IWRM TOOL - C5.03

Virtual Water

Summary

Virtual water is water embedded in a product not in a real sense but in virtual sense. The concept has a number of practical implications and allows to connect water resources, food production, and international trade. This Tool introduces the concept of virtual water and water footprint, provides an overview of accounting methods for virtual water, discusses virtual water trade flows, and highlights how it can be used to promote water savings.

Defining Virtual Water

Virtual water was initially developed to describe water embedded in agricultural commodities (Allan, 1998). Later on, it was extended to water contained in agricultural or industrial product "not in a real sense, but in virtual sense" (Hoekstra, 2003, 13). Virtual water content refers to the volume of water consumed or polluted while producing the product along the entire supply chain (Water Footprint Network, 2011). The virtual water content of crops is based on crop water requirements and yields (FAO, n.d.) whereas virtual water volumes required for live animals are higher as the calculation is based on virtual water content of the animals' feed and the amount of service water consumed during lifetime (Chapagain and Hoekstra, 2004). For instance, 1-2 m3 is required to produce 1 kg of grain on average, whereas 1 kg of beef needs 16 times more water (Chapagain and Hoekstra, 2003).

Water Footprint and Virtual Accounting Methods

The water footprint was developed as a tool to estimate the amount of virtual water used across the whole supply chain (Ray et al., 2018). It is a multidimensional indicator incorporating the water volume embedded, the sort of water being used, as well as time and geographical characteristics of the water utilised. Three types of water footprints may be distinguished: green, blue, and grey. All three stand for the volume of water consumed as a result of the production process, except for the green indicating water from precipitation (before it becomes runoff), the blue – ground water and surface water, the grey – water required to assimilate pollution. Water footprint assessment includes a wide range of activities from quantifying all types of footprints to assessing the three pillars of sustainability of this water footprint to formulate a strategy (Water Footprint Network, 2011). The assessment can be done for a business (Tool C5.05), a consumer, a product, or be scaled up to a national level (UNESCO and UN-Water, 2021).

The national water footprint accounting scheme (Fig. 1) allows to adjust traditional national water use accounts which refer solely to the water use within a country (Mekonnen and Hoekstra, 2011). The new approach claims that water footprint of national consumption includes both internal and external water footprints proposing that virtual water trade should be looked at from the perspective of the exporting country too (Hoekstra, 2017). Obviously, countries with large populations have a larger national water footprint with China, India and the United States being at the top of the ranking. It makes sense to look at water footprint per capita which demonstrates that industrialised countries have higher indicators than developing countries.

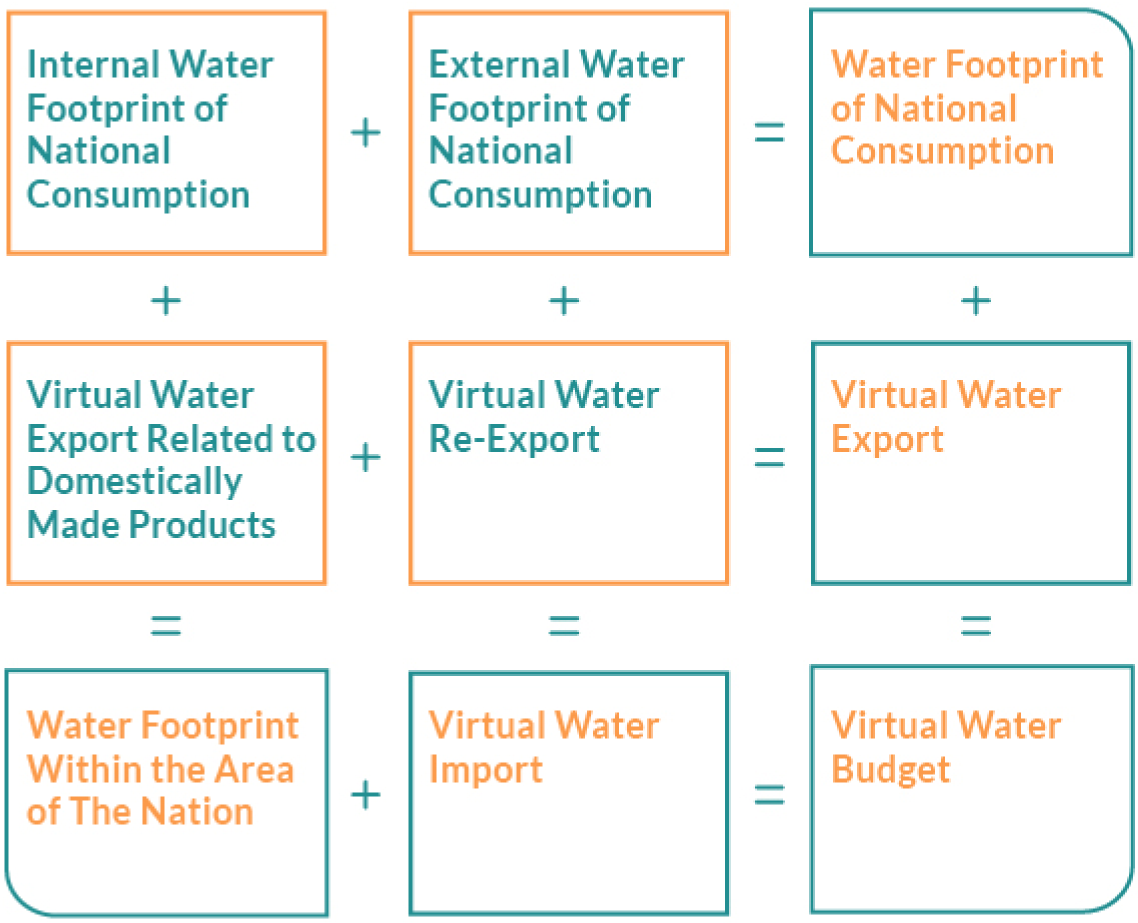

Figure. 1. The National Water Footprint Accounting Scheme (Adapted from Mekonnen and Hoekstra, 2011).

It is estimated that that 20% of the world's water footprint goes towards export (Hoekstra and

Mekonnen, 2012). The gauge of virtual water export may be quantified as a sum of water volumes embedded in the exported products that were produced domestically and those re-exported. For instance, some MENA countries, such as Gulf Cooperation Council countries have high rates of re-export supplying other countries of the region and diversifying their oil exports (Haddad, 2000). As such, the total virtual water budget of a country incorporates the local water footprint plus the balance from the virtual water imports and exports.

Virtual Water Flows and Trade

Virtual water flows between geographical locations (usually two countries) can be defined as trade transactions involving a certain volume of virtual water being transferred from one location to another (Water Footprint Network, 2011). The virtual water concept can thus serve as an interesting entry point to rethinking our global trade based on how water-abundant regions interact with water-scarce regions via exchange goods and services (Allan et al., 2003).

For semi-arid and arid regions encountering water shortages, food deficiencies can be addressed with the help of virtual water trade (Allan, 1992) – trading water resources themselves are often technically difficult due to the bulky nature of the commodity (Hoekstra, 2003). For the period 1996-2005, almost 80% of the virtual water flows between countries were related to international trade in crops with animal, while industrial products accounting for 12%.

Among the major virtual water exporters were the US, China, India, Brazil, Argentina, Canada, and others. The biggest virtual water importers were represented by the US, Japan, Germany, China, Italy, Mexico, France, and others (Mekonnen and Hoekstra, 2011). The future projections show that virtual water exports will more than triple by the end of the century due to incremental population growth. China is expected to shift from the virtual water importer to exporter of wheat and rice products embedding water as a result of shrinking domestic demands. The opposite is expected in Africa where increasing demand will not be met by domestic production (Graham et al., 2020).

Virtual Water and Water Savings

Virtual water trade transactions help generate national and global water savings if it is directed from a more efficient country to a less efficient one in terms of water resources (Dalin et al., 2012). National water savings are calculated as the import volume of a commodity times water footprint of the commodity on the territory of the importing country. Global water savings calculation mechanism is similar using the difference between water footprint of a commodity in the importing and exporting countries (Mekonnen and Hoekstra, 2011). Estimated increase in global water savings may be explained by the increase of water-efficient trade transactions when an exporting country has a lower virtual water content, the growth of traded food volumes and the expanding gap between virtual water content in the importing and exporting countries (Dalin et al. 2012).

At country level, governments should include virtual water accounts as an instrument of decision-making and water resources (re)allocation (IHE Delft & WWC, 2003). Virtual water can help unravel how water scarcity can be caused by specific misallocations, e.g., to water intensive industries such as the agricultural sector. Virtual water can also be used for environmental education towards fostering water saving societies (Tool C3.01).

At the international level, it is important for governments in water-scarce countries to recognise their dependency on water resources from other geographical location to develop their foreign and trade policies accordingly (Hoekstra and Mekonnen, 2012). Members of international organisations, such as the World Trade Organisation (WTO), may take into account water balance of a country in relation to trade of water-intensive agricultural products and curb the growing import of water-intensive products from places with poorly managed water resources (Mori, 2003).

Thematic Tagging
WEFE Nexus

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