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Volumetric Water Pricing and Conjunctive Use: Alta Irrigation District

By Juliet Christian-Smith and Chris Kaphiem

Introduction

Public interest in the issue of irrigation water pricing has increased worldwide in recent years, with a growing awareness of water scarcity and a greater appreciation of the opportunity costs of allocating water among competing uses (Wichelns 2010). Much of the irrigation water in the western U.S. is developed and delivered by state and federal agencies, including the U.S. Bureau of Reclamation and the California Department of Water Resources. These agencies rarely work directly with farmers; rather they typically enter into contracts to supply water to irrigation districts that represent groups of farmers. These quasi-public entities collect fees from their members to pay for the costs of capital, operations, and maintenance of their delivery facilities and to pay the state or federal agency for the water supply (Wichelns 2010).

Irrigation water pricing can serve as a financial policy tool, an economic policy tool, and an environmental policy tool (Molle and Berkoff 2008). Irrigation water pricing can serve as a financial policy tool by ensuring that some portion of the costs of constructing, operating, and maintaining an irrigation project is repaid. Irrigation water pricing can serve as an economic policy tool by encouraging efficient water use through higher prices for inefficient water uses. Irrigation water pricing can serve as an environmental policy tool when rate structures are designed to protect or enhance surface and groundwater sources. For example, volumetric water pricing – where water users are charged based on the volume of water that they use – can serve as an incentive to use water wisely (economic tool) (Wichelns 2010).

Many water suppliers in the U.S. charge by volume in order to recover costs and in order to ensure that costs are spread equitably amongst water users. Volumetric water pricing has been advocated by the World Bank and other international donors, and is mandatory in many projects in the western U.S. that receive water from federally-owned reservoirs (Burt 2006). However, there are still many agricultural water suppliers that charge a fixed fee, which is generally based on acreage and crop type rather than by volume of water that is used. A new law in California requires that all large irrigation districts (serving more than 25,000 irrigated acres) adopt volumetric water pricing (e.g., Water Conservation Act of 2009, Senate Bill x7-7). Before volumetric pricing can be implemented, the district must ensure several necessary pre-conditions are met, including the ability to measure the volume of water delivered to users, the capacity to manage data related to water orders and billing, and the implementation of an equitable fee collection mechanism (Burt 2006). In addition, as a result of California Proposition 218, any changes to local fee collections, including water rates, must be approved by a majority of water users. This case study explores how Alta Irrigation District has successfully implemented a volumetric water rate structure with widespread support.

Alta Irrigation District, like many others, overlies a groundwater aquifer that is an important water supply for its customers. Due to unreliable water deliveries from many state and federal water projects as well as severe overdraft of local aquifers, the district is engaged in an active conjunctive use program. “Conjunctive use” refers to coordinating the use of surface water and groundwater to improve the overall reliability of water supply. In general, when surface water supplies are plentiful, they are either used by water customers in lieu of groundwater or diverted to recharge groundwater reserves. Groundwater is then used during dry periods when surface water is less available. Surface water can recharge groundwater basins through both natural and artificial means. Natural or incidental recharge results from percolation into the basin through natural waterways, fed by rainfall, snowmelt, or excess water applied for crop irrigation. Artificial recharge replicates and promotes natural processes by capturing and retaining water in surface impoundments (dams, dikes, and infiltration areas) to allow water to percolate into the underlying basin. Another form of artificial recharge is direct injection of water into groundwater basins through injection wells. An additional form of recharge is “in-lieu,” which refers to the groundwater that remains in basin when groundwater users switch to surface water instead of pumping from aquifers. Whether physical or in-lieu recharge methods are used, groundwater is stored in the basin for later use (see Groundwater Banking case study).

Background

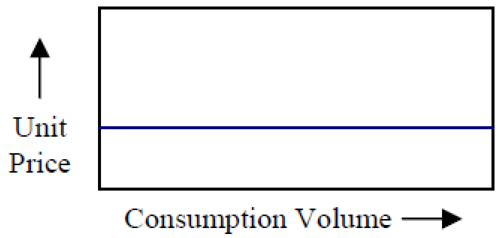
Water Charges and Rate Structures

Costs of supplying irrigation water vary widely, reflecting different combinations of water sources, suppliers, distribution systems, and other factors such as field proximity to water, topography, aquifer conditions, and energy source. Thus, there are numerous ways to design individual water pricing structures. District water rates often consist of a combination of fixed charges or stand-by charges and volumetric charges, described below:

- Fixed charges: Districts may assess a fee for each acre of land in the service area; this may also take into account the crops that are grown on that land (as some crops have higher water requirements than others). Districts may also choose to assess a fee for access to district surface water and delivery service regardless of whether or not the land is in production (often called a stand-by charge).
- Volumetric charges: Districts may assess a per unit charge for each acre-foot of water delivered.

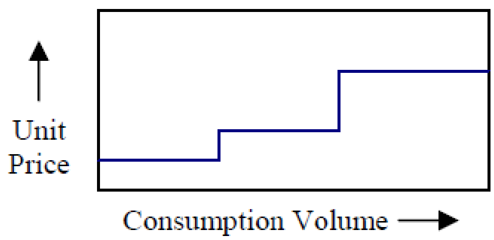
Volumetric charges can be organized into different water rate structures from uniform rates to increasing/decreasing block rates or tiered rates, to seasonal rates, described below.

- **Uniform rates:** The unit price for water is constant, or flat, regardless of the amount of water consumed.



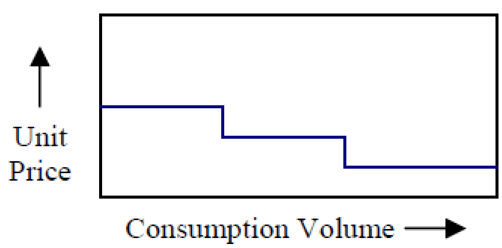
Source: Western Resource Advocates 2006

- **Increasing block rates:** The unit price for water increases as the volume consumed increases. This structure consists of a series of price blocks, where the unit prices for each block increase as the block volumes increase. Those who use low or average volumes of water will be charged a modest unit price; those using excessive volumes will pay higher unit prices. A variety of approaches can be applied to setting each block volume.



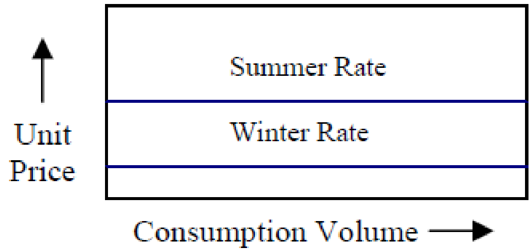
Source: Western Resource Advocates 2006

- **Decreasing block rates:** The unit price for water decreases as the volume consumed increases. Similarly to increasing block rates, the structure consists of a series of "price blocks," which are set quantities of water sold at a given unit price. The unit prices for each block decrease as the block quantity increases.



Source: Western Resource Advocates 2006

- **Seasonal rates**: The unit price for water is set to vary from season to season. For instance, summer or pre-irrigation season water rates are set higher than winter rates in order to reflect the fact that water is more valuable, and costs more to provide, in the spring and summer. Seasonal rates can be flat, uniform, increasing or decreasing.



Source: Western Resource Advocates 2006

It is important to consider the incentives that are created by water charges as well as water rate structures. For instance, increasing block rates can be used to incentivize conservation and efficiency, while decreasing block rates may encourage waste. Seasonal rate structures can provide incentives to use or store water when there is more water available to the district. Finally, districts may implement pricing or other financial incentives to improve the conjunctive use of surface and groundwater supplies. In dry years water suppliers may encourage, through higher prices for surface water, pumping more groundwater and leaving surface water for other uses such as environmental benefits. Conversely, in wet years pricing may be used to encourage greater surface water application to facilitate recharge. Conjunctive use is an issue in Alta Irrigation District and will be described further below.

Conjunctive Use

The groundwater basins that underlie the Central Valley contain one-fifth of all groundwater pumped in the nation and are, in effect, California's largest reservoirs. In 2009, the United States Geological Survey (USGS) released a long-term analysis of groundwater levels in the Central Valley based on GRACE data. Among the study's major findings were significant declines in groundwater levels over the last forty years (Faunt 2009). These declines have been primarily driven by the overdraft in the San Joaquin Valley. Between 1962 and 2003, an average of 9.1 million acre-feet of water went into storage annually, and an average of 10.5 million acre-feet were removed annually (Faunt 2009). Thus, in typical years the net loss in groundwater storage was about 1.4 million acre-feet.

Groundwater overdraft is particularly severe during dry periods, when the data show that not only the Tulare Basin but also the Sacramento Valley and San Joaquin Basin pump more groundwater than is replenished. A more recent study (Famiglietti et al. 2011) finds that groundwater levels in the San Joaquin Valley dropped 2-to-6 feet per year from October 2003 – March 2009 while groundwater levels in the Sacramento Valley dropped a less extreme 0.3 to 0.5 feet per year over that same time period (see Figure 1). Overall, the Sacramento-San Joaquin River Basin lost approximately 25 million acre-feet over the time period – roughly the capacity of Lake Mead, the largest reservoir in the U.S. (Famiglietti et al. 2011). In addition, during the drought years, groundwater storage declined by over 29 million acre-feet (Famiglietti et al. 2011). Therefore, the reduction in the volume of total groundwater during the drought was 48 times greater than pre-drought reductions over same number of years.

California's Water Code provides for an astounding array of over 20 types of local water agencies that may be established anywhere in the State (Cal. Dep't of Water Resources, 2003, p.34, Table 32). On the ground, there are about 2,300 of these agencies that may have interests in groundwater. These agencies may supply groundwater to their customers, or supply surface water to customers who also use groundwater. These districts may also wish to protect their groundwater resource because they plan to use it as a source of supply in the future. Such agencies include California water districts, county water districts, irrigation districts, reclamation districts, water conservation districts, water replenishment districts, water storage districts, and waterworks districts (Nelson 2011). The Alta Irrigation District actively manages its surface and groundwater resources conjunctively to provide greater water supply reliability, particularly in dry years. They do so through a series of groundwater recharge and banking projects and a commitment to increased agricultural water efficiency. In the words of Chris Kapheim, "The best groundwater recharge program is to turn off the pumps [reduce water demand]….That's why we encourage water conservation."

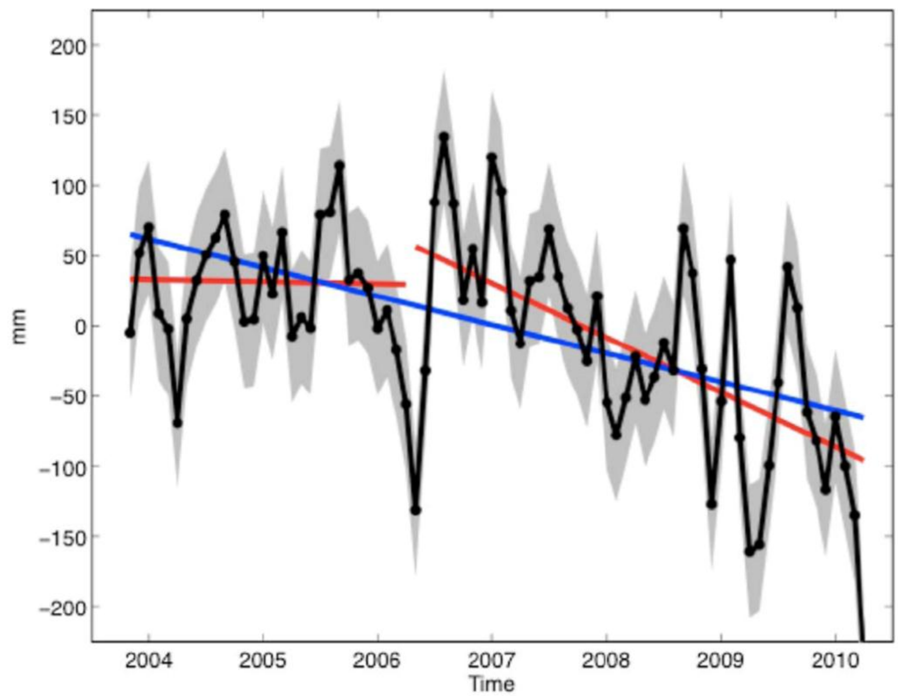


Figure 1. Groundwater storage depth (mm) changes in the Sacramento-San Joaquin River Basins, 2003-2010
Source: Famiglietti et al. 2011
Note: Red lines indicate separate October 2003 – March 2006 (pre-drought) and April 2006 – March 2010 (drought period) trends in groundwater storage; the blue line is the overall trend in groundwater storage from October 2003 – March 2010; gray shading indicates monthly errors.

Case Study: Alta Irrigation District

Alta Irrigation District is located on the east side of the San Joaquin Valley, in Tulare, Fresno and a small portion of Kings Counties. The towns of Dinuba and Reedley are within the district's boundaries. The district's surface water supply is from the Kings River, which is stored in the Pine Flat Dam. The district boundaries encompass approximately 129,000 acres, with 111,000 cropped acres. The district operates 250 miles of open canals and 75 miles of pipelines.

Alta Irrigation District supplies water to users on a modified arranged schedule. Surface water users that flood irrigate can do so only about once every 15 days, according to the ditch-tender's schedule. Growers using drip or micro-spray irrigation have more flexibility in their water ordering (they can take smaller flow rates more frequently). Water users place water orders by calling ditch-tenders' cell phones directly. Water users can operate their own turnouts.

Volumetric Pricing

The district began considering a volumetric basis about ten years ago. The decision to shift to volumetric pricing was related to a strategic planning process undertaken by the district’s Board of Directors. The planning process illuminated the district’s financial problems, as it was not raising enough revenue for basic operation and maintenance costs, and called for a cost-of-service study to determine how much it actually cost the district to deliver water. The cost-of-service study concluded that large water demands (long water runs) had larger costs associated with them, and these costs should be collected from those that requested the longer water runs. In 2005, the Board unanimously approved an increase in fixed water rates and a volumetric surcharge.

In order to price water based, at least in part, on volume, a district must first accurately measure the water delivered to individual farm gate turnouts. In the Alta Irrigation District, water volume is measured at farm turnouts using a modified constant head orifice and recording the time the turnout is opened and closed. Ditch-tenders in the Alta Irrigation District now use computer systems to input this information, reducing human error. District General Manager, Chris Kapheim, estimates that these measurement devices are +/- 10% accurate.

Figure 2. District staff measuring water at a modified constant-head orifice turnout in an Alta Irrigation District canal

Before changing the water rate structure, Alta Irrigation District conducted cost-of-service studies to determine how much it actually cost to deliver water and how those costs should be allocated amongst users. Based on the results, the Board proposed creating a volumetric “surcharge.” The district conducted extensive outreach to customers about the proposed water rate changes, including sending out a mailing with frequently asked questions and information about public workshops where the water rate changes would be discussed.

Water pricing is a combination of a flat fee and a volumetric charge. Irrigators pay a per acre fee of $19.95 (100% entitlement areas), which covers fixed costs such as insurance and debt service. In addition, the district covers variable costs through a volumetric rate of $4.10 per acre-foot of water. Kapheim states that this pricing structure has helped his district have more revenue stability and be more equitable: “Our surface water costs reflect the cost of service to turnouts during a water run. There are considerable costs associated with a long water run. Before, everyone had to pay for that, now the person who benefits from the use of surface water pays for it.” The price structure went through a Proposition 218 election and was supported by a majority (62%) of landowners. Kapheim credits extensive outreach to customers as one of the reasons why the water rates were approved.

TABLE 9

FUTURE DISTRICT OPERATIONAL BUDGETS

Volumetric Water Surcharge		**$3.65**		**$3.76**		**$3.90**		**$4.10**
Fiscal Year		**06/07**		**07/08**		**08/09**		**09/10**
Water Run Revenues								
Water Surcharge	$	365,000	$	376,000	$	390,000	$	410,000
Water Surcharge Penalty		500		500		500		500
Pine Flat Power Income 50%		84,476		84,476		84,476		84,476
Total Water Run Revenues	$	449,976	$	460,976	$	474,976	$	494,976
Water Run Costs								
Maintenance Ditchtender Trucks	$	8,000	$	8,400	$	8,800	$	9,200
Fuel - Ditchtender trucks		30,000		33,000		36,000		39,000
Cell Phone - Ditchtenders		6,000		6,000		6,000		6,000
Answering Service		400		400		400		400
Algicide		24,000		24,000		24,000		24,000
Operational Payroll		263,423		270,535		277,840		285,342
Payroll Tax/Benefits		84,885		87,177		89,531		91,948
Drop Boards		6,100		6,400		6,800		7,200
Total Water Run Costs	$	422,808	$	435,913	$	449,371	$	463,090
Add reserves for maintenance of pipeline:	$	25,000	$	25,000	$	25,000	$	25,000
Net Operational Cash Flow	$	2,168	$	63	$	605	$	6,886

Figure 3. Alta Irrigation District operational budget 2006-2010, including volumetric water surcharges

Conjunctive Use and Conservation

The groundwater basin utilized by the Alta Irrigation District is currently over drafted and well levels have fallen precipitously in some areas. For years, the district has understood the importance of both surface water and groundwater to their ability to supply their customers. In 2008, the District initiated a series of groundwater management projects to address the increasing, localized overdraft. The district, in partnership with the City of Dinuba, developed a recharge project to collect storm water and other surplus surface water in a series of basins comprising 28 acres along with the Harder Pond Project. Subsequently, the Traver Pond Project was planned to compliment the Harder Pond Project in collecting storm water and agricultural runoff. These projects will capture and conserve two million gallons of water per day, which will then be treated and provided as drinking water to an area currently limited to groundwater that is not sustainable on a long-term basis. The location of these projects and the corresponding depth to groundwater in the fall of 2008 to the fall of 2010 is shown in the following groundwater maps (Figures 4a and 4b).

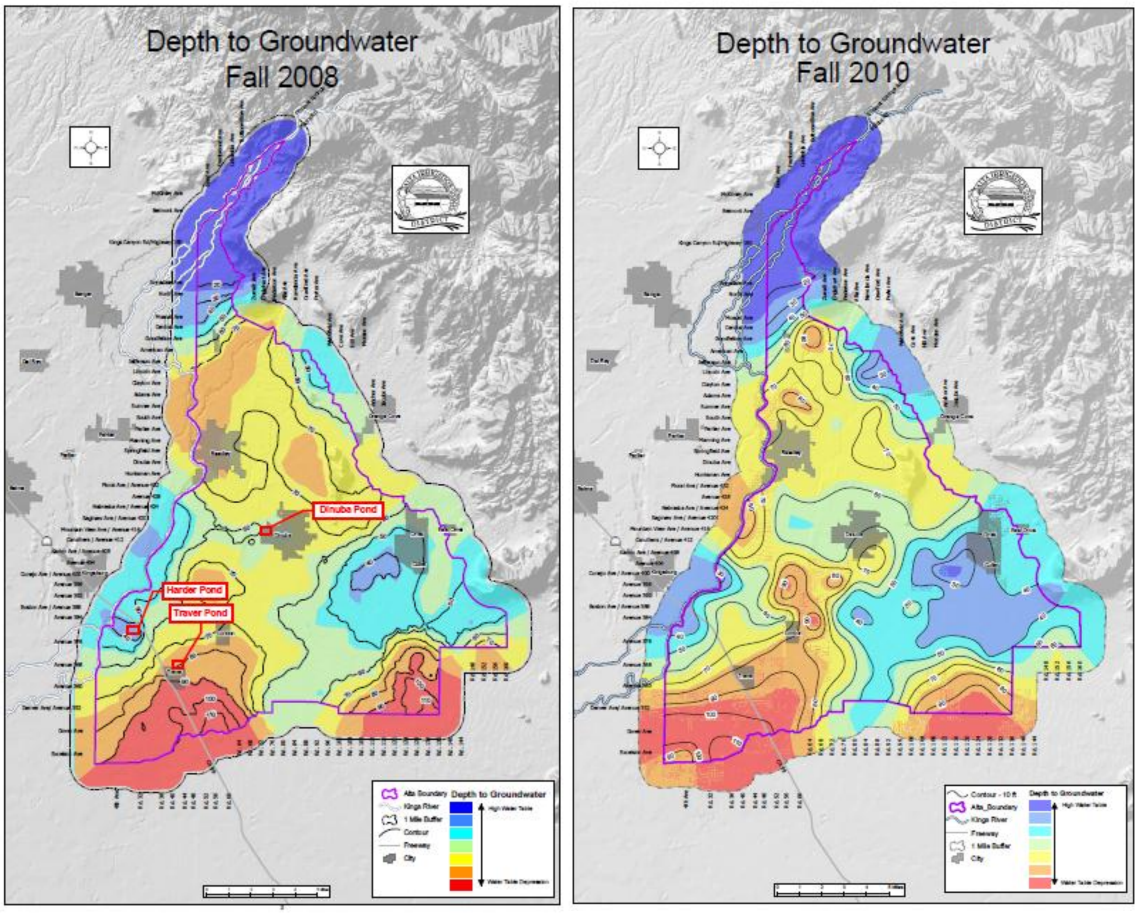


Figure 4a and 4b. Depth to groundwater in Alta Irrigation District, Fall 2008 and Fall 2010 (Alta Irrigation District 2010)

In 2008, the District implemented the Harder Pond Banking Project to recharge stormwater and other surplus water supplies in the westerly portion of the District. The project will enable the District to direct water supplies to designed recharge areas and by means of extraction wells, to make more efficient downstream agricultural deliveries. The District is also moving forward with the Traver Pond Banking Project, which will also allow water to be recharged and extracted for downstream agricultural deliveries. The Harder and Traver Banking Projects are designed to conserve and thus generate the two million gallons per day of potable surface water for the proposed surface water treatment plant to serve Cutler and Orosi (Alta Irrigation District 2010).

Water banking is an important tool available to the District enabling it to better utilize available water supplies. The water banked will necessarily exceed the extraction amount. The banked water will bolster the groundwater in the immediate area of the banking project. The water extracted will be utilized to supplement the surface water deliveries, thereby reducing downstream groundwater extractions. Additional locations for future banking projects will continue to be evaluated by the District. Where suitable locations are found and it is determined additional water is available to effectively utilize the site, the District will seek additional funding. Expansion of the Harder and Traver Pond sites will also be considered.

Yet, Chris Kapheim stresses that improved water efficiency is the best groundwater recharge strategy because it reduces demand that draws down groundwater in the first place. Alta Irrigation District's water conservation efforts have required partnerships with local, regional and state interests. Initially, Alta Irrigation District worked with several local irrigation districts to initiate a regional water conservation program. Subsequently, cities and environmental interests were added to form a joint powers agency to address regional water conservation issues (see Integrated Regional Water Management case study). The regional conservation program has allowed Alta Irrigation District access to funding under California's integrated regional water planning program that resulted in improved surface agricultural water deliveries, enhanced groundwater recharge and flood control, and opportunities to address groundwater quality issues.

Conclusion

Alta Irrigation District's Board of Directors has taken a long-term approach to managing its water resources, engaging in strategic planning that has focused on maintaining its fiscal solvency and enhancing its water supply reliability. In order to achieve these goals, the district has implemented a variety of programs, including volumetric water pricing, active groundwater recharge and conjunctive use, and a focus on agricultural water use efficiency. The results have been positive as groundwater levels have begun to rebound in the district, agricultural water demand has decreased, and the district has balanced its budget. General Manager, Chris Kapheim, devotes much of this success to the Board's commitment to long-term planning.

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