

Estimation of Blue and Green Water Resources in the Wei River Basin, China.

Wei River, the largest tributary of the Yellow River, is suffering from water scarcity, water pollution, and shortage of ecological and environmental water requirement. In order to estimate the amount of water resources in the study area, a hydrological model was developed by using SWAT (Soil and Water Assessment Tool), and calibrated and validated with SUFI-2 (Sequential Uncertainty Fitting program) based on river discharge. Sensitivity and uncertainty analyses were performed to improve the model performance. Water resources components of blue water flow (water yield plus deep aquifer recharge), green water flow (actual evapotranspiration) and green water storage (soil water) were estimated at the HRU (Hydrological Response Unit) scales. Water resources in HRUs were then aggregated to subbasins, catchments, and then city/region scales. Blue water scarcity at the HRU scale was also estimated based on model results. The results showed that: (1) most parts of the Wei River basin were experiencing serious blue water shortage, especially for the Loess Plateau in the north. The middle reaches of the Wei River and the lower reaches of the Beiluo River have relatively sufficient precipitation and green water resources to sustain the ecosystems, and the development of rain-fed agriculture in those regions; (2) the inter-annual variability of blue water flow is large in the headwater catchment and middle reaches of the Wei River, and the headwater catchment of the Jing River. It decreased significantly from the 1960s to the 2000s, while the variation of green water flow and precipitation was smaller. The intra-annual variability of blue water flow shows large uncertainties in flood seasons (July-October), which means unreliability of water supply in those months. The Loess Plateau maintains sufficient green water storage over the years; (3) some cities/regions near the outlet of the Wei River basin have a relatively large blue water flow, while the cities/regions in the headwater catchment of the basin have a small blue water flow. The quantity of green water flow in the cities/regions located in the south of the Wei River is relatively higher than other cities/regions. The green water storage in Xi'an is notably small, while those of Tongchuan, Yan'an, Pingliang, and Qingyang in the north of the Wei River show relative rich soil water storage. The most southern part of the Wei River basin (Guanzhong Plain), one of the most important grain production bases in China, is experiencing serious water scarcity. This study would provide useful information for the optimal utilization of water resources in the Wei River basin.