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Increased evapotranspiration in the Yellow River basin brings additional precipitation locally and downwindwards

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The ecological restoration benefits in the Yellow River Basin (YRB) are significant, characterized by increased vegetation and reduced sediment. However, afforestation has resulted in elevated water consumption, posing a threat to the sustainability of ecological functions and socio-economic water use. Previous studies treating evapotranspiration (ET) as absolute water consumption and neglecting the precipitation increase from water recycling, have introduced considerable uncertainty and limited our understanding and prediction of the process. By combining GLEAM ET data and UTrack data, we depicted the contribution of ET in the YRB to local and surrounding basin precipitation. Our study reveals a substantial increase in ET in the YRB from 1980 to 2020. ET in this basin contributes to precipitation in both local and downstream areas through moisture recycling. On average, ET contributes 107 mm/yr of precipitation locally (21%), with the primary contribution from the Upper and Middle region. Additionally, ET contributes 63, 23, 20, and 20 mm/yr of precipitation to the Haihe River Basin, Yangtze Basin, Huaihe River Basin, and Songliao River Basin, respectively. Alongside the increase in ET, its contribution to precipitation is also rising, diminishing outward from the YRB. The increased ET brings about approximately 11 mm/yr of additional precipitation to YRB, offsetting about a quarter of the ET increase. We also provide a schematic diagram illustrating the water cycle in the YRB, elucidating the proportions of each component. This work contributes to a clearer understanding of the basin's hydrological processes, offering scientific support for water resource management and sustainable development in the changing conditions of the YRB.