Balancing Water Supply Reliability, Flood Hazard Mitigation and Environmental Resilience in Large River Systems

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Abstract

Many of the world's large ecosystems are severely stressed due to population growth, water quality and quantity problems, vulnerability to flood and drought, and the loss of native species and cultural resources. Consequences of climate change further increase uncertainties about the future. These major societal challenges must be addressed through innovations in governance, policy, and ways of implementing management strategies. Science and engineering play a critical role in helping define possible alternative futures that could be achieved and the possible consequences to economic development, quality of life, and sustainability of ecosystem services. Science has advanced rapidly during the past decade with the emergence of science communities coalescing around 'Grand Challenges' and the maturation of how these communities function has resulted in large interdisciplinary research networks. An example is the River Experiment Center of KICT that engages researchers from throughout Korea and the world. This trend has been complemented by major advances in sensor technologies and data synthesis to accelerate knowledge discovery. These factors combine to allow scientific debate to occur in a more open and transparent manner. The availability of information and improved communication of scientific and engineering issues is raising the level of dialogue at the science-policy interface. However, severe challenges persist since scientific discovery does not occur on the same timeframe as management actions, policy decisions or at the pace sometimes expected by elected officials. Common challenges include the need to make decisions in the face of considerable uncertainty, ensuring research results are actionable and preventing science being used by special interests to delay or obsfucate decisions.

These challenges are explored in the context of examples from the United States, including the California Bay-Delta system. California transfers water from the wetter northern part of the state to the drier southern part of the state through the Central Valley Project since 1940 and this was supplemented by the State Water Project in 1973. The scale of these activities is remarkable: approximately two thirds of the population of Californians rely on water from the Delta, these waters also irrigate up to 45% of the fruits & vegetables produced in the US, and about 80% of California's commercial fishery species live in or migrate through the Bay-Delta. This Delta region is a global hotspot for biodiversity that provides habitat for over 700 species, but is also a hotspot for the loss of biodiversity with more than 25 species currently listed by the Endangered Species Act. Understanding the decline of the fragile ecosystem of the Bay-Delta system and the potential consequences to economic growth if water transfers are reduced for the environment, the California State Legislature passed landmark legislation in 2009 (CA Water Code SS 85054) that established "Coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem". The legislation also stated that "The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." The challenges of integrating policy, management and scientific research will be described through this and other international examples.

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