A Country-Specific Water Consumption Inventory Considering International Trade in Asian Countries Using a Multi-Regional Input-Output Table

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Appendix 1: Calculating the water consumption

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Here, we explain the method used to calculate the water consumption. The target year was 2005. Details of the water consumption in Japan and Korea were obtained from Ono *et al*. [1] and Kim *et al*. [2], respectively. More details, including an explanation of the theoretical origin and introduction of the data treatment procedure can be found in the literature [1, 2] and are not presented here.

Agricultural sector [Sector numbers 1-4]

The water consumption for agriculture was calculated using the following formula:

$$Water\ consumption = \sum (WCC_{c,i}\ [m^3/t] \times Crop_{c,i}[t]) \tag{1}$$

where *WCC* is the water consumption coefficient, *c* is the country, and *i* is the kind of agricultural product (*e.g*., wheat, beans, carrots, fruit, etc.). WCC covered 146 primary crops in each countries, and it include type (rain water, surface water, and groundwater) of water. Method for separation of water were determined as follows in accordance with the procedure from a previous study (Water Footprint 2011). WCC is multiplier Et0 and Crop coefficients (Kc). The grid-based dynamic water balance model used in Mekonnen and Hoekstra [3] 's study computes a daily soil water balance and calculates crop water requirements, actual crop water use and actual yields. The model is applied at a global scale using a resolution of 5 by 5 arc minute (10km by 10km). Crop coefficients (Kc) for crops were obtained from Chapagain and Hoekstra [4]. Crop planting dates and lengths of cropping seasons were obtained from FAO [5], Sacks et al. [6], Portmann et al. [7] and USDA [8]. The crops were from FAO[9].

Livestock sector [Sector number 5]

The water consumption by livestock was calculated using the following formula:

$$Water\ consumption = \sum (WCC_{c,i}\ [m^3/t] \times L_{c,i}[t]) \tag{2}$$

where *WCC* is the water consumption coefficient, *c* is the country, and *i* is the kind of livestock (*e.g*., cattle, chickens, pigs, sheep, etc.). *L* is number of kinds of livestock and was obtained from the FAO [9]. *WCC* was obtained from Mekonnen and Hoekstra [10].

Forestry Sector [Sector number 6]

The water consumption for forestry was calculated using the formula:

$$Water\ consumption = \sum (FA[ha] \times Et_c[mm]) \tag{3}$$

Where *FA* is the forestry area and was obtained from the FAO [11]. Et_c is evapotranspiration, and

was obtained from the FAO [12, 13]. If Et_c is less than the amount of rainwater, all of Et_c is assumed to be from rainwater. If Et_c exceeds the amount of rainwater, the difference between Et_c and supplied rainwater is assumed to be zero.

Industrial Sector [Sector numbers 12-60]

The water consumption by industry was calculated as follows:

$$Water\ consumption = \sum(WC_{c,i}\ [m^3] \times R_i [\%]) \tag{4}$$

Where $WC_{c,i}$ is amount of water consumption for sector i and country c. As $WC_{c,i}$ does not exist, $WC_{c,i}$ is estimated from the water consumption and R_i. The amount of water consumption in each country is provided by the FAO [14]. R is the ratio of water consumption, and is obtained from the water consumption of sector i relative to the total Japanese industrial water consumption. Consequently, these countries and sectors might not reflect the real situation.

Other sectors

The water consumption of the Electricity and gas [Sector number 61] and Water supply [Sector number 62] sectors in Indonesia, Malaysia, the Philippines, Singapore, and Thailand used FAO data [9], that for China used the China Statistical Yearbook [15], and that for the USA was from United States Geological Survey (USGS) data [16]. As the USGS water supply [16] gives daily data, we multiplied the USGS daily data by 365. The water consumption by the Fishery sector [Sector number (7)] used USGS data [16] for the USA, and the only other data were for Korea and Japan. As explained above, because the USGS [16] shows daily data, we multiplied the USGS daily data by 365. The water consumption by the Crude petroleum and natural gas sector [Sector number 8] used the China Statistical Yearbook [15] and USGS [16] data; the only other countries with data were Korea and Japan. Again, we multiplied the USGS daily data by 365. The water consumption used for the Iron ore, Other metallic and non-metallic ores, and Quarrying sectors [Sector numbers 9-11] used the China Statistical Yearbook [15]; the only other countries with data were Korea and Japan. Where data are lacking for the sectors of some countries, these sectors are underestimated.

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