

Incentivizing Multibenefit Outcomes in Surface and Groundwater Markets

Technology and institutions like law, regulation, private contracts, and social norms evolve together to shape the way humans interact with our environment. This article examines the way in which water law and other water institutions have co-evolved with technology across different water resource and economic environments.

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This research highlight is based on work in progress.



Drought and over appropriation of water rights result in years when growers do not receive enough water to grow crops on previously irrigated fields. Outside the farm gate, these water supply imbalances create secondary impacts including reduced environmental flows, land subsidence, dry domestic wells, impacts to habitat, water quality degradation and more. Water markets are often mentioned as a way to mitigate water scarcity impacts, but market opponents raise concerns about potentially exacerbating secondary impacts. In this paper we show how water scarcity impacts to primary water users (e.g., agriculture) can be

partially mitigated through water markets. Mitigation of secondary impacts, however, can be expensive for water use types that do not directly generate any economic returns. For example, in-stream flows and local groundwater-dependent habitat ecosystems. In this project we show how targeted incentives within a smart market for water trading can mitigate secondary impacts at a lower cost than alternatives such as restricting water trades or other direct regulation.

We apply the Open Water Trade smart market water trading algorithm. This is an electronic

clearinghouse that matches eligible buyers and sellers of water subject to local rules and restrictions on trade. We expand Open Water Trade by incentivizing trades that reduce undesirable results through targeted third-party payments to encourage specific market outcomes. That is, we expand Open Water Trade to allow a third party environmental water buyer offer additional, incremental payments for specific types of trades that occur in specific locations, river stretches, or times of the year. We call this concept multibenefit outcomes in water trading.

We demonstrate this concept with

an application to the Yakima Basin in which we allow an environmental buyer to offer small additional payments for trades that result in additional instream flows in specific stretches of waterways in the Yakima Basin. We develop a second application for groundwater trading in the San Joaquin Valley in which we allow an environmental buyer to offer small additional payments to encourage land fallowing near existing habitat refuges. We demonstrate that this incentive-based approach is lower cost than other mitigation strategies (e.g., direct regulation or rules).

Yakima Example

During drought years in the Yakima Basin, water levels sometimes fall below minimum instream flow requirements. Significant investment has occurred through the Yakima Basin Integrated Plan to prevent this, including expensive fish passage construction, improvements to surface water supply, and targeted water conservation on farms. Figure 1 shows stream reaches in red designated as priority areas for instream flow needs.

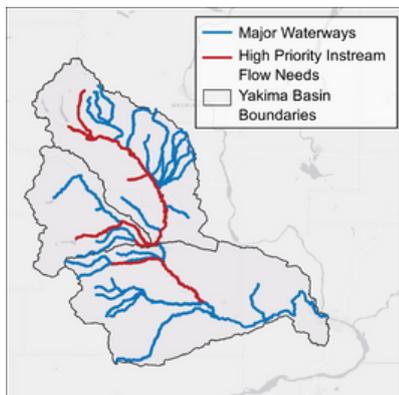


Figure 1. Yakima Priority Waterways

We apply Open Water Trade to a synthetic dataset of farms in the Yakima Basin to show how small environmental incentive payments can increase flows on sensitive stream sections. Each farm diverts its surface supply from a particular point along the system. By incentivizing trades where the seller is upstream of a sensitive flow section of the system and the buyer is downstream, the amount of water passing through that section in a particular year increases.

Using Washington State Department of Agriculture field data and Department of Ecology water rights data we can create a model that closely mirrors the true economic conditions among growers in the basin. Using this model, we compare outcomes in the basin under drought conditions where a smart market exists with and without an incentive payment for environmental flows. The results of the model show the total flow increases at different sensitive sites along the river system, given different levels of third-party spending for environmental flows.

San Joaquin Valley Example

Over appropriation of groundwater resources in the San Joaquin Valley has led to groundwater pumping restrictions in some agricultural areas. The restrictions limit the amount of water that can be pumped in a particular groundwater basin, however they do not restrict the location of

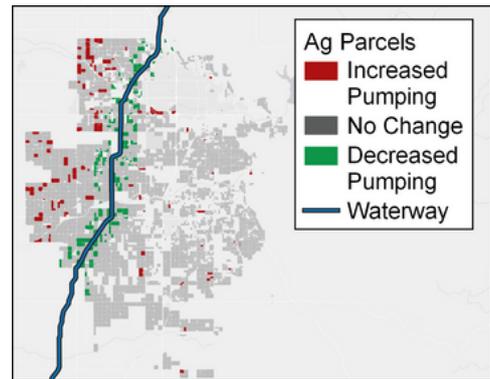


Figure 2. San Joaquin Valley Land Fallowing

pumping within the groundwater basin (Figure 2).

Secondary negative consequences associated with groundwater pumping such as subsidence, stream depletion, habitat, and aquifer depth can be highly localized. As a result, the ability of water managers to convey water through streams may be reduced, domestic wells may go dry, wetland habitat may be impacted, and pockets of degraded water quality might appear.

We apply Open Water Trade to the Tule Subbasin in California’s San Joaquin Valley to evaluate multibenefits from groundwater trading for wildlife habitat. In a baseline scenario water is traded using a smart market that operates according to Subbasin rules and restrictions. Then we include small third-party payments that provide an incentive to reduce pumping near existing wildlife areas in the Subbasin are added to the basic smart market. We compare results with a third-party incentive payment to approaches that achieve the same reduction through direct regulation to measure the effectiveness of the approach.

Application of Modeling and Results

To our knowledge this is the first paper to model outcomes under different types of incentive payments to encourage specific co-benefits within a smart market for water. We estimate outcomes under different supply reduction and payment conditions and discuss the feasibility of using incentive payments to augment a groundwater trading market to provide other co-benefits by reducing undesirable results

(e.g., stream depletion). This method is particularly relevant for the Yakima Basin and other areas that need to achieve in-stream flows, as well as overdrafted groundwater basins that are implementing allocations to limit groundwater pumping. This approach leverages small payments for a buyer (in this case, an environmental buyer) that typically has



A water pump pumping water into an irrigation canal in San Joaquin Valley, CA.

limited ability to pay and would otherwise not be able to meaningfully participate in the market.

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