

## **INNOVATIONS IN AGRICULTURAL WATER CONSERVATION AND USE: FERTILE GROUND FOR LASTING SOLUTIONS**

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A lot has changed on the Colorado River since Marc Reisner famously characterized it as "the most legislated, most debated, and most litigated river in the entire world." In short, collaborative processes are now the preferred vehicle for addressing most of the basin's issues, including efforts within states to stretch water supplies serving both agricultural and urban users. Increasingly, voluntary trading mechanisms provide incentives for farmers, users of 70 percent of the basin's water, to transfer some of this water to cities seeking larger or more reliable supplies. This movement of water is inevitable, fueled by powerful economic and demographic forces.

As water trading evolves further, the challenge facing the basin states is to establish and promote mechanisms that not only work for buyers and sellers, but also respect the critical role of irrigation water in sustaining rural economies, social networks, and environmental resources, and in ensuring regional food security. This normally requires maintaining some minimum level of agricultural productivity. Protecting this full spectrum of water-dependent values is only possible through carefully constructed rules and incentives.

### ***Water Conservation and Trading Mechanisms: Terms and Tools***

*Water transfers (or trades)* are voluntary, incentive-based agreements that shift water to new users, uses, and/or locations. Traditionally, most transfers entail a permanent, formal (legal) shifting of both water rights and water from the seller (usually a farmer) to a buyer (usually a city). Even in those limited cases where lands are revegetated with native plants or transitioned to dryland farming, these *buy-and-dry transfers* can entail significant environmental, economic, and social impacts in rural areas where jobs and lifestyles are linked to agricultural production. Despite these drawbacks, buyers often favor buy-and-dry transfers for their permanence, magnitude, familiarity, and relative simplicity when compared to the emerging variety of temporary, leasing-based approaches. In order to achieve the promise of water markets that prove beneficial to both farms and cities, this emphasis on strict buy-and-dry must change.

Alternatives to buy-and-dry take many forms<sup>1</sup>, but all operate on the premise that water used in existing farming practices can often be managed in a way that meets critical needs in both the agricultural and

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<sup>1</sup> Many innovative mechanisms are notable for dynamically adjusting to water conditions, leaving water in agricultural uses in most years while transferring water to urban users only in droughts and other water-short conditions. In *option-based approaches*, cities negotiate in advance to lease water under given "triggering" conditions (and for a specified cost, duration, and other terms), while the farmers retain ownership of the water right. In *lease-back arrangements*, the water right is legally transferred to the city, but water is leased back to

urban sectors. A wide variety of organizations, programs, and strategies are engaged in efforts to free up some agricultural water for transfer while minimizing socioeconomic impacts on rural communities. Ultimately, the challenge is four-fold: implementing on-farm practices that reduce water consumption while maintaining (to the extent possible) agricultural productivity; precisely measuring reductions in consumptive use concurrent with maintaining return flows serving other water rights holders; making conserved water available to new users when and where it is needed; and developing payment mechanisms under which urban or environmental users return revenues to rural communities sufficient to incentivize the arrangement.

Three of the most intriguing approaches to on-farm water conservation are rotational fallowing, deficit irrigation, and crop switching. Each presents its own opportunities and liabilities, but each is potentially well suited to the Colorado River Basin's most widespread, water-intensive, and thus most debated crop: alfalfa.

### ***Rotational Fallowing***

In most regions, rotational fallowing is the easiest and most proven method (as noted in the sidebar). Temporarily taking lands out of production can offer many benefits, including reduced withdrawals and consumption, increased future productivity from “rested” soils, opportunity to transition to organic production, and improved pest management. By linking these efforts to ag-to-urban water transfer leases, the farmer can recoup lost revenues (and perhaps achieve a net profit), and water saved goes to cost-effectively meet urban demands. It is a formula that can work for both the buyer and seller; however, third party impacts are more difficult to generalize. For the rural communities and the farm support services they provide, income streams and tax revenues are likely to be depressed (in proportion to the amount of land being fallowed) absent any mechanism for compensation. Additionally, in areas with salty subsurface moisture—a common occurrence in the basin—salts can be drawn to the surface during fallowing, necessitating flushing flows that negate some of the water savings. Special efforts must be taken to manage weeds and erosion on fallowed fields. Some environmental resources dependent upon agricultural diversions and return flows may also be negatively impacted.

Establishing lease-fallowing programs may require reforms to state water law or delivery contracts, will require a means for quantifying the savings, and may necessitate new infrastructure for storing or moving water. Operational changes to ditch systems may be necessary to ensure other water users on the system are not compromised by the arrangements. Simple in concept, lease-fallowing can be exceedingly complex in practice. However, when the alternative is buy-and-dry, there is ample incentive to work through the situation-specific challenges.

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farms—again, under pre-negotiated terms—when not needed by the urban owner. Other leases operate on a more predictable and stable schedule, but still guided by the principle that farms must maintain a minimum threshold of water to maintain productivity. Where allowed by state law, leases can be designed to suit particular time scales (from seasonal to multi-year), types of water involved (surface water, groundwater, reservoir storage), different categories of uses and users (including environmental and industrial), special approval processes and legal structures (such as easements), unique arrangements regarding water conveyance and storage, and other considerations.



## SOUTHERN CALIFORNIA FALLOWING PROGRAMS

The *Basin Study* and subsequent *Moving Forward* reports developed by the basin states and Reclamation identified many opportunities for additional agricultural conservation in the basin, primarily from fallowing-based programs. Undoubtedly, this emphasis on fallowing reflects the success of existing programs in Southern California, where the presence of high levels of agricultural water use, high urban water demands, and the relatively small number of urban water providers and agricultural water districts has encouraged the germination of several ambitious programs. Led by the Metropolitan Water District and Imperial Irrigation District—and later joined by the San Diego County Water Authority, Palo Verde Irrigation District, and the Coachella Valley Water District—a complex web of long-term deals has emerged to ultimately convert hundreds of millions of urban dollars into millions of acre-feet of conserved agricultural water made available to municipal users. Funding is also provided to community programs managing third party impacts, and to finance some environmental flows (through 2017) to mitigate declining runoff to the Salton Sea.

### **Deficit Irrigation**

A related approach is deficit irrigation, which refers to the use of irrigation schedules that deliberately reduce water deliveries within a growing season to maximize yields per unit of water consumed. When done correctly, a given reduction in irrigation water deliveries, say 25%, may result in a disproportionately smaller reduction in crop yield and net income, perhaps 10% or less. In regulated deficit irrigation, this is accomplished by reducing water in less-critical plant life cycles, while in “split season” deficit irrigation, irrigation is reduced or ceased in specific parts of the growing season—e.g., particularly in summer when evapotranspiration (ET) rates are high and yields are low—in order to encourage plants to go into dormancy. The most common approach used in the basin is split-season irrigation of alfalfa. This is a less disruptive and more efficient water-saving approach than taking the land out of production entirely—in which a 100% reduction in water deliveries results in an equivalent (100%) reduction in crop yield.

As with rotational fallowing, deficit irrigation can create several on-farm challenges, such as increased soil salinity, and is generally not well suited to vegetable crops. Off-site, the most challenging component is the leasing of saved water to the urban customer, including the legal reforms needed to quantify and to establish ownership and control of the water savings. Additionally, some third party impacts in the rural community may be difficult to avoid in programs that result in reduced crop yields and economic activity.

## *Crop Switching*

Crop switching is perhaps the most challenging of the water-saving methods to implement, even if the concept is simple: reduce water use by replacing water-intensive crops, such as alfalfa, with less water-intensive alternatives, such as sorghum. When considering crop switching, it is important to acknowledge that farmers' choice of a crop reflects a wide variety of considerations. Important factors include market forces (including crop prices, market shares, and the availability of loans, subsidies and insurance options), on-site equipment and off-site infrastructure (such as processing and transportation facilities), local weather and soil conditions, labor availability, and the skills of the farmer. The viability of any new crop must be evaluated against these same factors. These considerations illuminate why alfalfa is king in the Colorado River Basin: it is easy to grow (e.g., it requires little if any fertilization and does not need to be replanted each year), drought tolerant, adaptable to widely different climates, easy to harvest and store, and has a strong and well-established place in the marketplace. Also working against crop switching (and many other water-saving innovations) is western water law, which does not ordinarily recognize a right to capture (sell or lease) water saved in this way. Certainly, many of these obstacles can be overcome through legal reform, the development of markets, and the general restructuring of incentives; in the meantime, alfalfa is a low-risk, high-reward option. Nonetheless, given the magnitude of potential water savings—especially in the Lower Basin where ET rates are high and where climate and soil conditions can support a variety of crops—experimentation with crop switching will likely need part of the equation for agricultural sustainability in the basin.

## *Conclusion: A Crisis and an Opportunity*

Innovation can be seen throughout the Colorado River agricultural sector. Already in recent decades, farmers have employed better crop genetics, management, and technology to achieve significant gains in productivity and economic returns without an increase in water consumption. Moving forward, any viable pathway to a balanced regional water budget must consider a net reduction in agricultural water consumption. The open questions are how will this be achieved, who pays, and how much.

If new incentive-based arrangements fail to flourish then balancing water budgets will largely take the form of involuntary curtailments—through mechanisms such as the Lower Basin shortage sharing rules, the administration of prior appropriation rights, and potentially a Compact call—and through additional permanent buy-and-dry water transfers from agricultural to urban users. This is a losing proposition for the vast majority of the basin of rural communities. Further, this highly contentious and disruptive default disrupts food supplies, threatens environmental resources dependent upon agricultural water diversions, and permanently alters the rural aesthetic of the basin.

Where there are opportunities to do better, we should. Refining and expanding the use of innovative agricultural water conservation and transfer mechanisms provides such an opportunity. This is fertile ground.

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