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Characteristics of reservoirs to mitigate drought effects with a hedging rule triggered by drought limited water level

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Severe droughts are challenging the development of society and economy worldwide. Whilst hedging rules for reservoir operations contribute to reduce the risk of unacceptably severe water shortage during droughts, they could be of trivial value for some reservoir water supply systems considering water supply reliability, vulnerability and resilience. There is still no consensus on the quantitative characteristics of water system hedging rules should be applied to. In this work, reservoir water level named as drought limited water level(DLWL) is employed to trigger practical zone-based water supply rule firstly. Then the impact of DLWL on the water supply performance is analyzed with a range of hypothetical reservoir water supply systems. Based on it, characteristics of reservoirs which DLWL should not be applied to is identified using scenario discovery. For these reservoirs, main influencing factors are revealed and effective drought management measures to ensure reliable water supply are proposed accordingly. For the rest reservoirs that DLWL should be applied to, a multi-objective DLWL optimization method is proposed and applied to Qing Reservoir, a typical water supply reservoir in Northern China. The influence of changing environment on DLWL is studied with a comprehensive sample of deeply uncertain factors. Results show that hedging policy triggered by DLWL has a remarkable advantage over the standard operation rules to mitigate effect of drought. To adapt to increasing water supply pressure featured with increasing demand, decreasing streamflow volume and more variable streamflow, DLWLs during high water demand period ought to be raised and DLWLs during dry season ought to be reduced. Insights from this work have general merit for taking the most effective measures to relieve water shortage and regulate existing hedging rules to adapt to changing environment.