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Significant drivers of the virtual water trade evaluated with a multivariate regression analysis

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International trade of food is vital for the food security of many countries, which rely on trade to compensate for an agricultural production insufficient to feed the population. At the same time, food trade has implications on the distribution and use of water resources, because through the international trade of food commodities, countries virtually displace the water used for food production, known as “virtual water”. Trade thus implies a network of virtual water fluxes from exporting to importing countries, which has been estimated to displace more than 2 billions of m³ of water per year, or about the 2% of the annual global precipitation above land. It is thus important to adequately identify the dynamics and the controlling factors of the virtual water trade in that it supports and enables the world food security.

Using the FAOSTAT database of international trade and the virtual water content available from the Water Footprint Network, we reconstructed 25 years (1986–2010) of virtual water fluxes. We then analyzed the dependence of exchanged fluxes on a set of major relevant factors, that includes: population, gross domestic product, arable land, virtual water embedded in agricultural production and dietary consumption, and geographical distance between countries. Significant drivers have been identified by means of a multivariate regression analysis, applied separately to the export and import fluxes of each country; temporal trends are outlined and the relative importance of drivers is assessed by a commonality analysis.

Results indicate that population, gross domestic product and geographical distance are the major drivers of virtual water fluxes, with a minor (but non-negligible) contribution given by the agricultural production of exporting countries. Such drivers have become relevant for an increasing number of countries throughout the years, with an increasing variance explained by the distance between countries and a decreasing role of the gross domestic product. The worldwide adjusted coefficient of determination of fitted gravity-law model is 0.57 (in 2010), and it has increased in time, confirming the good descriptive capability of selected drivers for the virtual water trade.