewel L. Meyer is Farm Advisor, Stanislaus County, University of California.

Norman Ross is Farm Advisor, Stanislaus County, University of California.

Verne H. Scott is Associate Professor of Irrigation, University of California, Davis.

Clyde E. Houston is Extension Specialist in Irrigation and Drainage, University of California, Davis.

Grower Alfred Wilson, of Hughson, cooperated in the study reported in the above progress report.

WATERSHED

Continued from page 5

Other studies include the development of reconnaissance techniques to evaluate rainfall disposal and possibilities of yield increase, and to investigate watershed paving as a possible means of yield maximization and debris control.

The potentialities of vegetation management as a means of increasing California water supplies are being considered in detail. Early results indicate that vegetative management may be a new tool to assist in the beneficial utilization of watersheds to produce increased runoff.

R. H. Burgy is Assistant Professor of Irrigation, University of California, Davis.

A. F. Pillsbury is Professor of Irrigation and Engineering, University of California, Los Angeles.