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Adaptation portfolio to combat future climate change impacts in the water sector of the Chao Phraya River Basin, Thailand

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Climate change will increase the intensity and frequency of flood and drought events and the global population exposed to these extreme events, thereby enhancing economic damage. Therefore, adaptation measures should be taken to combat the inevitable consequences of climate change, particularly flooding and water scarcity. However, quantitative and concrete views on what adaptation measures should be taken have yet to be explored, especially in developing countries. Hence, in this study, the effect of several combinations of adaptation measures was examined to address both the future extremes in the Chao Phraya River in Thailand. The selected adaptation measures were (i) structural measures, which include dam construction, dam capacity enhancement, use of water-efficient irrigation equipment, and diversion channels, and (ii) non-structural measures, which include reforestation, changing the reservoir operation rules, and retention area enhancement. Future climate scenarios were constructed from the bias-corrected outputs of three general circulation models from 2080 to 2099 under RCP4.5 and RCP8.5.

Future flood and drought risk were analyzed using the number of flooding days and cumulative abstraction to demand (CAD) index, respectively. The major findings that can be drawn from this study are as follows: (i) the structural measures are capable of reducing the number of flooding days and increasing the CAD index; however, this pattern varies from region to region within the basin. (ii) the non-structural measures reduced both flooding days and CAD index, significantly impacting the basin's water availability during the dry season. The reduction of the CAD index was mainly due to the increased evapotranspiration from the reforested land use that resulted in a decreased runoff. (iii) the adaptation portfolio (combination of structural and non-structural measures) exhibited a reduced number of flooding days and increased CAD index similar to the structural measures. The results revealed that the adaptation measures for flood or drought risk reduction could negatively impact the risk of the other hazard (i.e., reforestation reduces the flood risk but increases the drought risk). Therefore, different combinations of adaptation measures and basin-wide actions would allow us to better address the tradeoffs between these extremes and measures taken at different temporal and spatial scales.