Irrigation Efficiency Study

increasing demands on water necessitate efficient irrigation practices to apply correct amount of water at proper time

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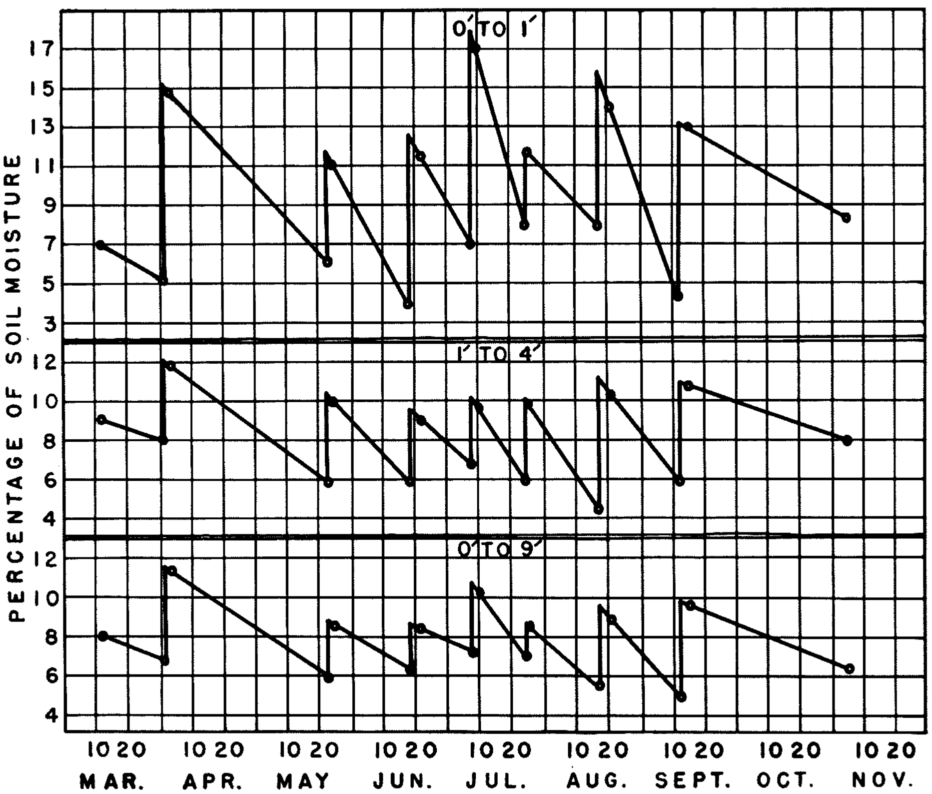

Soil moisture variations, peach test plot—Stanislaus County, 1956.

Economic production of practically all crops in California is dependent on irrigation.

Efficient use of irrigation water requires knowledge of soil characteristics and of water use by the plant—among other factors—to design an irrigation system that can apply the correct amount of water to the proper depth of soil at the required time interval. Research workers have investigated these factors and developed standards for design under relatively ideal conditions. The farm operator's problem is to apply those standards to his crop, soil and water conditions.

Procedures used to develop information on consumptive use of water by peaches and irrigation efficiencies possible are exemplified by a study conducted on a one-acre plot in a commercial bearing orchard near Hughson, Stanislaus County. The trees—Fay Elberta variety—were planted on 20' centers in 1949. The orchard is clean cultivated and the 1956 yield was 25 tons per acre. The soil in the study plot is Hanford sandy loam with an apparent specific gravity of 1.55. It is formed from recent alluvial material of granitic origin, absorbs water readily, and retains it fairly well. It is an excellent agricultural soil, well adapted to a wide variety of crops, and has a Storie Index of 95%. The study plot was surrounded by a 1' levee and all water applied was retained in the basin.

The first step in an irrigation evaluation study is to measure—as accurately as field conditions will permit—the water applied. In this study, water was delivered through a 24" monolith concrete pipe on a rational-demand schedule, normally in flow rates of 15 cubic feet per second. The flow was discharged simultaneously through two 24" valves each located in the center of a 5' concrete box. The box was open on one side, permitting the water to flow into the check after some of the high velocity of water discharging from the pipe line had been dissipated.

For these conditions a sharp-edged suppressed weir, equipped with an automatic water stage recorder, was used. It consisted of a steel plate extending across the full width of the concrete box. A stilling well connected to the face of the weir housed a float which responded to the height of water passing over the weir. This level was transmitted to the chart of the recorder. The amount of water applied to the plot was computed from the length of weir and the length of time the average depth of water passed over the weir. There was practically no rainfall during the irrigation study season.

Soil sampling was done to show extent and control of a continuous supply of moisture. Soil samples were obtained in 1' increments in 9' of soil profile before and after each of the irrigations during the season. The samples were immedi-

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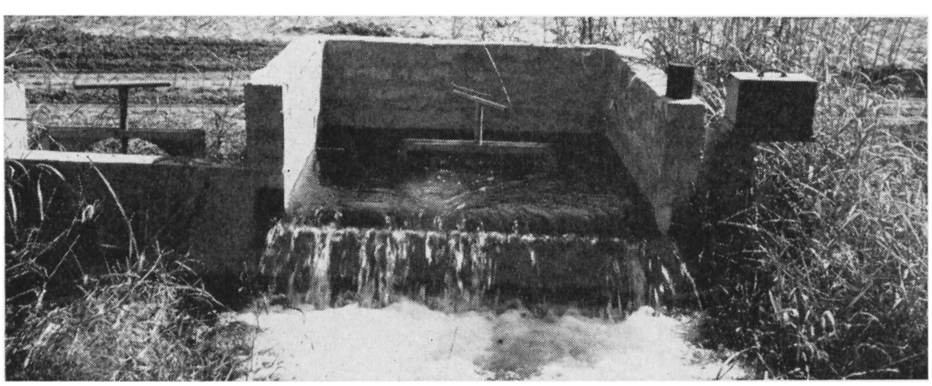
Type of weir used in field irrigation study.



DISTRICTS

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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.

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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

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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′.

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

WATERSHED

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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.

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