[WATER TRANSFER THROUGH INTERPROVINCIAL TRADE WITHIN CHINA: FROM THE PERSPECTIVE OF VALUE CHAIN]

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Overview

Suffered from water challenge due to the uneven water reources distribution, China faces increased water demands from industrial uses, agriculture etc. As an alternative choice for redistributing uneven water resources, the virtual water has been analyzed in terms of the virtual water trade and its impacts on the global, national and regional water use (Zhao et al., 2015). And the virtual water trend and driving factors like technology efficiency are identified. While, as Meng et al. (2013) has noticed, in addition to technological efficiencies, regional economic scales etc., the regional position in domestic and global supply chains also affect the environmental characteristics of a region. This was overlooked in the existing studies, though some distinguished the final and intermediate goods related virtual water trade. Thus, from the perspective of value chain, we decompose three trade patterns for one region to discuss how these trade patterns affect its water trade and also the national water use.

Methods

A multi-regional input-output method is used to evaluate the water transfer via interprovincial trade in China. Based on the multi-input-output table, the total exports from province s to province r is $T^{sr} = Y^{sr} + A^{sr}X^{r}$, Y^{sr} represents the final demand of province r from province s. In the second term, A^{sr} is the input coefficient matrix that represents the intermediate use in province r of goods produced in province s and X^{r} is the total output in province r. Furhter, we can decompose the T^{sr} into three parts, namely, T_f^{sr}, T_i^{sr}, T_v^{sr} i.e. the trades in final products, intermediate products for the final stage of production, and the value chain related trade. Then the virtual water transfer from province s to r VW^{sr}, can also be obtained under three trade patterns, and so as to the balance of embodied water, $BVW^{sr} = VW^{sr} - VW^{rs}$. Further, the national water saving of different trade patterns are evaluated.

Results

Firstly, we evaluate the provinces' water uses from five parts, including water uses induced by its domestic activities, its exports to foreign countries and its exports to other provinces, including embodied water in three trade pattens. As Fig. 1 shows, the water uses distribution is uneven with the largest water consumers in coastal developed provinces like Jiangsu, Guangdong and some low water use efficiency provinces such as Xinjiang. Mostly for domestic activities, the water use varies for other uses in 30 regions. The coastal regions consume more water for international exports, and the water uses embodied in final goods trade contributes most to Anhui, Ningxia and Xinjiang. In terms of intermediate goods and value chain related trade, they play a vital role for central regions like Inner Mongolia, Guizhou, Shaanxi etc. This indicates that they're vital for other region's exports or domestic use.

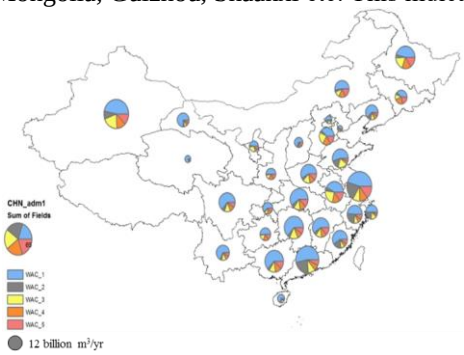

Fig.1. Total water uses and its decomposition based on five use patterns in 30 provinces.

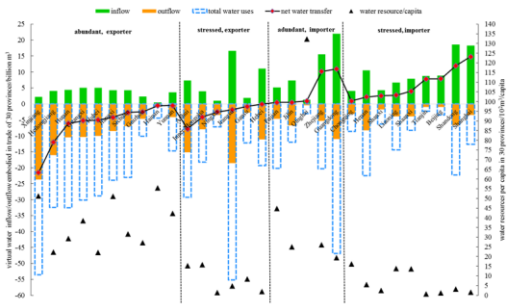

Fig.2. The net water transfer and water resources per capita of 30 regions

Seconly, not only a region would export virtual water embodied in its products exports, it also imports virtual water via products imports. The virtual water trade balance is presented in Fig. 2, which shows that coastal regions

are major net water importers and some undeveloped regions in northwest, southwest are major net water exporters. It implies that the developed regions depend more on other region's water uses, for example, Tianjin, Beijing and Shanghai import more than 3, 2 and 1 times of their domestic water use. When considering the water scarity in north regions, the net water export of Ningxia and Inner Mongolia may exacerbate their water shortage problem.

Thirdly, the virtual water trade in different provinces relies on different trade patterns, which is closely related to their positin in the domestic production network. As Fig. 3 presents, the net virtual water trade in Tianjin, Shanghai, Xinjiang etc are mainly through final goods trade directly. And Shandong would import virtual water via the intermediate products, which needs its further processing. Guangdong, Zhejiang are active in the value chain related trade, which indicates that they are the main destination of raw materials from other provinces and would participate in lots of products trade with other regions.

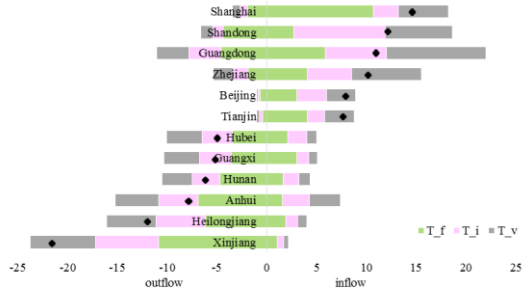

Fig.3. Decomposition of virtual water trade in 6 largest net water importers and exporters. (Unit: billion m^3)

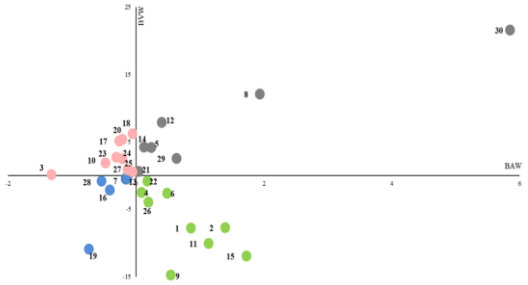

Fig.4. The distribution of BVW and BAW in 30 regions. (Unit: billion m^3)

Further, we analyze the bilateral water trade under three trade patterns, as presented in Fig. 5. The east coast regions like Shanhai are main destination for final goods import from Xinjiang, Hebei, Heilonglinag etc. And Shandong palys a vital role in the intermediate goods trade especially from Xinjiang. And Guagndong, Shandong and Zhejiang are important provinces in the value chain related trade from the north regions, central regins and southwest reginons respectively. The virtual water mainly flows from the northwest, southwest and central regions to coastal regions, and the main trade provinces change from the east coast provinces in the final goods trade to south coast regions in the value chain related trade.

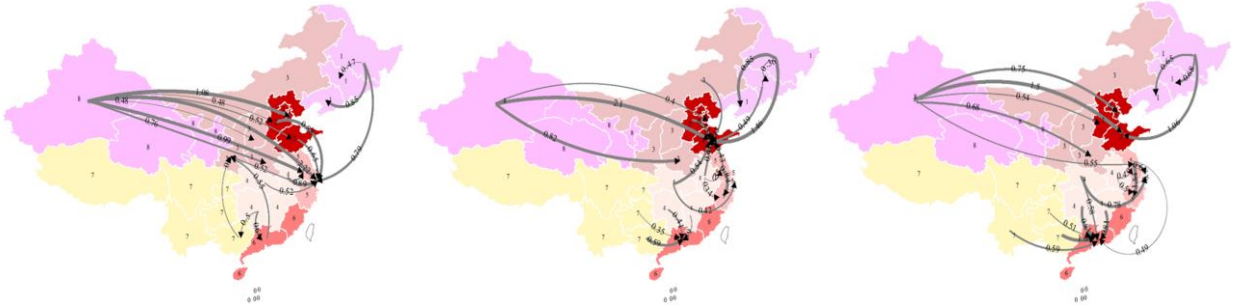

Fig.5 The 20 largest net water flows of bilateral water trade in final goods (left), intermediate goods for the last stage of production (middle), value chain related trade (right).

When we consider the national water saving effects under three trade patterns, the final goods trade results in savings of national water with 3.1 billion m^3, while the intermediate goods trade consumes more water uses by 14.2 billion m^3. This is mainly due to the Xinjiang and Shandong's virtual water trade (see Fig.4). And different sectors should be paid attention to in them, like agriculture products in Xinjiang, and agriculture products, electricity production and supply sector, crude oil and natural gas extraction sector in Shandong.

Conclusions

Different provinces played different roles in the virtual water trade, firstly, water use efficiency is of great importance to save both regional and national water uses, especially agriculture products. Secondly, virtual water trade is not always a good choice to relieve the uneven water resources distribution situations induced by different trade patterns. Thirdly, Thirdly, the biltateral water trade presents the water flows direction from southwest, northwest and central regoins to coastal regions, where the water compensation scheme would be a practical solution to distribute the ecological burdens equally. Finally, the national water uses are consumed more due to the intermediate goods trade, which should be paid more attention to in our domestic production network. And Guangdong is a representative region for saving national and regional water uses,which should be learned by others.

References

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