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The Economics of Groundwater Management

Associate Professor C.-Y. Cynthia Lin Lawell, University of California, Davis
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The management of groundwater resources for use in agriculture is an issue that reaches far and wide; many of the world's most productive agricultural basins depend on groundwater and have experienced declines in water table levels. There is a socially optimal rate of extraction that can be modeled, measured, and achieved through policy and a complete definition of the property rights that govern groundwater. However, there are several factors that may affect farmers' groundwater use decisions and behavior and may lead them to overextract groundwater. In our research, collaborator Lisa Pfeiffer and I find that programs that subsidize efficient irrigation technology cause farmers to respond by switching to more water intensive crops, thereby increasing, not decreasing, water extraction. Thus, incentive-based groundwater conservation programs may have perverse consequences. I would like to thank Lisa Pfeiffer, Louis Sears, and Ernst Bertone Oehninger for their excellent research. Funding was received from the Giannini Foundation of Agricultural Economics. All errors are my own.

Worldwide, about 60 percent of groundwater withdrawn is used in agriculture, and in some countries, the percent of groundwater extracted for irrigation can be as high as 90 percent. Increasing competition for water from cities and environmental needs, as well as concerns about future climate variability and more frequent droughts, have caused policy makers to look for ways to decrease the consumptive use of water. There are several factors that may affect farmers' groundwater use decisions and behavior and may lead them to overextract groundwater. These include increases in irrigation efficiency, perverse incentives from policy, institutional incentives, and externalities. When designing water management policies, it is important to consider any possible perverse consequences from the policy. For example, in many places, policymakers have attempted to decrease groundwater extraction through conservation policies that encourage the use of more efficient irrigation technology. However, in our research, we find that programs that subsidize efficient irrigation technology such as dropped nozzle systems cause farmers to respond by switching to more water intensive crops, thereby increasing water extraction. Thus, incentive-based groundwater conservation programs may have perverse consequences.

Key Points:

- ✦ Policies that encourage the adoption of more efficient irrigation technology may actually increase rather than decrease groundwater extraction.
- ✦ Incentive-based groundwater conservation programs may have perverse consequences.
- ✦ When designing policies, policy-makers need to be wary of any potential unintended consequences.

Implications for Policy

Complete, measured, enforceable, and enforced property rights that consider the physical properties of the resource have the possibility of inducing the socially optimal rate of extraction in many cases. Where externalities occur, whether they are caused by the physical movement of water, by environmental damages or benefits, or by other causes, careful policy can provide incentives to move towards optimal extraction. However,when designing policies and regulation, policy-makers need to be wary of any potential perverse consequences of their policies. Incentive-based groundwater conservation programs are a prime example of a well-intentioned policy that may have perverse consequences, for they may actually increase groundwater extraction. Similarly, property rights regimes such as prior appropriation may adversely impact the dynamic optimality of water extraction.