

AN ECONOMIST LOOKS AT RESEARCH ON WATER

By

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In discussing water resources in an eastern state I feel like the little old lady who was asked if she had seen Halley's Comet, and replied "Yes, but only from a distance." And so I will not presume to lecture Pennsylvanians on matters better known to them than to me. Instead, I am here to tell you what I as an economist think I have learned from experience of the western states in economizing on water, and suggest what eastern researchers might learn by directing some of their efforts toward sifting and evaluating the western history. This is one subject in which history flowed backwards: the western evolution anticipated yours by a hundred years. Learning from the West does not mean copying the West altogether, for there are mistakes to observe as well as successes. From the total experience I will now undertake to distill what seem to me to be general economic truths bearing on water resources.

1. Water development is a fit subject for community action. There is little real scope for a free market in water supply systems, which involve economies of large scale all along the line, and particularly in distribution. Water supply has all the qualities of a classic natural monopoly, and usually should be treated as such. This does not mean that the community should not use good economic pricing and costing principles in planning, sizing, delimiting, upgrading, pricing, and otherwise

managing its water supply system. It does not rule out consumer sovereignty. It simply means that these economic problems need to be settled in the public arena rather than the market place.

Western water users have had long experience with community organizations at the local level. These are commercial water companies, municipal governments, mutual water companies, and a variety of public districts. Of these, I will discuss today the most successful of the lot, a type of special service district called an "irrigation district." These originated and have their prototype in California, but have spread, with modifications, to all states.

California irrigation districts originated historically from the extremity of small farmers who needed an organization wherewith to furnish themselves an essential service which otherwise would, because of its large scale, be the sole preserve of giant landowners. Without districts, these giants would dominate arid lands agriculture, an outcome which was indeed envisioned and fostered by the Desert Land Act of 1877. For their success, districts required three basic powers: taxation; bonding; and forced inclusion of lands within the economical service area. Taxation let them engage in and cover the deficits of marginal-cost pricing, a practice essential to the best development of decreasing cost services. Bonding let them build large works as units, ahead of demand, a practice necessary to achieve economies of scale. Forced inclusion let them serve a compact area, a practice essential to avoid dissipation of gains in fragmentation of service area, and "irrigation sprawl." In addition, it has proven vital that their tax power be limited to bare land, thus avoiding focusing of taxes on early improvers, fragmentation of demand, retardation of development, and hardship on smaller landowners and intensive farmers.

With these powers, small farmers were able to pool their economic strength and develop water. Irrigation districts now serve over four million acres in California. In these areas, subdivision of land into small farms has been the rule, during a half century when consolidation and engrossment have been the paramount national trends. Irrigation generally presupposes an intensive application of labor and capital to land, with close management of small tracts. Small optimal scale of the farm unit in contrast with large optimal scale of the water supply unit led to waste wherever one factor was allowed to override the other, and made it optimal to separate the two functions: hence the great success of districts.

The economies of scale achieved by the districts are in the main the following:

a. Pooling of supplies to regularize the total. Water flows are a variable raw material to their consumers, and whatever firms up the supply is of particular value. On top of natural flow variability there is an added instability imposed on users when a river is divided among many small claimants under various historical rights of use. A district pools these various supplies and legal rights. Offsetting fluctuations counteract one another, reducing aggregate instability and uncertainty. The same pooling principle applies on the demand side as well.

b. Water storage, surface and underground. Surface storage generally enjoys large scale economies within the limits of the market, although these are limited by the qualities of specific damsites. Irrigation districts have built more and larger dams than any private agency, and are only outdone by Federal agencies, many of whose dams, incidentally, provide service for the primary benefit of those same giant landowners whose

whose size is often explained by their exclusive ability to achieve economies of large scale development, but who have called in government to do the big jobs for them.

c. Diversion from streams and pumping from aquifers. Scale economies to these operations are fully realized at low volumes, but they are important in humid areas today because scale economies are usually first perceived in diversion and pumping.

d. Conveyance and distribution. Because aqueduct costs increase with length of line, but only in proportion to the square root of line capacity, nothing is so wasteful as parallel lines. The principle is nearly universal, and results in distributive networks' of all kinds being recognized as natural monopolies. "Bundling" of small individual water lines into large ones makes it economical to carry water long distances, so much more land may be served from a given source. It also makes it feasible to supply the peaking capacity needed to supply water on demand.

e. Financing. Irrigation districts have much better credit ratings than their component members, and can tap national credit markets through bond sales. The credit they receive is passed on to incoming settlers in an interesting way. Note, first, that the conversion to more intensive agriculture, and the payoff to the investment in water supply, presupposes immigration. The small farmers who are willing to submit to the exacting work of developing new farms are not wealthy, and they need credit. Irrigation districts pass credit along to new settlers in the form of unappreciated land prices. It is not that districts depress prices--then there would be little motive for the original landowners to form them.

But they prevent gross speculative increases, and they discourage holdouts. That is because they tax land, and their bonds are liens on land. The settler thus buys land cheaper, because it is mortgaged to the district. And as he pays his taxes over many years, he pays off the mortgage.

This feature of district finance is little understood, but is probably the most important single factor in their success.

f. Synchronization of interdependent development. The development of new communities requires simultaneous risky investments by large numbers of independent decision makers. The success and viability of each investment depends on the others. Whoever gets out ahead runs more risk, and is in that sense exploited by laggards. A giant landowner can if he will (a big "if") "internalize the externalities," and proceed on all fronts at once, needing only confidence in himself. A community of independent men needs a community synchronizer. An irrigation district serves the need. By this tool, the community as a whole makes the initial commitment--and immediately puts tax pressure on all its members to match up.

g. Compactness of settlement. By forcing inclusion of contained lands, and limiting service areas, irrigation districts achieved great savings in distribution. This saving in water supply cost, however, proved to be the least of the gains. Every other distributive network--roads, power, telephone, delivery and collection systems for farm inputs and outputs, etc.--benefited as well. The purchasing power of many small farmers was brought to focus on local towns, which responded with improved storage, packing, shipping, retailing, farm supply, and so ad infinitum. Farmers had closer contact with one another, virtually eliminating the need for self-sufficiency and vertical integration which forces many

isolated ranches and plantations to be so huge, and paternalistic or tyrannical. The way was opened for the development of "total community."

Along with the benefits, the total community suffered some of the diseconomies of regional specialization, as land taxes forced each parcel to its highest use. There is a peaking problem in seasonal demand for farm labor that may be aggravated by specialization. But irrigators responded to this with a diversification to match the specialization--both are possible when a high volume comes from a small area. The classical evils of monoculture are the product of plantations, and have been overcome by intensive irrigators.

h. Management of aquifers. As aquifers underlie large areas, and as water is pooled in them, they require unified management. Irrigation (and other) districts have undertaken this. Aquifer storage is cheaper than surface storage as a rule, and with modern developments in pumping and electric power distribution, aquifer management is the vital frontier of water supply.

i. Drainage. Every water supply creates a drainage problem, usually for someone else. There is no money in water removal, but it must be done, and it is obviously best done on a large scale under a unitary system.

j. Multipurpose river development. Irrigation districts, as semi-public agencies with tax power, have been able to justify devoting some of their reservoir space to flood control. They have also gone into power, and recreation.

k. Marshaling social surpluses to finance social infrastructure. Economic development of an area generates many spillover benefits and costs, produced by some individuals but received by others. In general, the net balance is strongly positive, that is, spillover benefits exceed spillover

costs. This creates and constitutes a social surplus. The surplus is indigenous to a limited area within which economic development has occurred, and so is in the main captured by local landowners in the form of higher rents and land values. Irrigation districts, having a first mortgage on this income, can tap it to pay for prerequisite projects of large optimal scale. Thus the surplus is harnessed to useful purposes.

Surplus-generating spillovers are of two kinds: technological and pecuniary. The technological kind is easier to understand: if my irrigation water, imported from a surface source, percolates underground, raises my neighbor's water table, and reduces his pump lifts, he benefits. The pecuniary kind is more important, more likely to be positive, more transcendent of particular technologies--but harder for the concrete mind to grasp, and therefore less appreciated. It comprises the benefits of "total community" discussed above (f, g).

Pecuniary spillover benefits are not limited to physically adjacent lands because they are transmitted not by touch but through the market. They show up mainly in towns and cities serving farm hinterlands. California's irrigation districts recognized this relationship long ago, and acquired the right to include cities and to tax their lands at market value to help finance the farmers' irrigation water. Far from resenting this, city voters have usually supported irrigation bond issues by larger margins than the associated farm voters! In a few cases they have carried them over a negative majority of farmers!

Irrigation farming in the arid western states has had a powerful impact on national markets. The irrigation district device is the prime mover. Heavy fixed charges on land prompt rapid, intensive and compact development. This in turn fosters local markets and social life and

"total community." It has made small farming economically viable, in a half century when everywhere else the trend is toward farm enlargement. In the last decade, it is true, there has been some reconsolidation inside irrigation districts: irrigation farmers are not entirely immune from the same factors of mechanization and finance and marketing that have favored consolidation elsewhere. But a greater cause has been the retirement of old bonds, and resulting reduction of land taxes and rise of land value as an investment for absentees. Whenever new districts are formed, or whenever existing districts are revitalized by new bond issues, the tax pressure on land is renewed and subdivision of land becomes again the paramount trend. Those concerned with saving the family farm and the farm community could do no better than to study and reduplicate the irrigation district experience.

2. Other levels of community action. I have devoted most of my time to discussing irrigation districts because of my various points I think that is the least likely to be available from other sources. The summary treatment of the remaining points does not indicate low importance, but limited time. You may also find an available literature on most of them.

State level action is desirable, too. The primary need is for the State to define property rights in water. In most states these rights are ambiguous and, to the extent they are clearly defined, not intelligently defined. The ambiguity is exploited by the possessors of superior rights to maximize their own position, often at considerable social cost. This begins by their gaining enjoyment of a public resource without ever paying the public anything for it--often euchering the public into paying them to develop it--and then denying that the valuable resource they enjoy