Irrigation Districts

payment complex of land assessment and water tolls key tool for pricing policy

Michael F. Brewer

The irrigation district is the dominant type of public water district in California's agriculture. More than 4.4 million acres are within the boundaries of irrigation districts. Approximately 2.4 million acres are irrigated annually, either totally or partially, from water they provide. Since organic legislation—The Wright Act of 1887—irrigation districts have undergone changes paralleling developments in California agriculture and shifts in land use within their boundaries.

The pricing mechanism of an irrigation district has been especially important in facilitating district adaptation to change. This mechanism—the payment complex—consists of an assessment on unimproved property within the district, and a water toll that is related to the quantity of water used in a particular irrigation season. These charges represent the outlays members must make to obtain district water, and may be regarded jointly as its relevant price. At the same time, the payment complex is the chief source of district revenues and must produce revenues sufficient to cover the estimated costs of operation, maintenance, administration, and capital account items for the ensuing year.

The district assessment is a cost to all members, whether or not they irrigate. Its magnitude is determined by the amount of land owned within the district, its valuation, and a rate of levy which is designated annually by the district's board of directors. The only way an assessment can be avoided is by land sale or exclusion resulting from boundary changes. The size of the water toll, on the other hand, varies with the amount the member used throughout the irrigation season. This fundamental distinction between the fixed and variable cost components of the payment complex gives rise to numerous possible lines of its influence on water use.

Appraisal of the pricing practices of California irrigation districts may be made from at least two viewpoints. Practices may be evaluated in terms that reflect interests internal to the district. Appraisal is also possible and relevant from the standpoint of society in general. This relates to the degree to which a particular district attribute facilitates efficient resource allocation and production organization.

The provision of water at least cost to members is a prime constituent interest. The nonprofit nature of the districts, their power to issue bonds, and the technical economies of large scale development and distribution facilities are advantages in this regard. When districts are so constituted that physical interrelationships among different sources of water used by their members entail joint costs, district pricing practices, although directly related to district water deliveries alone, may also affect the costs of obtaining water from all available sources. Under such circumstances district pricing must be evaluated in terms of the cost of the entire water system of which district deliveries is only a part.

Pricing practices may result in different charges to individual members for similar amounts of water. Under such circumstances, being unable to disassociate from the organization at will, these individuals may form factions or dissension groups. These may become sufficiently numerous and powerful in terms of member voting blocs that district administration becomes unwieldy and difficult. The development of such factions has resulted in the replacement of district-wide development programs by smaller, localized units, organized and financed through individual improvement districts within the same parent irrigation district. The extent to which different pricing practices avoid, or tend toward equity problems, is an important internal evaluatory criterion.

Additional internal criteria pertain to the effects of pricing on district solvency. This refers to the ability of a district to pay current debts as well as to finance capital improvements. Pricing practices may influence district solvency in two ways. First, the practices may affect the certainty that revenues will be adequate to meet a district's outlays for a particular year or longer period of time. Secondly, the pricing practice adopted by a district over a period of time affects the marketability of district bonds, and may influence the rate of interest they carry.

A fourth criterion for evaluation pertains to the status of a district's water rights. Under California law, both the extent and type of water use by members of a district may affect the tenure uncertainty of these rights, principally in terms of their jeopardy to prescriptive capture.

Appraisal of pricing practices from the standpoint of society in general relates fundamentally to public welfare. Particular effects of pricing practices that tend to enhance public welfare may be used as evaluatory guides. One such effect is the degree to which irrigation district agriculture is free to adjust itself to secular economic conditions of the state and nation. Adjustment possibilities are affected by a district in two main ways: The physical structures involved in a district's distribution system render the water input more divisible as a factor of production; and, pricing that functionally relates costs to the quantity of water used makes more production alternatives economically relevant to a district member.

Actual pricing behavior represents a compromise of all these criteria. Frequently the criteria are not consistent with respect to a given payment complex—either between these two sets or within the same one. What may be a desirable practice from the standpoint of reducing the tenure uncertainty of a district's water rights may tend toward an inefficient use of irrigation water by members or give rise to equity conflicts.

The polarity between these two sets of criteria is not stable over time nor does it exist in the same degree for different districts. Differences between the two increasingly have become evident as districts have approached what may be considered as a stage of maturity with respect to internal irrigation development. For young districts with a small proportion of its land under irrigation, the use of a relatively large assessment component holds advantages from both internal and social standpoints. The facilitation of the transfer from dry-land to irrigated cultivation, the administrative desirability for a fixed source of receipts, and the legal

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CALIFORNIA AGRICULTURE

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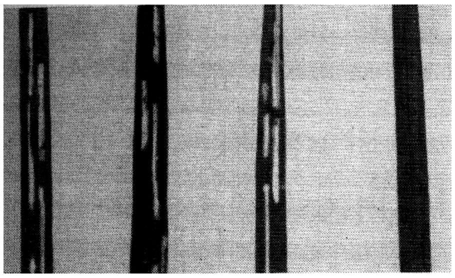


Longitudinal feeding scars of adults on leaves of rice. Undamaged leaf on right.

occur a year, with adults over-wintering in matted grass or Spanish moss. When rice is flooded in these areas the adult beetles move into the fields. The beetles fly at night and are often attracted to lights.

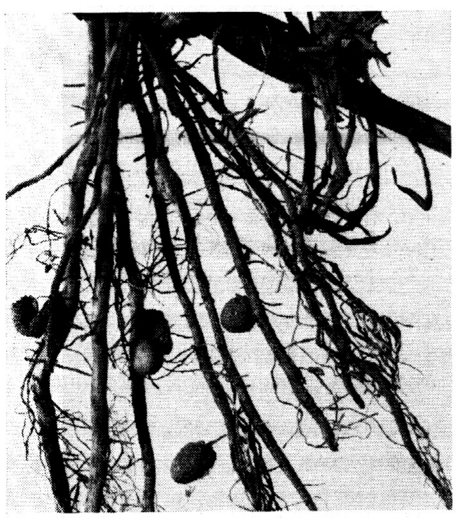
In California, it was apparent that the first feeding occurred on water grasses and sedges about the edges of the fields and then the adults moved out to feed on the rice as it emerged. More activity and beetles were found about the edges of the fields than in the rice checks 10′–20′ from the banks.

The weevil is at home above or below the water surface. Adults at Biggs were able to swim under or on the surface, and readily moved up and down the stems of the plants. Adults rested during the day in shady spots on grasses or on rice blades lying prostrate on the surface of the water. Weevils were usually easy to collect as they rested on the leaves and often remained motionless once an attempt was made to collect them.

Adults feed on the leaves—particularly those lying on the surface of the water—causing slits the width of the beak. Unlike the feeding of midges, adults fed from the top leaving the lower epidermis. The epidermis disappears leaving characteristic open slits. Adult feeding caused some drying up of the leaves, but did not seem to interfere with normal growth of the new leaves. On June 1 at Biggs populations of adults varied from 3–4 per square foot along the edges of the fields to 1/25 beetle per square foot out in the rice checks.

The rice water weevil is reported to feed on many grasses and aquatic plants and to breed on many grasses. It is considered a native species feeding naturally on grasses growing in swampy areas. At Biggs, observations on July 1 indicated that the weevil was able to breed on several species of grasses and sedges as larvae were collected about the roots of these plants. In addition to rice the observed hosts include: *Echinochloa crus-galli,* watergrass or barnyard grass; *Polypogon monspeliensis,* rabbitfoot grass; *Agrostis avenacea,* a bentgrass;

Pupal cells of rice water weevil attached to roots of a sedge.



Setaria geniculata, knotroot bristle grass; *Eleocharis palustris,* spike-rush; and *Scirpus mucronatus,* rough-seed bulrush. Adults were found to feed on jointgrass, *Paspalum distichum,* but no larvae were found on the roots. Watergrass seemed to be the most favorable host at Biggs, with as many as 6–8 larvae on the roots of individual plants. However, it is assumed that the watergrass was present around the edges of the fields prior to rice and allowed an earlier build-up.

In the southern states control has been accomplished by drainage of rice fields and by insecticide applications. A drainage period of about two weeks is necessary for control; a method not too practical in California due to a possible increase in weed problems. Work in the southern states gave control with 4–16 ounces of dieldrin per acre applied prior to flooding. Usually, rice is not drilled in California, but dieldrin is commonly applied for control of the rice leaf miner; a treatment which should be fairly effective against adults of the rice weevil if applied at the time they are active on the foliage. Texas investigations have demonstrated the value of seed treatments with lindane, aldrin, and dieldrin. In experimental plots four to eight ounces of toxicant per 100 pounds of seed gave 90% control—and dieldrin at one ounce per 100 pounds gave an 80%–90% reduction of larvae in a field trial. The mode of action of seed treatments in controlling the rice water weevil is unknown.

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The identification of the weevil was made by R. I. Sailer, Acting Chief Insect Identification and Parasite Introduction Research Branch, U.S.D.A., and Miss Rose Ella Warner, United States National Museum.

Grasses were identified by Beecher Crampton, Senior Herbarium Botanist, Department of Agronomy, University of California, Davis.

On July 16, 1959 the California State Department of Agriculture reported that a 400 square mile area in Butte, Glenn, and Yuba counties was infested by the rice water weevil—Ed.

DISTRICTS

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consolidation of the district's water rights tends to be advanced by the use of the assessment. Moreover, during this stage, the development objective frequently is espoused by the entire district constituency—urban and rural, irrigating and dry-farming alike. Equity problems arising within districts during this early phase of irrigation development generally have emphasized the inequity of a high water toll to the irrigating member rather than the cost incidence on nonirrigators resulting from assessments. Because of frequent parallelism in the two sets of criteria during the early stage of development, pricing practices could satisfy both types to a reasonably full extent.

The two sets of criteria tend to diverge, once relatively full irrigation development has occurred within the district, and the compromise manifest in actual pricing behavior becomes more pronounced. The developmental transition is marked by changes in the functions of district management. The large initial district outlays for distribution systems no longer obtain once the development phase is passed. Similarly, bonded district debt becomes less burdensome, and the degree and urgency of district solvency is not so pressing as during the earlier stage of development.

This transition likewise holds implications for district members. The relatively high outlays required for converting to irrigated agriculture are no longer facing the majority of members. Continued use of district assessments at the developmental level may be less justified economically, if the principal impact of secondary benefits has been capitalized into district land.

The efficiency of pricing practices—in most districts—may be predicated upon the extent to which those practices render district production reflective of the external economy of California irrigated agriculture. With increased competition in irrigated production, a continuation of pricing practices used during the early period of district development—characterized by relatively high assessments and a low variable cost for district water—tends to shield member irrigators from secular economic change, and thus may cause stickiness in the responsive-

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tions occurred in all treatments including the check but the differences between the treatments did not appear significant.

The heads of Double Dwarf 38 are characteristically tight and compact. In the test field many heads were covered by the dense foliage, which made it almost impossible to apply liquid insecticides thoroughly to the heads. Furthermore, most of the larvae in the field were mature or nearly mature at the time of treating. Many of the larvae were leaving the plants to pupate. This factor alone undoubtedly accounted for much of the difference in numbers of larvae between the pre- and post-treatment counts of the check. The age of the larvae undoubtedly influenced the degree of control, because mature larvae are more tolerant of certain insecticides than are the younger larvae.

Excellent control of the corn earworm was obtained in the RS610 variety with DDT spray and dust—each 98.8%—followed closely by Phosdrin—97.1%—and Thiodan—95%. Guthion with 84.9% and Dylox with 89.1% gave the poorest control. The RS610 variety produces heads on stalks high above the foliage. The heads are loose and not as compact as those of Double Dwarf 38. While a much heavier infestation was in the RS610 field the larvae were mostly immature—first to third instars—at the time of treatment.

From these experiments it appears that DDT is highly effective in reducing numbers of corn earworm larvae in grain sorghum heads. However, spray applications of DDT result in significant residues on the grain at harvest. Although residues on threshed grain were extremely small in the dusted plots, Federal regulation prohibits any residue.

The results of these tests indicate that Phosdrin, Thiodan, and perhaps Dylox are materials that could be substituted for DDT. Dust formulations of these materials were not tested, but it is possible that dusts may prove to be superior to airplane spray applications in penetrating the grain sorghum heads.

To achieve maximum control, fields should be treated while the larvae are small and before extensive feeding damage has occurred in the heads. The presence of small larvae can be detected readily without removing the heads from the plant by jarring the heads over a pan.

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LIME

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should be more friable and easy to cultivate. Power requirements for tillage should be reduced and seedbed preparation less difficult. No plant differences could be attributed to the changes in physical condition but greenhouse methods minimize the effect of physical condition on yield.

Samples of the same three soils—Colusa silty clay, Yolo silty clay loam, and Capay clay—were tested for hydraulic conductivity by the laboratory method of determining the flow of water through a column of soil to gain information on the permeability of soils. As was the case with modulus of rupture, some soils are affected more favorably than others by the addition of lime. The permeability of a soil is increased by the addition of lime, the first increment of 10 tons per aore being practically as effective as larger amounts. Hydraulic conductivity and modulus of rupture data indicate an improvement in the physical conditions of some soils.

Because the tomato plants showed an increase in growth, which could be attributed to the phosphate, the phosphorus content of 23 samples of sugar beet by-product lime—representing old and new production—was determined chemically.

Sugar beet lime may contain from 0.06% to 0.64% phosphorus or an average of 0.38% phosphorus. An application of 10 tons per acre of sugar beet lime may add to the soil some 12 to 128 pounds of phosphorus per acre or, expressed as phosphorus pentoxide, from 27.5 to 313 pounds per acre. Laboratory and greenhouse studies indicate that this phosphate is readily available.

It is evident that modulus of rupture and permeability of some soils can be improved by lime applications and other soils may be improved only slightly or show no change. At present, there is no test or measurement that can be readily utilized to determine which soils might be changed favorably by lime applications. While increased yields may not result from this improvement, cultivation and seedbed preparations may be somewhat easier. No adverse nutritional effects could be demonstrated.

Sugar beet by-product lime can not be considered a fertilizer and the response obtained in these studies might be nutritional rather than a result of physical improvement of the soil. The percentage of phosphate in sugar beet by-product lime varies—even from the same refinery—and there is no assurance that the lime will always contain a uniform concentration of phosphorus.

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ness of district agricultural production to one or more of the external economic conditions.

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ALFALFA

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At such locations growers applied phosphate fertilizers, and yield responses were observed. The survey indicated also alfalfa fields where phosphorus application was not needed. Strip tests with superphosphate were tried in many such fields and—in no case—was a response to fertilization obtained.

Plant analysis shows real promise as a means of evaluating the phosphorus status of alfalfa fields and as a guide for the development of improved fertilization practices.

Samples of alfalfa plants for tissue analysis must be collected at the one-tenth bloom stage—the ideal time for hay harvest—or when one out of 10 plants is in bloom. In spring or fall the plants are in a growth stage comparable to the one-tenth bloom period when the small regrowth shoots, growing up from the plant crown, are $\frac{1}{4}''$–$\frac{1}{2}''$ in length. The soluble phosphate concentration in the midstem tissue will be too high in alfalfa plants sampled before the one-tenth bloom stage and, at more mature stages of growth, the phosphorus readings will be too low. The critical values reported in this article apply only to alfalfa plants in the one-tenth bloom stage of growth.

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