Managing Reservoirs and Aquifers Use

Larry L. Dale
werri.lbl.gov

Motivation

Water storage in California is usually managed to serve the particular needs of limited user groups. Some reservoirs serve downstream water users; some reservoirs serve the electricity grid; most aquifers serve only overlying water users. Very few reservoirs or aquifers are managed to serve all electricity and water user groups.

Technological Challenges

Although coordinated management of water storage could benefit all users, the principles for doing are not very well worked out either in theory or in practice. In this set of studies we explore use of simple models to identify principles of conjunctive storage and complex models to evaluate the potential gains from conjunctive use and the impact of climate change on these gains.

Research

The simple model used to capture the main features of surface and groundwater storage in California includes a surface reservoir generating electricity while supplying water and an aquifer using electricity supplying agricultural water (Figure 1).

The simple model, holding the in period value of electricity and and water fixed, identifies some storage practices needed to equate the marginal value of reservoir releases with the marginal value of aquifer withdrawals (Dracup and others, 2007).

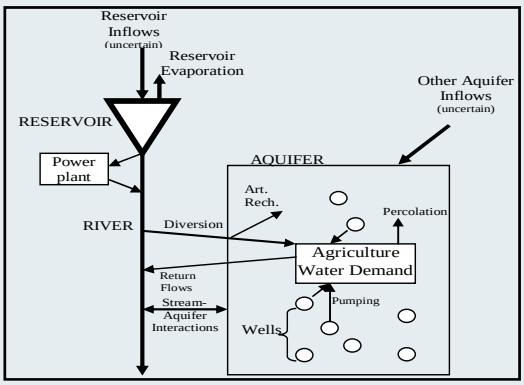

Figure 1. Elements of Conjunctive use Model

A more realistic model includes a comprehensive set of groundwater head-groundwater stress relationships (pumping, applied water at farm (Dracup and others, 2007). The model is used to simulate changes in groundwater head associated with historic stress in the Merced Groundwater Aquifer and evaluate gains from coordinated reservoir and groundwater management (Figure 2).

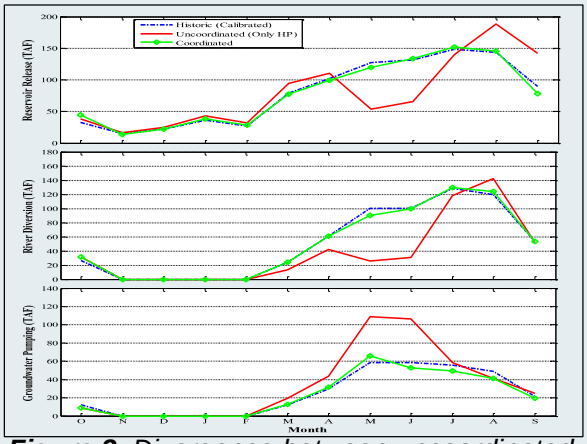

Figure 2. *Divergence between uncoordinated and coordinated aquifer reservoir management in Merced*

These results indicate that historical reservoir operations diverge somewhat from the social optimal (Figure 2). Clearly, coordination of reservoir and aquifer operations would confers some financial benefit.

Related studies apply water energy models to evaluate the impact of climate change on reservoir operations, energy generation, agricultural water use and municipal water use (Dale and others, 2015; Dale and others 2013); Vicuna and others 2011).

References

"An Integrated Assessment of Water-Energy and Climate Change in Sacramento, California: How Strong is the Nexus?" Larry Dale, Nihan Karali, Dev. Millstein, Michael Sohn and others. Climatic Change. July 2015.

"Simulating the Impact of Drought on Central Valley Hydrology, Groundwater and Cropping." Larry Dale, Emin Dogrul, Charlie Brush, Tariq Kadir, Francis Chung, Norman Miller, Sebastian Vicunia. British Journal of Environmental and *Climate Change* January 2013.

"Climate Change Impacts on the Operation of Two High Elevation Hydropower Systems in California." S. Vicuna, L. Dale, J. Dracup. Climatic Change. May 2011.

"Conjunctive Use of Aquifers and Reservoirs: Tradeoffs Between Energy Generation and Water Supply." John Dracup, Larry Dale and Sebastian Vicuna. California Energy Commission PIER Report. November 2007.