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Global water governance: Conceptual design of global institutional arrangements

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GLOBAL WATER GOVERNANCE:

CONCEPTUAL DESIGN OF GLOBAL INSTITUTIONAL ARRANGEMENTS

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Summary

This study builds upon the explorative study of Hoekstra (2006), who puts forward an argument for coordination at the global level in 'water governance'. Water governance is understood here in the broad sense as 'the way people use and maintain water resources'. One of the factors that give water governance a global dimension is 'virtual water trade' between nations, i.e. the trade in water in virtual form through trade in water-containing products. Virtual water trade involves advantages as well as disadvantages. The development of institutional arrangements to account for these disadvantages has not kept pace with the enhancement of international trade in general and virtual water trade in particular.

The objective of this study is to design alternative institutional arrangements to deal with the global dimension of water governance. The study elaborates three arrangements: a Water Pricing Protocol, a Business Agreement on Sustainability Reporting of water-intensive goods, and a system of Water Footprint Permits. The three institutional arrangements are aimed to improve the ecological sustainability, economic efficiency and social equity of water governance. The arrangements aim to influence change agents in the virtual water chain (the production chain of water-containing products). Behavioural mechanisms bring about behavioural change of other agents in the virtual water chain.

We define the Water Pricing Protocol as an international 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. Such a protocol will favour an efficient and sustainable use of water resources. By putting a price on water, conservation becomes economically efficient. The Water Pricing Protocol should account for the issue of social equity. The greatest challenge is to bring the theory of full marginal cost pricing into practice. Practical difficulties involve the flowing character of water, disruption of historical water management systems and the need for national capacity to set up the institutions necessary for water pricing.

We define the Business Agreement on Sustainability Reporting of water-intensive goods as an agreement between companies that commit themselves to report on the impacts of their business on water resources. Such an agreement will promote sustainable and efficient water governance. The Business Agreement merits from the fact that it focuses on so-called 'channel leaders' (agents in the production chain capable of imposing their will on other agents). In the Business Agreement, channel leaders agree on a standardized chain-based measuring and reporting method for the sustainable use of water resources. Sustainability reporting is done in corporate responsibility publications. In this way, companies can compare the environmental performance of their products over time and with the products of others. This may lead to the conservation of resources. The fact that the Business Agreement is not binding threatens its effectiveness.

A system of Water Footprint Permits defines a maximum global water footprint, which is allocated among participating countries. The system of Water Footprint Permits favours a fair allocation of global water resources among the people of the Earth. The water footprint of an individual is defined as the total volume of freshwater used to produce the goods and services consumed by that individual. Comparable to the Kyoto

Protocol, nations voluntarily participate in the system. The state parties define a global maximum water footprint each six years. This global maximum is allocated to nations, based on the number of inhabitants. When a nation's water footprint is smaller than its permit, the national government can sell part of their permit to countries whose water footprint is bigger than its permit. It can also reduce its water footprint by applying domestic instruments to change the behaviour of stakeholders in the virtual water chain. The transaction costs of the system are the highest of all institutional arrangements investigated. Whether the benefits outweigh the costs remains a topic of further research.

The institutional arrangements are not mutually exclusive. All three institutional arrangements require monitoring efforts, which can be combined. On the other hand, combinations may be less effective than the sum of effects of the separate institutional arrangements. A combination of Water Footprint Permits and the Business Agreement is promising. This way, governments, civil society and business society involve in the equitable and sustainable water governance at the global level.

The study was a first-order exploration of possible institutional arrangements for global water governance. Further research should adopt a multi-disciplinary and multi-level approach. Strategic alliances with other institutional arrangements are possible. Water Footprint Permits are much more relevant when combined with Ecological Footprint Permits. A Water Pricing Protocol will be more effective when combined with other measures to change existing subsidy schemes, particularly the US and EU agricultural subsidy schemes. Designing and implementing global institutions to account for the global dimension of water governance requires forms of communication, information, and trust that are broad and deep beyond precedent, but not beyond possibility.

1. Introduction

1.1. Background

The United Nations General Assembly, in December 2003, proclaimed the years 2005 to 2015 as the International Decade for Action 'Water for Life'. The primary goal of the Decade is to promote efforts to fulfil international commitments made on water and water-related issues by 2015 (UN-Water, 2003, 2006; Martinez Austia & Van Hofwegen, 2006). Although achieving good water governance is regarded as a global challenge, water governance is generally seen as a local or regional issue. Where water issues extend beyond the borders of local communities, the river basin is generally seen as the most appropriate unit for analysis, planning and institutional arrangements (UNGA, 1997; GWP, 2000). As a result, most efforts focus on seeking proper institutional arrangements (structures or mechanisms of social order and cooperation) at a local or river basin level.

The international water community, for two reasons, has not recognized the necessity of global coordination in 'water governance'. Water governance is understood here in the broad sense as 'the way people use and maintain water resources'. First, coordination at the global level seems to be at odds with the subsidiarity principle, which states that water issues should be handled at the lowest governance level possible. Second, global water resources are not scarce, because aggregate annual withdrawals are and will remain below annual renewable water resources at the global level (Gleick, 1993; Postel et al., 1996; Shiklomanov, 2000; Vörösmarty et al., 2000; Zehnder et al., 2003). The issue is rather the mismatch between water demand and supply at smaller spatial scale at particular periods of the year.

Hoekstra (2006) shows, however, that water governance does have a global dimension. The most important factors that give water governance a global dimension, include (i) climate change, (ii) privatization of drinking water, sanitation and irrigation services, and (iii) increasing 'virtual water trade' between nations (the trade in water virtually embedded in traded goods and services). The latter factor received little academic attention until five years ago (Hoekstra, 2003). Thus far, virtual water trade has been researched either to quantitatively assess actual virtual water flows between nations (Hoekstra, 2003; Zimmer & Renault, 2003; Oki and Kanae, 2004; Hoekstra & Hung, 2005; Chapagain & Hoekstra, 2008), or with a policy focus at the national or regional level (Allan, 1998, 2001; Turton, 2000).

Institutional responses have not kept pace with the effects of climate change, privatization and trade liberalization that have led to or are expected to lead to changes in water supply or demand in various places. People traditionally regard water scarcity as a responsibility of the national government or of the producers of agricultural products. The production of agricultural products accounts for 70% of total global water withdrawals (Shiklomanov, 2000). Hoekstra (2003) has proposed a 'water footprint' as an indicator that emphasizes the link between consumption and water use. The water footprint of an individual is defined as the total volume of freshwater used to produce the goods and services consumed by that individual. The water footprint can be related to a problem of water depletion or pollution near the production site, for instance in the case of European cotton consumers and the desiccation of the Aral Sea (Micklin, 1988; Chapagain et al., 2006).

Figure 1.1 shows that many parts of the world depend on foreign water resources to sustain their lifestyles, making water a global resource.

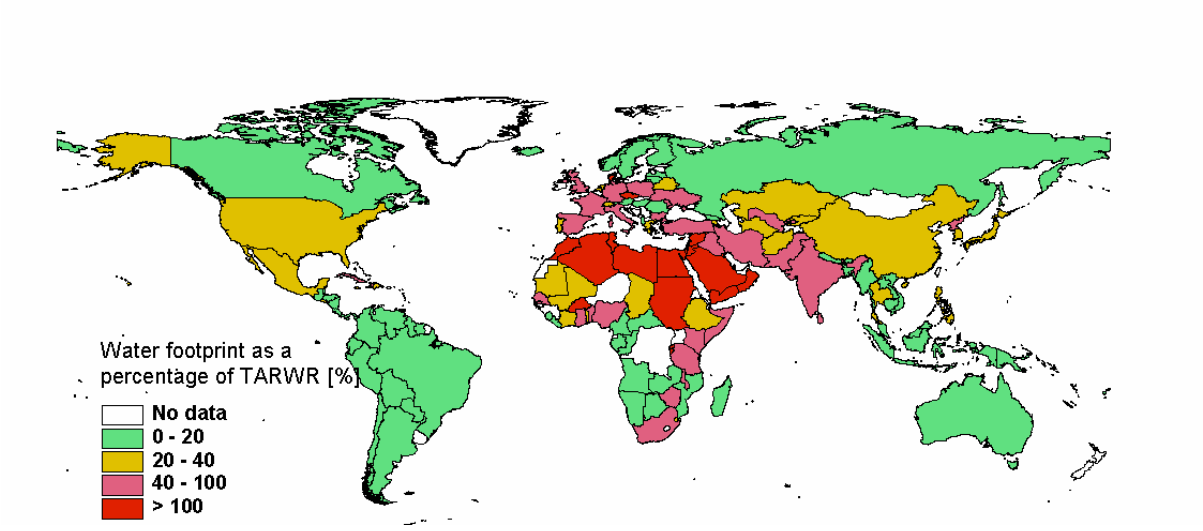

Figure 1.1: Water scarcity based on a consumer oriented indicator: water footprint as a percentage of total actual renewable water resources (Data source: Chapagain & Hoekstra, 2004).

1.2. Objective and scope

The objective of this study is to design alternative institutional arrangements to deal with the global dimension of water governance. It elaborates a number of the institutional arrangements that have been introduced by Hoekstra (2006). The current study still has an explorative character, which is inherent to the subject. We are aware that fundamentally different perspectives do exist with respect to the desirability and feasibility of the types of arrangements elaborated here. We feel therefore that some reflection at the enterprise of this study from the beginning is necessary.

A relevant question that can be posed is why at all one would design institutional arrangements? Are not institutional arrangements evolving by themselves when desired? Economists generally assume that rational utility maximizers will reach agreement on mutually beneficial institutional arrangements whenever a zone of agreement exists. In this view, this will lead to a Pareto-optimal institutional arrangement, much like the Smithsonian 'invisible hand' of a free market. Thus, the rational process of institutional design (the deliberate formulation of an institutional arrangement) is largely unnecessary and may even invite for interventions that result into suboptimal outcomes. However, Young (1989) claims that because of large asymmetries of bargaining strength among stakeholders, there is considerable scope for exercising leadership toward coherent and desirable outcomes by means of institutional design. In this study we adopt the latter view.

Another question that arises is why global arrangements are necessary if local arrangements can be made as well? It is well conceivable that cumulative local arrangements may enhance good global water governance more efficiently or effectively than global arrangements would. At this stage of research on global water governance, it is premature to evaluate and compare arrangements across levels. This study is limited to the

design of global arrangements; we acknowledge that in a later stage the efficiencies of the global institutional arrangements designed here have to be compared to the efficiency of a multitude of local arrangements.

A final question relates to the feasibility of global institutional arrangements. The conceptual designs made in this study form the starting point for the technical designs of legal contracts between agents. Without doubt, designing contracts will lead to new difficulties that are unaccounted for in the present study. The policy-making process can have large influence on the final design (Bressers and Huitema, 1999). We acknowledge this; it implies that we will not address the issue of political feasibility of the institutional arrangements designed. The study is limited to the designs themselves and the assessment of their likely economic, social and environmental effects.

2. Method

2.1. The perspective of sustainable development

The aim to design global institutional arrangements for global water governance (the way people collectively appropriate global water resources), is still broad. To benchmark the design of global institutional arrangements, this study adopts the concept of sustainable development.

The Brundtland-report and the Earth Summit in Rio de Janeiro mark the worldwide acceptance of the notion of sustainable development (WCED, 1987; UNCED, 1992). Sustainable development consists of three dimensions: the social, ecological, and economic dimension (Rogers et al., 1998; WSSD, 2002; Hildering, 2004). The business community often refers to these dimensions as *people-planet-profit*. In order to make these three dimensions more tangible, criteria have been proposed against which policy can be evaluated (Daly, 1996; Rogers et al., 2002). These criteria are ecological sustainability, social equity and economic efficiency. The need for indicators that cover these criteria results in the following overview:

- Social equity: This can be measured by means of the Gini-coefficient, a measure of inequality of a distribution of resources (in this case: water resources). The Gini-coefficient is a ratio with values between 0 (uniform distribution) and 1 (fully inequitable distribution). The numerator of this ratio is the area between the Lorenz curve of a distribution and the uniform distribution line; the denominator is the triangle area under the uniform distribution line. The uniform distribution line represents full social equity.
- Ecological sustainability: For water governance, ecological sustainability requires human appropriation of water resources to stay within certain environmental limits. The position of these environmental limits is subjective to some extent. Raskin et al. (1997) introduced a simplified categorization of ecological sustainability. When the 'criticality ratio' (the withdrawal-to-availability ratio) is between 0.2 and 0.4, this is referred to as *water stress*, while a ratio above 0.4 is referred to as *water scarce*. Consequently, ecological sustainability occurs when the criticality ratio remains below 0.2.
- Economic efficiency: This can be measured by the criterion of Pareto efficiency, which defines the economically optimal situation as the state in which no individual can be made better off without another being made worse off.

A glance at the present and future situation of these criteria shows that without change, global water governance will not reach a condition of social equity, ecological sustainability and economic efficiency.

With regard to social equity, water footprints differ strongly among countries, partly because of differences in consumption but also partly because of differences in water productivities. While the average American has a water footprint of 2480 m^3/cap/yr, China has an average water footprint of only 700 m^3/cap/yr (Chapagain & Hoekstra, 2004). Many countries have an average per capita water footprint below the threshold value required for sufficient food, which is about 1000 m^3/cap/yr (Zehnder et al., 2003; UN-Water, 2006).

With reference to ecological sustainability, Postel et al. (1996) argue that if average per capita water demand remains the same in 2025 compared to the 1990 level (which is conservative, because withdrawals per capita increased nearly 50% between 1950 and 1990), human appropriation of geographically and temporally accessible runoff will be 70%. Because Postel et al. (1996) do not account for environmental flow requirements; this figure implies a large strain on ecosystems throughout the world. The three main reasons for an increasing human appropriation of water resources are (i) an increasing human population, (ii) increasing standards of living and (iii) the growing need for biomass as an energy carrier.

With respect to economic efficiency, the price of water resources generally does not reflect all costs. Failing price structures, perverse subsidies and privatization without sound regulation are common in both developed and developing countries (Van der Zaag & Savenije, 2006; UNDP, 2006). In such situations, countries that import water-intensive goods profit to the detriment of vulnerable water users in exporting countries that lack a strong voice, such as small farmers, fishermen, women or local ecosystems.

2.2. The virtual water chain

This study adopts the concept of the 'virtual water chain', a concept that fits in the tradition of production chain analysis as known from the field of Life Cycle Assessment. The virtual water chain is the chain of production and consumption of water-intensive goods. A typical virtual water chain consists of a farmer at the primary production end, a consumer at the consumption end and, depending on the commodity at stake, some intermediaries such as a food processor and a retailer (Figure 2.1). Causal connections and behavioural mechanisms operate through the virtual water chain. An effective institutional arrangement may have a direct effect on agents in one particular stage of the chain, but indirectly influence the behaviour of other agents in the chain. For example, raising the price of water withdrawal in agriculture can eventually lead to a higher consumer price for water-intensive products.

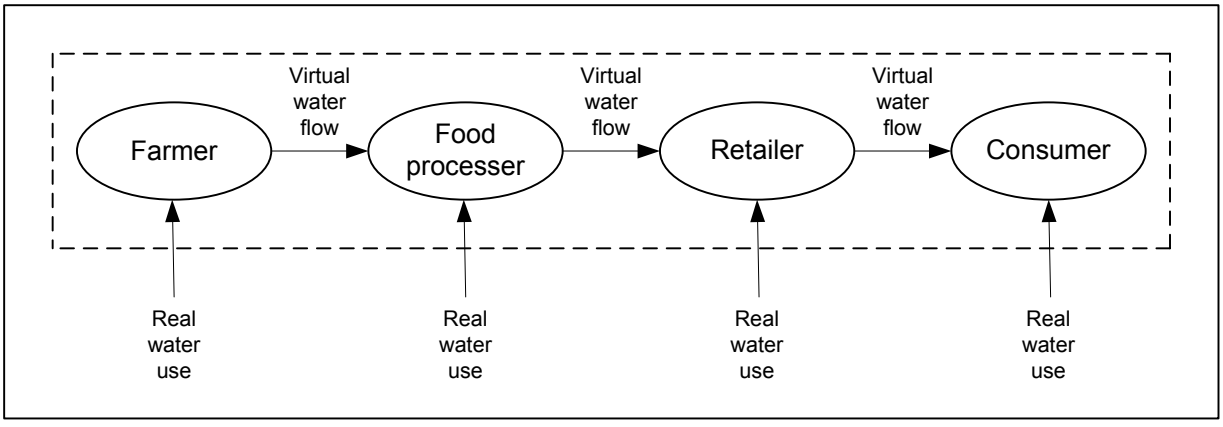

Figure 2.1: The virtual water chain.

2.3. Three global institutional arrangements

This study elaborates three alternative global institutional arrangements that derive from a longer list presented by Hoekstra (2006): the Water Pricing Protocol, the Business Agreement on Sustainability Reporting, and the Water Footprint Permits. The three arrangements have been selected, because they are complementary in two ways: i) they address different criteria of sustainable development (Figure 2.2) and ii) they focus on different actors in the virtual water chain (Figure 2.3).

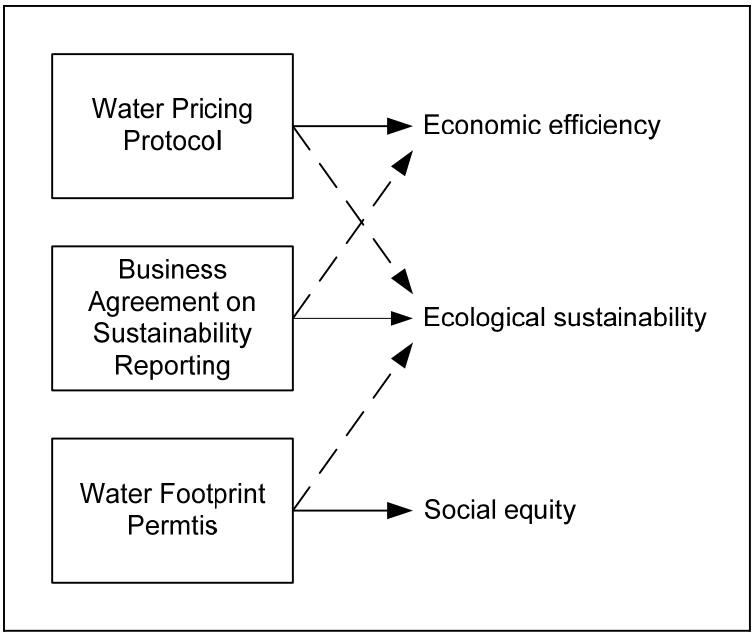

Figure 2.2: How the three institutional arrangements are supposed to affect the criteria of sustainable development primarily (full arrow) and secondarily (dashed arrow).

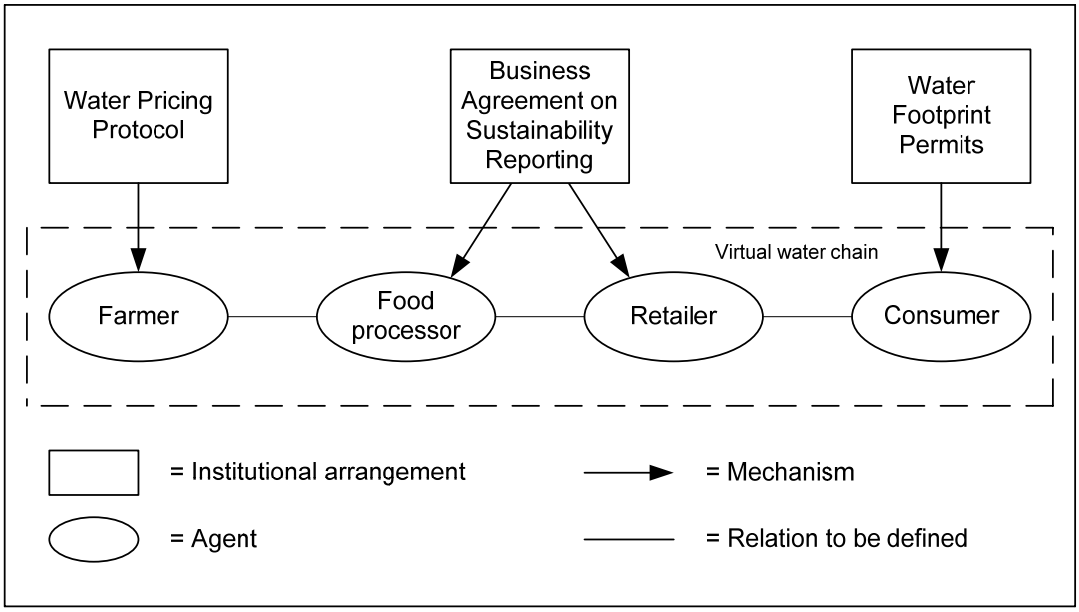

Figure 2.3: How the three institutional arrangements are supposed to affect different agents of the virtual water chain directly (the arrows) and indirectly (through the connections between the chain agents).

1. Water Pricing Protocol

The Dublin Conference in 1992 has accepted to regard water as an economic and social good (ICWE, 1992). To date, however, few national or local authorities have implemented the principle of water as an economic good. Unilateral implementation is expected to be at the cost of the countries moving ahead (although it may also stimulate innovation which is in the benefit of the countries moving ahead first, see Bressers and Rosenbaum, 2003). An international protocol on water pricing (Water Pricing Protocol) may help to overcome this problem. A Water Pricing Protocol would serve as 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 Water Pricing Protocol primarily promotes economic efficiency and secondarily ecological sustainability. The main agents in a Water Pricing Protocol are producers of water-intensive products.

2. Business Agreement on Sustainability Reporting of water-intensive goods

Hall (2000) claims that chain dynamics can be triggered when there is a 'channel leader' with sufficient power over its suppliers (the extent to which one stakeholder can impose its will on other stakeholders in the supply chain), with technical competencies, and under specific environmental pressure. In global water governance, large manufacturers or retailers are candidates to become channel leaders of certain virtual water containing products. Providing them with a standardized method for sustainability reporting may improve the ecologically sustainable development of water resources. This standardized method would have to be agreed upon in a Business Agreement on Sustainability Reporting of water-intensive goods.

3. Water Footprint Permits

The limited availability of freshwater resources implies that there is a sustainable maximum to the human water footprint (the amount of water needed for the production of all goods and services). The question is how large a nation's or individual's share of the globe's fresh water resources can be. An institutional arrangement on this matter is comparable to the Kyoto Protocol on the emission of greenhouse gases. A system of water footprint permits would define a maximum global water footprint and share it among the participating countries or individuals. The system of water footprint permits promotes social equity and ecological sustainability. The main agents are consumers (represented by their government).

2.4. Design method

The design method is an iterative process as shown in Figure 2.4. This process is followed for each of the three institutional arrangements separately. The first step is to formulate the rationale of the arrangement. A rationale describes why an arrangement can contribute to social equity, ecological sustainability or economic efficiency. The rationale is the basic argument to elaborate an institutional arrangement.

The second step is to design a possible institutional set-up per institutional arrangement. Although institutions have been in place throughout human history, institutional design has only been a topic of scientific research since the 1990s (Goodin, 1996; Weimer, 1995). In fact, academic knowledge about existing global institutional

arrangements, or 'international regimes' as some scholars label it, is still limited (Rittberger & Mayer, 1993; Young, 1989, 1999ab). International regimes are sets of rules, roles and relationships, or issue-specific institutional arrangements that may or may not be legally binding, may or may not assign some role to UN agencies, and often accord important roles to non-state actors (Young, 1999a).

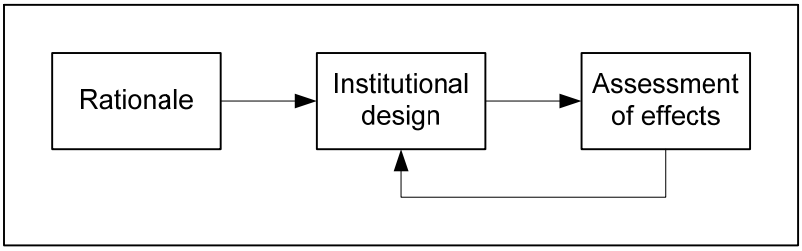

Figure 2.4: Design method

The fact that knowledge about international regimes is still evolving, and the fact that it does not offer a design method for successful institutional arrangements, does not attenuate its legitimate notion of the presence and impact of such arrangements at the global level. Young (1989; 1999ab) acknowledges this view and offers a rather pragmatic approach to institutional design. Following this approach, this study defines that the institutional set-up should include:

- who holds rights and duties in the institutional arrangement;
- what is being arranged in the institutional arrangement;
- how do behavioural mechanisms work through the virtual water chain;
- how do these mechanisms promote compliance with the institutional arrangement.

The third step is to make an assessment of effects by qualitatively evaluating each institutional arrangement on its projected impact on social equity, ecological sustainability and economic efficiency. The impact can be either positive or negative:

- Social equity considerations involve the impact institutional arrangements have on economic opportunities in developing countries, reflected in, for example, the price of basic food commodities.
- From an economic efficiency perspective, the benefits of the arrangement should outweigh its transaction and opportunity costs.
- From an ecological sustainability point of view, the arrangements should be sufficient to arrive at a sustainable level of water use.

After having assessed the effects per institutional arrangement, we reflect on each arrangement by addressing a number of topics that relate to the feasibility of the arrangements:

- We discuss the compatibility of the institutional arrangements with their legal context. Important documents of international environmental law are the Stockholm Declaration (UNCHE, 1972), the Rio Declaration

(UNCED, 1992) and the Johannesburg Plan of Implementation (WSSD, 2002). The World Trade Organization (WTO) trade rules represent international trade law.

- Evaluation of the political feasibility of the arrangements depends on the school taken as a starting point. Realism is a scholarly tradition in international relations that pictures world politics to be a struggle for power between states, in which every state tries to maximize its own interests. The opposing tradition is that of institutional liberalism, a tradition that believes in cooperation under conditions of anarchy. The design of institutional arrangements typically falls within the latter tradition. As a result the arrangements can be contested particularly from a realist's point of view.
- Water issues relate to broader issues, including environmental, social and economic ones. It may therefore be naïve to design institutional arrangements for water governance alone. The study identifies possible alliances that make the arrangements more feasible and effective.

3. Water Pricing Protocol

3.1. Rationale

Around the globe, governments subsidize freshwater provision and wastewater treatment. As a result, there is a lack of incentive for water users to conserve water, not pollute water and use the resource as efficient as possible. The lack of incentive is to the detriment of a country's natural freshwater capital and leads to a suboptimal use and allocation of water resources.

A way to increase economic efficiency is to put a price on freshwater. Governments are reluctant to pricing water, however, for economic or socio-cultural reasons. One of these reasons is of macro-economic concern: a country that unilaterally increases water prices affects the international competitiveness of its national producers of water-intensive products. International agreement on water pricing diminishes this disadvantage.

3.2. Institutional set-up

3.2.1. Parties of the Water Pricing Protocol

The envisaged Water Pricing Protocol focuses on irrigated agriculture and water use in industry, because the main concern in an international Water Pricing Protocol is the water used for export products. Generally, irrigation agencies set prices for irrigated agriculture. Industries extract water directly from the environment, sometimes controlled by a regulating authority. Ideally, irrigation agencies and the regulating authorities are the signatories to a Water Pricing Protocol. However, it is justified to invite state parties to be signatories for the following three reasons.

First, the concept of state sovereignty forms the base of international treaty law. States are accountable in international law. Second, irrigating cash crops is an important part of national economic development and irrigation networks are often under direct supervision of a national governmental department. Third, industries often have the power to arrange individual water abstraction and disposal, with limited governmental involvement. Even in OECD countries, 75% of total water consumption by the industrial sector comes directly from the environment (Jones, 1999). Committing national governments to the Water Pricing Protocol may urge them to force industries to reduce harmful wastes and the depletion of resources.

3.2.2. Selection of a pricing method

Johansson et al. (2002) identify four alternative methods for water pricing in irrigated agriculture, the sector that represents the major part of water demand at the global level:

- *Volumetric pricing methods* charge for water based on the quantities of water consumed. A special case of volumetric pricing is *marginal cost pricing*. Marginal cost pricing equates the price of a unit of water with the marginal cost of supplying the last unit of water. When neglecting transaction costs, marginal cost pricing is the only pricing method able to achieve a Pareto-efficient allocation. However, marginal cost

pricing requires a system of pricing, metering, billing, fee collection and fund allocation. When these activities involve relatively large overhead costs, other methods may become more efficient.

- *Non-volumetric pricing methods* charge for water based on output, input, area or land values. Particularly pricing on a per area basis is popular, because this method is easy to implement and administer. Metering is not necessary, but this pricing method still requires a system of pricing, billing, fee collection and fund allocation.
- *Water markets* are local institutions in which market pressures determine the price of water. Water markets require a system of property rights or water use rights, and both infrastructure and institutions to divert water. Water markets are more flexible than centrally controlled allocation mechanisms.
- Assigning *quotas* to individual farmers to some extent mitigate equity issues or resource management issues that arise with a water market or marginal cost pricing.

Theoretically, the concept of marginal cost pricing is favourable, because of the prospect to reach Pareto-efficiency. Because the scope of this study is restricted to the global dimension of water governance, large irrigation schemes used for the production of export products are of main interest. This study proposes to limit the scope of the Water Pricing Protocol to large irrigation schemes producing export products. Such schemes may have a large impact on local water resources. At the same time, the number of farmers in such schemes is relatively small, so overhead costs (pricing, metering, billing, fee collection and fund allocation) are modest. That means that marginal cost pricing is generally favourable in such schemes.

Marginal cost pricing involves the set-up of national institutions to cover the activities of pricing, metering, billing, fee collection and fund allocation. In the Water Pricing Protocol, state parties are free to determine how to arrange the activities of metering, billing and fee collection. However, as will be described in the next two sections, the Water Pricing Protocol does provide for guidelines for the marginal cost pricing methodology and fund allocation.

3.2.3. Marginal cost pricing methodology

Marginal cost pricing leaves enough room to tailor systems to situational circumstances. However, it is important to apply the same methodology to put a price on water everywhere when agreeing on a Water Pricing Protocol. Otherwise, the Protocol will suffer from many disputes between parties.

Rogers et al. (1998) provide for a further elaboration on the methodology of marginal cost pricing. They make a distinction between costs, benefits and prices. In a monopolistic market, which is mostly the case in water governance, the government is the sole supplier and determines the price. To promote an efficient allocation, the government should set the price equal to the marginal cost of the supplied quantity where marginal costs and benefits are equal.

According to Rogers et al. (1998), the marginal cost consists of five components: (i) capital charges; (ii) operational and maintenance costs; (iii) scarcity rent, (iv) economic externalities and (v) environmental externalities. According to Rogers et al. (1998), there are many ways to calculate each cost component. In the

Water Pricing Protocol, the domestic water-pricing agencies are free to determine the methodology to calculate the cost components. However, water-pricing agencies will not always have the capacity to determine a price. Particularly the scarcity rent and environmental externalities are difficult to determine (see next Section). The Global Water Partnership could set up a water-pricing toolbox like the IWRM toolbox (see Section 3.4.1) in order to assist water-pricing agencies.

In many cases, setting the 'right' price will be a matter of trial and error. In order to arrange that prices are not set unreasonably high, the Water Pricing Protocol allows for an incremental approach. In this approach, a water-pricing agency imposes the rise in price incrementally and combines the increase with service improvements where possible. The disadvantage is that water-pricing agencies will not be able to cover all costs in the first years.

Marginal cost pricing ignores equity concerns and does not guarantee full cost recovery under all circumstances. Therefore, three adjustments are permissible to account for local or national interests (Tsur & Dinar, 1997):

- *Two-part tariff pricing methods* extend the marginal cost pricing method with a fixed admission charge. This pricing method is appropriate in situations where a public utility produces with marginal cost below average cost while aiming to cover total costs.
- With *tiered pricing* or *block pricing*, water rates vary as the amount of water consumed exceeds certain threshold values. It creates incentives for an individual farmer to stay within a certain block and thus, to save water. This pricing method can also level incomes among farmers. Block pricing is widely applied in urban areas as a panacea for the urban poor, but evidence of price perversities is stunning (UNDP, 2006; Van der Zaag & Savenije, 2006). Knowledge about local circumstances and the use of crop water requirements as a starting-point for determining the threshold values are prerequisites for applying block pricing.
- A *minimum water quota* assures low-income farmers that are prone to be put out of business because of marginal cost pricing.

3.2.4. Fund allocation

A triangular relation develops between the beneficiaries of the water used, people harmed by the water use, and public agencies that provide for services of delivery and financing. Without institutions for allocation, fee collection makes the government a beneficiary. Therefore, the public agency that collects the fees should allocate the resulting fund to the cost components of the water provided to the beneficiary. The ease of this allocation depends on whether it is easy to determine (i) the extent of the cost component and (ii) to whom the fund should be allocated.

Public agencies themselves bear the *capital charges* and *operational and maintenance costs*. Compensation is thus relatively easy. In an open democratic society, it is also relatively easy to determine the people subject to *economic externalities*. These people will reveal themselves when they object to major water abstractions. State

parties of the Water Pricing Protocol are free to determine the extent of the compensation. One way is by means of litigation, but the costs and risks involved might be a major obstacle for the people harmed. National governments may prefer to determine clear legal procedures for complaints and compensation.

A *scarcity rent* is the cost of depleting scarce resources. The scarcity rent is relevant for non-renewable resources and overexploited renewable resources (e.g. a lake or an aquifer). Future generations can use the scarcity rent to match supply and demand of water resources in spite of the depletion of resources. Restoration of these resources, such as in progress in the Aral Sea, increases supply. Demand management has two features: adaptation to the new circumstances and the search for substitutes. Inherently, water is vital for crops and thus, there are no substitutes in irrigated agriculture. Therefore, the public agency should allocate the scarcity rent to adaptation or restoration options. Because of the time lag between pricing and financing of adaptation or restoration options, the public agency should put the money in a trust. This is why allocation of the scarcity rent is difficult. It is not clear which particular generation is justified to appropriate this 'scarcity rent trust'. In addition, it is difficult to determine the extent of the scarcity rent, because the present generation cannot know how much future generations will value water resources.

Local circumstances require a case-by-case analysis of the environmental impact of water abstraction and pollution. There are many ways to monetize *environmental externalities*, but all methods suffer from important disadvantages (Tietenberg, 2001). States are free to exploit their own resources pursuant to their own environmental policies (UNCHE, 1972). In the Water Pricing Protocol, state parties are free to determine environmental externalities. Optionally, the Water Pricing Protocol can oblige parties to formulate environmental policies to guide the determination of environmental externalities.
Table 3.1 shows that allocation is particularly difficult for the scarcity rent and environmental externalities.

Table 3.1: Identification of the ease to allocate revenues to cost components of water use.

	Is it easy to determine whom to compensate for harm?	Is it easy to quantify the cost component?
Capital charges	Yes	Yes
Operations & maintenance	Yes	Yes
Scarcity rent	No	No
Economic externalities	Yes	No
Environmental externalities	No	No

3.2.5. Compliance mechanisms

The wasteful use of water resources is to the detriment of the natural freshwater capital of a country. Implementing the concept of marginal cost pricing will be beneficial to an optimal national allocation of water resources. This is an important incentive for national governments to comply with the Water Pricing Protocol.

The Water Pricing Protocol tries to reduce distortions in international trade. Typically, the Protocol falls within the tradition of WTO trade rules. With regard to compliance issues, the Water Pricing Protocol can learn from these WTO trade rules.

3.3. Assessment of effects

3.3.1. Trade impacts for irrigated agriculture in developing countries

Beneficiaries of irrigation are typically a privileged group within the agrarian sector. Where charges are low, they receive water services at the expense of the economy in general (Perry, 2001). Perry (2001) and FAO (2004) conclude that gradually setting prices to recover costs, combined with an increased performance of delivery service, does not negatively influence economic development of irrigated agriculture. Marginal cost pricing, therefore, does not necessarily put farmers in developing countries out of business.

Water pricing only applies to irrigated agriculture, making rain-fed agriculture more attractive than irrigated agriculture. Rain-fed agriculture is most profitable under temperate climatic conditions, typically prevalent in developed countries. Rain-fed agriculture is subsidized, particularly in the European Union and the United States. Compensating this comparative disadvantage for irrigated agriculture thus lies outside the Water Pricing Protocol.

3.3.2. Food still affordable for the poor in developing countries

Applying marginal cost pricing to irrigated agriculture increases the costs of producing food. Producers pass this cost on to consumers, perhaps to the level that irrigated crops become unaffordable for poor households. This is why the scope of the Water Pricing Protocol is limited to large irrigation schemes producing export products. Problems arise when irrigation schemes produce commodities for both domestic and foreign consumption. Targeted subsidies to either the consumer or the producer in the domestic food market will bridge the gap between the marginal cost price and the affordable price. National governments are free to target these subsidies in a transparent way.

3.3.3. Efficient practice is not necessarily sustainable

The economic approach of marginal cost pricing assumes that natural resources and capital are exchangeable. The two flaws that occur here are that 1) water is not fully substitutable because it is a basic need and 2) the present generation cannot know how much future generations will value water resources, because there is no market to define market prices. As Tietenberg (2001) shows, an efficient allocation is not necessarily sustainable. To achieve ecological sustainability, the present generation may need to impose stronger rules on themselves. This study proposes to apply the three principles of intergenerational equity put forward by Brown Weiss (1989) to account for such stronger rules. These three principles of intergenerational equity are labelled

(i) conservation of options (ii) conservation of quality and (iii) conservation of access. According to these principles, the present generation should (Brown Weiss, 1989):

- conserve the diversity of the natural (…) resource base, so that it does not unduly restrict the options available to future generations in solving their problems and satisfying their own values;
- maintain the quality of the planet comparable to the one enjoyed by previous generations;
- provide its members with equitable rights of access to the legacy from past generations and conserve this access for future generations.

3.3.4. Cost recovery and compensating externalities

Due to the generally low price elasticity of demand, increasing prices result into increasing revenues. From an economic point of view, the first priority is to use these increased revenues to cover invested capital and operation and management costs. Cost recovery nullifies subsidies towards the privileged economic activities of industrial production and growing *cash crops* to the benefit of public funds. This study assumes that in many places there is scope for cost recovery of invested capital and operation and management costs. This is because the focus is on export commodities for which the cost component 'water' will remain minor. The findings of FAO (2004) and Perry (2001) support this assumption. In addition, the revenues make it possible to compensate for economic and ecological externalities. This compensation promotes social equity.

3.3.5. Demand management: incentive for more water-efficient practices

Full marginal cost pricing surely increases the producer's need for water-efficient practices, but the producer must also have access to knowledge, technology and investment capital to implement such techniques. According to Perry (2001), the price of water must be significant in order to curtail demand, but the price structures and levels that are within politically feasible and acceptable range are usually too low to have a significant effect on demand. Contrary to what one might expect, the Water Pricing Protocol will not lower water demand drastically.

Even when a producer manages to apply water-efficient practices, it is not certain that demand will decrease due to the 'rebound effect'. The concept of a rebound effect (also known as the Khazzoom-Brookes postulate) comes from the energy sector and works as follows. Gains in the physical efficiency of water consumption will result in a per unit price reduction of water. As a result, consumption may increase, partially or even completely offsetting the impact of the initial physical gain.

It is hard to predict the extent of the rebound effect in water consumption because research on this topic does not exist. Greening & Greene (1997) and Greening et al. (2000) provide for surveys of literature on the rebound effect in energy consumption. Greening & Greene (1997) identify three types of the rebound effect. The first type is the direct rebound effect: the increased use of energy services caused by lower prices per unit. The second type is the indirect rebound effect: because of lower costs of energy services, the consumer has more money to spend on all goods and services. Third, there are general equilibrium effects, which involve both

producers and consumers and represent the result of myriad adjustments of supply and demand in all sectors. Generally, researchers only account for the first type of the rebound effect (Herring, 2006).

For water consumption, this study assumes that the extent of the rebound effect depends on whether water is a limiting production factor. If so, a physical efficiency gain enables a farmer just to produce more with the same amount of water and the rebound effect will approach 100%. If not, than water is not scarce. The price of water will probably not be high enough to make water efficiency measures attractive in the first place. Thus, water pricing is not effective for demand management.

3.3.6. Re-allocation from low-value to high-value uses

Water is generally allocated first to municipal and domestic use, second to industrial and commercial use, and third to agriculture (environmental allocations are also growing in volume and priority). This sequence of priorities is generally consistent with social and economic objectives that many would share. This fact, together with the bulkiness of water, does not invite for diversions from low-value (agricultural) use towards high-value (domestic and industrial) uses. Water pricing is only a means to give a higher priority to environmental water use.

Within sectors, producers will try to get 'more dollars per drop'. Farmers will choose to grow the crop that maximizes their net benefit. Tsur & Dinar (1997) give an example of how pricing methods can influence a farmer's choice to grow a certain, more water-efficient, crop.

3.4. Discussion

3.4.1. Compatibility with Integrated Water Resources Management

Proposing a Water Pricing Protocol implies that to date, no international agreement exists for water pricing. However, the process of integrated water resources management (IWRM) does account for economic instruments. The Johannesburg World Summit on Sustainable Development in 2002 has produced a Plan of Implementation[1]. By means of paragraph 26, Heads of States agreed to develop IWRM plans by the year 2005. Paragraph 26b accounts for economic instruments in general and full marginal cost pricing in specific only conservatively: "Employ the full range of policy instruments, including regulation, monitoring, voluntary measures, market and information-based tools, land–use management and cost recovery of water services, without cost recovery objectives becoming a barrier to access to safe water by poor people, and adopt an integrated water basin approach."

[1] Available at www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/WSSD_PlanImpl.pdf

The Global Water Partnership provides for tools and good practices in an online IWRM toolbox[2] for specialists and practitioners. According to this toolbox, economic instruments work best in combination with other supporting measures: they are unlikely to be effective acting alone. For successful application, economic instruments need appropriate standards (e.g. for discharges or surface water quality), effective administrative monitoring and enforcement capabilities, institutional co-ordination and economic stability.

The concept of full marginal cost pricing is far from common practice in international water law, due to other governmental objectives, conceptual disagreement and operational limitations. Due to the limited scope of the Water Pricing Protocol, it is well possible to develop both the Protocol and IWRM plans.

3.4.2. Conceptual disagreement about marginal cost pricing method

Different scholars propose different methods to determine the full marginal cost of water. This study leaves one cost component out of the full marginal cost of water: the 'opportunity cost'. The interpretation of opportunity costs varies among policy makers and scholars of water governance. Rogers et al. (1998) define opportunity costs as the *total benefit foregone* of the best alternative use. This view neglects the costs that would have been made in the best alternative use. In addition, Rogers et al. (1998) account for total benefits foregone even if satisfying the best alternative use does not depend on the use under consideration. An alternative definition is the *net benefit foregone* in the best alternative use, with the reservation that this marginal water amount is demanded by, but not supplied to the alternative user. In Section 3.3.6 we mentioned that water provision generally follows rules of priority. This way, no better alternative use exists and opportunity costs reduce to zero. The third interpretation of opportunity costs assumes that the use of water is at the cost of future opportunities. In this study, the scarcity rent accounts for this type of costs. The scarcity rent is the marginal opportunity cost imposed on future generations by extracting one more unit of a resource today. The scarcity rent is only non-zero in the case of depletion of water stocks.

3.4.3. Alliance with EU and US agricultural subsidy structures

When a substantial amount of countries complies with the Water Pricing Protocol, there are no comparative advantages from the perspective of water governance. However, water is only one production factor. Global trade in commodities is subject to market distortions that are far greater, for instance American and European agricultural subsidies. Political will to implement the Water Pricing Protocol increases when combined with the resolution of other distorting mechanisms in international trade.

[2] The IWRM toolbox is available at www.gwptoolbox.org.

4. Business Agreement on Sustainability Reporting

4.1. Rationale

Nowadays, the business society regards its economic performance in conjunction with its social and environmental performances (Steg et al., 2001). Regulatory compliance is not always sufficient to manage the negative environmental or social impacts of business operations effectively. Within this context, there are two pathways to address sustainability issues in the virtual water chain from a global perspective.

The first pathway is an ´International Agreement on the Sustainable Production of water-intensive goods´. Governments may not be able to, or may not want to impose stringent rules. The formulation of internationally agreed standards, like the ISO 14000 series, forces producers to apply sound environmental production standards. While this is straightforward conceptually, it is almost impossible to implement practically. Criteria and data would need to be set at farm level. The interconnectedness of water systems and the large number of farmers make this expensive.

The second pathway is a 'Business Agreement on Sustainability Reporting of water-intensive goods'. Companies are under pressure when they fail to manage negative social and environmental impacts. This raises three serious risks: (i) the threat of increased regulatory control by national governments and international organizations, (i) financial risks caused by pollution and large resource use, and (iii) damage to the corporate image (Rondinelli & Berry, 2000). Consequently, companies gain from proactive management of sustainability issues. The lack of internationally accepted reporting standards on what, when and where to report makes it difficult to assess sustainability, but a promising step has been made in the Global Reporting Initiative (GRI, 2000). The design and development of a measuring and reporting method for sustainability helps companies to compare trends of sustainable corporate performance over time, to compare results with targets and to benchmark companies against others (Gerbens-Leenes et al., 2003). This study elaborates upon this second pathway.

4.2. Institutional set-up

4.2.1. Parties of the Business Agreement on Sustainability Reporting

In deciding on which parties to include in the Business Agreement on Sustainability Reporting on water-intensive goods (in short: Business Agreement), it is important to note that a chain-based approach is preferable over a company-based approach in order to prevent companies to transfer negative effects of operations to other companies (Gerbens-Leenes et al., 2003). The Business Agreement will be most effective when the key agents are involved. Hall (2000) uses the term 'channel leader' for a company that has sufficient power over suppliers to change its behaviour in a preferred direction. Hall (2000) claims that a channel leader with technical competencies and under specific environmental pressure can trigger chain dynamics.

This study identifies manufacturers (food processing companies) and large (western) retailers as candidates to be channel leaders in virtual water chains. This is supported by the achievements of the manufacturing company Unilever[3] and the retailing company Sainsbury's (Hall, 2000) in exercising their channel power in certain product chains. Channel leaders can be organized in the World Business Council on Sustainable Development (WBCSD), an organization that is suitable to host the negotiation, formulation and enforcement of a Business Agreement. The WBCSD is a platform for some 190 companies to explore sustainable development, share knowledge, experiences and best practices, and to advocate business positions on these issues in a variety of forums, working with governments, non-governmental and intergovernmental organizations. Twenty-nine large multinational companies are organized in the World Business Council on Sustainable Development Water Working Group (WBCSD, 2007) and try to identify the roles businesses can play in collaborative actions for sustainable water management (WBCSD, 2005ab). This voluntary effort indicates that large multinational companies recognize the need for sustainable corporate performance in the field of water governance.

4.2.2. Measuring and reporting method

The parties of the Business Agreement on Sustainability Reporting are free to agree on what and where to report. This section describes some general directions on these issues with relevance to global water governance.

When deciding on what to report, it is essential to note that water scarcity is not the only issue in sustainability reporting. Gerbens-Leenes et al. (2003) provide for a literature study about the use of environmental indicators in food production systems. They found that such indicators often focus on events at a local level. The enormous number of indicators found in the literature generates too much data that often provide no additional knowledge on the environmental sustainability of a system. Moreover, although environmental research has addressed many aspects of sustainability, it has often ignored interactions. As a result, the understanding of total environmental implications of food production is poor. Gerbens-Leenes et al. (2003) propose a measuring method that uses three indicators to address global environmental issues: the use of energy (from both fossil and renewable sources), land and water. The systemic approach can calculate trade-offs along supply chains that make up a production system. The method produces three performance indicators: the total land, energy and water use per kilogram of available food. Measuring water use in the operations and supply chain of a business could be done following the methodology of 'business water footprint accounting' as described in Gerbens-Leenes and Hoekstra (2008). In the Business Agreement, obtaining data is the responsibility of the channel leader.

In addition, companies should decide on where to report. There are several ways to communicate the measurements through the supply chain. This study identifies three instruments to communicate measurements through the supply chain: (i) a sustainability label for consumers, (ii) a sustainability certificate for producers (business to business) and (iii) corporate responsibility publications.

[3] Unilever assesses the water footprint of some of their products along the supply chain, and sets targets to reduce the water footprint of their products over a number of years. See www.unilever.com/ourvalues

A sustainability label informs consumers about characteristics of the product. A sustainability label provides for simple 'yes-or-no' distinctions: the production process is either sustainable or unsustainable. However, reality is often more complex than the simple dichotomy of a sustainability label presumes. For water-intensive products, product labelling is not appealing because it would be costly to monitor production practices and to preserve the information through the virtual water chain, especially compared to the benefit of such an effort. Only a very small percentage of consumers may choose to buy a less water-intensive product and, although this number is increasing, such people are destined to remain a minority[4].

A sustainability certificate does not put the label on products, but on producers. Certification is similar to labelling, because both activities require the definition of criteria at the farm level, a monitoring framework and an authority to give out the label or certificate. Certification is not appealing for producers of water-intensive products because commercial benefits of the system are lacking.

Alternatively, channel leaders may report on sustainability issues in their corporate responsibility publications. Many multinational businesses already have such publications. Data generated can be used to regard trends over time, to compare results with targets and to benchmark a product against products of other companies (Gerbens-Leenes et al., 2003). Corporate responsibility publications are the preferable tool to communicate about sustainability issues.

4.2.3. Compliance mechanisms

The Business Agreement on Sustainability Reporting is voluntary by nature. In the absence of enforcement procedures, compliance must come from within the channel leaders themselves. The reporting method of the voluntary Business Agreement recognizes not only consumers and NGOs as important drivers of corporate responsibility, but also shareholders and employees.

4.3. Assessment of effects

4.3.1. Trade impacts for small producer firms in developing countries

The Business Agreement intensifies buyer-supplier relations. The Agreement thus reinforces the position of large multinational companies as the channel leader of food production chains. Channel leaders can use their power to force local producers to implement more sustainable practices. On the one hand, this is exactly the aim. On the other hand, some may regard subjecting food producers of the developing world to the Business Agreement as a new form of imperialism.[5]

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[4] Richard Holland, WWF International Freshwater Programme, personal communication.

[5] For a comprehensive discussion of the advantages and disadvantages of closer buyer-supplier relations, consult Lyons et al. (1990), Barringer (1997) and Hall (2000).

Obviously, it is not the aim of designing the Business Agreement to give an opportunity to channel leaders to squeeze small producer firms in developing countries. Case studies on present sustainability labelling and certification schemes such as the Better Sugarcane Initiative (see below) will give valuable insights into these buyer-supplier relations in food production chains.

4.3.2. Conservation of resources

Ecological sustainability is the driving criterion of the Business Agreement. Effects on ecological sustainability (e.g. conservation of resources) will only take place when the Business Agreement alters behaviour of the agents in the virtual water chain. Of these agents, local producers are most capable of environmental innovation because of their direct contact with water resources. Farmers, however, often lack incentives to invest in environmental innovation because it does not directly improve their financial performance. This is the point where channel leaders become important 'change agents'. While local producers may not be under environmental pressure, they are often under considerable pressure from their customer firms (Hall, 2000). That means that channel leaders should set targets to reduce the water footprint of their products. In order to reach these targets, the channel leader should exercise its channel power over local producers, who necessarily will adapt to the channel leader's policy.

The Business Agreement requires a sufficient degree of participation to be effective. In some virtual water chains of water-intensive commodities, many manufacturers or retailers may be active. Even if the degree of participation is sufficient, monitoring and reporting will not lead to more sustainable practices directly. Increasing sustainability requires behavioural change. There are promising signs of such behavioural change in virtual water chains. A good example is the 'Better Sugarcane Initiative', a collaboration of progressive sugarcane retailers, investors, traders, producers and NGOs who are committed to developing internationally applicable measures and baselines that define sustainable sugar cane[6]. Implementation of the Business Agreement is much easier when connected with such initiatives.

4.4. Discussion

4.4.1. Adequacy of the standard

One of the most complex issues in the Business Agreement is deciding on an adequate measuring and reporting standard for the ecological and social issues. Certain issues will require tailor-made standards, while this study only suggests a general method, limited to ecological sustainability. This is why channel leaders, in cooperation with their branch of industry, should decide on what standard to use.

Section 4.2 focuses on ecological sustainability. In reality, businesses regard their overall economic, ecological and social performance. Further development of this institutional arrangement should focus on the interaction with the broader environmental, economic and social context.

[6] More information on the Better Sugarcane Initiative can be found at www.bettersugarcane.org.

4.4.2. Compatibility with international law

It is likely that the Business Agreement will reinforce international social and environmental law. Since the Business Agreement is a voluntary scheme, it may even set higher goals than the norms enforceable in contemporary international law. Therefore, conflicts with international law are most likely to be on the subject of economic efficiency. The legitimate concerns for environmental and social justice may pose an obstacle to international trade.

Three determinants express the extent to which the Business Agreement is compatible with WTO trade rules: (i) the nature of the instruments applied; (ii) whether compliance is mandatory or voluntary; and (iii) the degree of public intervention (Van der Grijp et al., 2004). The instrument proposed is a mere measuring and reporting system, with limited regulation. Participation is voluntary and the role for governmental agencies is limited. Thus, the Business Agreement is not likely to be in conflict with WTO trade rules.

Individual states are very cautious in regulating the market for sustainable products. The fact that many sustainability labelling and certification schemes are subsidized by public funds witness the strategy of governments to hide behind private initiatives in order to avoid formal litigation (Van der Grijp et al., 2004). This study assumes that for this reason public funds are available to subsidize part of the Business Agreement.

4.4.3. Corporate responsibility or public intervention

The Business Agreement is a private undertaking to organize the sustainable use of water resources around the globe. In doing so, it aims to fill the gap provided by national and international regulation as a consequence of conflicting mechanisms at various governance levels, inadequate enforcement mechanisms, or simply remaining silent (Van der Grijp et al., 2004).

There are three ways to think of the relationship between public intervention and the Business Agreement (or sustainability reporting in general). The first way of thought is that the Business Agreement is more effective than public intervention. In this view, the Business Agreement facilitates experiments with educational activities, innovative technologies initiated by channel leaders or local governance structures for which regulatory measures are not flexible enough. Costly enforcement mechanisms are unnecessary, and the organizational continuity and effectiveness is in the hand of strong multinational companies with sufficient funds. The aim for the Business Agreement is then to increase the number of participants.

The second way of thought is that, although public intervention is preferable in the end, the Business Agreement can act as a catalyst for such public intervention. In this view, the Business Agreement triggers the provision of a participatory infrastructure, a monitoring regime, knowledge about sustainability issues at all levels of governance and draft criteria and principles. The aim for the Business Agreement is then to promote an integrated, chain-based approach.

The third way of thought condemns the Business Agreement, for it distracts from the moral obligation of governments to protect natural resources and promote the welfare of the disadvantaged. In this view, governmental subsidies to private schemes are at the cost of means to support public intervention. The aim should be to object to the whole concept of the Business Agreement and to terminate its existence.

5. Water Footprint Permits

5.1. Rationale

The idea of water footprint permits follows from the understanding that every individual has a right to appropriate a certain amount of global fresh water resources (Petrella, 2001; Barlow & Clarke, 2002) and that total appropriation should not exceed the carrying capacity of the Earth. Water footprint permits are tradable to promote not only an equitable, but also an efficient allocation of water footprint permits. As a system, water footprint permits are comparable to the well-known Kyoto Protocol that assigns (tradable) quotas of carbon dioxide emissions.

5.2. Institutional set-up

5.2.1. Parties of the system of Water Footprint Permits

The nature of the system of Water Footprint Permits requires high-level political attention. Therefore, this study proposes that nations constitute a new General Assembly of the system of Water Footprint Permits. Every six years, the General Assembly decides upon the maximum global water footprint permit. This period of six years is convenient, because it enables to flatten year-to-year variability of water supply and demand, it does not demand a great deal of time of the General Assembly, and the proposal to the decision can be prepared by the ministerial conference of the triennial World Water Forum.

The General Assembly allocates Water Footprint Permits to nations, not to individuals. The allocation of permits to individuals would be an important awareness-raising instrument. When people are aware of the consequences of their consumption, they might reconsider their consumption pattern to the benefit of the Earth's water resources. However, five reasons limit the feasibility of this option. First, many human beings in the developing world are not registered and thus practically unable to exercise their rights. Second, it would be virtually impossible to get a substantial amount of individuals together to participate in the voluntary scheme of water footprint permits. Third, it would be extremely difficult to monitor individual's water footprints. Fourth, compliance at the individual level will be difficult to achieve. Fifth, individuals are not the natural entities for allocation of water, but rather communities. Thus, this study chooses to elaborate on the mode in which maximum water footprint permits are allocated to nations. This is convenient, because the legal system and monitoring infrastructure is already largely in place at this level. Moreover, the most promising options to match actual water footprints with water footprint permits feature at the national level (see Section 5.2.5).

5.2.2. Defining a maximum global water footprint

Though estimates of the annual volume of rainfall over land are available (Shiklomanov, 2000), it is very difficult to give a global figure for a maximum sustainable global water footprint. Various reasons for this include (i) uncertain environmental flow requirements, (ii) disputable level of water use efficiency, and (iii) unknown potential for rain-fed agriculture (Hoekstra, 2006). According to an estimate of Hoekstra (2007),

human appropriation of ‘green water resources’ (soil moisture from rain) is 8% and the human appropriation of ‘blue water resources’ (surface and groundwater) 17%. Postel et al. (1996) take much broader definitions of green and blue water use and arrive at appropriation estimates of 26% and 54% respectively. This appropriation obviously leads to unsustainable conditions in many places throughout the world, as witnessed by the reported cases of water depletion (UN-Water, 2003; 2006).

Not only is it hard to determine a maximum sustainable global water footprint, it would lead to a suboptimal outcome from both the economic and the environmental perspective. Determining the environment for which to define environmental flow requirements is arbitrary and subject to trade-offs. From an environmental perspective, presuming the existence of a maximum sustainable global water footprint that simply represents the difference between annual renewable water resources and environmental water requirements implies that not using water resources up to this maximum would be a waste of renewable resources. From an economic perspective, the negotiated maximum footprint is not necessarily the most efficient threshold.

This study proposes the following pragmatic solution to this problem. When parties agree on the rationale of tradable water footprint permits, this system needs to allocate sufficiently low rations in order to be effective. Low rations make water footprint permits scarce, their value becomes higher, and the evolving trade system will strengthen the institutional arrangement. This trade system gives the opportunity to impose an overhead charge needed to operate and maintain the system of water footprint permits. On the other hand, when rations are set too low, non-compliance becomes an attractive option to many and the institutional arrangement will be ineffective. Within these boundaries, it seems feasible to negotiate a maximum global water footprint.

In defining the maximum global water footprint and in issuing water footprint permits, one will have to distinguish between a green, blue and grey component. These components refer to evaporated rainwater, evaporated ground/surface water and polluted water respectively. The grey water footprint can be quantified by assessing the volume of water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards.

Like many environmental regimes, the system of water footprint permits depends on voluntary cooperation between nations. The actual size of the maximum water footprint will therefore be a political question driven by environmental science, comparable to the procedure followed under the United Nations Framework Convention on Climate Change.

5.2.3. Allocating the maximum global water footprint permit to nations

The maximum global water footprint is to be allocated among the people of the Earth. Either historical use rights or ethical reasoning can guide such allocation. Typically, historical use rights guide the allocation of natural resources. The Kyoto Protocol, for instance, applies this allocation mechanism. It is thus conceivable that the allocation of water footprint permits is subject to bargaining between agents, where some agents will

use their contemporary high water footprints as an argument for a large share of the global maximum water footprint.

Ethical reasoning starts with stating that every human being has a moral right to appropriate the same amount of water resources. However, some people live under unfavourable climatic conditions compared to others, while they rely largely on domestic food production for their nutrition. Because these people are least advantaged, they should receive some compensation in the form of a higher tolerable water footprint. Then, making the permits tradable enables the permits to flow towards high-valued uses, without compromising the basic needs of poor people. Selling part of their water footprint permit even generates income for the poor. The permits should be set for one year or maybe some subsequent years. This recurrent assessment possesses the virtue that people can reconsider how much of their water footprint to keep, so the rationing system will not restrict economic development.

5.2.4. Monitoring water footprints of nations

Hoekstra & Chapagain (2007, 2008) provide for an analytical framework for the assessment of virtual water content of commodities, virtual water flows and water footprints. The virtual water content of a product is the volume of freshwater used to produce the product, which depends on the water use in the various steps of the production chain. The virtual water content of a product breaks down into a green, blue and grey component, which refers to evaporated rainwater, evaporated ground/surface water and polluted water respectively.

International virtual water flows can be calculated by multiplying commodity trade flows by their associated virtual water content. If the exporting country does not produce a commodity itself, but only imports it for further export, one should take the virtual-water content of the product as in the country of origin.

The water footprint of a nation can be assessed through either a bottom-up or a top-down approach. In the bottom-up approach, the water footprint of a nation is calculated by multiplying all goods and services consumed by the inhabitants of a country by the respective virtual water contents of those goods and services. It is straightforward, although data demanding. Alternatively, one can use the top-down approach, which takes total water use in a country as a starting-point and then subtracts the part of the water used for making export products and adds the incoming virtual water flow.

This analytical framework forms the base of the monitoring effort needed in the system of water footprint permits. It is comprehensive in the way that it accounts for blue, green and grey water use. The level of detail is sufficient for the permit system. However, the method needs improvement before it is applicable for recurrent monitoring. First, the grey water component should be introduced into the water footprint of nations as defined by Chapagain & Hoekstra (2004). Second, uncertainty analysis should be carried out to be clear about the limitations of the method. Third, all state parties should make transparent monitoring data available recurrently on a year-to-year base. Finally, one will have to address the issue that consuming one cubic metre of water in one place is not necessarily comparable in terms of its environmental or social impact to consuming one cubic

metre of water in another place. This can be solved by either weighting the water volumes consumed based on their relative impact or setting spatially and temporally explicit standards with respect to the maximum water footprint such that the (marginal) impact of a water footprint in one place/period become comparable with the impact in another place/period.

5.2.5. Five national responses to match footprint to permit

The effectiveness of the system of Water Footprint Permits results from the actions taken by agents to match the national water footprint to their water footprint permit. Five options exist for nations, the primary agents of this institutional arrangement. The first one is to buy part of the permit of another country. The attractiveness of this option depends on the price and available quantity of permits. The second option is to improve water-inefficient practices in the country where major imports come from. Creating incentives for virtual water importing countries will generate funds to invest in efficient and sustainable agricultural practices. The third option is to shift imports towards more water-efficient regions. The fourth option is to appropriate water that is not included in the maximum global water footprint, most notably salt water. When nations invest in desalination they augment the water resource base (to the detriment of their energy resources). It is fair that nations profit from their own effort. The fifth option is to change total consumption or the consumption pattern of the nation. This option implies to involve the nation's inhabitants, either by awareness raising instruments (e.g. scaling down the water footprint permit) or by taxes on water-intensive products.

Beforehand, there is no preferred set of options for a country to match their water footprint permit. Particular characteristics and circumstances lead to different sets of preferred actions. It will remain within national sovereignty to determine this set of actions. Whatever the set of actions, consumer awareness about their water footprint will increase.

5.2.6. Compliance mechanisms

Countries comply with the permit system when their actual water footprint is equal to or smaller than their acquired water footprint permit. Non-compliance occurs when a nation's actual water footprint is larger than its permit. Three situations may occur. In the first situation, all countries have remained within their ration. There is no compliance problem, but the rations in the next period of six years may be set lower. In the second situation, some countries have consumed more than their permit allows them to, while others have consumed less. In retrospect, countries can trade water footprint permits for the period at hand without further regulatory measures. Third, the majority of countries have a larger water footprint than their permits allow them to. For this situation, a clear penalty system should be in place. The collection of penalties creates a fund that can be used to back the restoration of local systems that have suffered most from depletion and degradation during the period under consideration. In this respect, much can be learned from the Kyoto Protocol process, for which compliance mechanisms must be in place when the emission target deadline of 2012 passes.

A major compliance issue is of methodological nature: the time lag between determining a nation's water footprint permit and its actual water footprint. The water footprint permit for a certain period (six years, see Section 5.2.1) is determined by setting a global maximum beforehand and allocating this permit among nations. The actual water footprint is determined by evaluating climatic parameters, crop parameters, crop product yields, international trade data, and industrial and domestic water withdrawals[7] afterwards. One way to minimize this problem is to predict the actual water footprint. Probably, the water footprint of nations is not very volatile, so trend analysis of national water footprints would provide for a sufficient certainty of prediction.

5.3. Assessment of effects

5.3.1. Poverty alleviation

This study proposes that nations that aim to have a larger water footprint than their equitable share allows them to, can buy some of the permit of countries that are satisfied with a lower water footprint. This trading system leads to cross-subsidies from countries with large water footprints towards countries with low water footprints, virtually to reward them for their higher conservation of global water resources. If high water footprints positively correlate with high incomes, these cross-subsidies lead to poverty alleviation.

Chapagain & Hoekstra (2004) found a positive relation between per capita Gross National Income (GNI) and domestic water consumption, as well as between per capita GNI and the water footprint resulting from industrial consumption. They did not find a relation between per capita GNI and the water footprint resulting from the consumption of agricultural commodities. The reason is that other factors – climate, agricultural practice and consumption pattern – interfere to such extent that these factors should be filtered out first in order to see the individual effect of GNI per capita.

In Section 5.2.3 we have argued that people living under unfavourable climatic conditions and highly dependent on domestic food production should receive compensation in their share of the maximum global water footprint. It is beyond the scope of the present study to refine the analysis of Chapagain & Hoekstra (2004) to find a positive relation between GNI per capita and the water footprint because of consumption of agricultural commodities. It suffices to say that using a 'climate compensation factor' and/or a 'water productivity compensation factor' will probably produce a positive relation.

Note that the improvement of poor agricultural practices, funded by donor countries, directly leads to poverty alleviation.

[7] These parameters are derived from Chapagain & Hoekstra (2004), but may be extended with parameters to incorporate dilution water (grey water).

5.3.2. Conservation of water resources

Conservation of water resources occurs when countries shift imports towards water-efficient regions, improve water-inefficient agricultural practices domestically or abroad, lower their total consumption or change towards a more water-extensive consumption pattern.

5.3.3. Transaction costs exceed benefits

It is conceivable that transaction costs will exceed the benefits. Transaction costs consist of costs for information, negotiation, definition and enforcement of a contract (Hazeu, 2000). Further quantification of these transaction costs and benefits delivers further insight on this matter.

5.4. Discussion

5.4.1. Incompatibility with international environmental law

Water footprint permits underscore the environmental limitations to human behaviour. Implementing the concept of water footprint permits could be in direct conflict with the influential Principle 21 of the Stockholm Declaration: “States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction (UNCHE, 1972).”

Geographical spread of water availability becomes less important in the system of Water Footprint Permits. Water-rich countries will try to hang on to their state sovereignty over natural resources. However, in international politics in the past, environmental regimes have evolved based on voluntary collective action. The permit system requires a certain degree of participation to have a significant effect, but it does not need a unanimous consensus.

5.4.2. Political unfeasibility

Water footprint permits seem to be largely to the benefit of developing countries with low consumption. Thus, it is possible that countries with a large water footprint will not participate in a permit system, comparable to the US rejection of the Kyoto Protocol. Obviously, this is a major issue for the permit system. However, this study identifies three aspects that make it more likely that nations will cooperate.

First, such reasoning typically belongs to the tradition of realism and neglects a liberal view to world politics. The permit system is a voluntary system, in which bargaining over the size of the permitted global maximum water footprint leaves room for national interests. Second, the contemporary distribution of water footprints is

not morally justifiable[8]. When all human beings would have a water footprint equal to that of the average US citizen, human appropriation of water resources would double (Chapagain & Hoekstra, 2004). This appropriation cannot be considered to remain within environmental limits. Transnational NGOs make governments, producers and consumers aware of that. Third, it is possible to break the seemingly obvious link between economic growth and increased water use, by applying techniques in agriculture that augment the 'crop per drop'. Self-restraint and economic development are not necessarily mutually exclusive aims.

5.4.3. Alliance with an ecological footprint permit

Freshwater is not the only natural resource that suffers from scarcity at the global level. Other important scarce resources that sustain our lifestyles are various types of lands and energy carriers. The water footprint concept has been derived from the ecological footprint concept put forward by Rees & Wackernagel (1996). Where the water footprint determines the amount of freshwater (in m^3) that is needed to sustain the consumption pattern of an individual or nation, the ecological footprint does the same for productive land (in ha) (Hoekstra, 2007). The ecological footprint converts human consumption of food (including fish), energy and forest products to a certain amount of land and adds it to the amount of land needed for the built-up environment.

Though the water footprint and ecological footprint are measured in different units (m^3/capita vs. m^2/capita), the rationale for a permit system is similar for both concepts. The feasibility and usefulness of a water footprint permit system increases when combined with an ecological footprint permit system. The need for a permit system is even higher for ecological footprints than for water footprints, because the global ecological footprint exceeds the Earth's biocapacity by 23% (WWF, 2006) or 39% (Venetoulis & Talberth, 2006).

[8] Moral justice is best represented here by Immanuel Kant's categorical imperative: "I ought never to act except in such a way that I can also want that my maxim should become a universal law."

6. Synthesis

The preceding sections describe conceivable and – under certain assumptions – feasible institutional arrangements for global water governance that promote social equity, ecological sustainability and economic efficiency.
Table 6.1 presents the rationale for and the key features of the institutional arrangements. Figure 6.1 displays the behavioural mechanisms through the virtual water chain, triggered by the institutional arrangements. Table 6.2 summarizes the assessment of effects and topics of discussion by means of a SWOT-analysis (the analysis of strengths, weaknesses, opportunities and threats). It shows differences in the extent to which the institutional arrangements address the three criteria of sustainable development. In addition, the Table gives the opportunity to relate the institutional arrangements to each other.

Table 6.1: Key features of three global institutional arrangements.

	Water Pricing Protocol	**Business Agreement on Sustainability Reporting**	**Water Footprint Permits**
Rationale	Full marginal cost pricing increases efficiency. The deadlock of countries unwilling to restrain themselves requires international cooperation.	Companies gain from proactively addressing environmental sustainability issues. The Agreement channels business efforts to increase the environmental sustainability of their activities.	Every individual has a right to appropriate a certain amount of global fresh water resources and total appropriation should not exceed the carrying capacity of the Earth.
Change agents	National governments	Word Business Council on Sustainable Development	National governments
Primary agents	Producers	Food processors; Retailers	Consumers
Substantive elements	▪ Full marginal cost pricing method ▪ Fund allocation method	▪ Measuring method ▪ Reporting method	▪ Maximum global water footprint definition ▪ Permit allocation ▪ Monitoring framework
Behavioural mechanism	Price increase is passed on, ultimately to consumers	Channel leadership involves the producers; Sustainability reporting involves consumers	Various instruments are available to national governments to involve all agents in the virtual water chain

The effectiveness of the institutional arrangements is subject to risks. The main risk of the Water Pricing Protocol is the assumption that national governments, with some assistance, will be able to have domestic institutions in place to arrange the various steps of water pricing. Various reasons may limit the implementation of water pricing: financial capacity, interference with cultural heritage (for instance the warabandi system in Pakistan and India), and physical constraints of metering (the uncontrolled flooding of terraces in South-East Asia).

The main risk of the Business Agreement on Sustainability Reporting is that there is no separation of powers, or *trias politica*. Thus, the Business Agreement is not binding. The platform that will draft the Business Agreement (the World Business Council on Sustainable Development as proposed) should be as autonomous as possible in order to account for effective enforcement mechanisms.

The main risk of Water Footprint Permits is that the transaction costs will outweigh the benefits of the system. Apart from monitoring efforts, the system requires a great deal of political attention. Necessarily, the system should seek strategic cooperation. A system of Ecological Footprint Permits would be a promising partner for the system of Water Footprint Permits.

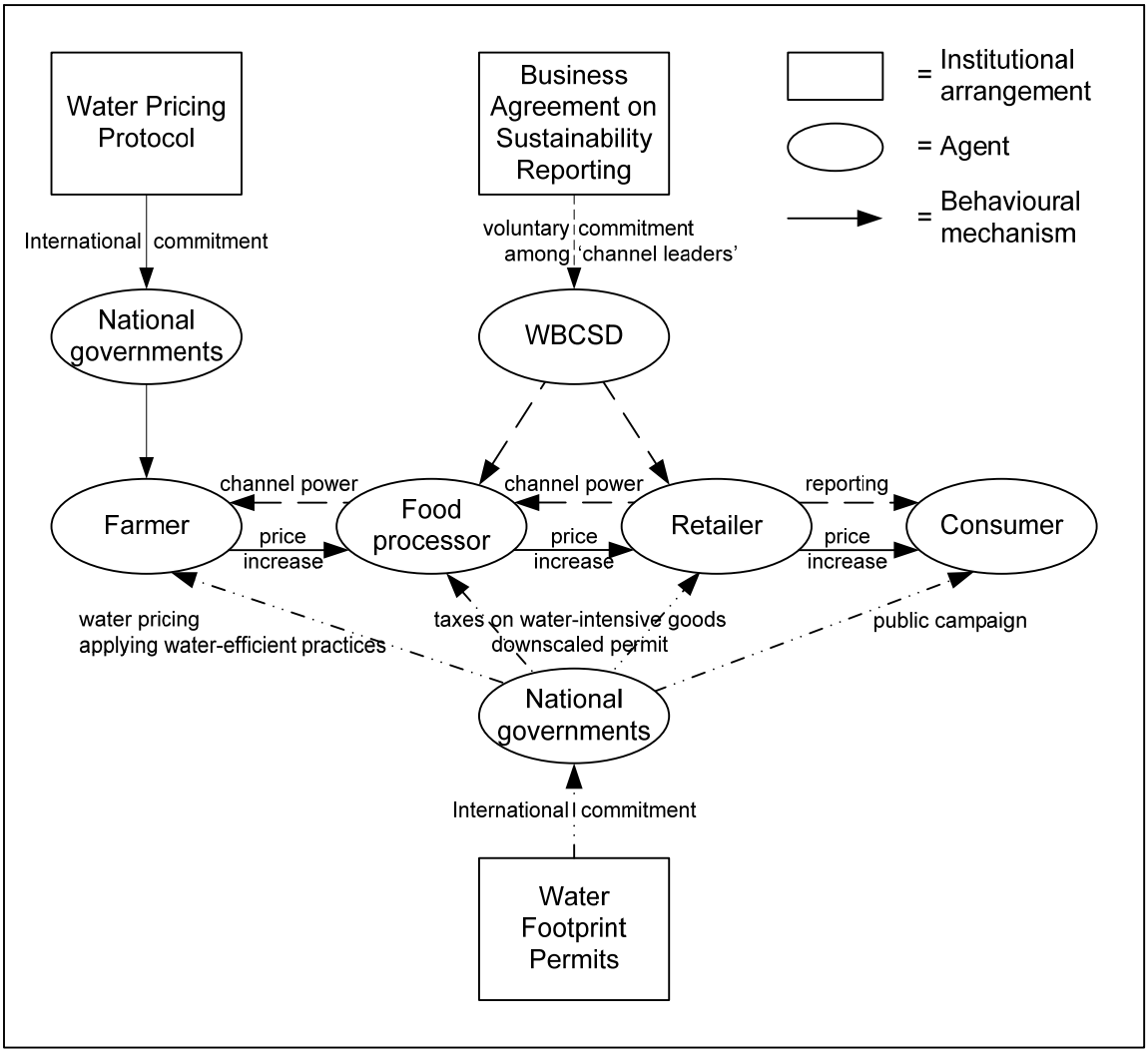

Figure 6.1: Behavioural mechanisms triggered by institutional arrangements. [WBCSD = World Business Council on Sustainable Development]

Table 6.2: Summary of the strengths, weaknesses, opportunities and threats of the institutional arrangements.

	Water Pricing Protocol	**Business Agreement on Sustainability Reporting**	**Water Footprint Permits**
Strengths	▪ Privileged economic sectors less dependent on public funds ▪ Efficient crop patterns ▪ Cost recovery ▪ Compensation for externalities ▪ Restoration of depleted resources ▪ Optimization comparative advantages	▪ Awareness of water footprint through business society ▪ Conservation of resources ▪ Reduced risk of regulation, environmental degradation and corporate image ▪ Increased corporate responsibility	▪ Awareness of water footprint through government & civil society ▪ Equal right to the global water footprint ▪ Poverty alleviation ▪ Conservation of resources ▪ Tradability of permits contributes to efficient allocation of water resources
Weaknesses	▪ Irrigation less competitive than rain-fed agriculture ▪ Increased food prices ▪ Ecological sustainability not guaranteed ▪ High domestic transaction costs (pricing, metering, billing, fee collection, fund allocation)	▪ Moderate transaction costs (monitoring) ▪ Reinforced power 'channel leaders' over local producers ▪ Arrangement is a substitute for strong regulation ▪ Lack of enforcement mechanisms	▪ Local overexploitation remains possible ▪ High transaction costs (negotiation, contract design, monitoring, enforcement)
Opportunities	▪ Alliance with reduction farm subsidies in industrialized countries	▪ Link up with the Global Reporting Initiative	▪ Alliance with Ecological Footprint Permits
Threats	▪ Domestic ability to apply marginal cost pricing ▪ Interference with cultural heritage	▪ Adequacy of the reporting standard	▪ States' adherence to sovereignty over natural resources ▪ Monitoring method not solid enough as a basis for international law

7. Discussion

The involvement of other scientific disciplines other than water governance would strongly mature the design and assessment of institutional arrangements. Particularly the fields of economics, law and public administration could provide for greater insight and better quality of the institutional designs. Apart from integration across disciplines, further research should take a multi-level approach. The institutional designs in this study suffer from generalizations and assumptions that will have unanticipated effects at the river basin or local level. The other way around, institutions at the local or river basin level may be more effective in promoting the criteria of sustainable development at the global level.

The institutional arrangements are not mutually exclusive. Table 6.2 helps to identify opportunities and threats of simultaneous implementation of the institutional arrangements. Combinations that reduce negative effects are promising. The Table reads that all three institutional arrangements require monitoring efforts, which could be combined. On the other hand, combinations may be less effective than the sum of effects of the separate institutional arrangements. When a Business Agreement leads to the conservation of water resources, fewer opportunities to reduce human water use exist for a system of Water Footprint Permits. A combination of Water Footprint Permits and the Business Agreement is promising, because governments, civil society and business society involve in the equitable and sustainable appropriation of global water resources.

With reference to the individual arrangements, further research could explore strategic alliances. The Water Pricing Protocol would be much more effective when coupled to a global agreement on directing agricultural subsidies. The system of Water Footprint Permits should seek cooperation with the field of Ecological Footprint analysis. In addition, case studies will provide more detailed information on the behavioural mechanisms of the institutional arrangements. For the Business Agreement on Sustainability Reporting, the search for simple but comprehensive indicators of ecological sustainability is ongoing. In this regard, the effort of the Better Sugarcane Initiative is promising. The Better Sugarcane Initiative is very relevant for this arrangement, because it takes a life-cycle approach, it involves different stakeholders across the virtual water chain and the water-intensive sugarcane is traded worldwide.

Global water governance is new as a research topic. The three institutional arrangements in this study are explorations of ways in which human society can deal with the global dimension of water governance. The design of these arrangements is only a first step towards a multidisciplinary debate on global water governance.

8. Conclusion

In general, freshwater availability, use and scarcity are addressed at the local or river basin level. However, demand for water-intensive commodities (i.e. particularly agricultural commodities) increasingly induces export flows and the emergence of a global market. Economic development, for example in China, stimulates demand for commodities that cannot be produced in the country itself. The increasing importance of international trade in agricultural commodities on a global market results in large virtual water flows from one river basin to another, creating a link in socio-economic and political sense between water systems that are disconnected from a hydrological point of view (Hoekstra and Chapagain, 2008). From the societal perspective, freshwater becomes important at a global level and should also be addressed at that level.

The sustainable use of freshwater on a global level includes social equity, ecological sustainability and economic efficiency. All humans have similar rights for freshwater, ecosystems should be maintained, and water should be used as efficient as possible. To address the three dimensions of the sustainable use of water, we propose three institutional arrangements: the Water Pricing Protocol, the Business Agreement on Sustainable Reporting and the Water Footprint Permits. The Water Pricing Protocol increases efficient water use by full marginal cost pricing and passes costs on to final consumers. The Business Agreement on Sustainable Reporting stimulates business to use freshwater in a sustainable way. This arrangement adopts the systems approach from life cycle analysis and introduces the concept of the virtual water chain. The Water Footprint Permits are based on the principles that every individual has a right to a certain amount of freshwater and that total appropriation should not exceed the carrying capacity of the earth. The three arrangements are not mutually exclusive but supplementary and strengthen each other in such a way that freshwater is used in a sustainable manner on a global level.

The institutional arrangements for global governance address not only governments and businesses, but also private consumers creating a shared responsibility for this natural resource. The study has explored options for institutional arrangements but acknowledges that the further design and development requires large efforts from the international community. From this perspective, this study is a first step towards the creation of international freshwater governance.

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