INTERACTION OF WATER SUPPLY PLANNING AND ENVIRONMENTAL PROTECTION

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The Paradox of Water -- Its Real and Rhetorical Value

The Value of Water When Diverted

A paradox arises in dealing with the value of water. The political and media rhetoric asserts its enormous economic importance. This conventional view, however, contrasts with the reality that the resource exhibits a relatively low economic value at the margin. Conceptually correct empirical estimates of the direct marginal value productivity of irrigation water usually fall in the range of $25-75 per acre-foot (Young, 1984). For the majority of crops the estimates are in the lower part of this range. Some even fail to reach the lower bound. Based on the cost of supply, the value of water in the municipal sector is no more than an order of magnitude greater.

In the intermountain states the value of water in irrigation can be as low as $10 per acre-foot in the Colorado River basin, though it is probably higher in drainages like the South Platte (Krutilla, et al. 1983). In the lower basin of the Colorado River, its value in irrigation is approximately $30 per acre-foot (Howitt, 1980). In other parts of the southwest, similar variations within the above-cited range are found. For example, in the Texas rice growing region, the value of irrigation water is probably less than $40 per acre-foot (Ellis, et al. 1984; Griffin, et al. 1984).

In other words, resources devoted to water development, conservation or management can justify a cost of only 1.5 to 3 cents per ton for irrigation and perhaps 30 cents per ton for household use. While a substantial total economic value may still be implied for large water supply projects, the point is that the marginal value of irrigation water to the user is often insufficient to justify major capital expenditures.

The Value of Water Left in Place

Having looked at the value of water used in an application where it usually has a market price, what can be said about the intrinsic value of the natural system from which it is removed? Because aquatic ecosystems -- habitats, wetlands, and streams -- are not traded in conventional markets that reflect such values, other methods must be used. There are direct methods, like contingent valuation (i.e., asking individuals their willingness to pay), and indirect methods that infer value from use. (For a thorough review of both, see Stavins, 1984). In addition, there are other survey methods that try to estimate "option values" and "existence values" that are above and beyond what individuals would be willing to pay now for an option to ensure access to, or existence of, an environmental resource in the future. Another approach is to base the value of a natural system on the cost of mitigating its loss should it be destroyed. Appropriate application of these methods can establish the value of natural systems and their associated water resources.

The statement that aquatic ecosystems are not traded in the market is not entirely true. There are states in which instream flow programs allow water rights to be purchased for the protection of natural systems. Presumably, rights are purchased at market rates and data on these purchases would provide an indication of instream flow values. Moreover, ownership restrictions found in some instream flow programs (e.g., Colorado's program prohibits private ownership of instream rights) may reflect a concern that, were a market to operate freely, instream flow values would set the price. Closing such interests out of the market suggests there may be fear, in some quarters at least, that instream values may exceed those of traditional "beneficial use" categories.

The point is: natural systems do have value, their value can be measured (if only indirectly in certain cases), and, with regard to the economic well-being of a region, the value of these habitats may be significant. Their loss cannot be left out of the accounting in water resource investment plans.

The Value of Water-Dependent Natural Systems if Lost

In the context of the loss of natural systems, a particularly interesting phenomenon arises when applying direct methods to measuring the value of a natural system. Damage or loss in well-being can be measured by either the maximum sum individuals would be willing to pay to avoid the loss, or by the minimum compensation they would require to accept it. The two were always assumed to yield equivalent results. Recent evidence suggests a strong and consistent disparity between outcomes based on paying for loss avoidance as opposed to compensation for its acceptance (Knetsch, 1984). In almost all cases, based on experimental and empirical data, the latter method yields valuations two to three times greater than the former, i.e., the compensation for the acceptance of loss exceeds the willingness to pay to avoid the loss. Such a divergence becomes particularly important when assessing the economic attractiveness of a project that would destroy a natural system.

Despite the data, in the ordinary course of discussions over the way in which a region may use its water resources, there appears to be a tendency to overemphasize its value when diverted (for example, see CACI, 1987) and underemphasize its value when left undisturbed (CWCB, 1952). In the West, the conventional argument seems to be that water must be developed to have worth; left in its natural course, it remains "unused" and, by implication, useless. It appears that the debate over water resources is based on assumptions of a growth-inducing relationship that lacks an empirical foundation (see, for example, Falkenmark, et al. 1987; Fullerton, et al. 1975; Howe, 1968; Martin and Young, 1969), an imputed value for water in certain applications that does not stand up to close examination, and an accounting system that heavily discounts the worth of the resource left in place.

The Status of Western Water Economies

Western water economies have passed from their "expansionary phase" (i.e., new supplies were readily available, few interdependencies existed among users, and -- after accounting for federal subsidies -- projects were relatively inexpensive), into what might be called their "mature phase" (i.e., costs of new supplies are rapidly escalating, water users are linked by elaborate physical systems, they are increasingly interdependent economically, and federal subsidies have evaporated) (Young, 1984). The systems have reached their present state under rules based primarily on technical feasibility, i.e., water management has traditionally been reviewed as a technical or engineering problem. Thus, the solution of problems rather than the efficient allocation of resources has been both the guiding principle and the basis for regarding achievement (Young, 1986). As a consequence, structural solutions favored by engineer-managers have led to elaborate physical systems. It should also be pointed out that believing in the hypothetical relationship between investments in water supply systems and economic development nurtured the process that led to selecting these solutions.

Given the maturity of the water supply systems, the relative value of water in agricultural and municipal applications, and the increasing recognition of instream values, we are led to question how efficient and equitable it is to continue allocating the resource and augmenting supplies in the same way we have done it in the past. Applying a Pareto optimality criterion (i.e., a system's state is said to be Pareto optimal if one entity can be made better off only at the expense of another), decisions that involve supply expansion are wasteful and inefficient. On the other hand, using the same criterion, individual irrigators, residential water customers, and commercial and industrial users are very likely to be making appropriate water use decisions. The apparent contradictions between system allocation decisions and individual user behavior is the residual of a paradox of overvaluing (but sometimes underpricing) water in certain applications while ignoring its value completely in others.

Literature Cited

Colorado Association of Commerce and Industry (CACI). 1987. Blueprint for Colorado: A plan for growth from the business community, Denver, CO.

Colorado Water Conservation Board (CWCB). 1952. A hundred years of irrigation in Colorado. Colorado Agr. and Mech. College, Fort Collins, CO.

Ellis, John R., Ronald C. Griffin, and Rod F. Ziemer. 1984. A supply-demand analysis of irrigation water use in the Texas rice belt, Dept. of Agr. Econ., Texas A&M Univ. College Station, TX. (paper presented at 1984 AAEA meeting).

Falkenmark, Malin, Asit K. Biswas, Hiroshi Hori, Tamon Ishibashi, George Kovacs, Peter Rogers and Hillel I. Shuval. 1987. Water-related limitations to local development, Ambio 16 (4): 191-200.

Fullerton, Herbert H., W. Cris Lewis, Jay C. Anderson, John E. Keith, and Reed Willis. 1975. Regional development: An econometric study of the role of water development in effectuating population and income changes, Utah Water Res. Laboratory, Utah State Univ. Logan, UT.

Griffin, Ronald C., Gregory M. Perry, and Garry N. McCauley. 1984. Water use and management in the Texas rice belt, Dept. of Agr. Econ. Texas A&M Univ. College Station, TX.

Howe, Charles W. 1968. Water resources and regional economic growth in the United States, 1950-1960, So. Econ. J. 34(4) 477-489.

Howitt, Richard E., William D. Watson, Richard M. Adams. 1980. A reevaluation of price elasticities for irrigation water, Water Resources Res. 16(4): 623-628.

Knetsch, Joel L. 1984. Legal rules and the basis for evaluating economic losses. Intern. Review of Law and Econ. 4: 507-521.

Krutilla, John V., Michael D. Bowes and Paul Sherman. 1983. Watershed management for joint production of water and timber: A provisional assessment, Water Resources Bul. 19(3): 403-414.

Martin, William E. and Robert A. Young. 1969. The need for additional water in the arid southwest: An economist's dissent, The Ann. of Regional Sci. 3(1): 22-31.

Stavins, Robert. 1983. The Tuolumne River: Preservation of development? An Economic Assessment, Environmental Defense Fund, Berkeley, CA.

Young, Robert A. 1984. Local and regional economic impacts of competition for irrigation water In: E.A. Englebert and A.F. Scheuring, eds., <u>Water Scarcity: Impacts on Western Agriculture</u>, Univ. of CA. Press, Berkeley, CA. 244-272.

Young, Robert A. 1986. Why are there so few transactions among water users? Amer. J. of Agr. Econ. 68(5): 1143-1151.