water extracted or a fixed allocation of water shares among the users on each canal.

Service contracts. Formal agreement between the service provider and users to ensure a steady flow of water can limit hoarding by farmers who otherwise could not rely on having water when they needed it. After such a reform, in Katerpura, India, farmers stopped flooding their fields in the dry season and often did not irrigate in the monsoon season, resulting in reduced water use per hectare and saving 7.7 million m³ annually. Moreover, irrigated area expanded by 80 percent.**

Education. Public education campaigns make farmers aware of water scarcity and often help save water. This is especially important where users have traditionally viewed water as a free good. In Katerpura, India, policymakers used newspapers, radio exhibitions, pamphlets, and posters to inform the public about water scarcity and the need for better water management.**

CONCLUSION

No silver bullet exists to improve cost recovery or water use efficiency of irrigation systems. However, many countries provide examples of successful reforms that policymakers and system managers can draw upon for inspiration and ideas.

A successful system will have the appropriate mix of technology, management, policy and institutional arrangements that facilitate transparent and efficient service delivery and increase farmer’s willingness to pay and to use limited water resources more efficiently.

This note is a product of the Water for Food team. It is based on the larger volume entitled Cost Recovery and Water Pricing for Irrigation and Drainage Projects by K. William Easter and Yang Liu. The book outlines guidelines for designing a successful system for cost recovery and efficient water use and provides numerous case studies of successful implementation. You can download a copy of the full report at www.worldbank.org/rural or email ard@worldbank.org.

NOTES

There are three major approaches to water pricing: area-based, volumetric, and market-equilibrium. Each has its own trade-offs and is best suited for different physical, social, and economic situations.

COST RECOVERY AND WATER PRICING FOR IRRIGATION AND DRAINAGE: WHAT WORKS?

BY: K. WILLIAM EASTER AND YANG LIU

Historically, water projects, particularly those with a significant irrigation component, have had low levels of water fee collection. This means that many irrigation projects have not been sustainable without large government subsidies and, over time, they have experienced significant declines in productivity. Many of these same irrigation projects have experienced over-irrigation, rising water tables, and rising salinity levels. This note outlines the approaches for water pricing and advances guidelines for improving cost recovery and reducing overuse of irrigation water.

A system of effective water fees is usually designed to at least cover the cost of operation and maintenance (O&M) and to make an irrigation project more financially sustainable. Where water is particularly scarce, projects have been using water pricing to encourage water conservation.

Approaches to Water Pricing

There are three major approaches to water pricing: area-based, volumetric, and market-equilibrium. Each has its own trade-offs and is best suited for different physical, social, and economic situations.

Area-based pricing. This approach uses the average cost pricing principle to levy a fixed charge based on the area that is supposed to be irrigated. This area can vary across years and seasons. For instance, more area is irrigated during the rainy season than the dry season in large systems with many small farms, it may be the only economically feasible method. Managers have developed variations on this approach to account for seasonal charges, the different crops irrigated, or the technology used. For instance, area-crop-based pricing may charge higher for rice because that crop requires more water. This variation can also provide an incentive for farmers to switch to crops that save water.

Volumetric pricing. This is an optimal-pricing approach that charges based on the volume of water used by the farmer. Unlike area-based pricing, this approach also encourages farmers to better control their water use. Volumetric pricing works well in systems that are equipped to monitor and control on-farm water deliveries and the cost of implementing such a system is high. Depending on the technology used, the water fees in some systems can be high relative to farm income. Managers have developed two variations on volumetric pricing to address the impacts of water charges on farm income: block pricing and the two-part charges.

(i) Block pricing. This variation sets a price for a base amount of water to be used during a given period of time, and charges more for any water used beyond that base amount. The first block is generally set at the amount needed to support a farm family, which ensures equity in the system. Prices paid for the first block will usually not cover the O&M costs, but the charges for additional blocks make up the difference. The difficulty is in deciding on the size of the first block and the prices to be charged.

(ii) Two-part charges. This variation combines the volumetric pricing system with a fixed admission charge. Both volumetric and block pricing present a conflict between cost recovery and water use efficiency, which the two-part charges overcome. The volumetric part, based on marginal costs, encourages water conservation while the fixed fee can make up the deficits in O&M costs.


Incentive systems. It is important for a system to establish financial autonomy. Recovery mechanisms to improve cost features or employment. Authorities can seize their lands. Policymakers need to monitor against corruption. When irrigation officials extract large, unofficial rents from farmers, introducing reforms, like raising fees, is difficult. Active WUAs have proven effective in increasing transparency by involving farmers in decision-making and in improving service quality; however, they should also be monitored lest they pick up the same bad habits. One option is to establish an independent oversight board to review operations and finances.

Guidelines for Implementation

Improving cost recovery hinges on appropriate pricing and effective fee-collection mechanisms, which requires decisions about what costs to recover (e.g. fixed, variable, environmental costs) and what users pay what share of the costs (e.g., irrigators, cities, households, industry). Beyond that, a system needs good management mechanisms and incentives to raise collection rates, reduce water usage, or both. Creating a willingness to pay and achieving high collection rates may require a number of management reforms. In effective systems, farmers feel that costs are legitimate and are not inflated with unnecessary expenditures or employment.

Mechanisms to Improve Cost Recovery

Financial autonomy. Transferring management to a financially autonomous organization—government agency, local water user organization, or private entity—can improve cost recovery in a number of ways. First, system users are more assured that their payments go back into the project rather than being commingled with other taxes in the state treasury. Second, the service provider has a direct financial link to the users, who can use that link to demand quality service. Better service, in turn, gives farmers an incentive and increases their ability to pay their fees as their incomes increase. Finally, autonomous organizations that have strong user participation and a transparent process for setting water charges have had the most success in collecting water fees (see Table 1). Incentive systems. It is important for a system to establish incentives to prompt collection of fees by employees and prompt payment by users. Some systems encourage employees to collect fees by linking pay to collection levels. In Awati, China, staff salaries depend entirely on the fees they collect from farmers. The collection rate reached 98 percent after the institutional reform that established the financially autonomous management entity. In terms of payment, successful systems have strictly enforced penalties for default. Bayi Irrigation District in China cut off irrigation water to defaulters, while in Haryana, India, the authorities can seize their lands. Policymakers need to monitor against corruption. When irrigation officials extract large, unofficial rents from farmers, introducing reforms, like raising fees, is difficult. Active WUAs have proven effective in increasing transparency by involving farmers in decision-making and in improving service quality; however, they should also be monitored lest they pick up the same bad habits. One option is to establish an independent oversight board to review operations and finances.

### Box 1: Automated Irrigation Charge Collection, Shandong, China

Shandong is one of the biggest agricultural provinces in north China. Irrigation water accounts for between 70 and 80 percent of the total water use, but water is scarce. Consequently, to improve water use, a card automated system was adopted, where irrigators buy prepaid integrated circuit (IC) cards. The card must be inserted into an automated box before water is released, and it stops when the card is removed. After each irrigation, the farmer receives a receipt, stating the amount of water used, the price paid per unit, and the total deducted from the IC card. All servers are connected by the Internet, so they are easy to control and monitor, and administrative costs have been cut. Thus, if no one steals water, a 100 percent collection rate is assured. Each irrigation server costs 1,000 Yuan (about US$120), roughly the same value as the water saved annually. With more than 200,000 IC servers, the province saves about 5 billion m3 of groundwater annually.


### Table 1. Key Factors Influencing Fee Collection Rates

<table>
<thead>
<tr>
<th>Cases</th>
<th>Financial Autonomy</th>
<th>Incentives to collect</th>
<th>Penalty for non-payment</th>
<th>Improved irrigation service</th>
<th>User participation and transparency</th>
<th>Collection rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yushu, China</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
<td>N.A.</td>
<td>Yes</td>
<td>98%</td>
</tr>
<tr>
<td>Bayi ID, China</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>100%</td>
</tr>
<tr>
<td>Nanyao ID, China</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
<td>N.A.</td>
<td>Yes</td>
<td>95%</td>
</tr>
<tr>
<td>Shangdong, China</td>
<td>N.A.</td>
<td>N.A.</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>100%</td>
</tr>
<tr>
<td>Gujarst, India</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>100%</td>
</tr>
<tr>
<td>Haryana, India</td>
<td>Partially</td>
<td>Yes</td>
<td>N.A.</td>
<td>Yes</td>
<td>Yes</td>
<td>85-95%</td>
</tr>
<tr>
<td>Mexico</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
<td>Yes</td>
<td>Yes</td>
<td>90%</td>
</tr>
<tr>
<td>Alto río Lurias, Mexico</td>
<td>Yes</td>
<td>Yes</td>
<td>N.A.</td>
<td>Yes</td>
<td>Yes</td>
<td>100%</td>
</tr>
</tbody>
</table>

* N.A. Information not available.

### Transparency

Farmers are more willing to pay fees when they can see how much water they received; how their payments are used and how the water charges are determined. In Shandong, China, farmers purchase prepaid integrated circuit (IC) cards to operate machines that measure and control irrigation water releases (Box 1). Suppliers can also use awards and penalties to motivate their personnel to achieve high collections.

### Mechanisms to Improve Water Use Efficiency

Water is an increasingly scarce resource, and improving the efficient management of that resource requires systems to either move up the negatively sloping demand curve or shift the demand curve. Moving up the demand curve essentially means raising the unit price of water until farmers use less. This works in some instances, but for some crops water demand is highly inelastic. In Tunisia, for instance, water prices for high-value crops under controlled-water conditions had to increase significantly before water use decreased.1

This approach can adversely affect farmers’ incomes and is often politically unfeasible, unless alternative crops and/or technology are available to improve water use efficiency. Where this is a concern, policies and practices can be introduced to shift the demand curve. Supporting institutions and services. If farmers have the choice of alternative crops and technologies to choose from, policymakers can introduce a pricing policy that encourages farmers to switch. Additional mechanisms, such as low-interest loans for purchasing new technology can be used to give farmers an incentive to change. Governments also need to remove subsidies that encourage lavish water use and excess pumping—such as those for electricity—that hide the real cost of pumping.

### Quotas

When users do not respond to price incentives, quotas can effectively reduce water consumption. Policymakers can use a fixed quota for the amount of...