

# Incentive-Based Groundwater Conservation Programs May Have Unintended Results

C.-Y. Cynthia Lin, University of California at Davis

**T**he management of groundwater resources is an issue that reaches far and wide; regions around the world are struggling with ways to reign in extraction from aquifers that have been deemed over-exploited, and many of the world's most productive agricultural basins depend almost exclusively on groundwater.

The food we eat, the farmers who produce that food, and the local economies supporting that production are all affected by the availability of groundwater. Worldwide, about 70 percent of water extracted or diverted for consumptive use goes to agriculture, but in many groundwater basins, this proportion can be as high as 95 to 99 percent.

Many of the world's most productive agricultural basins depend on groundwater and have experienced declines in water table levels. In many places, policymakers have attempted to decrease rates of extraction through incentive-based measures. These policies are implemented under the auspices that they will decrease the total consumptive use of groundwater, a key goal of water managers, and are in response to declining aquifer levels that are occurring due to extensive groundwater pumping for irrigation.

Voluntary, incentive-based water conservation programs for irrigated agriculture are often billed as policies where

everyone gains. They are politically feasible, farmers are able to install or upgrade their irrigation systems at a reduced cost, resulting in substantial increases in profits, less groundwater is "wasted" through runoff, evaporation, or drift, marginal lands can be profitably retired, and farmers can choose whether to participate. However, such policies can have unintended, even perverse, consequences.

Recent work by my former Ph.D. student Lisa Pfeiffer and I suggests that policies of encouraging the adoption of more efficient irrigation technology may not have the intended effect. Irrigation is said to be "productivity enhancing," meaning it allows the production of higher value crops on previously marginal land. Thus, a policy of subsidizing more efficient irrigation technology can induce a shift away from dry-land crops to irrigated crops. They may also induce the planting of more water-intensive crops on already irrigated land, as by definition, more efficient irrigation increases the amount of water the crop receives per unit extracted.

A similar story emerges when one considers land retirement programs. An example of a land retirement program is the Conservation Reserve Program (CRP) created by the federal government in 1985 to "provide technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns

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on their lands in an environmentally beneficial and cost-effective manner.” These programs include payments to landowners to retire, leave fallow, or plant non-irrigated crops on their land. Such programs operate on an offer-based contract between the landowner and the coordinating government agency. The contractual relationship is subject to asymmetric information, and adverse selection may arise because the landowner has better information about the opportunity cost of supplying the environmental amenity than does the conservation agent. There is substantial evidence that farmers enroll their least productive, least intensively farmed lands in the programs while receiving payments higher than their opportunity costs, thus accruing rents. It is quite unlikely that an irrigated parcel, which requires considerable investment in a system of irrigation (which, in turn, enhances the productivity of the parcel), will be among a farmer’s plots with the lowest opportunity cost and thus enrolled in the program. Enrolling a non-irrigated plot in the CRP program will not have any effect on the amount of irrigation water extracted.

In our study, we focus on incentive-based groundwater conservation policies in Kansas and find that measures taken by the state of Kansas to subsidize a shift toward more efficient irrigation systems have not been effective

in reducing groundwater extraction. The subsidized shift toward more efficient irrigation systems has in fact increased extraction through a shift in cropping patterns. Better irrigation systems allow more water-intensive crops to be produced at a higher marginal profit. The farmer has an incentive to both increase irrigated acreage and produce more water-intensive crops. Similarly, land and water conservation and retirement programs have done little to reduce groundwater extraction, although billed as such. Theoretically, we know that because the programs are offer-based, farmers will enroll their least productive land. Our empirical results support this conclusion; we find essentially no effect of land conservation programs on groundwater pumping, which occurs, by definition, on irrigated, and thus, very productive land.

When designing policies, policy-makers need to be wary of any unintended results. Incentive-based groundwater conservation programs are a prime example of a well-meaning policy that may have bad consequences, for they may actually increase rather than decrease groundwater extraction.

*C.-Y. Cynthia Lin is a member of Controller John Chiang’s Council of Economic Advisors.*

