# Sustainable use of water resources in East Asia

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## 1. Introduction

In recent decades, globalization has led to trade volumes of goods expanding at a faster rate than GDP. The trade volume of 'virtual water' (water embedded in traded goods) has also increased; in some regions globalization may be exacerbating water shortages.

In this study we explore the most recent data on the issue. We find that China's water trade surplus expanded between 1995 and 2009, while the water trade deficit in the US and EU widened sharply. It could therefore be said that the EU and the US have contributed to water shortages in China. To improve the sustainability of water use, this study uses the E3ME model to assess the effects of a tax on water consumption. We apply a 40% tax on water consumption from the public supply, which is levied on all industrial sectors that use water. The water tax is imposed for eight years starting in 2020. We find that water demand could be reduced by about 10%, with minimal economic loss.

## 2. Scenarios and methodology

There is ample literature related to Global Value Changes. Some research has analyzed structural changes of vertical divisions of labor using input-output tables (e.g. Hummels et al., 2001; Koopman et al., 2008; Ye and Fujikawa, 2011). The common key word in these articles is 'Trade in Value Added', which is embodied in traded goods.

Value added is created by primary inputs that include labor and natural resources. Natural resources comprise energy, land, water and air. $CO_2$ emissions can be considered as a proxy variable for energy inputs, but also as use – or exploitation– of air since they are the main factor of global warming. Those value-added elements are traded internationally together with goods and services, such as embodied labor, $CO_2$, water, and land; our research in this chapter focuses on the change in water use.

We outlines the trend of international trade in water by using international input-output tables (WIOD). We also use input-output tables that include ten countries/regions; i.e. China, Japan, Korea, Taiwan, Indonesia, India, US, Russia, the

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European Union (EU) and the Rest of the World (RoW). And we use the E3ME model to simulate the change of water consumption in Asian countries when water is taxed.

### 3. Expected results and Analysis

The research discussed in this study draws on data from the WIOD database, and we link this to previous modelling carried out with E3ME. First, however, we focus on the structural change of water trade on an international level. Water trade is measured by virtual water embodied in trade of goods and services. The results obtained are summarized as follows.

1) In 1995, The water trade balance showed a surplus in China and India but a deficit in the US, EU and Asian countries Japan, Korea and Taiwan with that of Japan being particularly large.

2) Total global water use increased by 37% from 1995 to 2009. In this period, China's water trade surplus expanded, even though its water use increased remarkably. The water trade deficit of the US and the EU widened sharply and EU, Japan and the US have contributed to the overconsumption of water in China.

These findings stress the need to consider ways in which water consumption can be reduced in East Asia. We, therefore, tested the impacts of a tax on water consumption in each country. The model results should be considered as indicative because of limitations in the available data but it seems possible that a modest reduction in water consumption could be obtained by increasing prices. Furthermore, this could come at a very limited cost to the economy and, if revenues are recycled from this tax, potentially deliver some small economic benefits.

It may be possible to further reduce water consumption through levying a larger tax, but the range of uncertainty in the model results increases with an increase of the tax rates. Other regulatory policies (e.g. restriction of any production of biofuels) could play an important role and, as we found in other chapters, policy interaction is likely to be important.

### 4. Conclusion

In summary, there are many complexities when modelling the demand for water, and further data and analyses at both micro- and macroeconomic level are required. Our analysis shows that the issue of fresh-water resources in parts of East Asia is already becoming a priority and likely to become even more important in the future.