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# Water Demand, Risk, and Optimal Reservoir Storage

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With the recent confluence of drought, population growth, and increasing calls for the removal of dams in order to restore environmental values, the issue of optimal sizing (as opposed to management) of reservoir storage is once again of interest. Starting from a context of stochastic annual supply, this paper will consider the relationship between demand elasticity and the expected value of the resulting welfare. The nature of the tradeoff is generally well understood: with increasing storage the mean annual volume of available water is diminished due to evaporation, but the variance is also reduced. Thus as storage increases a higher delivery can be guaranteed to the higher valued uses, but the total which can be delivered over all years may decline. The paper will also seek to value reliability itself by adding assumed characteristics of risk averseness in further exploring the relationship between storage capacity and welfare. The approach is methodologically distinct from that in engineering practice which identifies the storage capacity sufficient to achieve a given level of reliability in water deliveries.

An empirical application will be demonstrated using the water short but storage rich Colorado River Basin as an example. This example is chosen given its regional significance, recently declining reservoir levels, and the ready availability of data characterizing inflows, water demand, and reservoir evaporation. With increasing water demands in the basin for both instream and offstream uses, and the recent inability to meet these demands without depleting reservoir storage, it is appropriate to consider the benefits and costs of both increases and decreases from the existing total level of reservoir storage in the basin.

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