Water Pricing and Marketing Issues

Water Pricing: An Overview

Charles W. Howe
University of Colorado-Boulder

What is the Price of Water?

The Northern Colorado Water Conservancy District distributes about 250,000 acre-feet of water per year from the Bureau of Reclamation's Colorado-Big Thompson Project (C-BT) to irrigators, rural water districts, large industries and towns in northeastern Colorado (see Tyler, 1992 for a detailed history). The District charges irrigators about $3.50 per acre-foot for water delivered to their shares in the District (so-called allotments). Cities and industry pay about $7.00 per acre-foot. The remaining costs of the District, including the repayment of the capital costs of the original C-BT Project, are paid from real estate taxes levied against all urban and rural real estate in the District.

The cities that use C-BT water have various pricing schemes. Fort Collins residential users are mostly unmetered and pay a flat fee of $17.47 plus $0.12 per 100 ft.^{2} of lot area per month. Boulder has an increasing block rate structure for residential users of $1.16 per thousand gallons for the first 6,000 gallons, $1.42 per thousand for the next 15,000 gallons, and $2.56 per thousand after that. In addition, there is a waste water treatment fee that depends on winter water use. Longmont is partly metered and partly unmetered.

There is an active market for shares (allotments) in the Northern District. The market is limited to the boundaries of the District, with a current market price of about $1,600 per share. Since the shares, on average over the years, deliver 0.7 acre-feet per share per year, this implies a price of about $2,300 per acre-foot for a perpetual supply or perhaps about $185 per acre-foot per year using an 8% interest rate. In addition, there is an annual market for the temporary use of C-BT water—the "rental" market in which share holders sell excess water to other users on a one-year basis. These "rental" prices range from $7.50 to $25.00 per acre-foot depending on time within the growing season (usually higher prices later in the season) and on snowpack and rainfall conditions.

So, what is the price of water in northeastern Colorado? There are many different prices, depending on what type of water user you are, where you are located, etc. If price is thought of as revenue, then the real estate tax constitutes a large part of total revenue for the District.

The correct definition of price should be "the amount paid per unit of water withdrawn from the supply system, for the *next* (or marginal) unit withdrawn." This is the correct definition because it is the *behaviorally relevant* measure of the cost incurred by the water user in using one more unit. It is that cost that a rational user will compare with marginal benefits in deciding how much water to apply.

Types of Decisions Affected by Water Price.

In the short term when water users' technologies and markets are pretty well fixed, the price of water (as defined above) will affect the quantities withdrawn from the supply system. If your lawn watering is about to move you into Boulder's most expensive block, and *if* you are aware of that, it may induce you to calculate your water applications more carefully. This decision will not be affected by other dimensions of the total "financial package" (or revenue structure) such as monthly fixed charges, charges per 100 ft.^{2} of lot area, sewage fees, or "up front" hook-up fees.

In the longer term, other types of decisions *will* be affected by these other dimensions of the financial package. Under the Fort Collins charge of $0.12 per 100 ft.^{2} of lot area per month, some house buyers might seek smaller lots, or if the lot area refers to *irrigated* area, many households may turn to xeroscaping or other ways of reducing the irrigable area.

In Denver, the current "hook-up" charge for a typical single-family residence is about $5,000, while the fee for an apartment is $2,800. Over time, this cost difference will affect decisions on types of housing to be built and will thereby affect the structure of the city.

The farmer applying irrigation water to corn or alfalfa within the Northern District might consider the cost (price) of water to be the District's annual charge of about $3.50 per acre-foot, but all farmers today are astute business managers and would immediately understand that they are foregoing short-term (rental) revenues of up to $25 per acre-foot and the possibilities of longer-term revenues (from permanent water sales) of as much as $185 per acre-foot.

Thus, the relevant measure of *cost* to the water user depends on the question being asked. In some cases, it is the price of water (as defined above) and in other cases the relevant cost contains other elements of the water supply "financial package."

The Conflicting Roles of Water Price

From the viewpoint of efficient allocation of resources over time, the primary function of water price is the efficient allocation of existing supplies in the short run and the provision of needed information for the optimal expansion of supply capacity over time.

In the short run, the delivery capacity of a supply system is fixed. Since price presumably (see below) affects the quantities users demand, price can be used to adjust demand to the available supply. During drought periods when demands are high and supplies low, price can be raised to reduce demands. Variations on this theme would include seasonal pricing (with higher summer prices, reflecting the higher costs of providing the higher flow rates demanded) and even time of day pricing to encourage users to diversify the timing of their demands during the day.

Why is price a good way of rationing water among users under fixed delivery capacities? We can assume that water users compare marginal benefits with marginal costs when deciding on changes in water use patterns. If all water users (of a particular class of user, say, residential users) face the same price, each will adjust their water use until their marginal benefits fall to equality with the price. All users in that class then exhibit the same marginal benefits—a common sense necessary condition for maximizing the total benefits from the use of available water. Naturally, there are other ways of rationing the available supply such as requesting cutbacks, requiring even-odd day watering, or prohibiting certain uses. While these rationing mechanisms often work, none of them guarantees that water will be distributed to the users who place the greatest value on the water, nor can users choose what types of use are more valuable to them. Naturally, some people will object on equity grounds to raising price during periods of shortage, but devices such as "life line" rate structures with a low price per thousand gallons for the first few thousand gallons can remedy these situations.

In the longer term, price *may* be of use in helping to determine optimum supply expansion over time. Looking again at the Northern District in Colorado, if water demands in the region grow, the price of District shares will rise. That price indicates the marginal value of added supply for the collective of water users. If the price rises to equality with the unit cost of the best available supply project, it could tell us that the new project is now warranted.

In fact, there are not too many situations where the price of water is free to respond to changes in the demand and supply situation. In urban systems, the price structure is determined by management since there is no free market. In some rural areas, the market for irrigation water is greatly restricted or even non-existent because the water supplies are from state or federal projects that contract with specific water users and price the water to cover historical construction costs and current O, M & R costs.

Another major function of price is the production of revenues for the water supply agency. Naturally, all components of the "revenue package" contribute to revenues. Whether increases in price (as defined above) will produce more or less revenue depends upon the responsiveness of users to price. Economists call this responsiveness the "price elasticity" of the user's demand for water.

There is a vast literature on the price elasticity of water demands in residential, industrial and agricultural uses (Renzetti, 1992; Schneider and Whitlatch, 1989; Nieswiadomy, 1990; Howe, 1982; Foster and Beattie, 1979; Boland *et al*, 1984; Billings and Agthe, 1980; Tate, 1990). The consensus conclusion is that residential and industrial demands (except for cooling water) are "inelastic" while agricultural demands are "elastic." Elasticity is defined as the percentage change in quantity demanded divided by the percentage change in price. It follows that, for "inelastic" demands, if price is raised, revenue collections also will rise; while for "elastic" demands, an increase in price will reduce revenues. Thus, a key to financial planning for water utilities is knowledge of demand elasticities.

Another consideration in water pricing is fairness or equity among water users. It is often asserted that raising the price of water or charging for it where it has historically been free will "hurt the poor" or be unfair to them. This may be a substantive issue in Third World countries where much of the population is at subsistence level, but in advanced countries, the fairness issue can be handled through "life line pricing" (as defined earlier). This is not to say that poverty isn't a problem in advanced countries, but lowering the price of water is an inefficient way of dealing with the problem.

Pricing and Water Quality

The pricing of irrigation water greatly affects the quantity of water applied to crops. It thus affects the volume of run-off and deep percolation that occurs. The results can be quite bad: water logging of the soil, drainage onto lands at lower altitude, and the solution and carriage of toxics and heavy metals from the soil and sub-soil. This is precisely the story of the Kesterson Reservoir in California which was poisoned by selenium from the drainage waters of the Westlands Irrigation Project (National Research Council, 1989). The State of California and the Bureau of Reclamation wanted to treat this as a drainage problem while the real origins of the problem were too cheap water (far below cost) from the State Water Project and the (federal) Central Valley Project and the large agricultural subsidies that made it privately profitable to open up irrigated lands that weren't appropriate for irrigation and weren't needed in the face of surplus supplies nationally.

In the administration of water quality, water pricing is again important. Imagine a town that uses water and returns a fraction of it to the municipal waste water treatment plant. The treatment plant, after primary, secondary and perhaps tertiary treatment returns the flow to the river. How is pricing relevant to this cycle of water use and waste disposal?

First, prices charged to residential, commercial, and industrial users will affect the quantity of water they withdraw and thereby the volume that returns through the sanitary sewer for treatment. The concentration of pollutants in the waste flow is thus affected and will affect the costs of treatment. While residential users have little freedom in adjusting their water-borne waste loads, commercial and industrial water users have a wide range of technology, input and product choices that affect their water-borne waste loads. Thus, charges on the waste flows from commercial and industrial establishments (i.e. prices for pollutants) will induce changes to lighten the pollution load. Toxics, heavy metals, etc. should be prohibited.

In the final step of this chain of events, the treated effluent is poured into the river, and the sanitized sludge is applied to farmland. The latter disposal operation is beneficial to farmers but involves costs of sludge treatment, transport and application. The nutrients that enter the river cause damages to other water users, and these damages should be reflected in charges (taxes) against the outflow of nutrients. These discharge taxes have been heavily promoted by economists and are widely used in Europe (but not in the U. S.).

Conclusions

We see that water prices, appropriately set and applied at different points of the water supply and use cycle, perform many valuable functions, namely to confront water users with the costs of providing water, to help signal water suppliers when supply augmentation is needed, and to help shape a rational approach to a healthy water environment.

Many pricing improvements need to be made. Irrigation water and waste water disposal need to be priced more in keeping with the total costs involved. City water users should be metered and, in most cases, charged according to an increasing block rate schedule. Urban hook-up fees should be raised to a level reflecting current raw water development plus treatment and distribution investment costs.

The regulations surrounding water pricing by supply agencies (urban utilities, rural companies) need to be reconsidered to allow more appropriate levels of prices and greater freedom to change price under changing conditions. Most utilities have a "zero profit" constraint that means they can reflect only O, M & R costs in the prices they charge. During drought, this means that raising prices is ruled out (except for the unlikely case of elastic demand). It may preclude building up sinking funds for future expansions. For many cities in the western U. S. which acquired their raw water supplies (water rights) long ago, the "zero profit" constraint means that the value of the raw water being used is not reflected in the water prices charged. City accounting practices should be changed to carry those water rights on the books as *assets* of great value and to count as a current cost reasonable interest charges on the value of those rights.

A final needed change relates to undoing or overcoming the effects of past inappropriate pricing of water. This is especially needed in the case of water (and electric power) provided by federal projects (Bureau of Reclamation and Corps of Engineers) where water is distributed to irrigation districts under long-term, fixed-price contracts. The resultant under- pricing of water is reflected in higher farm profits and hence into higher farm land prices. The same is true for the users of under-priced federal power. Any change in pricing policy, including changes that *should* occur upon renewal of the long-term contracts, will be translated into changes in farm and business profits and land values. Naturally, such a change will be resisted by the irrigated farming community and their political representatives.

It could be argued that this historical under-pricing of water was at least in part an intentional policy of the national government that should not be changed to the detriment of the intended beneficiaries without some compensation. The equity of this argument can be argued both ways ("They had it so good for so many years, why more?"), but there is no need to hold up the rational reallocation of water from agriculture (worth $30 per acre-foot at the margin) to growing urban and recreational uses (where marginal values are reflected in willingness-to-pay for new sources of water of $400 to $800 per acre-foot) because of equity concerns. *Water markets* will allow current water contract and water right holders to decide whether or not to sell some or all of their water. Many will decide to sell and will thereby receive the *capitalized value* of the subsidies created by their contracts. The water will then move to better uses, farm subsidies and surpluses will fall, and water owners will receive full compensation (Wahl, 1989). There are hundreds of such "win-win" opportunities in water pricing in the U. S. today.

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Chuck Howe is Professor in the Department of Economics and The Research Program on Environment & Behavior at the University of Colorado-Boulder.