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Integrated Spatial and Economic Analysis on Water Infrastructure Expansion Profitability and Affecting Climatic Factors within the Central Valley of California

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Climate signals have been consistently changing over the past century, together with increased population and human activities. Consequently, notable shifts in timing and magnitude of floods and drought and declining surface and subsurface water storage have been seriously posing effects on water supply and demand throughout the planet. Hence, it becomes relevant to understand the optimal water allocation to different water users such as agriculture, urban, environmental, and wildlife refuge and manage water infrastructure projects accordingly to support optimal water allocation. In the past, we have shown the successful application of the statewide hydro-economic model, also known as CALVIN (California Value Integrated Network)[1,2], to minimize water allocation costs and optimize water utility under the policy, operational, and environmental constraints.

This study utilizes economic and water allocation output from the CALVIN model historical run (1921 to 2003; monthly scale), and it explores the opportunity cost of water storage and conveyance expansion in California (economic data based on 2050 projected water use[3,4]). This study performs a time series analysis on the marginal economic value of expansion to characterize the correlation between historical climatic factors with water allocation capacity extension to characterize how climate events such as droughts or floods can affect the profitability of water infrastructure expansion projects. The result provides useful information for statewide planners and decision-makers in setting coping strategies for the future under climate change conditions[5,6]. Additionally, this study uses the historical run expansion cost results to identify the most profitable water infrastructure expansion locations using spatial analysis. This study concentrates on agriculture and urban water demands from surface and groundwater sources and categorizes the water allocation over different water years dictated by the California Department of Water Resources (DWR). This study offers a holistic approach to elucidate responses of existing water supply-demand nexus, and the results will be useful for the Sustainable Groundwater Management Act (SGMA) of California.

References: