

Gauging the climate-associated risks for paddy water management based on reservoir performance indices

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Abstract

Climate change is strongly threatening the performance of agricultural reservoirs, which are instrumental in ensuring uninterrupted water supplies for rice cultivation in Korea. In this study, various performance indices were derived and overall sustainability of the 400 agricultural reservoirs was evaluated in the context of climate change trends during 1973 - 2017. Rice crop evapotranspiration, irrigation water requirements, runoff generation in the upstream watershed, and volumetric evaporation losses were plugged into a water balance model to simulate the reservoir operation during the study period. Resilience, reliability, and vulnerability are the three main indicators of reservoir performance, and these were combined into a single sustainability metric to define the overall system credibility. Historical climate data analysis confirmed that the country is facing a gradual warming shift, particularly in the central and southern agricultural regions. Although annual cumulative rainfall increased over the last 45 years, uneven monthly rainfall distribution during the dry and wet seasons also exacerbated the severity and frequency of droughts/floods. For approximately 85% of the selected reservoirs, the sustainability ranged between 0.35 to 0.77, and this range narrowed sharply with time, particularly for the reservoirs located in the western and southern coast regions. The study outcomes could help in developing the acceptable ranges of the performance indices and implementing appropriate policy and technical interventions for improving the sustainability of reservoirs with unacceptable ranges of the performance indices.

Keywords : climate change, agricultural reservoirs, water balance, sustainability

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