

Reservoir Storage: Slowly Drifting into Failure?

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Abstract

The presentation demonstrates that river water has the greatest potential for sustainable development of fresh water supply systems and emphasizes that reliable water supply from rivers can only be accomplished by creating and maintaining the right amounts of storage. Reservoir sedimentation leads to continued reduction in reservoir storage, which currently results in more storage being lost than what is added through the construction of new dams. The effects of climate change results in increased hydrologic variability and increased sediment loads in rivers. Increased hydrologic variability requires greater amounts of storage to maintain the reliability of water supply, while increased sediment loads in rivers leads to increased loss of storage through reservoir sedimentation. It is argued that fresh water supply infrastructure experiences a slow drift into failure, characterized by common failure characteristics of such large complex systems.

Four typical characteristics of complex system failure include competition for scarce resources, a drift into failure through small incremental events and normalization of decisions that exposes the system to failure, the important role of initial conditions that eventually leads to system failure and drawing in of regulators that are expected to ensure the continued functioning of complex systems.

The scarcity of resource typically results in dams being designed and constructed without consideration for the effects of reservoir sedimentation and without providing facilities to manage reservoir sedimentation. Throughout modern dam history economic analysis and dam design practice normalized the idea that it is acceptable for dams to only last for a limited period of time, until filled with sediment; which is in conflict with the concept of sustainable development and the need to create intergenerational equity. The effect of normalizing these practices are reflected in the continued reduction in reservoir storage, which continues to impact the reliability of water supply. Furthermore, the complexity of dams and reservoirs, including the stochastic nature of river flow and increasing challenges associated with climate change poses complex threats requiring urgent attention. In the case of reservoirs it is also noted that initial conditions contribute to them slowly drifting into failure. The fact that most dams and reservoirs are not equipped with approaches to manage reservoir sedimentation eventually leads to their demise due to this undesirable initial condition. It is furthermore alarming that no regulatory agency assumes the responsibility of ensuring the long-term sustainability of fresh water supply systems. No policy exists for ensuring sustainable development of water resources, neither are there any legal requirements, nor regulations and regulators to enforce sustainable development.

Solution to this problem, aimed at preventing a slow drift of these systems into failure, is to firstly develop policy for sustainable development of water resource infrastructure, which is then followed by development of a legal framework and regulations to be enforced by regulators. Development of wise policy, laws and regulations will guide design and operation of dams and reservoirs to thoughtfully apply scarce resources when designing and constructing dams. It will require application of these resources in a manner ensuring sustainable development of the water resource infrastructure. It will also prevent critical decision making related to economic

analysis and dam design practice from being normalized. It will require implementation of more pragmatic and rational approaches to develop water resource infrastructure that recognizes the associated complexity associated with climate change, hydrology, sediment transport and human factors.