DAM REOPERATION AS AN ADAPTATION STRATEGY FOR SHIFTING PATTERNS OF WATER SUPPLY AND DEMAND

A CASE STUDY FOR THE XIN'ANJIANG-FUCHUNJIANG RESERVOIR CASCADE, CHINA

Climate change, rapid economic developments and further growth of the human population are regarded as the major drivers of increasing water-related problems worldwide. The changing hydrological circumstances and water demand patterns pose a challenge to the management of water resources systems as these are designed to maintain a fragile balance between water supply and demand. With the projected changes, this balance is likely to be disrupted, ultimately requiring adaptation of existing infrastructure. Adjusting the operation of reservoirs could be a promising strategy for adaptation.

The objective of this research project was to determine whether reoperation of the Xin'anjiang-Fuchunjiang reservoir cascade (Hangzhou Region, China) is an effective adaptation strategy to mitigate potential impacts of climate change and regional socio-economic developments. We used a scenario-based approach to explore the effects of various degrees of water stress for the future period between 2011 and 2040, which were compared to the control period 1971-2000. Scenario-wise changes in water supply and demand were used as forcing for the WEAP water allocation model, which was employed to simulate reservoir performance. This performance was measured with the Shortage Index (SI) and Mean Annual Energy Production (MAEP).

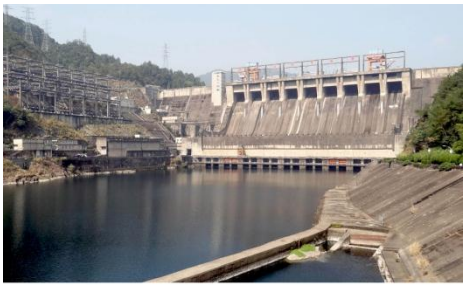

Figure 1: The upstream Xin'anjiang Reservoir.

The impact of climate change and socio-economic developments was determined by simulating the performance of conventional reservoir operating rules for both the control period and each future scenario. We found a SI of 0.007 for the control period and values ranging from 0.05 to 0.92 for the investigated future scenarios. Even though the increasing SI implies that more drought problems are likely in the future period, the deficits are still fairly small compared to what is generally regarded acceptable. Compared to the control period, the MAEP decreases with -12.8% to -16.3% in the future scenarios.

In a second step the WEAP water allocation model was interlinked with the NSGA-II metaheuristic algorithm in order to derive long-term multireservoir operating rules adapted to each scenario. Compared to conventional operation, adapted operating rules reduce the SI with 72% while the MAEP shows an average increase of 5.4%. Based on the optimization results, we conclude that for the studied case dam reoperation is an effective adaptation strategy to reduce the impact of changing patterns of water supply and demand, even though it is insufficient to completely restore system performance to that of the control period.

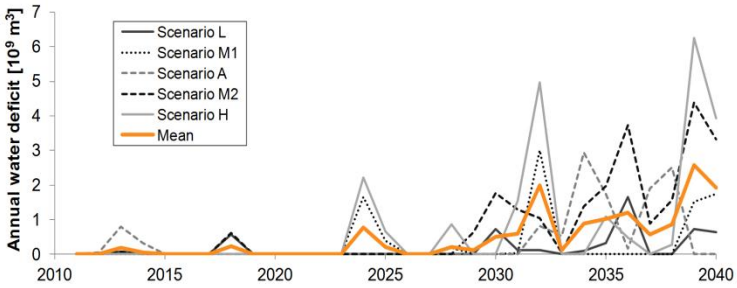

Figure 2: Development of the annual water deficit for the investigated scenarios (increasing water stress from scenario L to H).

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