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The global dimension of water governance: Nine reasons for global arrangements in order to cope with local water problems

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THE GLOBAL DIMENSION OF WATER GOVERNANCE: NINE REASONS FOR GLOBAL ARRANGEMENTS IN ORDER TO COPE WITH LOCAL WATER PROBLEMS

A.Y. HOEKSTRA*

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Summary

Where water problems extend beyond the borders of local communities, the catchment area or river basin is generally seen as the most appropriate unit for analysis, planning and institutional arrangements. In this paper it is argued that addressing water problems at the river basin level is not always sufficient. It is shown that a substantial part of today's water issues carries a (sub)continental or even global dimension, which urges for a governance approach that comprises coordination and institutional arrangements at a level above that of the river basin. This paper distinguishes and reviews nine developments that support this argument:

- Local issues of water scarcity and flooding will be enhanced or weakened by human-induced global climate change.
- Local problems of water pollution are often intrinsic to the structure of the global economy.
- There is a growing presence of multinationals in the drinking water sector.
- Several national governments are developing plans for large-scale inter-basin water transfers.
- An increasing number of water-short countries seek to preserve their domestic water resources through the import of water in virtual form.
- Global trade in water-intensive commodities offers the opportunity of global water saving if this trade is from countries with high to countries with low water productivity.
- The water footprints of individual people are increasingly externalised to other parts of the world, so that many local water problems are strongly related to consumption elsewhere.
- Some people around the world have comparatively high water footprints, which raises the question of whether this is fair and sustainable.
- Due to its increasing scarcity and uneven distribution across the globe, water is gradually becoming a geopolitical resource, influencing the power of nations.

The described developments raise the question of what kind of institutional arrangements could be developed to cope with the global dimension of water issues. A few possible directions are identified in an explorative analysis: an international protocol on full-cost water pricing, a water label for water-intensive products, a disposal tax on goods that will cause water pollution in their waste stage (to be used for pollution prevention and control), international nutrient housekeeping, minimum water rights, maximum allowable water footprints, and tradable water footprint permits.

1. Introduction

Since many water problems extend beyond the borders of local communities, often due to upstream-downstream linkages within catchments and river basins, it has been widely acknowledged that – if necessary to move towards a higher spatial level – the river basin is the most appropriate unit for analysis, planning and institutional arrangements. In this paper it is argued that addressing water problems at the river basin level is not always sufficient. It is shown that a substantial part of today's water issues carries a (sub)continental or even global dimension, which urges for a governance approach that comprises coordination and thus some form of institutional arrangements at a level above that of the river basin. This paper distinguishes and reviews nine developments that support this argument.

The central premise of this paper is that any water system is an inseparable part of the environmental system as a whole and that the societal and environmental systems are inextricably bound up with each other as well. There is plenty of evidence that use of and changes to water systems cannot be understood separately from land use (Foley *et al*., 2005; Nicholson, 2000; Gallart and Llorens, 2003), spatial planning (Mitchell, 2005; Terpstra and Van Mazijk, 2001), soil management (Syvitsky *et al*., 2005), climate change (Arnell, 1999), demographic developments (Vörösmarty *et al*., 2000), economic consumption and production (Duarte *et al*., 2002), public health (WHO, 2005), environmental management (Postel *et al*. 1996; Smakhtin *et al.*, 2004), trade politics (Allan, 2001), development cooperation (World Bank, 2004) and national security (OECD, 2003; WMO *et al*., 2006). In line with this understanding, it is assumed that 'water governance' (the manner in which people deal with water) should be understood as an integral part of governance (the mode of social organisation) in a much broader sense. According to the Global Water Partnership, 'water governance' refers to the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society (Rogers and Hall, 2003). 'Governance' in its general sense refers to the processes and systems through which a society operates. It relates to the broad social system of governing, which includes, but is not restricted to, the narrower perspective of government as the main decision-making political entity. Governance refers to both formal and informal structures, procedures and processes.

Achieving effective water governance demands a broad approach, which essentially means: coordination with other forms of governance. 'External coordination' in the context of water governance is understood here as coordination with the broader set of processes and systems through which society operates. For effective water governance it is not sufficient to question which instruments water managers have or which arrangements water managers can make to solve the water problems of today and of the future. One should address the broader question of how societies as a whole can manage their water resources in a wise manner. This approach of 'good water governance' necessarily has a much broader perspective than that of the water manager. The relevance of 'external coordination' is taken as a starting point in this paper.

The central argument of the paper is that the relevance of external coordination for effective water governance brings with it the necessity of including coordination at higher spatial levels than that of the river basin. It will be argued in this paper that neglecting the global dimension of water governance would carry the risk that developments outside the domain of water governance could overrule and possibly even nullify the good intentions in the domain of water governance.

The next section reviews a number of developments that urge for global arrangements in order to cope with local problems of water scarcity, flooding and pollution. The third section includes an explorative analysis of possible global water governance arrangements. Explorative means in this case that it is not intended to be exhaustive and that identification of possible types of arrangements has priority over reviewing the political feasibility of the identified arrangements.

2. The need for global governance in water issues

2.1. The effect of global climate change on local water conditions

Local precipitation and thus local water availability and peak flows depend on local climate conditions, which in turn are influenced by global climate conditions (Arnell, 1999; Milly *et al*., 2002). Evidence is available that humans have played and will continue to play a role in changing climate through changing land use (Kalnay and Cai, 2003; Pielke, 2005; Feddema *et al*., 2005) and by contributing to the emission of aerosols (Bellouin *et al*., 2005) and greenhouse gases (Karl and Trenberth, 2003). Whereas the effects of land use changes are often still limited to the climate at (sub)continental level (Savenije, 1995), the effects of aerosols and greenhouse gases are very much global (Houghton *et al*., 2001). Good governance of local water systems can thus be hampered or impaired by mechanisms that go beyond the governance domain of water managers, who operate at the local, national or river basin level. They can use their power to influence water use, but not land or energy use, to say nothing about the fact that their power does not surpass the scale of the river basin. Arrangements for good water governance would include institutions that coordinate efforts to manage water with efforts to manage the land in the wider surroundings as well as the globe’s energy resources. Overlooking this external component of water governance could in some cases possibly result in the extreme situation that the good work of local water managers is completely nullified by external, global developments. Consider the case of the Dutch river delta, where the work of water managers in the coming decades will be continuously challenged by sea level rise, changing local climate and growing peak river discharges (all three due to global climate change) and subsidence of the land (due to land use and gas extraction) (Van den Hurk *et al*., 2006; Crutzen *et al*., 2005; Middelkoop *et al*., 2001). Similarly, dedicated water demand strategies in the Mediterranean will have little effect in closing the gap between demand and supply if gains in reducing water demand are accompanied by climate change-driven reductions in water availability.

2.2. Local water pollution is often inherent in the structure of the global economy

Overexploitation of the soil in some places, excessive use of fertilisers in others, long-distance transfers of food and animal feed and concentrated disposal of nutrient-rich wastes in densely populated areas of the world cause disturbances in the natural cycles of nutrients such as nitrogen and phosphorus (Grote *et al*., 2005). This has already led and will further lead to depletion of the soil in some areas (Sanchez, 2002; Stocking, 2003) and eutrophication of water elsewhere (McIsaac *et al*., 2001; Tilman *et al*., 2001). For example, the surplus of nutrients in the Netherlands is partially related to deforestation, erosion and soil degradation in those areas of the world that export food and feed to the Netherlands. This implies that the nutrient surplus in the Netherlands is not an issue that can simply be handled by the Dutch in isolation. Dutch water pollution is part of the global economy.

The disturbance of nutrient cycles is not the only mechanism through which the global economy influences the quality of water resources worldwide. Meybeck and Helmer (1989) and Meybeck (2004) show how other substances are also dispersed into the global environment and change the 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 pollution shows that this phenomenon in itself is no longer news; what is now gradually being uncovered and 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 true 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 global economy, with the aim of the closure of element cycles. Making adjustments to the organization of the global economy would obviously require international coordination.

2.3. Multinationals in water supply

The past decade has shown a growing presence of multinationals in the drinking water sector. It has been said that drinking water is gradually turning from a public resource into a commercial commodity with global players. Questions such as whether water should be treated as a resource or a commodity and whether water should come under the regulations of the World Trade Organization or not, are nowadays hot topics at international water forums.

As a result of the process of privatisation in the water supply sector during the past two decades in several countries, water supplies have fallen to an increasing degree into the hands of large multinationals. Made possible and stimulated by the loan practice of the World Bank, 70% of the private water supply systems in the world is currently owned by the three largest water companies - Veolia, Suez and RWE Thames Water. Some consider this an obvious development, which will ensure that through enlargement of scale water supplies will become more efficient and that the standards of water supplies in the developing countries will be pushed up towards levels that are more common in the North. Others instead see a frightening picture, in which water, a basic need for everyone, becomes a tradable commodity that can be obtained only by those who can afford to pay (Barlow and Clarke, 2002). Shiva (2002) further argues that in many cases the privatisation of water leads to a situation in which companies profit from overexploitation of water resources, because scarce water resources can still be freely obtained and exploited.

2.4. Inter-basin water transfer

Water scarcity has become so great in some parts of the world that policy makers do no longer believe that it is unfeasible to transport water over large distances; witness the planned inter-basin water transfers in e.g. China (Liu and Zheng, 2002; Berkoff, 2003; Wu *et al*., 2006; Zhao *et al*., 2005; Yang *et al*., 2005; Yang and Zehnder, 2005), India (Jain *et al*., 2005), Southern Africa (Basson, 1995; Nel and Illgner, 2001) and Spain (Ballestero, 2004). Although not implemented, plans have also been developed to ship water from Turkey to Israel. The practice of inter-basin water transfers is not recent, but the scale of current proposals in terms of volumes and transfer distances is greater than ever before.

Large-scale inter-basin water transfer schemes might be technically possible and economically and politically feasible, but the nature of large-scale water transfers has huge impacts on the natural environments and societies of both the supplying and the receiving regions and downstream of these regions. Large-scale water transfers are not some sort of market exchange, nor a simple agreement between two national governments or two river basin agencies. Institutional arrangements at supra-basin scale need to be in place in order to prevent lack of coordination in trading off different interests.

2.5. Domestic water saving through virtual water import

An increasing number of water-short countries, most particularly in North Africa and the Middle East, seek to preserve their domestic water resources through the import of water in virtual form, that is by importing water-intensive commodities (relatively high water input per dollar of product) and exporting commodities that are less water-intensive. Jordan, as an example, imports about 5 to 7 billion cubic meters of virtual water per year (Haddadin, 2003; Chapagain and Hoekstra, 2004), which is much more than the 1 billion cubic meters of water annually withdrawn from its domestic water sources. Even Egypt, with water self-sufficiency high on the political agenda and with a total water withdrawal within the country of 65 billion cubic meters per year, still has an estimated annual net virtual water import of 10 to 20 billion cubic meters (Yang and Zehnder, 2002; Zimmer and Renault, 2003; Chapagain and Hoekstra, 2004).

The virtual water content of a product is the volume of water used to produce it, measured at the place where it was actually produced. The adjective 'virtual' refers to the fact that most of the water used in the production is in the end not contained within the product. The real water content of products is generally negligible if compared to the virtual water content. The (global average) virtual water content of wheat for instance is 1300 m^3/ton, while the real water content is obviously less than 1 m^3/ton (Chapagain and Hoekstra, 2004). While transfer of real water over long distances is very costly and therefore generally not economically feasible, transfer of water in virtual form can be an efficient way of obtaining water-intensive products in places where water is very scarce. The concept of 'virtual water import' as a means of releasing the pressure on domestic water resources was introduced by Allan (1998; 2001), when he studied the water scarcity situation of the Middle East. Virtual water import could be regarded as an alternative water source, alongside endogenous water sources. Imported virtual water has therefore also been called 'exogenous water' (Haddadin, 2003).

Further removal of trade barriers as foreseen for the future, particularly in the case of agricultural commodities, will facilitate increased international trade in water-intensive commodities. Virtual water import as a tool to release the pressure on domestic water resources can thus become attractive to an increasing number of water-short nations (Zehnder *et al*., 2003). Disregarding political objectives that might work in a different direction, according to international trade theory the people of a nation will seek profit by trading products that are produced with resources that are (relatively) abundantly available within their country for products that need resources that are (relatively) scarce. This theory, known as the theory of comparative advantage, has recently been proposed as a useful analytical tool to study the economic attractiveness of virtual water import for nations that have comparatively little water and of virtual water export for nations that have comparatively abundant water resources (Wichelns, 2004).

During the past few years five global studies have been carried out to quantify the actual virtual water flows between nations: Hoekstra and Hung (2002, 2005), Zimmer and Renault (2003), Oki and Kanae (2004), Chapagain and Hoekstra (2004) and De Fraiture *et al*. (2004). All studies show that North and South America, Australia, most of Asia and Central Africa have a net export of virtual water. The reverse, a net import of virtual water, can be found in Europe, Japan, North and Southern Africa, the Middle East, Mexico and Indonesia. Obviously, the import of virtual water in for instance Europe should be understood in a different context to the import of virtual water in North Africa and the Middle East. In the latter case, as has been demonstrated by Yang *et al*. (2003), the virtual water import can be explained – at least partially – by the actual water scarcity situation in the countries of this region. The water availability in most of the countries in North Africa and the Middle East falls below a threshold of about 1500-2000 m^3/yr per capita, below which net cereal import grows exponentially with decreasing water availability per person. It is not suggested here that all countries with a net import of water in virtual form do this because they intend to save domestic water resources. By importing virtual water they will indeed save domestic water resources, but this does not imply that the idea of water saving was necessarily the driving force behind the virtual water imports. International trade in agricultural commodities depends on many more factors than water, such as availability of land, labour, knowledge and capital, competitiveness (comparative advantage) in certain types of production, domestic subsidies, export subsidies and import taxes. As a consequence, international virtual water trade can in most cases not at all or only partly be explained on the basis of relative water abundance or shortage (De Fraiture *et al*., 2004).

As shown in Table 1, the (intended or unintended) national water saving as a result of international trade in agricultural products can be substantial. In Algeria, water use would triple if the Algerians had to produce all imported products domestically.

Table 1. Some examples of nations with net water saving as a result of international trade in agricultural products. Period 1997-2001.

Country	Total use of domestic water resources in the agricultural sector[1] (10^9 m^3/yr)	Water saving as a result of import of agricultural products[2] (10^9 m^3/yr)	Water loss as a result of export of agricultural products[2] (10^9 m^3/yr)	Net water saving due to trade in agricultural products[2] (10^9 m^3/yr)	Ratio of water saving to water use
China	733	79	23	56	8%
Mexico	94	83	18	65	69%
Morocco	37	29	1.6	27	73%
Italy	60	87	28	59	98%
Algeria	23	46	0.5	45	196%
Japan	21	96	1.9	94	448%

[1] Source: Chapagain and Hoekstra (2004)

[2] Source: Chapagain *et al*. (2006a). Agricultural products include both crop and livestock products.

The studies on international virtual water trade show that water should be regarded as a global resource (demand and supply match at global level), rather than as a river basin resource (demand and supply match within the basin). Effective governance of the world's water resources will require some type of coordination of the global 'water market', similar to the case of oil, where OPEC is one of the institutions that plays such a coordinative role. Coordination could refer for example to agreements on area-specific 'sustainable levels' of water supply and agreements on water pricing structures.

2.6. Global water use efficiency

The increasing demand for freshwater and the limited possibilities of raising supply urge for a greater efficiency in water use, that is: produce the same volume of goods and services with less water. Fortunately there are ample opportunities to increase water use efficiency. As pointed out by Hoekstra and Hung (2005), greater water use efficiency can be achieved at three different levels: the local, basin and global levels.

At local level, that of the consumer, water use efficiency can be improved by: charging prices based on full marginal cost (Rogers *et al*., 2002); stimulating water-saving techniques in farming such as water recycling, drip irrigation and the use of drought-resistant crop varieties (FAO, 2003b; Deng *et al.*, 2006); promoting the use of water-saving appliances in industries and households; and creating awareness among water users of the possible detrimental impacts of water use (Wilson, 2004). In irrigation, the largest water-using sector in the world, efficiency is as low as 24% in Latin America, 32% in Sub-Saharan Africa, 34% in East Asia, 40% in the Near East and North Africa and 44% in South Asia (FAO, 2006), which offers ample room for improvement. At the catchment or river basin level, water use efficiency can be enhanced by re-allocating water to those purposes with the highest marginal benefits (Beaumont, 2000), which can imply the re-allocation of water from the agricultural sector to the domestic or industrial sectors or the re-allocation of water from water-inefficient crops to more efficient crop types or varieties. Finally, at the global level, water use efficiency can be increased if nations use their comparative advantage or disadvantage in terms of water availability to encourage or discourage the use of domestic water resources for producing export commodities (respectively stimulate export or import of virtual water). Virtual water trade between nations – provided that trade goes in the right direction (from places with high to places with low water productivity) – can thus be a means of increasing the efficiency of water use in the world (Oki and Kanae, 2004; Chapagain *et al*., 2006a).

Whereas much research effort has been dedicated to study water use efficiency at the local and river basin levels (sometimes respectively called productive and allocative efficiency), few efforts have been made to analyse water use efficiency at global level. Nevertheless, there is sufficient evidence now that current global trade patterns result in global water saving, because much of the trade in water-intensive commodities takes place from countries with high water productivity (high value per unit of product) to countries with low water productivity. Thus far, four independent studies have been carried out to estimate the actual global water saving as a result of international trade. In the first study, Oki and Kanae (2004) estimated that the current global water saving as a result of international trade in rice, wheat, soybean, maize, barley, chicken, pork and beef is 455×10^9 m^3/yr in total. According to their study, the exporting countries use 683×10^9 m^3/yr, while the importing countries would have required 1138×10^9 m^3/yr if they had produced the imported products domestically. The difference is the global water saving. Oki and Kanae (2004) accounted for the differences in yields in different countries, but assumed a constant global average crop water requirement throughout the world (15 mm/day for rice and 4 mm/day for maize, wheat and barley). Thus the climatic factor, which plays an important role in the water requirement of a crop, was neglected. A second study, which does account for climatic differences, is De Fraiture *et al.* (2004), who estimated that international cereal trade in 1995 reduced global water use at crop level by 164×10^9 m^3/yr and irrigation water depletion by 112×10^9 m^3/yr. In a third study, Chapagain *et al.* (2006a) took a more comprehensive approach and looked at the global water saving as a result of international trade in *all* agricultural products, including both crop and livestock products. For the period 1997-2001, they estimate the global water saving at 352×10^9 m^3/yr, of which 63% related to international trade in cereals and cereal products, 19% to oil crops, 13% to livestock products and 5% to pulses and other crops. Most recently, Yang *et al.* (2006) calculated a global water saving of 337×10^9 m^3/yr, relating to international trade in the most important crops. Due to differences in period and scope, the results of the studies mentioned cannot easily be compared, but they all confirm that the global water saving as a result of international trade can be substantial when compared with the total water use in agriculture. According to Chapagain *et al.* (2006a), the global water saving through trade in agricultural products is equivalent to 6% of the global volume of water used for agricultural production.

Although it is clear that global trade and water use efficiency are connected issues, there is no international agency that has ever included this connection in either trade policy or water policy considerations. The growing scarcity of freshwater in the world and the fact that water could possibly be saved by producing water-intensive commodities in places where water is comparatively abundant and trading them to places where it is not, demand international research and policy coordination in this field.

2.7. Externalisation of water footprints

The water footprint of an individual or a nation is defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or nation. The water footprint does not only show water use within the country considered, but also water use outside the country borders (Hoekstra and Hung, 2002). The water footprint of the Dutch community for example also refers to the use of water for rice production in Thailand (insofar as the rice is exported to the Netherlands for consumption there). The water footprints of people are increasingly externalised to other parts of the world. Consumers do generally not pay for the negative effects of their water footprints, because water supply is mostly heavily under-priced and also the negative effects of pollution are not taken into account in the price of the products. Local water problems are thus strongly related to cheap consumption elsewhere, where ‘cheap’ refers to the fact that prices of water-intensive consumer goods generally include neither a water scarcity rent nor externalities that occur during production.

Global water use, including both green and blue water, is estimated to be 7450×10^9 m^3/yr. The global volume of virtual water flows relating to the international trade in commodities is 1625×10^9 m^3/yr, of which 1200×10^9

m^3/yr refers to the export of home-made products; the remainder concerns re-exports (Hoekstra and Chapagain, 2006). From these figures it follows that (1200/7450=) 16% of global water use is not for producing domestically-consumed products, but for products for export. Assuming that, on average, agricultural production for export does not significantly cause more or fewer water-related problems (such as water depletion or pollution) than production for domestic consumption, this means that one-sixth of the water problems in the world can be traced back to production for export.

The physical distance between production and consumption and the fact that much of the consumer information on product origin and production circumstances is generally at best limited to information about country of origin and some data on the main ingredients, mean that there is a disconnection between consumption decisions and detrimental impacts of production. Consumption can only be reconnected with the effects of production through a global approach. Local or national measures to include externalities and a water scarcity rent in water-intensive products will not work satisfactorily, because such local products run the risk of becoming too expensive in the global market, which is dominated by others who have not yet taken such measures. In debates about the subject over the past few years, the author of this paper found that different views exist on the usefulness of uncovering the link between consumers and the effects of production, in this case the effects on the water systems in the production areas. Economists in particular appear not to recognize the usefulness of such an exercise. In fact, an anonymous reviewer of one of my manuscripts wrote: ‘It is misleading to suggest that consumers of one nation are responsible for depleting resources in another via the mechanism of voluntary international trade.’ In my view, however, both consumers and producers have a connection with and bear at least partial responsibility for problems caused by production. When the consumption of a certain good in one area is related to a problem of water depletion or pollution in another area, as for instance in the case of European cotton consumers and the desiccation of the Aral Sea (Micklin, 1988; Chapagain *et al*., 2006b), this is an interesting starting point for an analysis of responsibilities and mechanisms that could possibly mitigate the environmental problem. The fact that trade is voluntary – and thus always beneficial for both trading partners according to economists – does not remove responsibilities from consumers and producers. The fact that trade is increasingly becoming a global issue means that mitigating the effects of production on water depletion and pollution also increasingly carries a global dimension.

2.8. Fairness and sustainability of large water footprints

Some people around the world have comparatively high water footprints, which raises the question of whether this is fair and sustainable. Under current production conditions it would be impossible for all world citizens to develop a water footprint of the same size as the present water footprint of the average US citizen. US people have, on average, the largest water footprint per capita in the world, viz. 2480 m^3/yr. China has an average water footprint of 700 m^3/yr per capita, while the world average is 1240 m^3/yr (Hoekstra and Chapagain, 2006). The issues of fairness and sustainability become very obvious in this imaginary growth scenario, but both are already relevant today.

Currently, more than 1 billion people do not have access to clean drinking water (UNESCO, 2003), while others water their gardens, wash their cars, fill their swimming pools and enjoy the availability of water for many other luxury purposes. In addition, many people consume a lot of meat, which significantly enlarges their water footprint. The average meat consumption in the United States for instance is 120 kg/yr, more than three times the world average. The water used to produce the feed for the animals that provide the meat for the rich cannot be used for other purposes, e.g. to fulfil more basic needs of people who however cannot afford to pay. The answer to the question of whether the current distribution of water footprints is fair is a political one and besides a global one. Redistribution of welfare among individuals is normally done within the borders of the nation state, but since the distribution of water and water-intensive products is very uneven across the globe, the redistributive question becomes a global one as well. The normative question at global level is whether wealthy water-rich nations should play a role in supporting developing water-poor nations, for instance by helping them to efficiently and sustainably use their scarce water resources.

What is a 'sustainable water footprint', given the 6 billion inhabitants of the earth and the fact that the total water availability in the world is limited? The current global water footprint is 7450×10^9 m^3/yr, which in many places obviously leads to unsustainable conditions, as witnessed by the reported cases of water depletion and pollution (UNESCO, 2003; 2006). Although the annual volume of precipitation over land is roughly known, it is very difficult to give a global figure for the maximum 'sustainable water footprint' as an upper limit to global water use. There are various reasons for this. One is that not all precipitation can be used productively, because its fall is unevenly spread in time and space, so that there are places and times that the water will inevitably flow to the oceans. According to Postel *et al*. (1996) about 20% of total runoff forms remote flows that cannot be appropriated and 50% forms uncaptured floodwater, so that only 30% of runoff remains for use. Although research in this direction has been done, it is not yet clearly established which fraction of this remaining flow should remain untouched in order to fulfil the environmental flow requirements (Smakhtin *et al.*, 2004). It has also not been established what fraction of the total evapotranspiration on land may be counted as potentially productive. Finally, what we would count as the maximum 'sustainable water footprint' at global level depends on what assumptions would be made with respect to the level of technology. One could take water productivities as they are in practice at present (which differ from location to location), or one could work with the potential water productivities based on existing technology. The latter would lead to a more optimistic figure than the former, but also a less realistic one. So far no estimates of the world's maximum 'sustainable water footprint' have been made, but a general feeling exists that if it has not passed it already, the current global water footprint will not be far below the maximum sustainable value, witness the widely promoted need for water demand management and water use efficiency improvements (Postel *et al*., 1996; FAO, 2003b; UNESCO, 2003; 2006). This brings us back to the issue of fairness, because is it fair if some people use more than an equitable share of the maximum global volume of annually available water resources? The average person in North America and Southern Europe certainly does.

2.9. Water as a geopolitical resource

Nations can be 'water dependent' in two different ways. They can be dependent on water that flows in from neighbouring countries and they can be dependent on virtual water import. The first type of water dependency follows from the ratio of external to total renewable water resources of a country. FAO (2003a) defines the 'external renewable water resources' of a country as that part of the country's renewable water resources which is not generated in the country. It includes inflows from upstream countries (groundwater and surface water) and part of the water of border lakes or rivers. A difference is made between the 'natural' and the 'actual' external renewable water resources. The first term refers to the natural incoming flow originating outside the country; the actual external resources are possibly less than the natural external resources, because in this case upstream water abstractions are subtracted, as are water flows reserved for upstream and downstream countries through formal or informal agreements or treaties. The 'internal renewable water resources' of a country concern the average annual flow of rivers and recharge of aquifers generated by endogenous precipitation. The total renewable water resources of a country are the sum of internal and external renewable water resources. Table 2 shows the 'external water resources dependency' for a number of selected downstream countries. For a country like Egypt the dependency is extremely high, because the country receives hardly any precipitation and thus mostly depends on the inflowing Nile water. Similarly, but to a lesser extent, Pakistan strongly depends on the water of the Indus, Cambodia on the water of the Mekong and Iraq on the Tigris and Euphrates. In all these cases water is an important geopolitical resource, affecting power relations between the countries that share a common river basin. In a country like the Netherlands external water resources dependency is high but less important, because water is less scarce than in the previous cases. Nevertheless, here too there is a dependency, since activities within the upstream countries definitely affect downstream low flows, peak flows and water quality.

Table 2. Dependency on incoming river flows for some selected countries.

Country	Internal renewable water resources[1] (10^9 m^3/yr)	External (actual) renewable water resources[1] (10^9 m^3/yr)	External water resources dependency[2] (%)
Iraq	35	40	53
Cambodia	121	356	75
Pakistan	52	170	77
Netherlands	1.1	80	88
Egypt	1.8	56.5	97

[1] Source: FAO (2003a).

[2] Defined as the ratio of the external to the total renewable water resources.

The political relevance of 'external water resources dependency' of nations makes water a regional geopolitical resource in some river basins. The other type of water dependency, virtual water import dependency, makes water a global geopolitical resource. The fundamental reason is the combination of increasing scarcity of water, its unique character that prevents substitution and its uneven distribution throughout the world. Where water-abundant regions did not fully exploit their potential in the past, they now increasingly do so by exporting water in virtual form or even in real form. The other side of the coin is the increasing dependency of water-scarce nations on the supply of food or water, which can be exploited politically by those nations that control the water.

From a water resources point of view one might expect a positive relationship between water scarcity and virtual water import dependency, particularly in the ranges of great water scarcity. Water scarcity can be defined as the country's water footprint – the total volume of water needed to produce the goods and services consumed by the people in the country – divided by the country's total renewable water resources. Virtual water import dependency is defined as the ratio of the external water footprint of a country to its total water footprint. As Chapagain and Hoekstra (2004) show, countries with a very high degree of water scarcity – e.g. Kuwait, Qatar, Saudi Arabia, Bahrain, Jordan, Israel, Oman, Lebanon and Malta – indeed have a very high virtual water import dependency (>50%). The water footprints of these countries have largely been externalised. Jordan annually imports a virtual water quantity that is five times its own yearly renewable water resources. Although saving its domestic water resources, it makes Jordan heavily dependent on other nations, for instance the United States. Other water-scarce countries with high virtual water import dependency (25-50%) are for instance Greece, Italy, Portugal, Spain, Algeria, Libya, Yemen and Mexico. Even European countries that do not have an image of being water-scarce, such as the UK, Belgium, the Netherlands, Germany, Switzerland and Denmark, have a high virtual water import dependency. Table 3 presents the data for a few selected countries.

In most water-scarce countries the choice is either (over)exploitation of the domestic water resources in order to increase water self-sufficiency (the apparent strategy of Egypt) or virtual water import at the cost of becoming water dependent (Jordan). The two largest countries in the world, China and India, still have a very high degree of national water self-sufficiency (93% and 98% respectively). However, the two countries have relatively low water footprints per capita (China 702 m^3/cap/yr and India 980 m^3/cap/yr). If the consumption pattern in these countries changes to that of the US or some Western European countries, they will be facing a severe water scarcity in the future and will probably be unable to sustain their high degree of water self-sufficiency. A relevant question is how China and India are going to feed themselves in the future. If they were to decide to partially obtain food security through food imports, this would put enormous demands on the land and water resources in the rest of the world.

Table 3. Virtual water import dependency of some selected countries. Period: 1997-2001.

Country	Internal water footprint[1] (10^9 m^3/yr)	External water footprint[1] (10^9 m^3/yr)	Water self-sufficiency[2] (%)	Virtual water import dependency[3] (%)
Indonesia	242	28	90	10
Egypt	56	13	81	19
South Africa	31	9	78	22
Mexico	98	42	70	30
Spain	60	34	64	36
Italy	66	69	49	51
Germany	60	67	47	53
Japan	52	94	36	64
United Kingdom	22	51	30	70
Jordan	1.7	4.6	27	73
Netherlands	4	16	18	82

[1] Source: Chapagain and Hoekstra (2004).
[2] Defined as the ratio of the internal to the total water footprint.
[3] Defined as the ratio of the external to the total water footprint.

3. An explorative analysis of global water governance arrangements

The described developments raise the question of what kind of institutional arrangements could be instituted to cope with the global dimension of water issues. A few possible directions are identified below in an explorative manner.

3.1. An international protocol on water pricing

First of all, there is a need to arrive at 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. The need to have full cost pricing has been acknowledged since 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 (Morocco 1997, The Hague 2000, Japan 2003, Mexico 2006), but these forums have not been used to take up the challenge of making international agreements on the implementation of the principle that water should be considered as a scarce, economic good. It is not sufficient to leave the implementation of this principle to national governments without having some kind of international protocol on the implementation, because unilateral implementation can be expected to be at the cost of the countries moving ahead. The competitiveness of the producers of water-intensive products in a country that one-sidedly implements a stringent water pricing policy will be 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. If an international protocol on full-cost water pricing were in place, this would have a positive effect on a number of the global water issues described in this paper. It would contribute to the sustainable use of the world's water resources, because water scarcity would be translated into a scarcity rent and thus affect consumer decisions, even if those consumers live at a great distance from the production site. Such a protocol would further contribute to fairness, by making producers and consumers pay for their contribution to the depletion and pollution of water. Finally, such a protocol would shed new light upon the economic feasibility of plans for large-scale inter-basin transfers, since it would force negative externalities and opportunity costs to be taken into account. Full-cost water pricing should be combined with a minimum water right, in order to prevent poor people not being able to obtain their basic needs.

3.2. A water label for water-intensive products

A second global arrangement could be a water label for water-intensive products, comparable to the FSC label for wood products. Such a label would make consumers aware of the actual, but so far hidden, link between a consumer product and the impacts on water systems that occur during production. A water label should give a guarantee to the consumer that the product was produced under some clearly defined conditions. The label could be introduced first for a few commodities that usually have great impacts on water systems, such as rice, cotton and sugar cane. Given the global character of the rice, cotton 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 label, but this would probably create new bottlenecks for implementation, so that a first step could be to agree on a separate water label.

3.3. A disposal tax and international nutrient housekeeping

Another global arrangement might be made to prevent water problems in the waste stage of products. This arrangement could have the form of a disposal tax on goods that will cause water pollution in their waste stage. The tax should be paid by the consumer; the money collected could be used to promote pollution prevention and control. The tax would be supposed to work as an incentive for producers to adapt production processes and for consumers to change consumption behaviour. This sort of arrangement can be implemented unilaterally within one nation state. However, it will be difficult to combat the type of pollution that relates to product trade in the global economy through unilateral disposal taxes. To counter processes of soil depletion and eutrophication that are linked to international trade in food and feed, as described in section 2.2, a global arrangement is essential. Such a global arrangement would combine measures to combat soil depletion in the exporting country with measures to combat eutrophication in the importing country. In fact there are only two sustainable solutions: either stop the one-directional trade flow of nutrients, or bring back the nutrients that come in the form of food or feed as fertiliser or other forms of food or feed. Both solutions impact on the economy of the trading nations. While international trade is currently governed by the requirement (at least over the long term) of closing national trade balances, another restriction should be imposed in the shape of a requirement that national nutrient trade balances should also close. This principle has been introduced and implemented in the Netherlands at farm level, but introduction at national level would be more complex and would require international cooperation.

3.4. Minimum water rights

Fairness and sustainability in water use require the establishment of both minimum water rights and maximum allowable levels of water use. The latter has received little attention from the international community and will be discussed in the next section. The issue of minimum water rights has had more consideration (Gleick, 1998; WHO, 2003; Salman and McInerney-Lankford, 2004). At international level efforts have been made to have access to clean drinking water accepted as a human right. The Universal Declaration of Human Rights from 1948 does not mention access to water as a human right, but the first paragraph of article 25 reads: ‘Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, …’. With a little good will, one could say that the right to a certain minimum of water is thereby implicitly established. A step towards the more explicit formulation of the right to water was made in 1976 with article 12 of the International Covenant on Economic, Social, and Cultural Rights, which acknowledges ‘the right of everyone to the enjoyment of the highest attainable standard of physical and mental health’. In 2000 the Committee on Economic, Social and Cultural Rights of the United Nations (in her General Comment No.14) accepted a supplement to this covenant which states that ‘the right to health embraces a wide range of socio-economic factors that promote conditions in which people can lead a healthy life, and extends to the underlying determinants of health, such as food and nutrition, housing, access to safe and potable water and adequate sanitation, safe and healthy working conditions, and a healthy environment’. In 2002 the same committee specified the right to water in her General

Comment No.15: 'The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses. An adequate amount of safe water is necessary to prevent death from dehydration, to reduce the risk of water-related disease and to provide for consumption, cooking, personal and domestic hygienic requirements.'

With these statements the human right to water has been formally established, but there are no enforcement mechanisms. Besides, the right specifically refers to water for basic needs in domestic use, not to water for food. Food itself as a human right had already been established explicitly in article 25 of the Universal Declaration of Human Rights. Although one cannot deny that the right to food translates into a certain volume of water required to produce the food, the right to food has never been translated into a 'right to water for food'. On the level of the individual this is also not useful, because that would wrongly presuppose that every individual produces his or her own food. However, the right to food implies that every individual has a sort of 'claim' on a certain volume of the world's water resources that is required to produce the amount of food that he or she is entitled to according to the existing right to food. Given the uneven distribution of water across the world, an important question is: How do the existing human rights to water and food translate into a moral obligation of communities that have abundant water resources at their disposal towards communities with severely limited water resources? One of the concrete steps taken by the international community has been the formulation of the Millennium Development Goals during the UN Millennium Summit in New York in 2000. Definite targets are for instance to reduce by half the proportion of people who suffer from hunger and also to reduce by half the proportion of people without sustainable access to safe drinking water (both targets referring to the period 1990-2015). The weak point of the Millennium Development Goals is that they lack a clear course of action and a mechanism for enforcement. As a result, there is no guarantee that the good intentions will be realised.

3.5. Maximum allowable water footprints and tradable water footprint permits

The issues of fair water allocation and sustainable water use demand some global arrangement about maximum allowable levels of water use. As argued in section 2.8, the limited availability of freshwater in the world puts a maximum on the human global water footprint. The question for the global community is how this global maximum can be transferred to the national or even the individual level. Or in other words: what is each nation's and each individual's 'reasonable' share of the globe's water resources? An international protocol on this issue would be comparable to the Kyoto Protocol on the emission of greenhouse gases (drafted in 1997, effective since 2005), which is based on the understanding that, to prevent human-induced climate change, there is a ceiling on the maximum volume of greenhouse gas emissions from human activities that can be accommodated by the global system. The fact that it is not known exactly what this ceiling is has apparently not held the international community back in setting political targets with respect to greenhouse gas emission reductions. The same would have to happen if the international community were willing to set targets with respect to maximum water footprints, because here also the precise ceiling on water use is unknown, as explained earlier in this paper. In the case of the Kyoto Protocol, the maximum allowable emission permits have been issued in the form of tradable emission permits. In the case of a protocol on water use, this could be done in the form of tradable water footprint permits.

3.6. Conclusion

The above exploration of possible global arrangements in order to contribute to good water governance is definitely not exhaustive. Not mentioned, for instance, are the necessary global arrangements to mitigate climate change (to be seen in addition to local and regional arrangements for adaptation), but the global community has taken some steps here already, as witness the work of the Intergovernmental Panel on Climate Change and the Kyoto Protocol. Also not mentioned is the need for an international business code for multinationals in the water sector, to guarantee that in cases where governmental control is ineffective, this is compensated for by international regulations. Such regulations could provide rules about supply obligations and dedicated pricing structures for the poor who cannot afford normal tariffs, and would need to include enforcement arrangements.

4. Discussion

The three most important factors that give water governance a true global dimension are: climate change, trade liberalisation and privatisation in the water sector. The three major areas where coordination at global level could contribute to effective water governance are: promoting water use efficiency, ensuring sustainable water use and encouraging equitable sharing of the limited water resources.

The argument for coordination at global level as made in this paper seems to be at odds with the subsidiarity principle, nowadays widely accepted and promoted in the field of water governance. This principle means that water issues should be settled at the lowest community level possible. Whether this causes tension depends on how one interprets the subsidiarity principle. In this paper it has been argued that the issues discussed are truly global issues that cannot be solved at a lower community level than that of the global community, so there is no conflict with the subsidiarity principle. However, it is a fact that global arrangements in the area of water governance do definitely subtract from the mandates at lower community levels. Finding a balance between institutional arrangements at different levels of governance will indeed be a true challenge.

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