THE PRICE OF WATER IN WESTERN AGRICULTURE

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Introduction

Here, and for the first time we believe, data on the distribution of prices of irrigation water in the Western states are assembled, showing prices with the corresponding irrigated acreages, water source (ground and/or surface water), type of application method and lift depths. Data on the price of irrigation water (or cost per acre foot for delivery and application) are necessary to determine the effectiveness of various government water conservation policies. The farm price of water helps determine farmer response to and social benefits derived from: (1) extension efforts to cut application rates, (2) cost-share and tax-benefit programs to adopt water saving technologies, (3) changes in government regulated water prices, and (4) changes in government or physically dictated water quantities available. Although a thorough analysis of these water saving policies, utilizing the water price data, is beyond the scope of this study, a few policy implications are drawn. First, the data indicate that one-fourth or more of the water is priced at $15.00 per acre-foot or less. In many, but not all areas. this price is too low to induce the use of technologies which cut per-acre water applications. Second, most water supplied by the Water and Power Resources Service (WPRS) costs $15.00 per acre-foot or less. Since the price structure for the WPRS water was established years in the past, other water often costs several times as much, and economic conditions have changed over time, a re-examination of the WPRS price structure may be in order.

Before presenting the data on water prices and implications, the procedures used to determine prices and associated factors are discussed.

Procedures

Data on the price of irrigation water (variable cost per acre foot, including fees for surface water, and the variable costs of energy, labor, and maintenance for on-farm delivery and application), plus corresponding data on area irrigated, water applied by source, system of application, and pump lift are taken from three sources: (1) Firm Enterprise Data Systems (FEDS) budgets developed by the USDA, (2) USDA data developed in a special study of federal reservoir projects for the Water and Power Resources Service (WPRS) Acreage Limitation Study, and (3) planning budgets developed by the Soil Conservation Service (SCS). Data are representative of 36 subregions, 18 federal reservoir projects, and three states for the FEDS, WPRS, and SCS studies respectively. All budgets are for the 1978 crop year. There are some 168 budgets, each representative of a different crop-location situation. Data are from 15 of the 17 western states--all except North and South Dakota. Of the 25 million acres of irrigated land represented by the data, most--some 21 million acres--are from the FEDS budgets. Approximately 14 of the 25 million acres in the sample are irrigated by groundwater.

The acreage represented by the above sources is only part of all irrigated acreage in the West. Other sources (Sloggett; U.S. Department of Agriculture, Soil Conservation Service; Murray, et al.; U.S. Department of Commerce, Bureau of Census; and Irrigation Journal) were used to obtain estimates of the entire irrigated acreage in the 15 western states. Although the estimates vary somewhat depending on the reference, our judgement is that in 1978 there were approximately 50 million acres of irrigated land of which 26 million acres received groundwater, 22 million acres received surface water, and 2 million acres were in areas using a combination of surface and groundwater.

The above two sets of statistics, those for the budget data and those for total irrigated acreage in the 15 western states, indicate that the budget data cover approximately 50 percent of the entire irrigated area. Budget data coverage is highest for groundwater areas--60 percent of the total groundwater acreage is represented by the budget data--and lowest for surface water areas--21 percent of the total surface water acreage is represented by the budget data. Although there are no statistical tests by which to judge how representative the budget data are, we believe it is usually quite representative of the aggregate situation in the West. A rather large share of the total acreage is represented, and the intent of those conducting the surveys upon which the budgets are based was to choose "typical" or "representative" farming situations.

Results

The data (Table 1) indicate several important things about the price of irrigation water in the West: (1) Nearly one-fourth of all water applications and about 16 percent of all irrigated acreage use water which costs less than $15.00 per acre-foot to deliver and apply. Since the budget data underrepresents surface water, and since surface water is usually lower priced than groundwater, it is likely that more than 25 percent of all water used costs $15.00 or less per acre-foot. (2) Nearly all water costing less than $15.00 per acre-foot is surface water. (3) Nearly 80 percent of all surface water supplied by the Water and Power Resources Service (former Bureau of Reclamation) costs $20.00 per acre-foot or less. (4) Flood and siphon systems predominate in areas of inexpensive water--$15 per acre-foot or less--and are used very little in areas of high priced water. Sprinkler systems are used very little in areas of inexpensive water, but predominate in high priced water areas. (5) Pump lifts are, in general, noticeably higher for water priced over $20.00 than for water priced below $20.00 per acre-foot.

Table 1. Cost of Irrigation Water by Acreage, Water Applied, Water Source, Irrigation System, and Pump Lift, 15 Western States, 1978.

Item	Unit	Cost - Dollars/Ac-Ft. 0.00-5.00	5.01-10.00	10.01-15.00	15.01-20.00	20.01-25.00	25.01-30.00	30.01-35.00	35.01-40.00	40.01 and over	Total
Observations	Number	13	25	38	32	25	14	15	2	4	168
Area	1,000 Acres	272	1,326	2,418	7,746	7,104	3,323	1,986	45	438	24,658
	% all Acres	1	5	10	31	29	14	8	0	2	100
Water Applied	1,000 Ac-Ft.	1,379	4,572	6,070	9,842	15,163	4,309	3,178	32	405	44,950
	% all Water Applied	3	10	13	22	34	10	7	0	1	100
Water Source											
Groundwater	% of Water in Price Range	0	8	8	73	76	77	71	0	96	57
Surface-Project[1/]	% of Water in Price Range	75	27	49	16	8	12	9	0	0	19
Surface-NonProject[1/]	% of Water in Price Range	25	65	43	11	12	11	20	100	4	24
Irrigation System											
Gated Pipe	% of Water in Price Range	0	0	4	69	34	53	9	0	0	33
Sprinkler	% of Water in Price Range	0	0	0	12	4	47	63	100	100	14
Flood	% of Water in Price Range	94	90	76	18	18	0	28	0	0	34
Siphons	% of Water in Price Range	6	10	20	1	44	0	0	0	0	19
Pump Lift	Average Feet	0	64	26	148	244	232	194	20	137	204

Source: See text.
Notes: 1/Project water refers to that provided by the Water and Power Resources Service (WPRS). NonProject water is not supplied by the WPRS.

Implications

Inexpensive Water in Part of West

The data indicate that at least 25 percent of all irrigation water costs $15.00 or less per acre foot. In many, but not all cases, $15.00 must be considered inexpensive water in that the price is not high enough to economically justify the adoption of water saving practices or technologies (defined here as those which reduce per acre applications). Three examples may be given. First, the data developed in Table 1 indicate that at $15.00 or less, farmers do not tend to use water-saving technologies; rather flood and siphon systems predominate. Only at higher water prices do gated pipe and sprinkler systems become common. Although field and delivery efficiencies vary according to soil texture, slope, climate, and other factors, flood and siphon systems are usually less technically efficient than sprinklers and gated pipe. Rough estimates of the irrigation field-delivery efficiencies for the four systems are approximately 50-55 percent for flood, 60-65 percent for siphon, 60-85 percent for gated pipe depending on the availability of a water reuse system, and 60-90 percent for sprinkler systems (Eisenhauer and Fishbach; Keller; Kruse and Heerman; and Soil Conservation Service, January 1979). The implication is, then, that farmers are not inclined to use water conserving technologies at prices below $15.00, but do use such technologies at higher water prices.

Second, recent estimates of crop-water production functions (Ayer and Hoyt) suggest that the elasticity of the demand for water by some of Arizona's most important crops--cotton, wheat and alfalfa--is extremely inelastic for water priced at $15.00 per acre-foot (given delivery and application efficiencies). In general, these elasticities are less than -.4 for a wide range of product prices and soil conditions. A -.4 elasticity indicates that if the price of water were to increase 10 percent, the amount of water reaching the crop would be cut by only 4 percent--usually less than 2 acre-inches per acre. Preliminary estimates of these elasticities of demand for irrigation water in Texas for corn, sorghum and wheat (Hoyt), and in California for corn and cotton (Kelley and Ayer) are also highly inelastic for irrigation water priced at $15.00 or less for a wide range of crop prices.

Third, estimates from another study currently underway (Ayer and Daubert) suggest that given a 10 acre-inch per acre water savings and under a wide range of product prices, investment costs, energy price changes and other conditions, water priced at $15.00 per acre foot is not high enough to make laser (basin) leveling--the water-saving technology which is spreading rapidly through Arizona and parts of other states--profitable. Since a 10 acre-inch per acre water savings is more than one-third of total per acre applications on most irrigated land of the West, the adoption of at least this technology appears doubtful in many areas of $15.00 water.

There are, of course, conditions under which a water price of $15.00 per acre foot, or at least $20.00 per acre foot, is sufficient to reduce per acre water application. First, in some parts of the West the elasticity of demand for irrigation water may be high at $15.00-$20.00 per acre-foot. Anderson, for example, suggests that in parts of Utah water priced at $20.00 per acre-foot drives the quantity demanded to 0.

Second, if the water saving technology is relatively inexpensive, adoption may be profitable. An example appears to be the case of laser (basin) leveling in the Newlands area of Nevada where the cost of this alternative, with very low original grades and reusable ditching, is apparently only one-fourth the cost in Arizona.

In short, a sizeable portion of irrigation water in the West is priced at $15.00 per acre foot or less. In many areas, a price of $15.00 may be considered inexpensive in that the price is too low to induce water conservation (cut per acre applications). In other areas, some evidence suggests that at $15.00-$20.00 per acre-foot water conservation will be profitable.

Pricing Surface Water

Most water costing $15.00 per acre foot or less is surface water and nearly 80 percent of the water provided by the Water and Resources Service is within this price range. A price of $15.00 contrasts sharply with other water prices. For at least some agencies which administer surface water, the basic pricing schedules were established many years ago--at a time when the competition among sectors and regions for a given quantity of water was not intense. Under today's conditions a restructuring of water prices administered by federal or other agencies may need to be reexamined. Restructuring may require a change in water law, and equitable changes may well involve the development of legal-economic mechanisms to compensate water losers.

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