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Inducing Water Conservation in Agriculture: Institutional and Behavioral Drivers

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Irrigated agriculture accounts for a major share of total consumptive water use and of withdrawals of surface water and groundwater in the United States. This is particularly true in western states, which have experienced severe water shortages in recent years. Climate change is expected to increase variability in precipitation and reliance on irrigation to maintain crop productivity. While the shift to pressure sprinkler irrigation systems has been increasing over time, water applied using inefficient gravity systems still accounts for a large share of total water applied in the United States (U.S. Department of Agriculture, 2013). Irrigated agriculture contributes to the depletion of major U.S. aquifers and the over-watering of crops causes run-off and leaching of nutrients, which have detrimental impacts on water quality.

Water use and technology choices have historically been affected by institutions and policies that have evolved over time. Recent government efforts seeking to induce water conservation have focused on providing payments through programs such as the Environmental Quality Incentive Program (EQIP) to induce adoption of water-efficient irrigation technologies. A recent U.S. Government Accountability Office report (2017) found that the billions of dollars spent on EQIP were not well-targeted to farmers who could provide the maximum environmental benefits at least cost because they often do not consider cost-effectiveness in selecting from among applicants. The voluntary nature of such programs and lack of data on performance-based outcomes from enrollment have constrained the ability of conservation programs to target payments to farmers in ways that ensure that outcomes are additional to what would have been achieved in the absence of the program.

Recent research in behavioral economics provides important insights on ways to supplement such programs and technologies with "nudges" that can motivate conservation behavior more cost-effectively. The articles in this theme discuss the drivers of farmers' water management choices and the role that climatic conditions, public policies and institutions, and behavioral factors play in influencing those choices.

In the first article, David Zilberman, Rebecca Taylor, Myung Eun Shim, and Benjamin Gordon provide a long-run perspective on water policy. They argue that water policies have been motivated largely by political considerations. Early in U.S. history, water policies were used as a mechanism to induce settlement in the West. In the 19th century farmers, were given water rights if they settled land and diverted water. In the early 20th century, the government invested in water-delivery projects. As water scarcity has increased, the government has

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introduced mechanisms to increase efficiency of water use such as, for example, allowing water trading, charging higher fees for government-supplied water, and requiring more responsible management of groundwater aquifers. These policies have led farmers to adopt water conservation technologies. More recently the emphasis is shifting to policies to achieve environmental objectives—including water quality and water allocation for environmental uses. This has led to further reliance on markets for trading water and higher water pricing. The article also suggests that the adoption of conservation technologies in California was enhanced by implicit collaboration between private irrigation developers and Cooperative Extension, which adapted crop management to new irrigation regimes.

The second article, by Steve Wallander, discusses regional variation in irrigation demand and supply across the United States and the effectiveness of federal policies to enhance conservation. He emphasizes the heterogeneity of irrigation systems in the United States, which reflects the diversity of U.S. agriculture in terms of water sources (ground vs. surface) and crops. There have been a gradual shift toward sprinkler and drip technologies, which have higher water use efficiency, and away from furrow and flood irrigation. Wallander argues this shift has occurred at least in part due to government policies like EQIP. The article describes the limitations of conservation programs such as EQIP in inducing technology-based approaches to water conservation due to difficulties in targeting payments based on performance-based measures and to farmers that would not have adopted otherwise. These technologies may also increase production, irrigated acreage, and water use rather than reducing overall water consumption. Alternative approaches including managed aquifer recharge and enhanced metering and pricing of groundwater may be more promising ways to protect groundwater.

In the third article, Ariel Dinar, Arisha Ashraf, and Julie Reints examine water management choices in two different studies of California avocado farmers (first study) and of farmers growing various crops in desert and other southern California regions (second study), both of which have faced prolonged droughts. Their findings suggest that farmers choose technology bundles that include multiple components aimed to address various tasks of irrigation soil moisture and salinity. The bundles are composed of various practices and technologies, such as weather monitoring, pruning, irrigation management, drainage management, salinity management, chemical application, and stumping (of avocado trees). The bundles vary in their degree of complexity, costs, and effectiveness, in terms of productivity and input use efficiency. Technology adoption varies in response to water availability and climatic conditions—water scarcity and perceptions about drought will lead to the adoption of more sophisticated technologies. Advanced technologies are more likely to be adopted in regions where extension is more active by farmers who are younger and more educated and obtain a larger share of their income from agricultural production. The second study also finds support for the policy of incentivizing technology bundling, as the likelihood of a grower adopting soil-moisture monitoring technology increased by almost six-fold when the grower had already adopted salinity-monitoring technologies.

The fourth article, by Paul Ferraro, Kent Messer, and Shang Wu, provides insights from behavioral economics to improve water security. The authors discuss how changes in the ways in which choices or information are presented to decision-makers can help achieve water conservation goals more effectively. Such “nudges” can, for example, induce greater participation in conservation programs by framing choices in ways that emphasize what participants would lose from not participating in the program rather than emphasizing what they would gain from participation. Such framing leverages a well-studied phenomenon among decision-makers called loss aversion preferences. Other possible simple changes to conservation program designs include altering default choices, which leverage the decision-maker tendency to stick with the status quo, and incorporating social or peer comparisons in outreach messages, which leverages decision-maker tendencies to follow social norms.

The articles in this theme emphasize the role that institutions such as Cooperative Extension, public policy initiatives (including water metering and pricing), and behavioral nudges can play in inducing the adoption of water-conserving practices in agriculture.

For More Information

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