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## Spatial simulation of water supply service flow in Ningxia, China

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Transregional Ecosystem Service (ES) flows are ubiquitous and are receiving more attention in an increasingly metacoupled world. Water has typical flow properties and is a common flow medium of Water-related Ecosystem Services (WES), such as water supply, water conservation, etc. Ningxia is in a transition zone from semi-arid to arid areas of the Yellow River basin of China. Its role in the water transfer from the Qinghai-Tibet Plateau to the downstream city and agriculture is important in allocating the scarce water resources in (semi-)arid regions. This study described the water flow process to/from Ningxia and revealed the supply-demand balance of water in Ningxia and its adjacent basins. On the grid scale, the total dynamic residual water in Ningxia from 2000 to 2015 was  $2.20 \times 10^{12} \text{ m}^3 \sim 6.26 \times 10^{12} \text{ m}^3$ . However, there was still a dynamic water demand gap of  $-72.25 \times 10^8 \text{ m}^3 \sim -59.08 \times 10^8 \text{ m}^3$ , which could only be supplemented by manual water intake. At the regional scale, Ningxia had two sides, which was both the beneficiary of the upper Xiaheyan basin, Qingshui River - Kushui River basin, Xiaheyan - Shizuishan basin, Hexi Inland River-Shiyang River basin, Hexi Inland Rive-Hexi desert basin and internal flow area, and the supplier of the downstream Shizuishan - Hekou town, Longmen to Sanmenxia subbasin. As the benefitting district, the total net inflow water supply service in the supply area from 2000 to 2015 was  $135.86 \times 10^8 \text{ m}^3 \sim 294.22 \times 10^8 \text{ m}^3$ , among which the non-Ningxia region in the sub-basin above the Xiaheyan basin was the main source region of water supply service in Ningxia. As the supply area, the net outflow volume of water supply service in Ningxia from 2000 to 2015 was  $72.83 \times 10^8 \text{ m}^3 \sim 200.46 \times 10^8 \text{ m}^3$ , mainly flowing to non-Ningxia regions from Shizuishan to Hekou town. Overall, the net volume of water supply service flowing into Ningxia from 2000 to 2015 ranged from  $63.03 \times 10^8 \text{ m}^3$  to  $93.76 \times 10^8 \text{ m}^3$ . This study can enhance the understanding of trans-boundary telecoupling relationship of WES in Ningxia and contribute to form a foundation for interregional management and allocation of WES in (semi-)arid regions to promote equity in sustainable regional development.