

Progress report on the BIOAg Award “The potential for data-based irrigation management adoption to improve the sustainability of water and nitrogen resources”.

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**Project Summary**

This project sought to improve understanding of the factors that influence irrigation management and how to communicate the benefits and costs of adopting irrigation management systems that improve water and nutrient use efficiency under a range of crop and climatic conditions. The project included an extensive review of the existing literature on irrigation management across the biophysical sciences and economics which identified clear gaps where there is significant room to improve research, extension, and communication. Work that followed has included (1) the preparation of an extension report that aims to guide irrigated farmers in how to determine whether a data-based irrigation management systems generates an adequate return, (2) development of an economic model that provides a more realistic perspective on how much effort and capital an irrigator should put into improving efficiency, and (3) empirical research on where efficient irrigation systems have been adopted in Washington using field level data.

**Work Completed**

The literature review and economic modeling for this grant provided the foundation for the economics portion of a large grant submitted by a team of researchers at WSU to the USDA to study the farm and regional impacts of deficit irrigation (PI: Claudio Stockle, title “Economic and Hydrologic Impacts of Selective Deficit Irrigation in Response to Water Supply Shortages in the Yakima River Basin of Washington”). While this grant was not funded it was placed in the second highest priority category which makes it a strong candidate for the next round of funding. The team expects to resubmit the proposal this year.

The central output of this project is an extension report currently under review as a WSU Extension Fact Sheet. This became a sizeable report (15 pages single spaced) integrating the (1) empirical analysis of efficient irrigation system adoption and (2) the set of decision tools for evaluating the financial implications of improving irrigation efficiency. Our novel integration of GIS based data revealed a number of new and important findings about the extent to which efficient systems have been adopted, when they have been adopted, and by whom. This will provide valuable information for a range of researchers, government agencies, and other stakeholder groups to target improved efficiency in irrigation water use. Improving efficiency has been a cornerstone of many of the State’s new water management strategies. The second half of the report provides an overview and step-by-step instructions for using farm management and budgeting tools to determine whether investing in irrigation efficiency makes financial sense at the farm level. This includes (1) determining the profit maximizing irrigation level, (2) partial budgets for improving efficiency through labor or capital investments, and (3) using decision trees to account for the risk of drought. Our initial thought with the project was to take a more biophysical and economically technical modeling approach. However, after reviewing existing extension products from WSU and other universities it was our view that there has been an overemphasis on this type decision support tool which often do not take a realistic view of how

farm management decisions are made. There is a need for simpler, more straightforward tools that farm managers can build on, which we think this report provides.

Research titled “Is Irrigation Inefficiency Due to Incentives or Complexity” by Michael Brady and Umesh Bastola was a selected paper at the Western Agricultural Economics Association Annual Meetings in Monterey, CA. The paper, presented on June 27<sup>th</sup>, summarized empirical research for this grant that sought to understand whether incentives for inefficiency inherent to water law under prior appropriations (“use-it-or-lose-it provisions”) or the complexity of irrigation management when surface water sources are subject to in-stream flows. The motivation for this research is the observation that even in areas where there are significant water scarcity concerns most land is irrigated using inefficient systems. We sought to exploit variation in prorationing across six Yakima Basin irrigation to estimate a statistical model that quantified the increased likelihood of a field having an efficient irrigation system if it was in a district that has experienced curtailments compared to being in a district that has not. We also hypothesized an alternative model of efficient irrigation adoption which posited that there are “first adopter” producers who are more likely to use new technologies first. They then influence their neighbors to adopt as well. If this is the case we should observe spatial clustering of efficient irrigation systems. Using the WSDA Cropland Data Layer, Yakima County Land Ownership Assessor’s Data, and other data sets on soil and climate we find evidence of both incentives and spatially based adoption. Specifically, fields in curtailed districts were 6% more likely to use efficient systems. This result will be important in modeling the farm level response to increased (climate change) or decreased curtailments (new water storage). To complete the project we are waiting on field level GIS layers that identify proratable rights holders in the Sunnyside and Roza Irrigation Districts which will help resolve remaining issues with statistical identification. No additional financial resources are required to complete this research.

Funding for the project was primarily used to provide resources for a Graduate Research Assistant, Umesh Bastola. Umesh has incorporated this work into his dissertation where he is constructing a dynamic stochastic programming model of optimal irrigation management.