

Impacts of climate change and human activities on streamflow of Upper Yongding River Basin, North China

Liqiang Deng¹, Ying Guo¹, Yongqing Qi¹, Yan-Jun Shen¹, and Yanjun Shen¹

¹Institute of Genetics and Developmental Biology Center for Agricultural Resources Research

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Abstract

Streamflow in semiarid area is facing rapidly decreasing, especially in North China, which make it important to analyse the characteristics and influencing factors of streamflow. Using hydro-meteorological data series during 1961-2017 in the Upper Yongding River Basin (UYRB)(including Yang River Basin (YRB) and Sanggan River Basin (SRB)), Spatio-temporal variation characteristics of air temperature, precipitation and potential evapotranspiration (E_0) were analysed. Results showed that: precipitation has no significant trend; temperature shows a significant increase by 0.09–0.52 per decade; E_0 shows a significant decrease from -0.18 mm/yr to -2.04 mm/yr (in 18 stations); the estimated rates of streamflow change are -0.74, -0.80mm/yr for SRB and YRB. As to spatial distribution: the YRB presents a higher E_0 value than the SRB; and the mountain area has more precipitation than the plain area. And the change points of streamflow occurred in 1982 and 2003. Both Budyko and DMC method were used to evaluate the impacts of climate change and human activities on mean annual streamflow. In the variation stage I (1983~2003), impacts of human activities account for 90.6% and 62.7% of the mean annual streamflow changes in YRB and SRB, respectively. In the variation stage II (2004~2017), the percentages are 99.5% and 93.5%, respectively. It is also noted that the first change point in streamflow was indeed at the beginning of China's land reform, when the farmers can manage their reallocated lands and therefore increased agricultural water consumption. The second change point coincided with "Capital Water Resources Planning" including water conservation projects and irrigation district construction programs. In general, human activities were mainly responsible for the significant decline in the annual streamflow of UYRB. This paper will provide valuable results for water resources planning and give guidance to the construction of water conservation function area and ecological environment support area of capital.

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