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Global Food Trade and Local Water Resources: Can We Bridge the Regulatory Gap?

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Abstract

Given that food production requires a lot of water, more than any other economic sector, one would expect that the world's food production concentrates in places where water is relatively abundant. This chapter, however, highlights the paradox that various water-poor countries produce food for export to water-rich countries. Food commodity prices do not reflect the cost of water inputs or of damaged water ecosystems, so that the global food market lacks economic incentives to source from places with less harmful impacts on local water systems. The costs of 'traded' embedded water thus remain invisible. The chapter proposes an international water label for water-intensive products and argues that international trade rules should include regulations on sustainable water use.

Keywords: Virtual water 'trade', water pricing, the water scarcity-export paradox, water footprint, sustainable water consumption.

Introduction

There is a growing interest from both trade and water experts in the relation between international trade and the use and overexploitation of freshwater resources. Until today, it has not been very common for water sector specialists to look at the relation between water use in a region and import into or export from this region. Traditionally, in their view, water demand in an area is simply a function of the amount and needs of the water users in that area. At the same time, economists do not generally consider the implications of international trade for the water sector. The reason is that water inputs usually hardly contribute to the overall price of traded commodities. This water-value-blind approach justifies the conclusion that water cannot be a significant factor influencing production and trade patterns. Trade specialists tend to overlook that water inputs are often heavily subsidized by national governments and that the impacts and costs of water use can be very significant. These impacts are never included in the price of water, and no country charges a scarcity rent for water inputs even though water is sometimes very scarce. When taking a narrow view of the prices of traded commodities, one will certainly get the impression that water scarcity cannot be a driving force of, or limiting factor to, international trade.

In addition, water is usually not regarded as a global resource. Whereas in most countries the energy sector has an obvious international component, the water sector is different. The international characteristics of water are recognized in the case of transboundary rivers, but the relation between international trade and water management is not something to which water sector officials give much attention. This is mainly because water itself—other than the tiny volumes in bottled water—is not traded internationally, due to its 'bulky' properties. Besides, there is little private ownership of water so that it cannot be traded as in a market (Savenije, 2002). Water sector specialists forget, however, that water is traded in virtual form, that is in the form of agricultural and industrial commodities (Chapagain and Hoekstra, 2008; Hoekstra and Hung, 2005). Although invisible, the import of 'virtual water' can be an effective means for water-scarce countries to allocate their domestic water resources more strategically (Allan, 2003).

One of the principles widely accepted in water resources management is the subsidiarity principle, according to which water issues should be settled at the lowest community level possible (GWP, 2000). When upstream water consumption impacts downstream users, it has been recognized that ideally a basin strategy should be adopted, considering water as a river-basin resource. In practice viewing water as a global resource is very uncommon. The Global Water Partnership writes: 'In order to achieve efficient, equitable and sustainable water management [. . .], a major institutional change will be needed. Both top-down and bottom-up participation of all stakeholders will have to be promoted—from the level of the nation down to the level of a village or a municipality or from the level of a catchment or watershed up to the level of a river basin. The principle of subsidiarity, which drives down action to the lowest appropriate level, will need to be observed' (GWP, 2000). There is no word about a global dimension of water governance.

Considering water management from a local, national, or river-basin perspective is, however, often insufficient. Many water problems are closely linked to international trade (Hoekstra and Chapagain, 2008). For example, subsidized water in Uzbekistan is overused to produce cotton for export (Rudenko et al., 2013). Kenya overexploits its water resources around Lake Naivasha to produce cut flowers for export to Europe (Mekonnen et al., 2012). Thailand experiences water problems due to irrigation of rice for export (Chapagain and Hoekstra, 2011). Chinese rivers get heavily polluted through waste flows from factories that produce cheap commodities for the western market (Economy, 2004). Not only water problems, but also water solutions, have an international trade component. For instance, various countries in the Middle East meet their demand for food and save their scarce water resources through food imports from overseas (Hoekstra and Chapagain, 2008); Mediterranean countries will experience increased water scarcity as a consequence of climate change, forcing them into the direction of increased importation of water-intensive products. Clearly, there are more connections between seemingly local and national water issues and international trade than have been recognized at first sight.

The point of departure of this chapter will be a reflection on the mutuality between water scarcity and trade and address two questions: what impact does international trade have on domestic water resources and, conversely, what impact does water availability have on international trade? After that, the water scarcity-export paradox will be identified, that is the counterintuitive phenomenon that some highly water-scarce regions in the world produce water-intensive commodities for export. Next, the chapter will discuss the need for an international agreement on proper water pricing, and reflect on the conflict between product transparency—which is aimed at enabling people to differentiate between sustainable and nonsustainable products—and the nondiscrimination principle, that is one of the basic building blocks of international trade agreements. Subsequently, the chapter will discuss the problem that strong international trade agreements exist, but that international agreements on sustainable water use are absent altogether, so that a legal basis to regulate trade based on mutually agreed sustainability criteria is lacking. The chapter will then advance the idea of an international water label for water-intensive products, and will conclude with a reflection on the risks and opportunities associated with the intensification of international trade in water-intensive commodities.

The Effect of International Trade on Domestic Water Resources

An obvious effect of international trade in water-intensive commodities is that it generates water savings in the countries that import those commodities. This effect has been discussed since the mid-1990s (Hoekstra, 2003). The national water saving associated with import can be estimated by multiplying the imported product volume by the volume of water that would have been required to produce the product domestically. The other side of international trade in water-intensive commodities is that it takes water in the exporting countries that can no longer be used for other (domestic)

purposes. Besides, the social and environmental costs that are often associated with water use remain in the exporting countries; they are not included in the price paid for the products by the consumers in the importing nations.

In many countries, international trade in agricultural and industrial products effectively reduces their domestic water demand (Table 1). These countries import commodities that are relatively water-intensive while they export commodities that are less water-intensive. During the period 1996–2005, Japan, the largest net importer of water-intensive goods in the world, annually saved 134 billion m^3 of water through trade (Mekonnen and Hoekstra, 2011). This volume of water is equivalent to more than three times the water footprint of production in Japan (42 billion m^3/y) and would come on top of the current water footprint within the country if Japan had produced all imported products domestically. In a similar way, Malta saves, through trade, 0.9 billion m^3 of water per year, which is more than ten times the water footprint within its own territory.

Table 1. Examples of nations with net water saving as a result of international trade (period 1996-2005).

Country	Total water footprint within the country (billion m^3/y)	Net water saving due to international trade (billion m^3/y)				Net water saving as percent of water footprint within the country
		Due to trade in crop products	Due to trade in animal products	Due to trade in industrial products	Overall	
Malta	0.09	0.60	0.30	0.005	0.90	1059%
Libya	5.3	10	29	-0.1	40	745%
Kuwait	0.57	2.3	0.94	-0.09	3.2	563%
Jordan	1.4	6.0	0.9	0.15	7.1	492%
Yemen	7.7	11	16	-0.03	27	354%
Israel	4.0	11	2.4	0.04	14	337%
Japan	42	123	14	-2.5	134	317%
South Korea	20	43	5.8	-0.53	49	248%
Cyprus	0.9	1.6	0.1	0.08	1.7	182%
Lebanon	4	2.3	2.4	0.20	4.9	138%
Saudi Arabia	15	17	3.3	-0.66	20	129%
Italy	70	35	19	-0.36	54	76%
Morocco	37	27	0.3	0.10	28	74%
Mexico	149	64	19	0.13	83	56%
Peru	26	11	0.5	0.02	12	46%
Spain	82	29	0.0	0.91	30	37%
Greece	18	0.5	5.2	0.84	6.5	37%
Iraq	36	13	1.1	-3.5	11	30%
Iran	113	23	0.6	-0.26	24	21%
Chile	16	2.9	0.1	-0.09	2.9	19%
Egypt	69	12	-0.5	0.36	12	17%

Source of data: Mekonnen and Hoekstra (2011).

People in Malta, but also in countries like Libya, Kuwait, Jordan, Yemen, and Israel thus survive owing to the fact that their national water footprint has largely been externalized to other parts of the world. Trade covers up the water shortages in those countries: export of goods that require little water per unit of foreign currency earned make possible the importation of products that need a lot of water per unit of currency expended on such imports.

Being able to enjoy a version of water security despite the scarcity of domestic water resources in countries through virtual-water ‘imports’—via the import of water-intensive products—thus looks

very attractive. There are, however, a number of drawbacks that have to be taken into account. First, water-scarce countries aiming to import food in order to relieve the pressure on their domestic water resources will have to generate sufficient foreign exchange to pay for it. Some water-scarce countries in the world are oil-rich, so they can easily afford to import water-intensive commodities. However, many water-scarce countries lack the ability to export energy, services, or water-extensive industrial commodities in order to afford the import of water-intensive agricultural commodities. Second, the import of food carries the risk of moving away from food self-sufficiency. This issue plays an important role in countries such as China, India, and Egypt (Roth and Warner, 2007) where food self-sufficiency is considered to be essential. Third, the importation of food will often be bad for the domestic agricultural sector and possibly lead to increased levels of urbanization, because food imports can reduce employment in the agricultural sector. It can often result in economic decline and the worsening of land management in rural areas. Fourth, in many water-scarce developing countries, where an important part of the agriculture consists of subsistence farming, promoting food imports often threatens the livelihoods of subsistence farmers and reduces access to food for the poor. Finally, increases in virtual-water transfers to optimize the use of global water resources, can relieve the environmental pressure on water-scarce countries, but may aggravate the impact on the environmental capital of the food exporting economies that produce the water-intensive commodities.

The export of water-intensive commodities obviously raises national water demand in the food exporting economy. In the period 1996–2005, nineteen per cent of the water use in the world was not for producing products for domestic consumption but for producing goods for export (Mekonnen and Hoekstra, 2011). The biggest water use for food export can be found in North and South America (the United States, Canada, Brazil, Argentina), Southern Asia (India, Pakistan, Indonesia, Thailand), and Australia. Assuming that, on average, production for export does not cause significantly more or fewer water-related problems (such as water depletion or pollution) than production for domestic consumption, roughly one fifth of the water problems in the world can be traced back to production for export. Food consumers do not see the effects of their consumption behaviour due to the distance between areas of consumption and areas of production. The benefits are enjoyed on the consumption side, and, since water is generally grossly underpriced, the costs remain on the production side. From a water-resources point of view, it would be wise for the exporting countries in the world to review their water use for export and decide the extent to which this is good policy given the fact that the foreign income associated with the exports generally does not cover most of the costs associated with the use of domestic water. The construction of dams and irrigation schemes and even operation and maintenance costs are generally covered by the commodity exporting national or state government. Negative effects downstream and the social and environmental costs involved are also not included in the price of the export products.

International trade negatively impacts natural ecosystems in other ways. For example, natural cycles of nutrients such as nitrogen and phosphorus are disturbed through the depletion of the soil in some places and the excessive use of fertilizers and nutrient surplus in others. The long-distance transfer of food and animal feed and disposal of nutrient-rich wastes in densely populated areas of the world are serious problems (Grote et al., 2005). These processes have already led to the depletion of the soils in many areas (Sanchez, 2002; Stocking, 2003) and to the eutrophication of water elsewhere (McIsaac et al., 2001; Tilman et al., 2001). The surplus of nutrients in the Netherlands, for instance, is partially related to deforestation, erosion, and soil degradation in those areas of the world that export food and feed to the Netherlands, for example in Brazil from where a lot of soybeans are exported as feed for the Dutch pigs and chickens. This implies that the nutrient surplus in the Netherlands is not an issue that can simply be understood as a Dutch issue. Dutch water pollution is part of the global economy.

The disturbance of nutrient cycles is not the only mechanism through which international trade negatively influences the quality of water resources worldwide. Meybeck (2004) has shown how other substances are also dispersed into the global environment and change the water quality of the world's rivers. Nriagu and Pacyna (1988) set out the specific impacts of the use of trace metals in the global economy on the world's water resources. The regular publication of new reports on global water pollution shows that this phenomenon in itself is no longer news; what is now gradually being uncovered and is therefore relatively new is the fact that pollution is not simply 'global' because pollution is so 'widespread', but that it is interlinked with how the global economy works, and is therefore, a truly global problem. Water pollution is intertwined with the global economic system to such an extent that it cannot be dealt with independently from that global economy. Indeed, pollution can be tackled by end-of-pipe measures at or near the location of the pollution, but a more cause-oriented approach would be restructuring the (rules for the) global economy, with the aim of closing element cycles and reaching a circular economy.

The Effect of Water Availability on International Trade

There is an immense body of literature about international trade, but there are only a few scholars who address the question of to what extent international trade is influenced by regional differences in water availability or productivity. International trade is rather explained in terms of differences in labour productivities, the availability of land, domestic subsidies to agriculture, import taxes, production surpluses, and associated export subsidies.

According to international trade theory, which goes back to Ricardo (1821), nations can gain from trade if they specialize in the production of goods and services for which they have a comparative advantage, while importing goods and services for which they have a comparative disadvantage. According to the Ricardian model of international trade, countries can best specialize in producing goods in which they have a relatively high productivity. In more precise technical terms, economists argue that countries have a comparative advantage in producing a particular good if they have a relatively high 'total factor productivity' for that good. Total factor productivity is a measure that relates output to all input factors which include labour, land, water, and capital. An alternative model of comparative advantage is the Heckscher-Ohlin model, which was formulated in the first half of the previous century. This model does not look at differences in factor productivity across countries, but at differences in factor abundance and in the factor intensity of goods. According to the Heckscher-Ohlin model, countries can best specialize in goods that use their relatively abundant factors relatively intensively. Neither model is comprehensive: whereas the Heckscher-Ohlin theory states that a country can best specialize in producing and exporting products that use the factors that are most abundant, Ricardo's theory says that a country can best focus on producing goods for which they have a relatively high productivity expressed in output per units of inputs. The rough idea is clear: production circumstances differ across countries, which gives some countries an opportunity in certain products, while it gives other countries an opportunity for other products, thus constituting mutual gains in trade. From the perspective of water, countries with either relative water abundance or relatively high water productivity (value of output per unit of water input), or a combination of both, will have a comparative advantage in producing and exporting commodities that are relatively water intensive.

A simple example may help to illustrate the idea of comparative advantage. Let us look at two countries and two crops and assume that there are differences in water productivities across crops and countries. We assume—for the sake of easy explanation— that water is the only input factor in production. Suppose that country A can produce 0.3 kg of seed cotton per m^3 of water and that country B produces 0.1 kg of seed cotton with the same volume of water. As an alternative to cotton, both

countries can produce rice. Assume that country A can produce 0.6 kg of paddy rice and that country B can produce 0.5 kg of paddy rice per m^3 of water.

From the productivity differences, we see that country A has higher water productivities for both cotton and rice, so we can say that country A has an 'absolute advantage' in both cotton and rice production. More relevant for the opportunity of trade, however, is to look at the 'comparative advantage' of each country. Therefore we have to look at the opportunity costs of water use. If country A applies one m^3 of water in cotton growing, it produces 0.3 kg of seed cotton, but if it would apply the water for rice growing, it would produce 0.6 kg of paddy rice. We can thus say that, for country A, the opportunity cost of producing 1 kg of seed cotton is 2 kg of paddy rice. Similarly, we can calculate that in country B the opportunity cost of producing 1 kg of seed cotton is 5 kg of paddy rice. Since the opportunity cost of seed cotton is lowest in country A, this country can best specialize on cotton growing and export to country B. Reversely, country B can best focus on rice growing, because in country B the opportunity cost of producing 1 kg of paddy rice is only 0.2 kg of seed cotton, while this is 0.5 kg of seed cotton in country A.

We say that country A has a comparative advantage in growing cotton, while country B has a comparative advantage in growing rice. The potential for trade does not only depend on differences in water productivities, but also on water availability per country. The picture becomes even more complex given that there are many countries (not just two), many different products that can be produced (not just two), and many production factors (not just water). How important water availability and water productivities are in telling what sort of trade makes most economic sense, depends on how scarce water is compared to other production factors.

There is evidence that water scarcity influences international trade. Yang et al. (2003, 2007) have shown that cereal imports have played a crucial role in compensating water deficits in various water-scarce countries. They demonstrate that below a certain threshold in water availability, an inverse relationship can be identified between a country's cereal import and its renewable water resources per capita. In the early 1980s, the threshold was at about 2000 m^3 per capita per year. At the end of the 1990s, it had declined to about 1500 m^3 per capita per year. Countries with less water than the threshold cannot do without the import of staple foods. This threshold declined over the past couple of decades as a result of improved water productivities and the expansion of irrigated areas.

It is interesting to note here that the mechanism through which water scarcity differences in the world currently influence some of the international trade flows is not the price mechanism. Water in water-scarce areas is generally not priced higher than in water-abundant areas; water is mostly free when consumed in crop and livestock production. In food production, water is priced far below its real value, throughout the world, as a result of which water scarcity is not factored into the price of traded commodities. The driving force behind some of the international food trade in the world is water shortage in the food-importing economies, but more often other factors determine food trade (De Fraiture et al., 2004; Yang et al., 2003). International trade in agricultural commodities depends on many more factors than differences in water availability in the trading nations—including differences in availability of land, labour, knowledge, and capital, as well as in differences in economic productivities in various sectors (Wichelns, 2010). The existence of domestic subsidies, export subsidies, or import taxes in the trading nations also influences the trade pattern. As a consequence, international virtual-water transfers usually cannot—or can only partly—be explained on the basis of differences in water availability and productivity.

The Water Scarcity–Export Paradox

The relation between water availability and trade can be counterintuitive. North China, for instance, has a very low availability of water per capita, unlike South China, but there is a very significant trade in food from North to South China (Ma et al., 2006). This is the result of relatively high investments in agricultural growth in the North, which transformed the water-scarce North from a food-dependent virtual-water importer into a water consumer producing export crops (Figure 1). This outcome has exacerbated the water problems in the North.

A similar case can be found in India, where water has become relatively scarce in the northern states of Punjab, Uttar Pradesh, and Haryana. Nevertheless, these states consume substantial amounts of water to produce food that is exported to the eastern states of Bihar, Jharkhand, and Orissa, which have much larger water endowments than the northern states (Verma et al., 2009). During the period 1997–2001, the net virtual water flow from North to East India was 22 billion m^3 per year. No simple reason will suffice to explain the counterintuitive situations with respect to the interregional trade within China and India because of numerous factors that are historical, political and economic. One factor that may play a role as well is that in water-scarce regions the incentives to increase water productivity are greater. As a result of the investments made in productivity, it becomes attractive to produce in those regions, which however worsens water scarcity. This may be a factor in northern India, where water productivities are indeed higher than in the eastern states, providing them with a comparative advantage although the water availability in absolute terms is much lower.

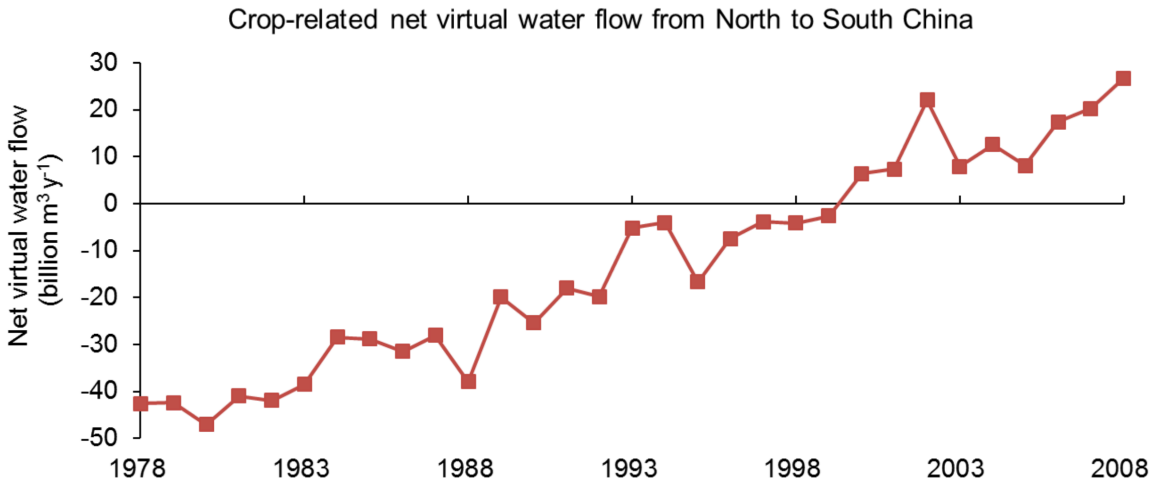

Figure 1. Virtual water trade between North and South China over the period 1978-2008. The net flow of virtual water reversed around the year 2000. Source: Zhuo et al. (2016).

Water Pricing

A major issue when talking about good water governance and international trade is the fact that the international market in agricultural products is heavily distorted. Since 92% of the global blue water consumption occurs in agricultural production (Mekonnen and Hoekstra, 2011), this is highly relevant for water. The distortion is related to all sorts of direct and indirect subsidies that agriculture receives in all countries in the world, albeit in different forms. This issue is widely known, but most discussion is about direct subsidies to farmers and about export subsidies and import taxes. Much less attention is given to the fact that water, an important input factor to agriculture, is generally underpriced or not priced. The result is that water is not a factor of economic importance in the establishment of

production and trade patterns. The outcome is perverse trade flows, where water-intensive crops are exported from areas where water is highly scarce and overexploited. There is no chance that current trading practices will ever bring about optimal production and trade outcomes from a water-perspective if water remains so underpriced.

There is a need to reach a global agreement on water pricing structures that cover the full cost of water use, including investment costs, operational and maintenance costs, a water scarcity rent, and the cost of negative externalities of water use (Hoekstra, 2011). Without an international treaty on proper water pricing, it is unlikely that a globally efficient and sustainable pattern of water use will ever be achieved. The need to have full cost pricing was already acknowledged at the Dublin Conference in 1992 (ICWE, 1992). A global ministerial forum to come to agreements on this does exist in the regular World Water Forums (Marrakech, 1997; The Hague, 2000; Kyoto, 2003; Mexico City, 2006; Istanbul, 2009; Marseille, 2012; Daegu-Gyeongbuk, 2015), but these forums have not proved to be capable of taking up the challenge of putting in place international agreements on the implementation of the principle that water should be considered as a scarce economic good. The World Water Forums are not organized under the umbrella of a UN organization. Alternative forums to initiate and negotiate an international water pricing protocol could be UN-Water or the UN Commission on Sustainable Development.

It is not sufficient to leave the implementation of the 'water-is-an-economic-good principle' to national governments without having some kind of international protocol, because unilateral implementation can be expected to be disadvantageous for the countries that are the first to put a serious price on water. The competitiveness of the producers of water-intensive products in a country that one-sidedly implements a stringent water pricing policy will be negatively affected, and this, together with the natural resistance of domestic consumers to higher prices of local products, will reduce the feasibility of a unilateral implementation of a rigorous water pricing strategy. An international protocol on full-cost water pricing would contribute to the sustainable use of the world's water resources: water scarcity would be translated into a scarcity rent and would thus affect consumer decisions, even if those consumers live at a great distance from the production site.

It is no more than fair to get producers and consumers to pay for their contribution to the depletion and pollution of water. Proper pricing of water would shed a fresh light upon the economic feasibility of plans for large-scale interbasin transfers, since it would force negative externalities and opportunity costs to be taken into account. As already acknowledged at the Dublin Conference (ICWE, 1992), full-cost water pricing should be combined with a minimum water right, in order to prevent poor people from not being able to obtain their basic needs (Gleick, 1999; Mehta and La Cour Madsen, 2005).

Product Transparency versus Nondiscrimination in Trade

Better pricing of water is important, but will not be sufficient. In addition, product transparency is necessary as a basis for well-informed consumer behaviour, governmental policy and company strategy. The 'product-transparency principle' requires that all relevant information about a product is publicly available, including information about the product as it appears as well as information about how the product was produced. When we limit ourselves here to how a product relates to the use of freshwater, relevant information may include for instance answers to questions such as: How much water was consumed to make the product in the different stages of its supply chain? How much water was polluted and what type of pollution? Does the water consumption or pollution take place in areas where water is relatively scarce and already polluted beyond acceptable limits? Are downstream users or ecosystems negatively affected? And could the water consumed have been used for an alternative purpose with a higher societal benefit?

Products may often look alike—and have the same colour, smell, feel, taste and quality—but nevertheless they may be quite different. Every product has a unique history. The origin of the ingredients may differ as well as the production circumstances of the ingredients. A beverage like cola contains sugars which can come, for example, from sugar beet, sugar cane, or maize (high-fructose maize syrup). The crop may be grown with irrigation water from the overexploited Ogallala Aquifer beneath the Great Plains in the United States or under rain-fed conditions in a water-abundant part of Europe. In other words, one bottle of cola is simply not equal to another. Two products can have a similar appearance, but a different history.

Production circumstances can vary among countries, but also within countries; differences can exist between brands, but also within brands and even between different batches of otherwise precisely the same product. From a water-footprint perspective, one may like to discriminate between seemingly similar goods, based on the different impacts the goods have on freshwater resources.

All countries, to a greater or lesser extent, import food from regions with unsustainable water use. Figure 2 shows how the blue water footprint of all products consumed in the United Kingdom can be localized in different regions of the world and which parts of that global water footprint are located in regions where blue water consumption is not sustainable. Hoekstra and Mekonnen (2016) find that half of the United Kingdom's global blue water footprint is located in places where the blue water footprint exceeds the maximum sustainable level. About 55 percent of the unsustainable part of the United Kingdom's blue water footprint is located in six countries: Spain (14 percent), the United States (11 percent), Pakistan (10 percent), India (7 percent), Iran (6 percent), and South Africa (6 percent). In each hotspot, we can identify specific products that most significantly contribute to the unsustainable water use. In Spain, for example, these products include rice, oranges, olives, mandarins, apricots, and grapes. The biggest water problems occur in the southern part of the country, in the Guadiana and Guadalquivir river basins (Cazcarro et al., 2015). Some farmers do far better than others, but discriminating in trade between sustainable and unsustainable products is problematic.

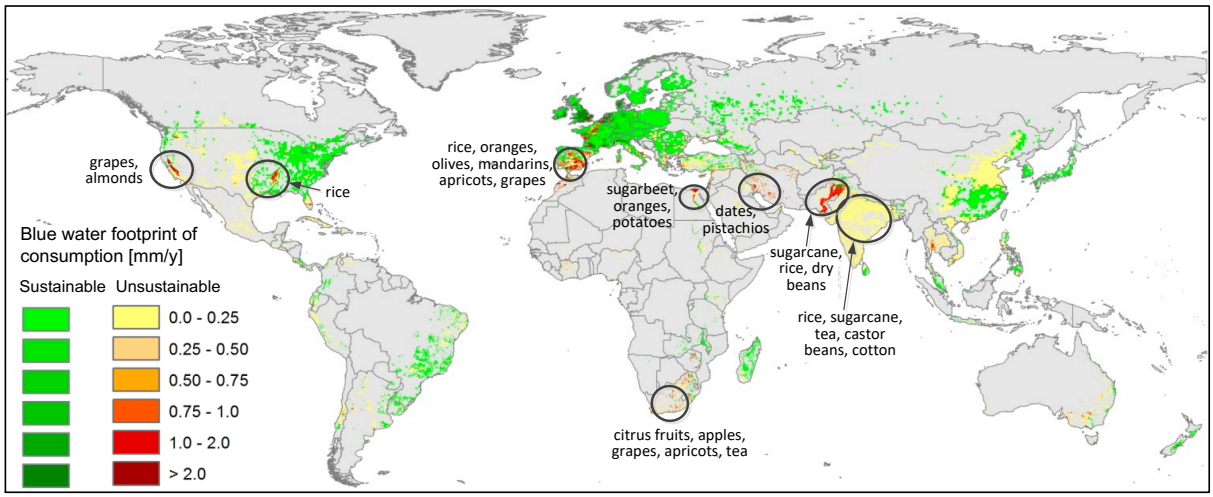

Figure 2. The sustainable (green) and unsustainable (yellow to red) parts of the global blue water footprint of overall consumption in the United Kingdom over the period 1996-2005, with an indication of critical products that significantly contribute to the United Kingdom's water footprint in some hotspot areas. Source: Hoekstra and Mekonnen (2016).

An important principle used in the context of international trade negotiations is the 'nondiscrimination principle'. This principle states that the international trading system should be without discrimination, which means that a country should not discriminate between its trading partners nor between its own and foreign products (WTO, 2008). A key question to be posed in this context is what are the criteria to evaluate whether two goods can be called similar. According to the nondiscrimination principle, one may not discriminate between cotton from one and cotton from another country or between beef from one and beef from another country. But what does the principle say if it appears that two seemingly similar products are not similar after all? Discrimination is considered unfair when products are similar, but discrimination is quite natural when products are not similar.

Fair international trade rules should include a provision that enables consumers, through their government, to raise trade barriers against products that are considered unsustainable. In practice, this means that the nondiscrimination principle would hold only for similar products that are considered also similar in terms of the existing impacts along their life cycle. It would imply that a country could favour the importation of a certain product from a country that can guarantee that the product's water footprint is not located in catchments where environmental flow requirements are violated or where ambient water quality standards are not met. This preference would have to hold—according to the nondiscrimination principle—for all countries that can give that guarantee. The favour, however, would not necessarily hold for countries that cannot provide that guarantee. Obviously, a guarantee of sustainability can be provided only when proper arrangements for product transparency are in place.

When arrangements for product transparency in a particular country are in place, it can be the case that one batch of a certain commodity from that country fulfils a set of specified sustainability criteria, while another batch does not. In that case, another country may be willing to have free trade with respect to the first batch, but raise trade barriers against the other batch. It seems justified to allow for such arrangements in international trade rules. Countries can either choose to agree on shared sustainability criteria, which can then be included in an international trade agreement, or they can leave the formulation of such criteria to each country separately. The former situation may be preferable, because it creates equity and market stability, but it would be at the cost of national sovereignty to respond quickly to new developments and to adapt sustainability criteria according to new insights. Besides, countries may have highly divergent opinions about what criteria should be chosen. Anyhow, trying to agree on shared criteria for product sustainability would ideally be part of international negotiations. These negotiations are to be done outside the World Trade Organization, because the WTO limits itself to trade negotiations and refrains from entering into negotiations on environmental protection. For environmental protection, the WTO refers to multilateral environmental agreements formulated in other international settings. According to WTO rules, a trade dispute that falls under a certain multilateral environmental agreement signed by two conflicting countries should be settled using the environmental agreement.

The Absence of International Agreements on Sustainable Water Use

The WTO does not see its 'free trade' approach to be at odds with 'green trade'. National governments have negotiated WTO rules voluntarily. Similarly, national governments negotiate and agree on international environmental agreements. If a dispute arises over a trade action taken under an environmental agreement, and if both sides to the dispute have signed that agreement, then they should try to use the environmental agreement to settle the dispute. However, if one side in the dispute has not signed the environmental agreement, then the WTO would provide the only possible forum for settling the dispute (WTO, 2008). Besides, it matters whether an international agreement contains rules that relate to trade or not. As Neumayer (2004) observes, most regional or international

environmental agreements do not contain any trade-restrictive measures. As a result, these environmental agreements will be irrelevant, and ignored, when settling a trade dispute. In the case where an international environmental agreement is absent and where a trade barrier is raised with reference to national environmental legislation, it will again be the WTO that can settle the dispute, but national environmental legislation will not count in a dispute over international trade.

Historic evidence shows that free trade rules agreed to internationally according to WTO rules go beyond environmental protection rules set by national governments or international environmental agreements that are not signed by one of the parties to the dispute. According to the WTO, if trade barriers could be raised with reference to national regulations, 'then any country could ban imports of a product from another country merely because the exporting country has different environmental, health, and social policies from its own. This would create a virtually open-ended route for any country to apply trade restrictions unilaterally—and to do so not just to enforce its own laws domestically, but to impose its own standards on other countries' (WTO, 2008).

Internationally binding agreements on sustainable water use or, more particularly, on 'sustainable water use in the production of goods and services' do not exist. The reason is probably that freshwater is primarily seen as a local resource, to be managed at the level of a nation or river basin at most. As a result, policies for water governance are always shaped in the form of national legislation, supplemented by international agreements on transboundary rivers and agreements at a regional level as in the European Union. This implies that whenever trade disputes with reference to freshwater protection arise, the dispute will be settled under WTO rules and that—with reference to the nondiscrimination principle—the outcome will favour free trade and not freshwater protection.

There is no legal basis to discriminate in international trade based on environmental standards for products. This is a fundamental weakness in the area of international agreements. In the WTO, international trade rules do not necessarily go beyond international environmental agreements, but in the absence of the latter, the international trade rule of nondiscrimination becomes decisive. The WTO agreements say two important things: 'First, trade restrictions cannot be imposed on a product purely because of the way it has been produced. Second, one country cannot reach out beyond its own territory to impose its standards on another country' (WTO, 2008). As many products on the world market have significant impacts on freshwater systems, because their production contributes to the violation of local environmental flow requirements or ambient water quality standards, it is expected that consumers will increasingly request product transparency and it is likely that consumers in some countries will start asking their government to ban imports of products that obviously do not meet domestic sustainability criteria. Yet, it is very unlikely that national efforts to ban products with reference to national standards on sustainable water use will succeed. Reaching greater product transparency, however, is an essential preliminary.

An International Water Label for Water-Intensive Products

A water label to products could be a means to contribute to product transparency. A 'water label' could be a label physically attached to a product, but also digital information about a specific product available through the Internet by scanning its barcode in the shop or at home. Furthermore, it could be a simple quality certification showing whether a product meets a certain set of sustainability criteria (a 'yes or no' label), but it could also be a more advanced label with detailed quantitative information on a number of relevant criteria. Introducing such a label would be most relevant for water-intensive products. The label could be introduced first for a few commodities that usually have great impacts on water systems, such as cotton, rice and cane sugar. Given the global character of the cotton, rice, and sugar markets, international cooperation in setting the labelling criteria and in the practical application

of the water label is a precondition. Consideration could be given to integrating the water label within a broader environmental or fair-trade label, but this would probably create new bottlenecks in global implementation, so that a first step could be to agree on a separate water label.

If one or a number of countries agree on some sort of water-labelling scheme, it is still unclear how current WTO rules could be interpreted in the event of a dispute. Consider the case in which a country raises a trade barrier for all countries that do not fulfil the requirements of the water-labelling scheme. Given the decisions made in earlier disputes—consider for instance the so-called tuna-dolphin dispute between the United States and Mexico—the WTO rules are unlikely to lead to acceptance of discrimination of products from another country not fulfilling a certain labelling requirement if that other country has not signed up for the labelling scheme.

The WTO stipulates that one country cannot impose its own environmental regulations on another country. However, some commentators have argued that under some conditions it is possible for WTO members to impose environmental regulations on another member (Charnovitz, 2002). Altogether, there is still much ambiguity about the role national environmental standards related to processes and production methods can have in influencing and restricting international trade. This situation underlines the future necessity of broad international agreements on a water-labelling scheme. Without international agreement, any labelling scheme will be useful for domestic products only and is unlikely be effective in restricting trade. If countries agree on an international water label, this label will likely be covered by WTO's Technical Barriers to Trade Agreement, which has been designed to ensure that regulations, standards, testing and certification procedures do not create unnecessary obstacles to trade. A water labelling scheme should thus fulfil a set of conditions set by the WTO.

A broad international water label laid down in an international agreement is not a near-term possibility. Liberalization of trade in water-intensive products under WTO rules makes it more difficult, if not impossible, for countries to take action against products from countries that are considered as undesirable because they either lack transparency or are transparent but do not meet certain domestically defined sustainability standards. Under existing WTO rules, countries have to let products that do not meet production standards enter the country on the same terms as similar products that do meet those standards. The only remaining option is that consumers select the commodities they judge to be sustainable in the shop. This choice will be hampered for the moment, however, by the lack of information, because countries cannot impose a transparent labelling scheme on imported products.

Intensification of Trade in Water-Intensive Commodities: Risks and Opportunities

The WTO rules on free trade apply to most products but still mostly exclude services and agricultural products. This situation is fortunate, because 92 percent of the water footprint in the world lies in agriculture (Hoekstra and Mekonnen, 2012). A free trade agreement on agricultural products would impede efforts to promote sustainability in agriculture. Any attempt to install a sustainable-water-use approach must ensure that new rules on international trade in agricultural products include terms that promote sustainable water consumption in traded food commodities.

International transfers of water in virtual form are substantial and likely to increase with continued global trade liberalization (Ramirez-Vallejo and Rogers, 2004). Intensified trade in water-intensive commodities offers both opportunities and risks. The most obvious opportunity of reduced trade barriers is that virtual water can be regarded as a possibly cheap 'alternative source' of water in areas where freshwater is relatively scarce. Virtual-water imports can be used by national governments as a tool to release the pressure on their fully used or overused domestic water resources. This import of virtual water—as opposed to import of real water, which is generally too expensive—will relieve the

pressure on the nation's own water resources. Besides, trade can save water if products are traded from countries with high to countries with low water productivity. For example in the period 1996-2005, Mexico imported maize from the United States, the production of which required 4.1 billion m^3 of water per year in the United States. If Mexico had produced the imported maize domestically, it would have required 12.2 billion m^3 of water per year. Thus, from a global perspective, the trade in maize from the United States to Mexico saved 8.1 billion m^3/y (Mekonnen and Hoekstra, 2011). There are also examples where water-intensive commodities flow in the opposite direction, from countries with low to countries with high water productivity. Available studies indicate, however, that the overall outcome of all international trade flows works in a positive direction.

A serious drawback of food commodity trade is that the indirect effects of consumption are externalized to other countries. While water in agriculture is still priced far below its real cost in most countries, an increasing volume of water is used for processing export products. The costs associated with water use in the exporting country are not included in the price of the products consumed in the importing country. Consumers are generally not aware of—and do not pay for—the water problems in the overseas countries where their goods are being produced.

According to economic theory, a precondition for trade to be efficient and fair is that consumers should bear the full cost of production and of costs of the impacts on natural ecosystems. Another downside of intensive international virtual-water transfers is that many countries increasingly depend on the import of water-intensive commodities from other countries. Jordan has an annual net import of virtual water of 5.7 billion m^3 of water (Mekonnen and Hoekstra, 2011), which is six times the 0.94 billion m^3 of total annual renewable water resources of the country (FAO, 2012). Other countries in the Middle East, but also various European countries, have a similarly high water import dependency. The increasing lack of self-sufficiency has made various individual countries, but also larger regions, very vulnerable to changes in availability of food on the global market and volatile food commodity prices. If, for whatever reason, food supplies cease—be it due to war or a natural disaster in an important export region—the importing regions will suffer severely. A key question is to what extent nations are willing to take such risk. The risk can be partially mitigated by promoting national self-sufficiency in water and food supply. The risk can also be spread and reduced by importing food from a wide range of trading partners. The current worldwide trend, however, facilitated by the World Trade Organization, is towards reducing trade barriers and encouraging free international trade, and decreasing interference by national governments.

The current global trade pattern significantly influences water use in most countries of the world, either by reducing the national water consumption of individual economies or by enhancing it. Future national and regional water policy studies should therefore include an assessment of the effects of trade on water policy. For water-scarce countries, it would be wise to make the reverse assessment as well—that is, they should evaluate the possible implications of national water scarcity on trade. In short, strategic analysis for water policymaking should include an analysis of expected or desirable trends in international or interregional virtual-water flows.

International agreements on the liberalization of trade in agricultural products should include provisions that promote sustainable water use in agriculture. As yet, it is unclear what such provisions would be, since the WTO explicitly refrains from making environmental agreements. An imbalance in global trade regulations will be created as soon as free trade agreements are enacted while sustainable-product and sustainable-water-use agreements to regulate international trade do not yet exist. Since sustainable water use is not a luxury but prerequisite for the world's future food supply, it is time to come to international agreement on proper water pricing, product transparency and trade rules that promote sustainable water use.

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