Regional Water Footprint Assessment: Method, Indicators and Application in Beijing

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Abstract

Water resource is an essential element for all lives on this planet. However, with the rapid growth of economics, urban population as well as the changes of land use, the contradictions between development and environment are becoming more prominent. Beijing, as the capital of China, is also facing with the issues of water scarcity and degradation. To analyze the environmental impacts of human activities on water environments, the present study established a modified approach that integrated water quantity and quality. The model was applied to Beijing, calculating the water footprint of 4 sectors from 2004 to 2013. In addition, this paper also explored the relationship between water footprints and urban development indices.

The studies showed that the water availability footprint and water degradation footprint of Beijing in 2004-2013 declined with urban developing. The water availability footprint declined gradually from $21.26 \times 10^8$ m$^3$ H$_2$O eq in 2004 to $14.47 \times 10^8$ m$^3$ H$_2$O eq in 2013, and the water availability footprint of domestic water use took the largest proportion of it, following with agricultural water use, industrial water use and environmental water use. Among them, the water availability footprint of domestic, agricultural and industrial water use decreased with urban development, while the environmental water availability footprint increased slightly. For all the water availability footprints, the curve reached to an extremely low value in 2008 and 2012. The main reason for this was the sharp increase of precipitation, as well as the stability of the amount and quality of water use.

The results of water degradation footprint showed that: from 2004 to 2013, the water acidification footprint decreased annually, declining from $19.1 \times 10^7$ kg SO$_2$ eq (2004) to $10.4 \times 10^7$ kg SO$_2$ eq (2013). Simultaneously, the water eutrophication footprint of NOx varied in two stages, with an obvious decrease of $0.8 \times 10^7$ kg NO$_3^-$ eq in the last 4 years. From 2011 to 2013, the aquatic ecotoxicity footprint of 5 heavy metals (Pb, Hg, Cr, Cd, and...
As) increased first and then decreased, with an increase of $419.1 \times 10^6$ m$^3$ H$_2$O eq in total. Furtherly, based on the results of the assessment, the correlation between water degradation footprints and some urban development indices is analyzed. It’s found that the slowdown of population growth, decrease of chemical fertilizer consumption, as well as the adjustment of industrial structure would facilitate the decrease of water degradation footprint.