

Volumetric irrigation water pricing considerations

Charles M. Burt

Abstract Volumetric water pricing is a popular topic within donor agencies for irrigation project modernization and sustainability. Implementation of an effective pricing program is quite complex and requires consideration of physical modernization, fee structure, enforcement procedures, and the level of water delivery service. Variations of volumetric water pricing and allocation are discussed.

Keywords Irrigation charges · Irrigation modernization · Volumetric · Volumetric water deliveries · Flow measurement · Water pricing

Introduction

Volumetric pricing has been advocated by the World Bank and other international donors, and is mandatory in many irrigation districts in the western U.S. that receive water from federal projects. Other irrigation districts in the U.S. charge by volume for their own fiscal health, although they are not required to do so by any law. However, volumetric pricing at a self-sustaining level, and the successful collection of the bills, are still uncommon in the vast majority of irrigation projects in the world.

A special social challenge for some projects interested in volumetric allocations or charges occurs if people consider water as a free “right” and do not understand that there are expenses involved in capturing and distributing the water. In other cases, some people interpret any discussion about volumetric pricing as a discussion of water as a commodity to purchase or sell—whereas volumetric allocation/pricing may be considered simply as measures that are needed to maintain/establish equity with a limited project water supply, and to recover costs.

Historical, topographical, hydrological, and social differences in irrigation projects throughout the world have created many variations of dealing with water as a “volume”. In

C. M. Burt

Irrigation Training and Research Center (ITRC), California Polytechnic State University (Cal Poly),
San Luis Obispo, CA 93407, USA

south Asia, irrigation designers and managers typically talk about water in terms of “water duty”, which means “flow rate”. Perhaps because of the predominance of run-of-the-river systems in many areas of south Asia, managers and designers are not accustomed to thinking about or managing water deliveries volumetrically.

In projects with reservoir supplies, a specific volume is often available for distribution in a season. Therefore, engineers and managers in these types of projects are more inclined to think in terms of unsteady flow, in which *flow rates* are constantly changed for various periods of time, to make the best use of an available *volume* of water.

Some forms of volumetric water management are:

1. *Volumetric limitation*. A specified volume of water is available to a project, water user association, or individual user for a season or year. In general, once a volume has been used, there is no more water available.
2. *Field irrigation scheduling* using the knowledge of soil–plant–water relationships. “Plant water requirements” are variable water volume requirements that correspond to the plant type, weather, and stage of growth of the plant.
3. *Water transfers*. Water sales to industry, municipalities, or between farmers or irrigation projects are generally described in volumetric terms. Implicit in discussions of water transfers are the notions that:
 - a. Water volumes are measured.
 - b. Users have a legal water right to own, sell, and transfer a volume of water.
4. *Water charges*. There are many ways to charge for irrigation service, including one or more of the following:
 - a. No charge at all.
 - b. A per-area fee.
 - c. A per-crop fee.
 - d. A per-irrigation fee.
 - e. A *charge per volume of water used*. Volumetric water charges may or may not be associated with volumetric allocations.

Justification of volumetric charges for water

Historical precedent

Most irrigation projects worldwide were developed totally or almost totally with government funds—with little or no involvement of water users in the original design, administration, or operation of the projects. Often there is no fee for water delivery service, or if there is a fee it is typically very small and there is a low collection rate. Therefore, the concept of charging a *significant* water fee is typically new. Fee payment requires an attitude shift by both farmers and project personnel, as well as the development of rules and mechanisms for charging and collecting fees. Often major hardware, operational, and political changes must take place to be able to implement a successful fee program of any type, with volumetric fees representing a huge shift in technology and attitude.

Irrigation as a business

The majority of irrigation projects that successfully charge volumetrically have administrations that were formed by the water users, and have water user associations that are

recognized by viable state or national water codes. In the western U.S.A., many of the original organizations were private “mutual water companies” with their own water supplies that eventually converted to quasi-governmental organizations under state water laws due to financial advantages that are not available to private companies. These projects may purchase all or part of their water from state or country government organizations, yet are economically self-sustaining.

The founders of these business units understood the need for investment and fiscal responsibility. Because the units were self-initiated and self-governed, the general concept of providing good water delivery service to customers always existed.

Additionally, the concept of *payment* for service has existed since the origin of these projects. Although many western U.S.A. irrigation districts originally charged for water by acreage or by crop type, the charges were typically sufficient to guarantee fiscal health of the districts. Recently (in the past 20–30 years), approximately 80% of the more than 100 irrigation districts in California have switched to volumetric charges, in which individual users pay based on the volume of water used per individual field. That money is collected by and retained by the irrigation districts (water user associations). In turn, the irrigation districts pay their suppliers for any water that is purchased, invest in modernization, pay for operation and maintenance, etc.

One justification of volumetric charges for irrigation water by farmers is this:

Water users (farmers, residents, industry) are able to survive and prosper because water is delivered to them. Therefore, it is only correct that they pay for project expenses in proportion to the volumes of water that individuals, or groups of individuals, use.

The manner in which this “pay-for-what-you-get” justification is translated to successful implementation of a volumetric charging program will depend upon many factors, including:

1. Whether water users have accepted the simple justification that they should pay for the irrigation system. This reluctance to pay for irrigation project costs can be exasperated by politics, local bullies, and destitute farmers trying to cope with falling crop prices. It may also be generated by a perception that charges are too high, and the charges do not accurately reflect the level of water delivery service that is provided to the users. Furthermore, the water users may have no input into the costs of investment, and the costs may exceed their abilities to pay.
2. Whether “Volumetric Charging” is used as a new way to fund improved water delivery service, or if it is simply a slogan for a new billing technique.

Volumetric allocation and charging does have an inherent new cost. There are additional administrative and hardware costs associated with “volumetric charging” because of the need to keep good records and to have accurate flow rate measurement devices.

The “service concept” of water delivery states that water is valuable and should be delivered in as usable a manner as possible to the users. Based on this “service concept”, the core basis for charging volumetrically (or charging for water at all) should be this:

A “customer” should be expected to pay a “reasonable price” for a commodity (in this case, water) that is delivered with a level of “service” that clearly makes that commodity valuable to the customer.

The reasonableness of a price is somewhat subjective (in the imagination of the customer), and partly objective (based on true value and necessary costs). The subjective aspect of “reasonable” fits irrigation systems in the same way as it does, for example,

purchasing a car. Some people are satisfied with a used small motorcycle while others with the same income and same needs feel the need to purchase a new large car. This subjective component of an acceptable price tends to rise if the users feel empowered to make their own decisions. In the western U.S.A., some irrigation districts have excellent modernization programs that have been championed by leading farmers in the community who want to be proud of their irrigation systems—something that goes beyond the simple concept of providing minimal service.

Water users will resist paying for things that they perceive as giving no value *to them*. This extends to altruistic goals that they may feel have been imposed upon them by outsiders, such as improving the environment. Although many people believe in these lofty goals, if the costs for them are included in the water charges, many users will strongly resist paying.

For these reasons, it is important that there be excellent *transparency* regarding the basis of water prices if water users are to be expected to be willing to pay for water. Farmers, like all consumers, will be much more likely to participate in a payment program if they understand that the charges they are required to pay are based on legitimate and reasonable expenses that provide benefits to them. It must be clear to farmers that they are not paying for:

1. Bloated administrations and staff.
2. Environmental protection schemes designed by outsiders to benefit others.
3. Poor water delivery service.
4. Insensitive project employees.
5. Poor investment decisions, or corruption.

Although we sometimes discuss volumetric charges for water as if this is a new concept, it occurs everywhere a farmer uses a private well for an irrigation supply. Such farmers make a deliberate decision to make a monetary investment in a well and pump, and pay for the cost of fuel (whether it be electricity or diesel or gasoline). These same farmers, who have substantial investments in water wells, are often unwilling to pay much lower fees for surface irrigation water. The well water may cost more, but it gives the farmer a sense of security in that he knows that he is getting what he paid for.

The challenge

When discussing volumetric charges, major government objectives can include the desire to recover costs, and sometimes to instill individual responsibility for water management among farmers. However, a successful volumetric water charging program requires much more than objectives and words.

Discussions of volumetric charge programs should “explicitly” recognize that water delivery service to the users must be “reasonably” flexible and reliable.

The explanations for this are simple but often overlooked. Factors to consider are:

1. It is almost impossible to improve field water management (except through land leveling and land consolidation) unless irrigation water is supplied in a manageable manner.
2. Farmers should not be expected to pay by the volume used if they have little or no influence over when the water is delivered, and in what volume. Fair is fair.

Basically, *this means that the water deliveries must be responsive to user requests*. The degree of flexibility and responsiveness will vary from project to project. This is a serious issue – almost all irrigation projects in the world are truly top–down in nature, which means that the farmers are forced to adapt to the irrigation project, not vice versa. The physical infrastructures in most irrigation projects provide little or no flexibility in water delivery, and have no ability to accurately control and measure the volumes delivered to individual fields or groups of fields. On the social and administrative side, the whole idea of providing responsive service is typically a new idea, and there is no effective existing organization for data management, collection of fees, enforcement of rules, etc. in a responsive environment. These are not minor issues. They require time, investment, and well-focused effort to resolve. Even more importantly, they require an attitude shift among irrigation project staff—from the top administrators to the lowest canal operators.

Centralization and decentralization

A combination of centralized and decentralized operation and management of irrigation water can make the administration easier than complete centralization of all tasks. For example, scheduling and control of flow rates through the main canals is almost always a task for a central office—decentralization of control almost always brings conflicts and poor control. However, the intricate water delivery scheduling decisions for individual fields are often best done in a decentralized manner, with requests for composite flow rate changes being transmitted to a central office. Likewise, in some social and legal conditions, it is almost impossible for a central office to collect fees from all individual farmers.

Characteristics of volumetric charges and influencing factors

Estimating or measuring volumes delivered

There are three basic strategies used throughout the world to determine volumes of water delivered:

1. Use a flow rate measurement device that has a totalizing function.
2. Use a flow rate measurement device that has no totalizer. Although it is possible to adjust the flow rate, it is kept constant during a delivery by maintaining a constant difference in head across a flow measurement structure. Volumes are estimated as:

$$\text{Volume} = (\text{Flow Rate}) \times \text{Time}$$

3. Use a flow rate measurement device that always delivers the same flow rate, and which is relatively insensitive to water level fluctuations in the supply canal. A device that is targeted to fit this description is the distributor module. However, it is designed for free flow conditions only and they rarely work properly in typical canal systems because of downstream submergence problems, sensitivity to water level fluctuations (in spite of claims to the contrary), and poor maintenance and installation.

Volumetric charges and annual volume limitations

Volumetric charges are not always associated with limitations in the amount of irrigation water that is available to users. For example, Imperial Irrigation District of California

(200,000 ha) has charged volumetrically for water used on individual fields (approx. 16 ha/field) for many years with no limitation on the annual volume that can be used by individual farmers. The district has recently considered also implementing volumetric limitations.

In projects that do have annual volume limitations for turnout deliveries, volumetric charges are a natural fit. Both the farmers and the project authorities must already have a means of keeping track of how much volume has been used to-date, and how much volume remains available. Assigning a charge per unit volume is a relatively simple step.

Fee structures

Determining the basis for a proper fee

For an established irrigation project with little or no history of successful water charge collection, the acceptable water charge for a new program will depend upon the politics, level of water delivery service provided, benefits to farmers, and other factors discussed in this section. For example, a project may decide to recoup all or only part of the expenses associated with:

- Operation, or
- Operation and Maintenance (O&M), or
- O&M plus Rehabilitation, or
- O&M plus Rehabilitation plus Modernization, or
- O&M plus Rehabilitation and Modernization, plus the original investment in the project organization and facilities.

Water delivery service. In general, the higher the fee, the better the water delivery service must be. Likewise, water users will sometimes accept inaccurate volumetric measurement and relatively inflexible water deliveries if the volumetric charges are very low. However, when water users become actively involved in the decision and water management process, they almost always insist on “adequate” water delivery service, for which they recognize a need to pay a certain fee.

Uniformity of fees among projects. If fees are truly based upon justifiable expenses, then water charges will be different in each project depending upon the source of the water, pumping expenses, age of system, quality and type of delivery system, labor costs, etc. Fees will often be different in various zones within a single project. For example, some groups of farmers may decide that they want to improve water delivery service in their zone, and they may decide to form an “improvement district” within a project to pay for system upgrades just in their area. Improvement districts are common within irrigation districts in the western U.S.A. In northwest Mexico, the irrigation district “modulos” within a project also have different fees, depending upon their organization and operation.

In some countries, there is a uniform national or statewide fee for water. Such a fee is simple to set but it is subject to the whims of politicians and immediately separates the fee from the realities of local conditions (costs) and qualities of service. A uniform fee that does not take individual realities into account is not recommended and almost automatically dooms the program to problems of poor service, low collection rates, and lower-than-realistic water charges.

Types of fees to be charged individual farmers

Once the magnitude of the total charges has been established for an irrigation project, there are numerous ways to design individual billing structures. Irrigation project expenses include both fixed expenses (repayment of loans, basic salaries, basic maintenance, long-term improvements, etc.) and variable fees that depend upon the volume of water delivered in a year (pumping charges, canal cleaning, water purchases, etc.). Furthermore, some farmers who do not receive surface (gravity) water but who instead have private well pumps may receive a benefit from the irrigation project indirectly through groundwater recharge—therefore, they may be assessed a fee. Although there are many variations, water user fees can generally be divided into several general categories:

1. *Base fees.* Base fees are used to provide a stable annual income that is sufficient to pay a certain percentage of the fixed fees that the project will have in all years. These fees are typically based on the irrigated area. This base fee has no aspect of volumetric charging in it.
2. *In-kind fees.* In some projects, in-kind fees are accepted as part or all of the payment for water delivery service. For example, the only “fee” for water delivery service may be an obligation to clean a section of drain or canal. In other projects, such an obligation may be *in addition* to cash payments.
3. *Charges based on crop type.* Projects with inflexible water deliveries and inexpensive water have often used this as a basis for fees. The implicit assumption is that crop “x” will be irrigated more times than crop “y”, and therefore should have a higher charge. This charging strategy can be relatively simple, but does not promote any sense of good water management by either the farmer or project personnel. Charges based on crop and soil type are not considered to be volumetric charges.
4. *Charges based on the number of irrigations per hectare.* This basis for fee charges moves one step closer to volumetric charges. Often these projects have a standard turnout size and a standard official turnout flow rate. Furthermore, a certain number of hours would be “typical” for irrigating a certain field area. Therefore, on the average and in theory, project authorities know approximately what volume is delivered to a field, per irrigation.
5. *Volumetric water charges.* These water fees depend upon the *volume* of water that is diverted or delivered in a season or year. The delivered volumes may have large annual fluctuations, depending upon the water supply and the variable costs associated with receiving, conveying, and delivering the water.

There are many variations of allocating volumetric water fees among farmers. These include:

- a. Charges for the volume of water used in a year or season, with a flat rate per volume. The volumes of irrigation water deliveries to individual farmers (or groups of farmers) must be measured for every irrigation event, or the cumulative volume over a time period (such as a month) must be measured and recorded. As discussed later in this report, the ease and accuracy of volumetric measurement depends upon the type of water level and pressure control, as well as on the type of flow measurement device. In

general, water users request an accurate control and measurement of flow rates if the water charge by volume is significant.

- b. Charges for the volume of water used in a year or season, with a tiered rate. That is, the use of up to “x” cubic meters of water per hectare will have one price, and any water used beyond that threshold will have a higher charge rate. There are numerous ways to justify one or more tiers, and to decide what the extra cost will be for each tier. There are even cases in which irrigation districts have considered reducing the cost per cubic meter as the volume increases, to encourage farmers to utilize surface water instead of using groundwater (where there is groundwater overdraft).

Sometimes, water agencies estimate the total costs beyond those covered by base fees, and assess an identical charge per unit area to all irrigators. This is mistakenly identified as “volumetric charges” in some irrigation projects, because the charge depends upon the total volume of water delivered within the project. However, it completely misses the point of true volumetric charges, in which individual water users, or groups of users, are responsible for properly managing and paying for the water volumes that they individually receive.

Payment, collection, and redistribution of charges

The following are possibilities for who has the *ultimate* responsibility to make the payment:

1. The farmer or shareholder.
2. The registered owner of the land, or his/her designated representative.

In the U.S.A., state and federal water agencies do not typically deal with individual farmers. Rather, they deliver water to irrigation districts or even to groups of irrigation districts. It is the responsibility of the districts to pay the state or federal agency for water supplied to the district. It is then the district’s responsibility to collect charges from individual farmers. This practice is viewed as desirable by irrigation authorities in many countries, as it limits the staffing requirements of the irrigation authority.

A special case can be found in the Philippines. In the Philippines, volumetric charges are seen by the National Irrigation Agency (NIA) as a means of obtaining simplicity of billing. However, this is because NIA only considers the interface between *NIA* and a *Water User Association* (WUA). NIA does not consider the dynamics between the *WUA* and *individual farmers*. For *NIA*, charging volumetrically will simplify the billing process because:

1. NIA will no longer need to verify actual harvested areas by individual farmers. Such verification has three problems:
 - a. It cannot be completed until well after the irrigation season has finished, which means that payments are delayed and cash flow problems can be serious.
 - b. Each individual field must be verified.
 - c. NIA must rely on individual farmer payments.
2. NIA will now only have one point of record-keeping. This is at the head of a canal that supplies a Water User Association.
3. NIA, until recently, did not consider that it was essential to have accurate flow measurement or flow control at the point of measurement. A simple staff gauge in the water was considered adequate. Of course, this is over-simplified and typically quite inaccurate...but it is inexpensive.
4. NIA will be able to charge for volumes of water as they are used, rather than having to wait to verify irrigated areas. With “volumetric charging”, NIA will not have to

consider what is grown or where or when—it will just charge based on the volume that is delivered to a WUA.

Most irrigation projects that collect full costs and have 100% collection rates share some of the same ideas as NIA, but there are remarkable differences, as well. In the western U.S.A. and in some Latin American countries (e.g., Mexico, Colombia), state and federal employees may not operate irrigation districts; the state and federal governments operate only major dams and canals that supply irrigation districts. Depending upon the country or state, the federal or state government may not necessarily own the facilities within the irrigation district or the water rights. The federal and state agencies collect their money from the irrigation districts; it is the responsibility of the irrigation districts to collect money from the farmers. However, there is generally a civilian police and judicial system that will enforce rules of payment and conduct if farmers do not comply with district policy.

Records of water orders, charges and payments

As charges evolve from a simple per-area basis to volumetric payments by individual users, the requirements for transparent and efficient data management may increase. Assuming that the irrigation authority will provide water more or less in response to user demands, the project must have a mechanism in place to efficiently manage data.

For these responsive systems with volumetric charges, records of water charges are often merged real-time with the records of water orders and water deliveries. In most systems, there is a procedure for water users to request, on a frequent basis, a certain volume of water at a specific time. However, for any number of reasons, the actual delivery may not equal the ordered amount—it may be greater or smaller. Therefore, there must be a reconciliation process upon which the actual water deliveries (and charges) are based. In general (but not always), farmers are billed for the actual volume that they receive. In some cases, farmers are billed for the volume ordered; if they take less water they are still charged for the full amount.

The system of fee collection will impact the type of records that are maintained. In some systems, farmers must pay in advance for each individual order. These systems are typically fairly inflexible, with small farmers who have simple on-farm irrigation systems. For these systems, the accounting is relatively simple and farmers may end up paying for water that they did not actually receive.

In societies with excellent communications, banking systems, and enforcement of rules, farmers are typically billed periodically (e.g., monthly) for water that they have received in the past. The water ordering and billing systems are often computerized. Some ordering/field verification/billing systems are integrated.

Ability to deliver upon order

A key aspect in any flexible water ordering system is that it must be possible to verify, in a short period of time (a few minutes or a day), if the water can be delivered to where it was ordered at the specified time. In most irrigation systems there are capacity limitations in various pipeline and canal sections, and in canals there are issues with lag (travel) times—the water does not arrive instantaneously at a distant point when it is introduced to the head of a canal.

Large canal/pipeline capacities, plus hardware to maintain fairly constant pressures (in pipelines) or water levels (in canals) as the flow rates change must generally accompany

these flexible systems. With high flexibility, less checking of capacities and operator availability is necessary when scheduling deliveries.

In general, irrigation districts/projects with volumetric deliveries rely on a “watermaster” in a central location who collects water orders and examines them for capacity constraints and water availability in the main delivery network. That watermaster typically has employees under his control who ensure that certain flow rate changes are made to secondary or lateral canals/pipelines in each zone. Operators (sometimes called “zonemen”, “zanjeros”, or “ditch-riders”) are sometimes given the responsibility of determining the actual schedule of deliveries within their zone of operation. The more flexible the system, the more flow rate changes/day are made at the head of each lateral and tertiary. Inflexible systems may only have one change per week; flexible systems may have five or six changes per day into a lateral canal.

In other systems, the zone operators accept the water orders for the previous day or previous week, decide how it will be possible to schedule those deliveries within their zone, and then pass on the requests for changes at the heads of their canals to the system watermaster. For flexible (only) deliveries, no record of individual deliveries needs to be maintained at the project office. But for a combination of flexible and volumetric deliveries, the individual turnout delivery orders must reach the main office daily for timely record keeping and billing. Some districts in the U.S. use handheld data recorders to record field data by zone, which they download to the main office daily. These same handheld units can be used to upload delivery schedules for the next day. Obviously, there are many different combinations possible.

Destination of water charges

There are many possibilities for water charge destinations. Successful flexible irrigation projects with high collection rates use the charges for clearly understood purposes—purchasing water, improving water delivery service, maintenance, etc. Fees are collected and kept within the project, only “exporting” the portion of fees necessary to pay for water purchases or to pay off debts.

In “top-down” projects, where the primary concern is collecting fees for the government (as opposed to a primary concern of providing good water delivery service to farmers), the fees generally go directly to the state or federal government, and later some portion of those fees may or may not trickle back down to the project. Users have little or no motivation to pay high fees, because generally the service is poor and little is returned to the project for the purpose of improvements in service.

Collection and timing of fee payments and enforcement

Payment rules are fairly meaningless if those rules are not enforceable. Irrigation projects often have elaborate irrigation scheduling rules and policies—but when one goes to the field it is obvious that those water delivery “promises” are not consistently met by the irrigation authority. Many rules have been designed for fee collection, but a close look at many projects shows a high delinquency rate of fee payment, or even non-payment of fees by more than 50% of water users. Ironically, countries that depend on state or federal employees to collect fees from individual farmers often have weak police and judicial systems and the collection rates are low.

It appears that the following rules are absolute requirements for success:

1. Canal operators should not be responsible for collection of fees. Instead, fees should be collected through an office with a clear accounting of the amount and timing of fee collection.
2. The notion that people are somehow able to collect substantial fees easily from their neighbors (an argument often heard in discussions of water user association benefits) is unsound and, if put into policy, will create unnecessary social friction.
3. Fees cannot be successfully collected in a timely and complete manner if there is no effective judicial and police power to enforce the collection policies. In most projects with successful volumetric charging policies, the fees are collected by the irrigation authorities (e.g., water user associations), with a first course of action taken by those authorities if fees are not paid. But upon clear notice that the problem persists, the WUA can rely on external judicial and police powers to jail people for damaging equipment, or to sell land if water charges are not paid.

Minimum requirements for volumetric water charges

Based on years of experience with irrigation authorities, the minimum requirements for successful volumetric water charges are:

1. A clearly understood (by users and suppliers) procedure for computing flow rates and volumes.
2. A clearly understood and agreed-upon fee structure, to include:
 - a. When fees are to be paid.
 - b. Penalties for non-payment of fees, or late payment of fees.
 - c. How fees are computed.
 - d. How the fees are requested.
 - e. Mechanism for fee payment (to what, and how)
 - f. Whether the user(s) can refuse payment for water that was delivered, but not requested.
3. A written agreement between the water supplier and the user(s) of the nature of water delivery service, to include:
 - a. Advance time required to order a new, change, or stop in flow rate.
 - b. Other details related to the flexibility of frequency, rate, and duration of water delivery service provided by the irrigation authority.
 - c. Accuracy of the flow rate measurement device.
 - d. Allowable percent variation in the actual flow rate from the agreed-upon flow rate at any time.
 - e. Who can make the flow rate changes (the supplier or user) at the control structure.
 - f. How frequently the flow rate can be changed.
 - g. How frequently the flow rate must be verified, and by what method it will be verified.
 - h. Responsibility for maintenance of the measurement and control structures.
 - i. Penalties to the water supplier if structures are not maintained or operated as specified, or if the quality of water delivery service is not as promised.
 - j. A procedure for when and how any volumetric limitations are determined.

4. A clear and viable judicial and police system that ensures enforcement of agreements.
5. The fee must be “reasonable” and reflect the value of the water delivery service that is being paid for.

Summary

There are numerous policy decisions that impact the effectiveness of volumetric water allocations and pricing. After much discussion, it is relatively easy to state that water will be delivered with a certain (+/-) flow rate accuracy, with a specified level of flexibility, and the charges will be such and such. However, volumetric water pricing and allocation cannot be accomplished simply by issuing a decree, changing laws, or forming water user associations. To actually implement a volumetric water pricing system requires the installation of structures such as good measurement devices at turnouts and supply canals, water level control structures in the supply canals, improved communications, changes in management styles, etc. Thorough planning, attention to the details, and ability to enforce rules, greatly improve the program's chances for success.