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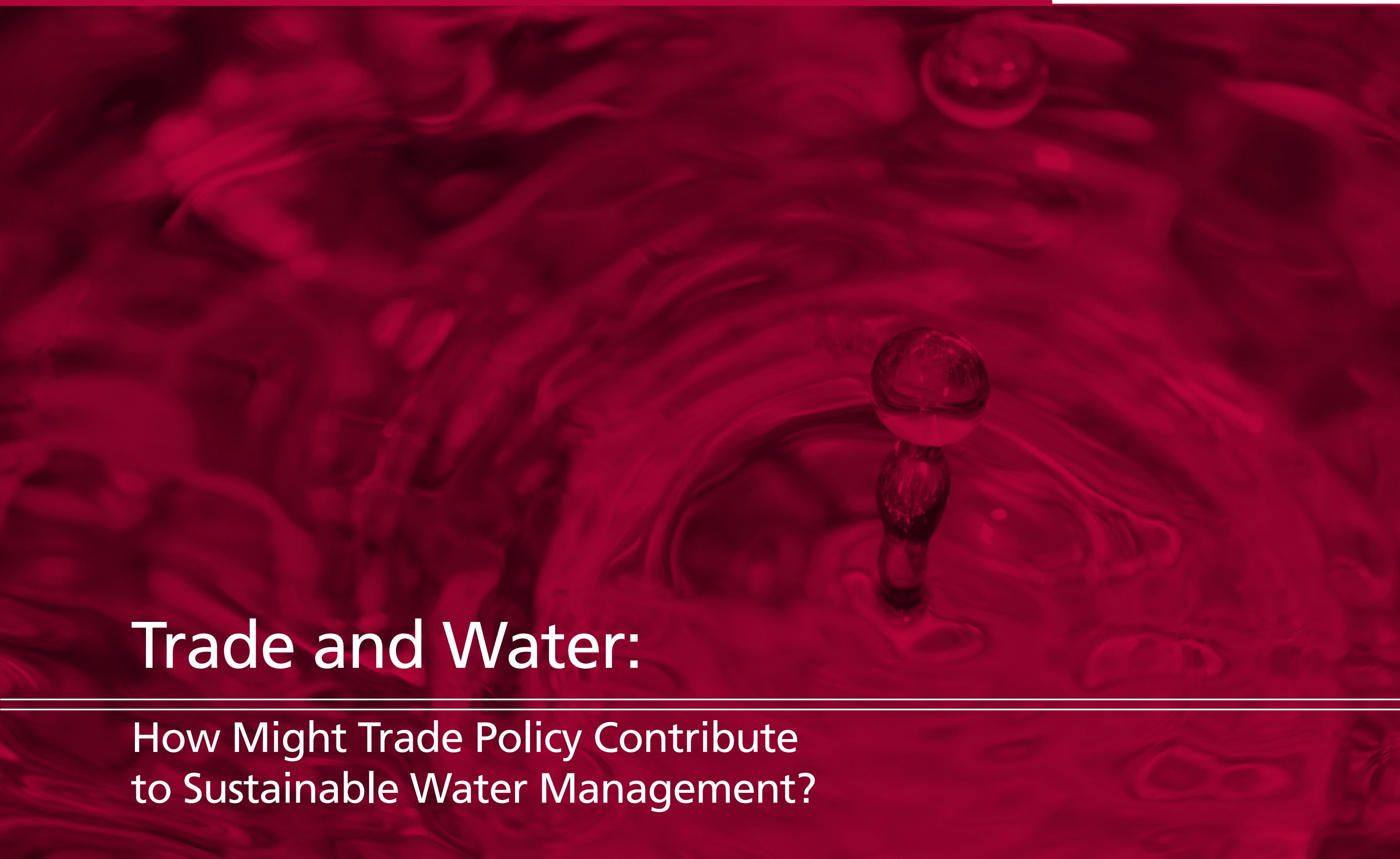

Trade and Water:

How Might Trade Policy Contribute to Sustainable Water Management?

Mike Muller

Christophe Bellmann

ICTSD

International Centre for Trade and Sustainable Development

Issue Paper

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LIST OF ABBREVIATIONS

AoA	Agreement on Agriculture
APEC	Asia-Pacific Economic Cooperation
ASCM	Agreement on Subsidies and Countervailing Measures
BIT	bilateral investment treaty
CGIA	Consultative Group on International Agricultural Research
CVP	Central Valley Project
EFTA	European Free Trade Association
EGA	Environmental Goods Agreement
EGS	environmental goods and services
EU	European Union
FAO	Food and Agriculture Organization
FSMA	Food Safety Modernization Act
FTA	free trade agreement
GATS	General Agreement on Trade in Services
GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
GHG	greenhouse gas
GPA	Agreement on Government Procurement
GW	gigawatt
IMF	International Monetary Fund
IPR	intellectual property right
ISO	International Organization for Standardization
kWh	kilowatt hour
LCR	local content requirement
MFN	most favoured nation
NAFTA	North American Free Trade Agreement
NT	national treatment
PPM	production and process method
R&D	research & development
RTA	regional trade agreement
SADC	Southern African Development Community
SDG	Sustainable Development Goal
SPS	sanitary and phytosanitary
TBT	technical barriers to trade

TiSA	Trade in Services Agreement
TRIMS	Trade-Related Investment Measures
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children’s Fund
WHO	World Health Organization
WTO	World Trade Organization
WWF	World Wide Fund

FOREWORD

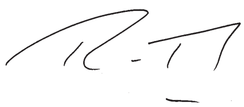
Water is essential to human life and critical to many aspects of sustainable development, from agricultural food production to health and sanitation and the generation of renewable energy. The availability and sustainable management of water and sanitation is one of 17 Sustainable Development Goals (SDGs) adopted by UN member states as part of the 2030 Agenda for Sustainable Development, making it an important focus for development efforts in the next 15 years. Water also underpins the functioning of our natural environment.

Debates around water use, whether at local, regional or global levels are often highly contentious, as is the interaction between those debates. For example, while there is a widespread perception that at a global level the world is facing an overall shortage of water, the nuanced perspective taken by this paper argues that although in some areas water use has clearly reached the physical limits of the resource, water availability (or scarcity) is often a question not of overall amounts but of quality, location and variability, and defined by social preferences and economic constraints. Similarly, debates around the impact of trade and trade policy choices on water use have been contentious in the past, and many continue to be so today.

In light of this complex background, this research paper, by Mike Muller, Adjunct Professor at the University of the Witwatersrand and Christophe Bellmann, Senior Resident Research Associate at ICTSD, aims to explore how trade and trade policy could contribute to sustainable water management. It identifies key issues and explores debates within what is a complex and evolving nexus of science, economics and policy-making. The paper discusses the merits of virtual water trade as an analytical tool and identifies and discusses key issues at the intersection of trade policy and water management, including subsidies to irrigation in agriculture, debates around the privatisation of water services, and the availability of the technology required to supply and treat water supplies.

The paper aims to survey the range of issues in this extremely complex intersection of two large fields of work, and to identify where further research and dialogue may be fruitful. The localised nature of water management challenges means there is no clear imperative for a single multilateral approach to them, but governments could use trade policy tools and frameworks to, for example, improve access to the goods and services they need to meet their particular water security challenges. This paper aims to serve as the basis for consultations with policymakers in the design and execution of further work by ICTSD on these issues.

I hope you find this paper a thought-provoking and interesting contribution to your work.



Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

EXECUTIVE SUMMARY

Water is at the centre of economic and social development: it is vital in order to maintain health, grow food, generate energy and create jobs while sustaining the natural environment. A wide variety of economic, social and environmental services are derived from water resources, ranging from water supply and hydropower generation to navigation and recreation. Many of these services may be provided concurrently from the same resource. Water resources are also an integral part of the natural environment, supporting a wide range of biodiversity as well as underpinning the agriculture which provides the world's food. Finally, natural water courses provide a range of "environmental services" such as water purification, flow regulation and flood mitigation as well as yielding food and building materials. Water security is therefore an integral part of the achievement of the United Nations 2030 Sustainable Development Agenda (UN 2015), including several Sustainable Development Goals (SDGs).

This paper identifies some of the key intersections between trade policy and water management, in areas such as agriculture, hydropower generation, water services and wastewater management. From a trade policy perspective, the main immediate concern is to ensure that international trade rules and disciplines do not unduly affect countries' ability to manage their water resources sustainably and according to their respective social preferences. While the local nature of water systems and the diversity of water management objectives is not conducive to the application of trade instruments to enforce a prescriptive, one-size-fits-all approach to water management, there is also a range of areas in which trade policy could support the sustainable management of water and related SDG objectives.

The peculiarities of water as renewable natural resource

It is often believed that water is a scarce natural resource and that the world's reserves are "shrinking fast", "posing a serious threat to public health, political stability and the environment" (WTO 2010). A more nuanced perspective recognises that the world's stock of water is effectively constant. Overall, there is no shortage of freshwater at the global level and water is not considered to be one of the natural resources whose overuse is exceeding "planetary boundaries" (Rockström *et al*. 2009). While at more local levels, water use has clearly reached the physical limits of the available resource, water availability is more often limited by its quality, variability, location, economic constraints and social preferences.

Water from diverse sources supports many different mixes of human activity. As a result, the objectives of water management vary substantially between jurisdictions. These specificities make it difficult to define global prescriptions for water management let alone to determine whether water is being sustainably managed at any particular point in time and space. Given this reality, other approaches have focused on the notion of "water security" defined as "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies" (Grey and Sadoff 2007) as the overarching objective of sustainable management.

In a similar vein, the simple specification of water challenges as one of scarcity with the response prescribed as correct pricing only deals with part of the problem. While "getting the price of water right" has resonance for economic policy makers, it is only one of a range of interventions that can be used to achieve sustainable water management. Water cannot simply be treated as an economic good and this has implications for the way in which water and trade policy interact.

Water and trade policy considerations

Besides bottled water, trade in bulk water remains limited and the resource is not generally transferable beyond local scales. Water is however a critical factor of production in most traded goods and its supply is enabled by a wide range of services. Agriculture in particular is the largest consumptive use of water on a global scale and in most countries, as well as being an important source of water pollution. Often, however, the impact of other uses of water resources, including for the disposal of industrial and urban waste, may be higher than that of agriculture.

Early research on trade and water focused on the movement of what was conceptualised as **virtual water**, defined as “the volume of water required to produce a commodity or service.” This work also gave rise to metrics such as water footprints, proposed as an instrument to assess and influence the impact of corporate activities and trade generally on the sustainability of water use and management (Hoekstra 2011). The underlying assumption was that trade can help ensure a better allocation of resources and that water-scarce economies would tend to import goods whose production is water-intensive and export goods that require limited water. Existing empirical evidence suggests, however, that water endowment is only one among several factors of production that play a role in determining trade flows. Academic commentators have noted that virtual water and water footprint analyses generally do not consider opportunity costs (Wichelns 2010) while a recent United Nations Environment Programme (UNEP) review concluded that, although the concept helped to understand how water-stressed countries and regions cope with rising water demands, it has “limited application from a policy perspective….” (UNEP 2015).

Liberalisation of **water services** has produced at best mixed results in terms of increasing access of the poor to water supplies and continues to be controversial, although the pressure to privatise these services has lessened. Restrictions on reversing liberalisation in the water services sector, together with the constraints imposed by externally adjudicated investment agreements on the policy space of developing countries, will remain a sensitive issue. This could inhibit efforts to experiment with new models of service provision, including liberalisation, for fear of “lock-in.” Private sector involvement in the more limited business of operating specialised treatment plants for both supply and waste, however, has been less controversial. While the World Trade Organization (WTO) has correctly pointed out that countries are not compelled to include water services in their General Agreement on Trade in Services (GATS) offers, bilateral negotiations often present difficult decisions. Aid for trade could support the development of regulatory mechanisms that could allow for small-scale (and therefore potentially less costly) experimentation with liberalisation and draw lessons from these.

A water sector-specific review of approaches to market access liberalisation and regulation adopted by governments within the context of the GATS and Reciprocal Trade Agreements (RTAs) and of the rules around post-establishment investor protection in international investment-agreement frameworks would be helpful. The way in which investment agreements balance investor protection with the regulatory flexibility needed to facilitate adaptation to change, notably in climate but also in other environmental and social dimensions, could also usefully be reviewed since this is a specific concern in water reform.

Industrial pollution and wastewater treatment generally offer significant opportunities for trade because of the growing need to address them effectively, the specialist nature of the services involved as well as the broad desire to promote a green economy. Several wastewater treatment-related goods have been identified in current negotiations about environmental goods. There is however a risk that core development principles of local (human and industrial) capacity development may be undermined if liberalisation leads to an over-reliance on foreign skilled labour and results in

hollowing out of domestic technical capacity. As the diffusion of (green) innovation depends on local capacities to adopt and adapt innovative solutions (see in particular OECD 2011), Aid for Trade could usefully support the development of local capabilities in industrial pollution and treatment.

With hydropower, there is a case for engagement to assist in the removal, or rationalisation, of barriers to investment in large-scale hydropower in comparison with other renewables, particularly insofar as they involve development financing, to support trade in renewable energy. Aid for Trade could also be targeted to support cooperation to promote intra-regional energy trade.

In agriculture, trade has helped maintain food security in countries where water availability limits domestic production. Trade and investment in agriculture can help countries to buffer the impact of climate variability and shocks, such as floods and droughts. It can also provide an important mechanism to offset climate change-induced production decreases and improve access to food. In practice, however, many countries with limited water resource endowments are likely to continue producing certain water-intensive goods, particularly food, which many countries regard as essential to their national security. While this may conflict with the objectives of trade liberalisation, it reflects concerns about the ability of global food markets and the trade system to meet national needs should exceptional circumstances arise. This applies particularly to large countries that cannot rely exclusively on international markets to feed their growing population and will constrain the contribution that trade can make to addressing water shortages. On the other hand, increasing the purchasing power of people in poor countries by helping (and not inhibiting) their products and services to gain access to global markets could make an important contribution to overall welfare. More specifically, trade policy makers could usefully consider ways of improving the transparency of irrigation subsidies, and designing agricultural support mechanisms that help to achieve social, economic and environmental goals. Measures to facilitate access to technology and finance to adapt to climate change-induced water stress would also contribute to both trade and development goals.

The acquisition of large-scale productive agricultural land by foreign investors—sometimes referred to as “land grabbing”—has prompted concerns about the use of local freshwater resources. In addition to social consequences, some commentators fear that this may place additional stress on local water resources. However, the broader picture is more complex and less clear-cut than the headlines suggest. The recent wave of foreign investments in agricultural land in Africa, for example, are also part of long-term efforts by African governments to attract foreign investment capital to increase the productivity of domestic agriculture, including greater water use efficiencies. In many cases, external investment is encouraged because it can enable under-utilised resources to be productively mobilised.

Finally, at a general level, the challenges of developing effective interfaces between trade and water policy are mirrored in other sectors. There is a general desire to understand better how water and its management contributes to the growth and development of economies and societies and what interventions are needed to ensure that this happens. For the trade policy community as for many others, a joint review of the role of water in development could assist it to identify where further interactions and partnerships may be productive.

1. INTRODUCTION: THE LINKED CHALLENGES OF WATER, TRADE AND SUSTAINABLE DEVELOPMENT

Water is at the centre of economic and social development: it is vital in order to maintain health, grow food, generate energy, manage the environment, and create jobs. Water security is therefore an integral part to the achievement of the 2030 Development Agenda. Without improving the management of water resources and ensuring access to reliable water and sanitation services, the world will not be able to meet the Sustainable Development Goals including nutrition and food security, poverty eradication, resilient cities, sustainable energy production, or combatting desertification and land degradation, to list just a few. Water security, however, still remains elusive for many countries. According to the United Nations Children's Fund (UNICEF) and the World Health Organization (UNICEF/WHO 2015) around 663 million people are without improved access to drinking water, and nearly 2.4 billion people are without access to improved sanitation facilities compared to 2000. Up to 90 percent of wastewater in developing countries flows into watercourses untreated.[1] Many countries also struggle to meet other objectives of water security, including ensuring reliable supplies for productive activities and safety from the impacts of extreme events such as floods and droughts.

Climate variability and change present growing challenges. While there is reasonably good understanding of the likely impact of climate change on temperature, there is weaker understanding of the consequences for rainfall and even less clarity about the effects on river flows and groundwater recharge. This uncertainty has justifiably raised fears that global water scarcity may affect development progress, starting with food security, since agriculture, according to the Food and Agriculture Organization (FAO 2014), is responsible for nearly 70 percent of global water withdrawals. There is also concern that increasing demand for water will result in over-exploitation of the resource and consequent environmental damage.

Trade can play an overarching role in support of local, national and global development goals. It enables households and communities to access goods and services that they cannot produce locally, national economies to make optimal use of their endowments and allows investments to flow between capital-rich and capital-poor countries. It should thus help to ensure that the world's water is used optimally in support of development goals.

Trade in water itself is very limited; the use of shared water resources is governed by international law principles of equitable and reasonable use and the doctrine of no significant harm (UN 1997) rather than by trade rules.[2] But trade in agricultural goods helps countries where water availability limits domestic production to achieve food security. And a secure water supply is essential for most industries and thus for trade in their products while flood and drought can cause massive disruption to regional and global supply chains. Trade also enables countries and communities to access the technologies, services and associated investments that they need to provide basic water and sanitation services and to treat and safely dispose of industrial waste.

Aside from these positive interactions between trade and water, trade may have negative impacts if it encourages economic activities that damage the water environment and domestic regulation is not strong enough to protect the resource. Similarly, commentators have raised concerns that involving foreign firms in providing water supply and sanitation services (henceforth, simply "water services")

1 UN Water World Water Day 2013 Facts and Figures website: http://www.unwater.org/water-cooperation-2013/water-cooperation/facts-and-figures/en/. Last accessed 6 July 2016.

2 In the case of shared water resources, the resource can be "local" to several countries, sharing a water basin.

may not deliver improved access by poor communities to basic services which are, increasingly, regarded as a human right; and that foreign private interests may acquire land and water for agricultural production at the expense of local food security.

There is not yet an adequate conceptual foundation to support a better understanding of the interaction between water and trade, let alone trade policy. The very language used can cause confusion. In water management "environmental services" are understood to be those provided by the natural environment, such as the dilution and purification of wastes from urban, rural and industrial activities. In trade discussions, they more often refer to the business of providing services, including water supply and sanitation services to communities.

In order to provide a basis for a broader, more holistic discussion, this report focuses on a number of specific activities where there is a clear inter-relationship between water and trade. After a general review of the peculiarities of water as a renewable natural resource and concerns around scarcity, water security and sustainable management in section 2, section 3 focuses on trade in water, and specifically on the concept of virtual water and water footprint. Among many other outcomes, trade enables countries with limited water resources to achieve food security. The **virtual water concept** analyses the movement of embedded water in international trade. Over the years it has given rise to an approach that seeks to quantify the water footprint of different commodities and products. It has been suggested that water footprints should be used to assess the impacts of economic activities on water and to guide the regulation of water use through formal global mechanisms or consumer advocacy and corporate social responsibility initiatives. This section discusses both the potential value of these concepts as awareness-raising tools as well as their limitations for policy-making.

Section 4 then reviews a range of trade policy instruments and interventions that may contribute to or impact on, sustainable water management and use. After some general considerations about the applicability of WTO law to both real and virtual water trade, the section looks at trade in **water services**, a focus of political contestation and international litigation across many countries. The inter-relationship between GATS, investment protection agreements and national policy needs to be better understood, particularly insofar as it impacts on the right to water. Conflicts over the privatisation of water services holds lessons about the potentially perverse outcomes of poorly-designed trade liberalisation in socially and environmentally sensitive areas.

The **management of wastewater** from manufacturing and mining, often characterised simply as pollution, is also a serious challenge as is pollution from domestic wastewater and agriculture. If not adequately managed, pollution renders water unusable for other purposes. But its control requires access to and investment in technology as well as institutions to set standards and enforce regulatory protection. Trade in services and goods can facilitate this. But there is also concern that what some countries have adopted as best practice water management standards may be used to block exports of goods from countries whose water management does not meet the standards of the importing country.

Hydropower development also lies at the intersection between trade and investment and water management. As regional electricity trade and the use of other renewable energy sources develop, hydropower is taking on increasing importance. Decisions that constrain infrastructure investment inhibit electricity trade and already constitute a significant barrier to some developing countries' electricity exports, potentially restricting the optimal use of their water resources. These policy decisions, together with support to fossil fuels and also to other renewables, which often receive national green economy support, may significantly distort investment in renewable energy generation, and therefore impact trade in renewable energy.

Finally, it is widely believed that subsidies for **irrigation** contribute to the overuse of water or, at the least, to its misallocation. Subsidies are disciplined under the WTO through the Agreement on Agriculture and the Agreement on Subsidies and Countervailing Measures (ASCM). However, in the many developing countries where the majority of the population is still rural, government agricultural policies and support programmes need to balance these considerations with the need to sustain rural livelihoods and improve productivity. A major challenge therefore consists in reconciling the environmental imperatives with livelihood and rural development considerations while avoiding to the extent possible trade distorting practices. In a similar vein, mitigation of climate change-induced water stress may require effective trade financing mechanisms and technology diffusion.

After a review of these different areas, section 5 concludes and suggests possible next steps that could further the discussion on trade and water in light of the 2030 Agenda objectives.

2. GLOBAL CONTEXT: WATER SCARCITY, WATER SECURITY AND SUSTAINABLE WATER MANAGEMENT

It is widely believed that water is a scarce natural resource and that the world's reserves are "shrinking fast," "posing a serious threat to public health, political stability and the environment" (WTO 2010). Since agriculture is the largest water user, it is feared that water scarcity will have dramatic impacts on the production of food and other vital products.

To address this, it has been suggested that water should be managed as an economic good through appropriate institutional arrangements. Effective water markets would ensure that water is used as efficiently and effectively as possible; to this end, a price should be placed on all freshwater resources. Trade policy should promote better water management and discourage the misuse of scarce resources.

A more nuanced perspective, detailed below, recognises that the world's stock of water is effectively constant, that freshwater is renewable and the overarching hydrological cycle is self-purifying. Most consumptive water use is drawn from flows rather than stocks. Hydrological sub-systems are weakly linked, local in nature and often extremely variable and unpredictable. Water management challenges, too, are often local and diverse.

While at some local levels water use has clearly reached the physical limits of the available resource, physical water scarcity is often not what limits water use; indeed in non-arid regions scarcity is often a consequence of a combination of economic constraints and social preferences. While all water uses impact on the natural environment, the desired levels of environmental protection vary between communities and in time. The overarching goal of water management is water security, whose achievement invariably requires the construction and operation of significant infrastructure. As water use increases, needs are met first through infrastructure development and later through institutional interventions. Since many water uses depend on the same resource, water security also requires effective institutions to mediate and promote cooperation between different water users; since the value of water in its different uses is not commensurable, pricing and trading have an important but limited role. Given these complexities, there is no one-size-fits-all solution to water security challenges.

2.1 Water Resources

Water is a renewable resource that is variably distributed around the world, both in time and space. It is found in a variety of locations and in different forms. By far the largest proportion (97.5 percent) of the global water **stock** is salt water in the world's oceans or underground. Of the 2.5 percent that is freshwater, it is estimated that almost 70 percent is contained in permanent ice and snow deposits with most of the remainder (30 percent) underground or in the top layers of soil; a small amount (0.04 percent) is in the atmosphere as water vapour or clouds; a miniscule proportion (less than 0.01 percent) of freshwater runs in rivers and streams. Human societies can be supported by this tiny proportion of accessible water because it is recycled rapidly by the natural hydrological cycle. On average, atmospheric water is recycled through rainfall and evaporation every eight days; water in rivers and streams, every 16 days (Shiklomanov 1993).

Water availability is often best considered in terms of the uses that can be derived from these **flows** rather than from a finite stock. Freshwater is generally described as a common-pool resource. Access to it is difficult to control and, since physical ownership is hard to establish, its legal status is usually defined in terms of usage rights rather than property ownership, which complicates its governance.

Local hydrological sub-systems such as rivers, lakes and underground aquifers are part of the global hydrological system. Evaporation

from oceans and land essentially purifies the water which returns as rain or snow. If it falls over land, some returns to oceans through the local sub-systems. Current evidence suggests these sub-systems are weakly linked, if at all, and they are often analysed and managed as separate units. The freshwater in them is sometimes termed “blue water” to distinguish it from the “green water” which falls as rain and is held as moisture in the soil but returns to the atmosphere through direct evaporation or evapotranspiration.

The localness of the management of blue water makes the global hydrological cycle very different to the global atmospheric system, in which CO_2 emissions from any local source immediately impact on the behaviour of the global system. There is little evidence so far to suggest that changes in local hydrological sub-systems significantly affect the global system. Changes in the global climate will have effects on local hydrological systems, however. A warming climate will increase the amount of water in circulation; one result will be more intense extreme events. It is also predicted that climate change may see some sub-tropical regions become drier while other regions will experience more rainfall.

2.2 Water Use

A wide variety of economic, social and environmental services are derived from water resources more or less directly, ranging from water supply and hydropower generation to navigation and recreation. Many of these services may be provided concurrently from the same resource. Water resources are also an integral part of the natural environment, supporting a wide range of biodiversity as well as underpinning the agriculture that provides the world’s food. Natural water courses provide a range of environmental services such as water purification, flow regulation and flood mitigation as well as yielding food and building materials.

Regions with reasonably stable climates can enjoy predictable water availability with limited built infrastructure while those with unpredictable climates, subject to extreme weather, need substantial infrastructure investments to enable reliable water utilisation and protect communities from water-related disasters. Storage infrastructure creates temporary stocks from which flows can be drawn when required. Underground sources, which recycle more slowly, are sometimes managed as stocks and unsustainably depleted.

Infrastructure is also required to transport water to where it is used. The large quantities involved place economic limits on the transportability (and thus tradability) of water. An average developed-country household may use 500 kg of water per day. Even larger amounts are used in agriculture. For example, to grow 1kg of wheat, enough for two loaves of bread, an average of 1800kg of water is consumed, usually as rainfall that is returned to the hydrological cycle through evapotranspiration without ever entering the freshwater cycle (Mekonnen and Hoekstra 2010).

Since agriculture is by far the largest consumptive use of freshwater in most countries, some observers predict that rising demand for food may cause water use to reach critical levels at a global scale (Rockström *et al*. 2014). Others suggest that efficiency gains in production and greater reliance on rainfall may reduce total water withdrawals for agriculture by 2050 (OECD 2012).

In support of proposals for global action to constrain water use, it has also been suggested that numerous local cases of water overuse may contribute to a global “syndrome” (Vörösmarty et al. 2013) but no convincing explanation has been provided of how this could become a global concern. There is no shortage of freshwater at a global level and water is not considered to be one of the natural resources whose overuse is exceeding planetary boundaries (Rockström *et*

al. 2009).[3] However, at more local levels, water use has often reached the physical limits of the available resource, and there is a widespread *perception* that crises related to access to water are a significant global risk (WEF 2015).

2.3 Understanding Water's Scarcity and Values

Much of the discourse on the sustainability of water use is predicated on concerns about water scarcity and its value. Water is of low financial value, particularly when used in high volumes, limiting its tradability. Further, its values in its different uses are not commensurable; there is no common scale on which to evaluate them (WEF 2014). Thus the value of water in agriculture derives from its consumption; its value for recreation and environmental amenity depends on it not being consumed. Hydropower's value is generated by high flows through steep gradients, navigation's by low flows and small gradients. These uses often occur simultaneously in the same system.

While the idea of "getting the price of water right" has resonance for economic policy makers, it is only one of a range of interventions that can be used to achieve sustainable water management. There are few examples where pricing has resolved competition between water-using sectors or the management of negative externalities, such as biodiversity reduction, not least because water's value in its different uses is often not commensurable. The price of water is thus often more useful to manage competition *within* water use sectors rather than *between* them. The price set can also ensure that users pay for their water and that their activities reflect the costs of making it available. While water pricing for domestic and industrial use is already well-accepted in several places, prices are generally set to recoup the costs of making the water available rather than to address water scarcity.

The simplification of the water challenge as one of scarcity, with the response prescribed as correct pricing, is thus not helpful. It is however useful to consider the different constraints to the availability of water for use that may be described as scarcity and to illustrate some of the values that are associated with water.

Variability as scarcity: The value of water often lies in its reliable availability (as opposed to a simple volume of the commodity). In many places, water availability is seasonal; under variable climates, it may be available in some years but not in others. In the absence of storage infrastructure to enable predictable availability, water will be considered to be scarce at some times and surplus in others.

Location as scarcity: Because water cannot easily be transported, it may be available in one place but not next door if local resources there are fully used or topography is problematic. So water is often scarce at the top of hills or close to coasts where all sources are saline.

Quality may determine scarcity: The quality of water determines its usability for different purposes. For instance, seawater cannot be used for agriculture; although desalination is well proven technologically and can support high-value water uses such as urban and industrial supply. Pollution originating from human activity is the largest and fastest growing impactor on water quality, decreasing the availability of useable water in many places.

Economic scarcity: Even where there is no overall physical shortage of water resources, there is often a lack of financial resources to capture, store and transport the water to make it reliably available where it is needed as well as to treat and return it to the environment after use. The distinction between economic and physical scarcity (Rijsberman 2006) is

3 In Rockström et al. (2009), planetary boundaries are the limits of key variables related to the global natural environment, within which humanity can continue to flourish, and beyond which human activity has a greater risk of creating abrupt or irreversible changes to the global environment. The fact that a boundary related to water has been proposed is, nevertheless, an important reminder that the resilience of the global hydrological system is not limitless.

particularly important in poorer developing countries where it is often reflected in the disparities in access of different groups in the society to water and water services.

Environmental preferences also determine scarcity: Societal decisions about environmental protection place limits on water use, effectively creating a socially determined scarcity. Although there are general global commitments to environmental protection, environmental goals vary dramatically across societies and change over time reflecting both societies' environmental preferences as well as the opportunity costs. Appropriate levels of water security (protection against risks of too much, too little or too polluted water) reflect local social preferences, not merely scientific evidence (OECD 2013).

Changing social and economic priorities: Societies' other preferences also change over time, reflecting the rise and decline of economic sectors, in ways that may create scarcity for particular sectors. In countries such as Australia, Spain and the United States of America, new sectoral scarcity is created as trade-offs are negotiated between agricultural, urban and environmental demands for water.

2.4 Water Security as the Objective of Sustainable Water Management

Water from diverse sources supports many different mixes of human activity. Since the socio-economic conditions of different communities vary, the local goals for water management and use are different. As a result, the objectives of water management, the investment and management functions necessary to achieve them and the institutional arrangements to give effect to and establish oversight of them vary substantially between jurisdictions.

Because of the localness of water management and use, there can be no global prescription for the economic, institutional or technical approaches to water management (OECD 2015a). Research on the institutional arrangements for the management of common-pool resources showed that small groups of local users often achieve successful management of a shared natural resource; the real challenge is to nest such local management in supportive, larger systems of polycentric governance (Ostrom 2010). These specificities make it difficult to define (let alone to determine) whether water is being sustainably managed at any particular point in time and space.

As highlighted above, the management of water resources involves a range of activities with more or less emphasis on different objectives. These objectives are encapsulated in the concept of water security, defined as "the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies" (Grey and Sadoff 2007). An important feature of this definition is not only that it includes an environmental sustainability dimension but that water-related risks are described as socially determined (socially acceptable) goals rather than as normative, technically defined objectives. The definition also covers almost all direct and indirect services provided by water as well as the disaster risks posed by water extremes.

Many functions have to be performed to achieve these objectives, including the storage, abstraction, transportation and treatment of raw water from natural sources, its distribution to users and the collection, removal and treatment of wastewater before its return to the environment. Protection works include the construction of dykes and drainage systems, influenced by and often informing spatial planning.

These functions require extensive data about the resource and its use and specialised institutions able to monitor, interpret and respond operationally to the information produced. They also involve ongoing dialogue with water users and the wider community that establishes the norms that govern the management and use of water.

These functions are performed at many different scales, determined by physical, administrative and political boundaries. Because the actions of each water user impact on others through their local hydrological systems, water has to be managed on an integrated rather than a sectoral basis, adding to the complexity. This integration also has significant implications for trade policies that focus on individual sectors. As an example, the regulation of hydroelectricity production and trade in a regional power pool must often reflect impacts on water supply to agriculture as well as environmental and flood protection objectives.

The very local characteristics of water supplies mean that the policy frameworks and investments required to achieve water security vary tremendously. Where demand for water exceeds the naturally available flows in a given locality, two options arise. The first option is that, if available water can easily be moved from one use to another, it may be transferred from lower to higher value uses - that value may be economic or socio/cultural. This avoids investment in infrastructure but terminates the initial use, which may be economically rational for individual users but limits the social and economic activity supported by the society's water endowment. To enable new uses and maintain existing ones, investments will be required; if the economic return from the new activity is greater than the cost, overall economic activity will increase. This can continue until all available water resources are fully utilised, within socially acceptable limits. At that point a second option comes into play: the allocation system (or the norms) will have to be adjusted in order to allow water to flow to the uses in which it can make the largest contribution to maximise the economic and social return from the available resource. The relevance of trade and trade policy in different circumstances will thus depend very much on a country's or locality's particular water security position.

3. WATER AND TRADE: THE VIRTUAL WATER PERSPECTIVE

Besides bottled water, trade in bulk water remains limited and the resource is not generally transferable beyond local scales. Water is however a critical factor of production in most traded goods and its supply is enabled by a wide range of services. Agriculture in particular is the largest consumptive use of water on a global scale and in most countries. It is also a significant contributor to economic activity in many developing countries, underpinning the livelihoods of rural communities where a majority of poor people live, and involving extensive land use and often substantial impacts on the wider natural environment.

Concern about the availability of sufficient water to sustain global food production and recognition of trade's contribution to food security and livelihoods has focused attention on the connections between agriculture, water and trade. Academic analysis has highlighted the potential impacts of agricultural trade on sustainable water management and use.

3.1 The Virtual Water Paradigm

Early research on trade and water was generally descriptive and focused on the movement of what was conceptualised as "virtual water," defined as "the volume of water required to produce a commodity or service" (Hoekstra and Chapagain 2007). The original work considered the Eastern Mediterranean region (Allan 1998) and sought to understand how a dependence on food imports had gained tacit acceptance among the governments of the region for whom self-sufficiency had previously been a priority. The opportunity cost of water made it logical for the arid countries of the region to allocate water away from grain production towards more important and productive purposes, such as urban and industrial supply. Grain could be imported from countries that did not suffer from water constraints. The early studies postulated that water was being traded or, more precisely, products were being traded that contained "embedded water." They also suggested that, through this trade in virtual water, countries' water endowments were determining their agricultural production and trade patterns.

A substantial literature now outlines the theoretical linkages between trade and agriculture's water use as well as documenting the movement of virtual water embedded in traded agricultural goods. Agricultural crop-related "virtual water flows" accounted for 13 percent of total global water use by crops between 1995 and 1999 (Hoekstra and Hung 2005). The bulk of these "virtual water exports" were from the USA, Canada, Thailand, Argentina and India, and the largest net importers were Japan, Netherlands, Republic of Korea, China and Indonesia.

This work also gave rise to metrics such as "water footprints," proposed as an instrument to assess and influence the impact of corporate activities and trade generally on the sustainability of water use and management. Proponents of the virtual water concept have also suggested that analyses of virtual water flows should be used to inform national policies and priorities on water and related economic sectors.

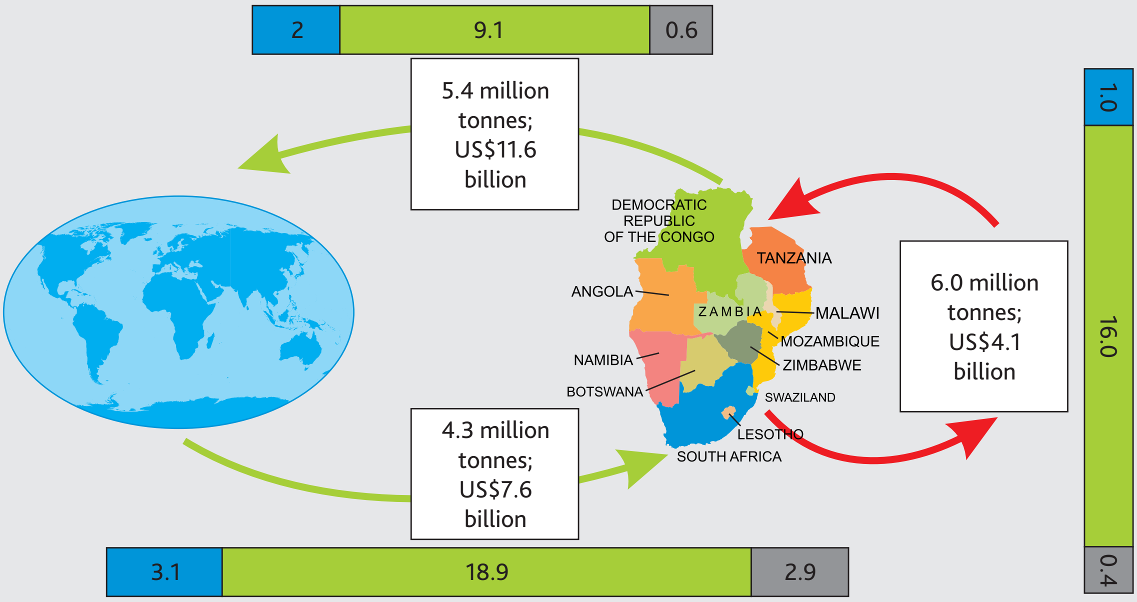
3.2 Impacts of Virtual Water Flows on Agricultural Production and Trade

Some analysis of agricultural trade flows supports the common-sense proposition that water-scarce economies will tend to import goods whose production is water-intensive and export goods that require limited water. Related to this, some models show that trade liberalisation in agriculture has been associated with a shift to less water-intensive activities in water-scarce countries. Other analysis suggests that the picture is considerably more complex than individual models, or cases, suggest. An example is provided by the contradictory results from a review of agricultural trade between Southern Africa and the rest of the world and between countries within the region. While in extra-regional trade, embedded water flows from water-rich to water-poor regions, the intra-regional data shows the reverse (See Box 1).

Box 1: Southern Africa's agricultural trade flows and water

Southern African trade with the rest of the world apparently confirms the thesis that virtual water will flow from water-rich to water-poor regions (Southern Africa is relatively water poor if the extensive endowments of the Democratic Republic of Congo and Angola, under-utilised for historical reasons, are discounted). The volume of virtual water imported was greater than the amount exported for both irrigated and rainfed production. As important, the data also shows that the *value* of Southern Africa's agricultural exports was greater than its imports—see Figure 1 (CRIDF 2014).

Figure 1: Imports and exports of agricultural products and virtual water trade, SADC countries



The imports and exports of agricultural products (in total) in 2012 amongst the continental SADC countries, and between these and the rest of the world. Tonnages and values are shown in text boxes; the accompanying blue, green and grey virtual water transfers are shown by 'colour' in cubic kilometers

Source: CRIDF (2014)

However, trade *within* the region shows the reverse. Net production and water flowed *from* South Africa (the most water-scarce country in terms of water availability per capita), to neighbours with considerably better endowments of water, land and labour. This reflects capital availability and technological capabilities as well as the support provided by greater endowments of transport, energy and communications infrastructure (Vink and van Rooyen 2009. Relatively water-constrained Malawi is also a net exporter of virtual water, probably a reflection of its low labour costs and limited economic alternatives.

Given the different water endowments across the region and pressures on South Africa's limited resources, it has been suggested that a proportion of regional agricultural production should be shifted from South Africa to countries such as Mozambique, Zambia and, to a lesser extent, Zimbabwe and Tanzania (Rutherfoord 2010). This would have useful livelihood trade-offs since agriculture is more labour intensive than South Africa's capital-intensive industry. It would also improve the balance of trade between South Africa and the rest of the region, an important indicator of the shared policy goal of economic integration. But this would require greater support for intra-regional trade (DBSA and GWP 2012).

Broader studies have looked at the rate of embedded water across a range of export sectors. Analysis of Chinese trade shows that, while the agricultural sector is the largest domestic user of water, it is not responsible for the largest proportion of trade in embedded water. Liao *et al*. (2008) considered the effect of WTO accession on Chinese agricultural water use. They found that agricultural trade accounted for a small net import of embedded water and that tariff changes associated with WTO accession may have accounted for a 1 percent reduction in water use (which may also have been due to improved water use efficiencies). Zhang *et al*. (2011) found that, across its economy overall, China is a major *exporter* of embedded water as a consequence of the extensive use of water in sectors such as textiles, electronics and power. This data does not capture the impact of deteriorating water quality on water availability, in many cases the result of pollution from export focused industries.

Many other examples show that factors other than water endowments affect the distribution of agricultural production and associated trade flows. More populous river basins of Europe are net water importers while less populous basins are net water exporters with population density, reflecting economic opportunity, and other natural endowments helping to determine the traded flows of virtual water (Vanham 2013). In Mexico, multi-factor economic modelling that considered physical water supply constraints to analyse the likely patterns of production under changing supply conditions found that high wages around economic hubs were more important than water availability in determining where food was produced (Duchin and López-Morales 2012). Wichelns (2010) demonstrates that land endowment is a better predictor of trade in agricultural products than water availability. Finally, strong structural pressures such as political instability and conflict can alter the expected flows of virtual water.

3.3 Limitations of the Virtual Water Concept

The evidence showing, unsurprisingly, that water availability is not the only factor that determines trade flows raises questions about the utility of virtual water concept as an analytical tool. A review of the limitations of virtual water as an analytical tool helps, however, to identify a more complete and coherent approach. It suggests that more traditional analytical approaches are needed to understand the drivers of water use in different situations. As well as the local opportunity cost of water, these will necessarily consider the cost and availability of many other factors of production as well as water, at global, regional and sub-regional levels as well as sustainable development priorities, including but not limited to water use, access to food and employment.

3.3.1 Multi-factorial nature of comparative advantage

The first limitation of virtual water as an analytical tool is that it does not consider other factors of production. “By focusing on the water resource endowment, alone, virtual water represents an application of absolute advantage, rather than comparative advantage” says Wichelns (2010). “For this reason, policy prescriptions that arise from virtual water discussions are not those that will maximize the net benefits of engaging in international trade. Comparative advantage is the pertinent economic concept, and virtual water considers only absolute advantage”.

This limited focus is understandable given that economic issues were generally secondary in earlier analyses. Allan (1998), for instance, was interested in the short-term impact of price volatility on policy makers’ decisions about a dependence on imported grain. Also, his focus was on the Eastern Mediterranean which, while water constrained, has relatively small populations and extensive hydrocarbon resource endowments. The determining factor for the policy makers was thus the purchasing power that enabled them to buy food in well-supplied global markets rather than their ability to rely on imported water. However, this point was often missed and the focus on water, with limited consideration of other factors of production, was repeated by other researchers

primarily interested in the implications for water policy (see, for instance, Velazquez 2007).

3.3.2 Opportunity costs of water

Following from this critique, the second critical limitation of the use of the virtual water concept is that it does not consider the opportunity costs of the use of water in different contexts. “Comparative advantage requires consideration of the opportunity costs of production for each trading partner” (Wichelns 2015). “The opportunity costs will depend on resource endowments and the technology of production in each setting. The virtual water perspective considers only a country’s water endowment. There is no consideration of technology and no comparison of the opportunity costs of production within or across trading partners.”

Debaere (2014) concurred, noting that concepts of the opportunity cost of water and comparative advantage were often missing from the virtual water literature. His analysis of water use intensity across 134 countries found that water did affect countries’ trade patterns with more water-abundant countries exporting more water-intensive products and vice versa. But he noted that “water contributes significantly less to the pattern of exports than the traditional production factors such as labor and physical capital” providing empirical support for the theoretical challenges (Debaere 2014).

3.3.3 Can water uses be formalised as property rights and traded in markets?

A final limitation of virtual water as an analytical tool is that trade can only contribute to an economically efficient distribution of global water use if the resource is subject to coherent market forces in both importing and exporting countries. As Berrittella *et al.* (2008) note, trade liberalisation will only be unambiguously welfare-improving where property rights are well defined, which is rarely the case for environmental resources, particularly in developing countries. The multiple uses of water, the natural monopolies around its distribution and extensive government regulation further limit the extent to which market forces allocate water both locally and internationally (Debaere 2014).

Smith (2008) has pointed out that the prior requirement for a functional system of water rights and markets is not trivial given the heterogeneity of uses, the costliness of monitoring them and the difficulties in predicting flows of water. Other commentators contend that the administrative use of economic incentives is sometimes confused with market approaches (Dellapenna 2000); this should be seen as a need to consider alternatives to markets (and prices). Formal markets will only be applicable to water in tightly bounded situations, with related uses, derived from the same local hydrological system (Dellapenna 2012).

In summary, the concept of virtual water (and also water footprints - see below) has certainly helped to highlight water-related issues in policy discussions and led to the creation of educational tools to assist consumers to understand some implications of their purchasing choices. But it has not provided a sufficient base for policy analysis and decision-making.

3.4 Towards Comprehensive Approaches to Trade and Water Scarcity

Early modelling of the interaction between agricultural trade and water management also highlighted the range of relevant factors at play. Perhaps the most authoritative statement about the potential contribution of agricultural trade to water management came from the Comprehensive Assessment of Water Management in Agriculture, a major study of the Consortium of International Agricultural Research Centers’ Consultative Group on International Agricultural Research (CGIAR) coordinated by the International Water Management Institute. The assessment did not dispute the movement of embedded water and estimated that, without trade, global water use for cereal production would have been 6 percent higher and irrigation depletion 11 percent. But

it questioned the significance of water saving through virtual water trade not least because much of the trade takes place between water-abundant countries. It also noted that not all water savings can be reallocated to other beneficial uses. Productivity differences between importers and exporters were more important than water scarcity and political and economic considerations would limit the potential of trade to mitigate water scarcity (Fraiture *et al.* 2004).

Further work has placed the analysis of water and agricultural trade on a firmer footing and provided a framework within which some of the more important policy questions can be addressed. It has shown that, overall, trade has helped maintain food security in countries where water availability limits domestic production and plays an important role in buffering the impact of climate variability (including floods or droughts). International trade, combined with increased investment in agriculture, can also provide an important mechanism to offset climate change-induced production decreases in certain regions, and improve access to food that may otherwise not be available through domestic production.

Perhaps the most important effort in this regard is that of Liu and her colleagues (Liu *et al.* 2014) who sought to identify the effect of future water scarcity on food trade and welfare. Their analysis has a number of features. First, it considers trends in 216 separate river basins, acknowledging that water availability is a local phenomenon and not a national aggregate. It also separates rainfed and irrigated agriculture since, if irrigation water supplies are limited, production may be shifted to rainfed locations rather than to other irrigated areas. It takes account of local land availability, possible crop mixes and the effects of other inputs such as labour, capital and energy.[4] This information is then analysed for trade flows and price effects using a generic global computable general equilibrium (CGE) model.[5]

Liu *et al.'s* results suggest that the impact of future water shortages might not be as dramatic as feared, because production lost in water-constrained areas can be transferred to other areas in which land and water will still be available. The net global welfare loss is estimated to be relatively small (US $3.7 billion at 2001 prices) largely due to the reduced efficiency of production. However, at a more local level, water-constrained regions would lose significantly, their losses counter-balanced by gains from regions whose production increased. In the most severely affected regions, South Asia (excluding India), China and India—all areas with high population density and high rates of poverty —the losses are projected to be 9 percent, 3.3 percent and 2.4 percent, of irrigation value-added, respectively. Importantly, this relatively benign outcome depended on a well-functioning global trading system. If trade only substituted for 75 percent of the regional production losses, welfare losses doubled in the hardest hit regions.

4 The model assumes current trends will continue in population and economic growth, water use efficiency in agricultural, industrial and domestic uses, as well as plans for investments in water infrastructure.

5 CGE models are often used to model the impact of policy changes or shocks on a country's economy.

4. INTERSECTIONS BETWEEN TRADE POLICY AND SUSTAINABLE WATER MANAGEMENT

Despite the importance of water in productive activities and the growing prominence of sustainable water management as a global policy goal, remarkably little attention has been given to the trade policy dimensions of water management. This section highlights some of the critical interlinkages between trade policy interventions and sustainable water management. In doing so it assesses the extent to which existing international governance frameworks are supportive of such objectives or whether they might need to be adjusted. The section starts with analysis of international trade rules as they apply to trade in both "real" and "virtual" water including the extent to which countries are allowed to differentiate products in their trade policy based on the amount of water used to produce them. It then focuses on four critical areas of water activity, namely, water distribution services, industrial pollution and wastewater treatment, hydropower generation and agriculture irrigation.

4.1 Trade in Water and the Applicability of WTO Rules

To the extent that water is traded as a good or a product, it is arguably covered by the obligations contained in the GATT/WTO rules. However, given its unique characteristics and vital functions, the extent to which water should be considered as a simple commodity remains debated. The most common and least controversial form of water trade is trade in bottled water or drinks containing water. Transfers of water through the diversion of flows on the other hand are normally regulated through specific international water agreements governing access to, allocation of, and use of water. The extent to which this form of water would be considered as a tradable commodity in the WTO is unclear. The question arose in the context of North American Free Trade Agreement (NAFTA) in a case involving water transfers from British Columbia to the United States through the diversion of water flow. When Canada sought to pass legislation banning such large-scale transfers for environmental reasons, some argued that such measure could interpreted as contrary to the NAFTA provisions prohibiting export bans (WTO 2010). To resolve this issue, Canada, Mexico and the US issued a joint statement in 1993 explicitly excluding water in its natural state from the scope of the regional agreement declaring that water "in lakes, rivers, reservoirs, aquifers, water basins and the like is not a good or product, is not traded and therefore is not and never had been subject to the terms of any trade agreement."[6] In other words, according to the statement, water does not become a good until it is removed from its natural state and transformed into a saleable commodity.[7]

Finally, water could be traded in bulk form—at least in theory—through super tankers, pipelines or giant sealed bags and exported to third countries. The aborted 2004 agreement between Israel and Turkey under which Israel originally agreed to import 50 million cubic meters of water annually over a period of 20 years provides an example of such large-scale projects (Turner 2004).[8] The extent to which such bulk water should be considered

6 1993 Statement by the Governments of Canada, Mexico and the United States. Reprinted in Weiss *et al*. 2005, Appendix D, p. 443.

7 The way in which such an issue would be dealt with in a WTO context may differ however. For example, the WTO Appellate Body concluded in the US—Softwood *Lumber VI* case that a tree and its roots shall be considered as goods if they are "destined" to be traded (Hughes and Marceau 2013).

8 For further details on government-to-government contractual transfers, see also Weiss (2005).

as a good when exported between states remains also uncertain under WTO law.[9] Assuming water would be considered as a good, some have raised concerns about the extent to which governments would be entitled to restrict such trade under WTO law for example by using export restriction or the general exceptions under GATT Article XX (Canelas de Castro 2015). This remains, however, a largely theoretical discussion. From a practical perspective, such trade is unlikely to become economically viable any time soon and, because water is rarely, if ever, privately "owned," would most probably not be conducted in the form of a private export arrangement, making the prospects for government restriction and consequent trade dispute under the WTO almost non-existent.[10] Finally, from a water security perspective, the amount of water that could possibly be exported through such technologies is unlikely to have any significant effect on water security prospects in exporting countries.

4.1.1 Can governments differentiate between products based on their water use?

Beyond the relatively limited amount of trade in real water, a question that may arise is the extent to which WTO law would allow countries to differentiate products based on their use of water resources. Could WTO members tax imports such as agricultural products differently according to the amount, or the quality of water that has been used to produce them, or the impact of the agricultural production practices on water quality? In practical terms, such distinctions, if allowed under WTO rules, could be implemented through a variety of measures like quantitative import restrictions, differential tariffs, labelling requirements or certificates of origin.

Under WTO law, the most-favoured nation (MFN) principle (GATT Article I) states that like products originating from different WTO members should be treated on an equal footing. Furthermore, the national treatment (NT) principle (GATT Article III) implies that equal treatment must be granted to foreign and domestic products once they have entered the market. Since the MFN and NT principles prohibit discrimination between "like products," the question is whether the production and process methods (PPMs) used to produce a certain good—in this case, the use of water—can be considered when defining whether two products are like products or not. In answering this question, one should not only look at the GATT but also at relevant provisions in other agreements such as the Agreement on Technical Barriers to Trade (TBT)[11] or the Agreement on Sanitary and Phytosanitary Measures (SPS).[12,13] These Agreements explicitly recognise the possibility

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9 Under the "Harmonized System"—the international product nomenclature developed by the World Customs Organization and used in the WTO to schedule tariff reduction commitments—sub-heading 2201 makes reference to waters including natural or artificial mineral waters. It also explicitly lists snow and ice, which could support the view that ground or surface water is covered by the Harmonized System. Others have remarked however that such references appear under the chapter "beverages", implying that water is only covered when destined for consumption and not when destined for other purposes such as agriculture or industry, as is usually the case for bulk transfers of water (WTO 2010).

10 One should note however that such an issue might arguably occur in the case of a state-owned enterprise responsible for the purchase or distribution of water.

11 The TBT Agreement refers both to mandatory requirements or technical regulations that imported products need to comply with and non-mandatory standards including labelling schemes. Mandatory regulations are subject to the NT principle and a necessity test. Finally, to the extent possible, such regulations should be based on internationally agreed standards if they exist.

12 The SPS Agreement sets out the basic rules for food safety and animal and plant health standards. It allows countries to set their own standards but says that they must be based on science, that they should be applied only to the extent necessary to protect human, animal or plant life or health and that they should not arbitrarily or unjustifiably discriminate between countries where identical or similar conditions prevail. As with TBT, member countries are encouraged to use international standards, guidelines and recommendations where they exist. However, members may use measures that result in higher standards if there is scientific justification or based on appropriate assessment of risks.

13 For an analysis of the cumulative application of GATT and TBT, see Marceau and Trachtman 2014.

of distinguishing between products based on PPM considerations when applying standards and technical regulations. For measures covered by the GATT, WTO members may also invoke the general exception clause under GATT Article XX including its para. (b) and (g). Such exceptions allow members to apply trade measures as follows:

> Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures: […]
>
> (b) necessary for the protection of human, animal or plant life or health: […]
>
> (g) relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption;”[14]

Jurisprudence tends to show that the provisions of the GATT and TBT agreements may indeed provide space for governments to condition imports on the existence of certain policies maintained by the exporting country.[15] However, such restrictions would still need to comply with the requirements of the TBT Agreement and with GATT Art. XX, including its chapeau, which requires among others things failed efforts at finding negotiated solutions before unilateral measures are imposed and the need to avoid unnecessary trade restrictions. In summary, unilateral distinctions between like products on the basis of water-related PPMs may be authorised under WTO law provided that the regulatory distinction is based on legitimate considerations and is not applied as a disguised restriction to trade. For example, the Sanitary and Phytosanitary (SPS) Agreement allows WTO members to establish food-safety norms requesting compliance with certain water quality standards in the production or processing of imported food products.

One recent example is the US Food Safety Modernization Act (FSMA 2011) the primary aim of which is “to ensure the safety of the U.S. food supply by shifting the regulatory focus from responding to food contamination to preventing it” (US ITA 2015). According to the Act, exporters that do not meet FSMA requirements, which include the quality of water used in the production of food, will be excluded from the US market. While such requirements are perfectly legitimate from a health and sanitation perspective, some are concerned that SPS norms may sometimes act as disguised protectionism and ultimately affect trade and investment flows. In the case mentioned above the US Trade Administration itself highlighted that the new Act would create opportunities for US industry. As growers and processors invest in improved water management as well as food processing, irrigation, packing-house equipment and IT, “U.S. manufacturers and exporters are especially well positioned to offer foreign buyers the equipment and systems that will enable them to comply with this new law” (US ITA 2015).

Besides water contamination, countries might also want to differentiate products such as agricultural commodities based on the amount of water used in the production of these goods. Such an approach, it is sometimes argued, could encourage trade in water-efficient products and ultimately contribute to a better management of water resources globally. Others consider that such measures are illegitimate as *de facto* they result in imposing a particular set of values

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14 Arguably, it is only in exceptional circumstances that water could be considered an “exhaustible natural resource.”

15 See WTO Appellate Body Reports, US-Tuna II (Mexico) WT/DS381/AB/R or United States—Import Prohibition of Certain Shrimp and Shrimp Products (US-Shrimp Turtle), WT/DS58/AB/R.

and social preferences on third countries by trying to define how products should be produced in the exporting countries. Water management, they argue, is very different from CO_2 emissions which affect not only the producing countries but the whole planet. In the case of water, scarcity is largely a localised or at best a regional concern with only limited transboundary effects, reducing the justification for such unilateral measures. Interestingly, from a WTO perspective, the fact that a PPM distinction results in unilateral measures with extraterritorial effect does not necessarily make such regulations WTO inconsistent.[16] As highlighted above, the fundamental question in this case would be whether the regulatory distinction is based on legitimate considerations or whether it results in unnecessary restrictions to trade, an issue that would have to be defined on a case-by-case basis in the event of a trade dispute.

4.1.2 The challenge of defining global standards

As highlighted above, WTO obligations under the TBT Agreement (Art. 2.4) provide that any water use-related requirements applied to imports by the importing country should ideally be based upon internationally agreed regulations and standards. However, as already outlined, the diversity of water use ecosystems and the subjective nature of environmental standards has made it impossible, so far, to agree on indicators to assess management performance or compliance. At their meeting in November 2015, UN agencies simply agreed to disagree on how to monitor the SDG targets for "water use efficiency" and "level of water stress" (UN Stats 2015). A possible measure is whether the percentage of available water actually abstracted from rivers leaves enough to sustain the aquatic environment. While national abstraction levels are sometimes reported as an indicator of sustainability, to be useful as standards they would have to be determined at river-basin level (Richter 2009), a long and complex process. At best, a global norm could be that such limits should be established. The International Standards Organisation (ISO) has established a standard for water footprinting, but clarified that it is not for regulatory use.

A systemic challenge is that any effort to set a global standard for sustainable water management would require information to assess performance. Despite the introduction by UN Stats of a draft standard for water accounting (UN 2012), few countries produce regular national accounts on either a hydrological or economic basis. This is largely due to the lack of data because, unlike many other natural resources, water is often produced and used without commercial intermediaries who might systematically record and report their activities. Data on the availability of water resources and their use is currently declining, although data sets such as the Food and Agriculture Organization's (FAO) Aquastat, which depends primarily on occasional rough estimates, may give the contrary impression. Indeed, one indicator proposed in the context of the SDGs as evidence of effective national water management is the existence of systematic resource monitoring.

4.2 The Role of Private Initiatives

Besides inter-governmental processes, and notwithstanding the definitional and other difficulties, a range of private initiatives to monitor and assess performance on the sustainability of water management and use have emerged at the local (company and community), regional (river), national and global level. Other processes and tools have been developed for use by corporates and/or consumers that could be diffused through trade. Some have proved useful

16 For example in the US-Tuna II case, the PPM distinction based on the method of fishing was not even discussed by the Appellate Body, which condemned the US for not having imposed similar standard on high sea fishing, demonstrating that the unilateral and extraterritorial nature of a measure does not automatically imply that it is WTO inconsistent.

and successful, others may carry significant risks and provide misleading information with negative outcomes for users and limited sustainability benefits.

- *Water footprinting*

  "Water footprinting" has been formally proposed as a standard, initially to require corporates to report the "water footprint" of their product or industry (Hoekstra *et al*. 2011). The footprint has a respectable ancestry as a methodology for estimating the land area required to meet human demands on the biosphere (Wackernagel and Rees 1994) and has been expanded to consider greenhouse gas (GHG) emissions. However, a review of environmental footprint methodologies found that the water footprint had significant limitations and had restricted applicability (Galli *et al*. 2012). The World Wide Fund for Nature (WWF), which helped to develop the concept, has retreated from suggestions that it could be used to monitor water management performance, while still recognising its value as a communications and education tool (Chapagain and Tickner 2012). The United Nations Environment Programme (UNEP) also acknowledges that footprinting remains the subject of much debate (UNEP 2015). Water footprints could, however, provide a useful internal auditing tool for companies to monitor their water use over time.

- *Common standards to control environmentally damaging products: the case of detergents*

  One successful intervention to promote sustainability in water use has been the reduction in production of environmentally harmful detergents and related chemical products. In the 1970s, high levels of phosphates in detergents aggravated water quality problems in many rivers and lakes. Due in part to community pressure, the global industry developed and introduced less harmful alternatives whose use is now being imposed through government regulation. But it has been a slow process. While Japan introduced controls in 1980, restrictions were only formally adopted in parts of the USA in 2010 and in the European Union (EU) in 2012. However, the products are now widely available through the global industry and, in this instance, pressure to adopt specific environmental improvement through product standards is having a significant impact that can be measured in terms of water quality.

The example of detergent standards shows that consumer information and campaigns can have a positive impact on sustainable water management. However, without a structured framework, product claims and labels can be misleading, and sometimes trade distorting, if they provide incorrect information or fail to disclose key risks. From a policy-making perspective, initial enthusiasm about the possibility of providing public information about the water-related impacts of different products has given way to more limited aspirations, with organisations such as WWF choosing *not* to encourage product water footprint information to be provided on labels (Chapagain and Tickner 2012). This is due in some measure to unfortunate experiences when attempts were made to use water footprint information (in one case allied to campaigns about the alleged impact of excessive "airmiles" of traded goods). The case of the Kenyan flower industry illustrates the difficulty of applying water footprinting standards to socially determined water use preferences in exporting countries (see Box 2 below). The history of the bottled water industry also demonstrates that, unless regulated in terms of agreed standards, labels will continue to be marketing tools rather than sources of reliable information (APHA 2009).

Experts have also underlined the need for caution and a realistic and holistic approach to the use of water footprint applications and data in the context of regulation and trade

policy. Chapagain and Tickner (2012) argue that calls for reform of trade frameworks using water footprinting data need to take account of the broader environmental, economic and social issues related to water use. While the ISO has developed an international standard for the use of water footprints (ISO 14046:2014), the organisation notes that the standard is not intended for regulatory use, and in the application of the standard, "societal, environmental, legal, cultural, political and organizational diversity should be considered, as well as differences in economic conditions" (ISO 2014).

Box 2: Kenya's floriculture: water impact, footprints and boycotts

Horticultural exports from developing countries to North America and Europe have been criticised because of the environmental costs of air freight (Chi *et al*. 2009) and, more recently, for their water consumption. Around Lake Naivasha, Kenya, there is extreme competition between rural people for land and water resources. Critics believed that local flower production aggravated water shortages and environmental stress and campaigned for a boycott of Kenyan flowers. What was not explicitly acknowledged in the debate was that water use for cash crops and subsistence at the expense of the lacustrine environment might reflect local social preferences.

While Kenya's greenhouse horticulture is both water efficient and productive, generating far more livelihoods and income per unit of water than most other rural water uses, the campaigns made horticulture more risky and production and employment fell. Policy advocacy, through corporate accountability mechanisms, used simplistic water accounting measures to promote one particular policy preference, despite its adverse impacts on the communities concerned.

There is no doubt that more effective governance is needed to achieve agreed levels of water abstraction and environmental protection in Lake Naivasha. Choices need to be documented and presented in an understandable form and context-specific water accounting could provide valuable guidance to policy makers and communities alike. But, at least initially, water accounting and water footprints were used to support external campaigns rather than to meet local needs and arguably damaged both (summarised from Muller 2012).

4.3 Water Supply and Sanitation Services: GATS, Public Procurement and Investment Agreements

Access to safe water for human consumption is a benchmark for development. It has been adopted as a sustainable development goal (SDG 6) as part of a framework that is expected to guide development planning for the next 15 years. The requirement is not just for adequate volumes of water but also for water of adequate quality. Large concentrations of humans generate large quantities of human waste which, if it enters water sources, can cause disease as well as environmental damage. The provision of safe water and the related removal and disposal of human waste and waste water has therefore become an important linked set of services that meets commercial and institutional requirements as well as domestic needs. Trade has a significant role in the provision of these services. The first contribution is by making available the goods and services required to build, operate and maintain the infrastructure required for the provision of water supply and sanitation services. The second may be for foreign companies to provide those services.

A range of trade issues are relevant. There are generic considerations around market access for the import of goods required for water supply, such as tariffs, and intellectual property protection. Since water services are still overwhelmingly provided by public agencies, rules about government procurement, local content, market access for foreign service suppliers and post-

establishment rules around the protection (and regulation) of foreign investment are important. Finally, the private provision of full-cycle services by foreign firms is particularly contentious.

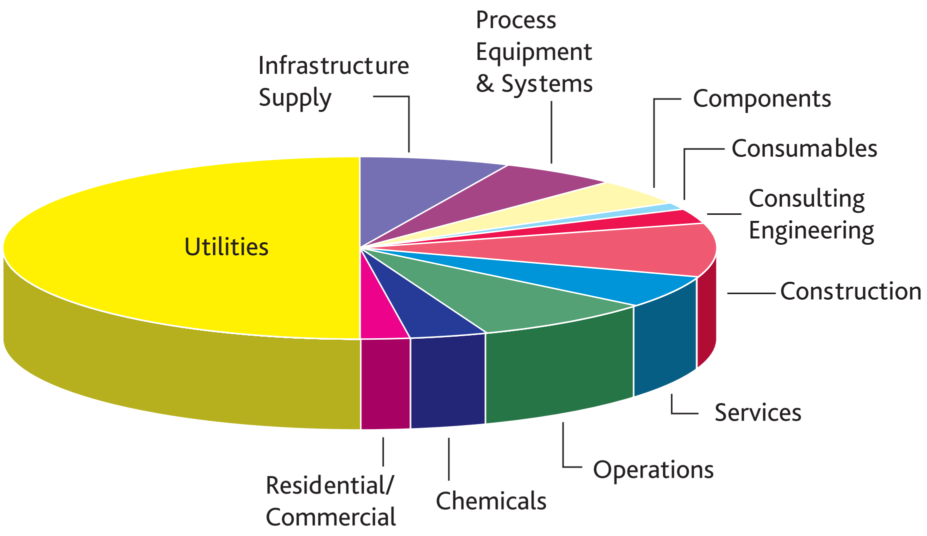
4.3.1 Water supply and sanitation services—the nature of the market

While often considered to be a prototypical public service, there is no technical reason why water services cannot be undertaken by private providers or supplied by a foreign provider established in the domestic market. However, public provision (through utilities, public companies or direct government provision) still accounts for more than 90 percent of water supply and sanitation services.[17] The mixed nature of the sector makes it difficult to estimate the size of the global water services market. One commercial source estimates it at approximately US$375 billion annually, consisting of:

Utility services revenue	US$185 billion
Municipal	US$145 billion
Private	US$ 40 billion
Construction, engineering, technical services	US$100 billion
Equipment, technology, chemicals	US$ 80 billion
Residential water treatment	US$ 9 billion

However, it is likely that this understates public provision, which falls under a range of different budget lines. The same source also provides an indicative breakdown of the segments of the global water industry (see Figure 2).

Figure 2: Global Water Industry Segments, 2015



Source: S-Network Global Water Indexes website (www.snetglobalwaterindexes.com). Accessed November 2015.

17 See. 'FAQ: World Bank Group Support for Water and Sanitation Solutions'. World Bank website: http://www.worldbank.org/en/topic/water/brief/working-with-public-private-sectors-to-increase-water-sanitation-access. Accessed 28 July 2016.

4.3.2 Private provision of water supply and sanitation services

The option of private provision of water supply and sanitation services presents a particular challenge of harnessing the benefits of efficient private investment with the need to regulate to ensure social and environmental needs for water are met, including access for the poor.[18] Where the service provider is foreign, trade and investment rules governing the relationship between the investor and the government add a further layer of complexity.

It is often suggested that supply gaps in poorer countries may be met through private provision. However, private provision on its own is unlikely to unlock investment flows where basic affordability at user level is the primary constraint in poorer communities. There are also challenges of affordability at utility and national level. Major water resource developments to ensure reliable availability are usually only financially feasible, even in middle-income countries, with long-term low-interest public finance. Network distribution infrastructure is also expensive; the cost of building and operating sanitation and wastewater drainage and treatment infrastructure, which is essential to manage the quality of water resources, is often higher than that for the supply of water. A substantial economic base is needed to support such investments and their operation.

In large cities the establishment and management of complex, capital-intensive technical systems with many users dispersed over a wide area requires a high degree of technical expertise and performance-oriented institutional arrangements, whether undertaken by public or private organisations. The monopoly nature of the network infrastructure used and the social dimensions[19] of the underlying service require effective public regulation that raises difficult policy issues, especially when services are privately provided. Prices have to be regulated, basic needs have to be met and subsidy systems designed. Performance of private providers is keenly monitored and their notional "social licence to operate" is often challenged. For regulators, it is difficult to determine fair rates of return for full-service private providers who control all four profit centres of the activity—providing technical services, construction and equipment supply, operations and finance.

For these reasons, private provision of water services and, in particular, the idea of committing to provide market access for foreign companies to provide water supply services, has been controversial. In developed countries, it is sometimes proposed as part of a broader political agenda to reduce the size of the public sector. In developing countries, it is often associated with the imposition of structural adjustment conditions. Concerns have been raised that governments committing to provide market access for foreign companies to provide water supply services under the WTO General Agreement on Trade in Services (GATS) would be "locked in" and prevented from reversing liberalisation if its results proved harmful (Hilary 2003). Further concerns have also been expressed in relation to the commodification and private control of natural resources (Barlow 2001).

The WTO has responded to clarify some of the issues (WTO 2014). The GATS provides a framework containing general rules applying to all services and service suppliers, such as the most-favoured-nation obligation (Art. II). It is complemented by individual country schedules where each member designates the sectors in which it undertakes specific

18 From a political point of view, private supply of sanitation services tends to be less controversial than private supply of water distribution services. It seems that the idea of a private company taking care of dirty water is politically more acceptable than that of the same private company dealing with clean water. However, from the perspective of particular need for heavy investment, regulatory stakes and application of international trade law, both types of water services raise very similar issues and are therefore treated together in this section.

19 Water and sanitation are often considered essential services and have been identified as a human right through Resolution 64/292 of the UN General Assembly, adopted on 28 July 2010 (UN 2010).

commitments on market access (Art. XVI) and national treatment (Art. XVII), subject to possible limitations and conditions. Despite the existence of similar principles between the GATT and the GATS, the agreements differ as a result of the mixed approach adopted by the GATS. This approach allows for national treatment, market access or other specific obligations to apply only to those service sub-sectors nominated by a member, whereas MFN obligations and transparency requirements (Art. III) apply "horizontally" across all sectors in a similar manner to GATT.[20] Consequently, trade liberalisation provisions only apply to a service sector which has been specifically designated by the member, prompting certain experts to call GATS an opt-in agreement.

Water-related services fall under the scope of the GATS, but are not identified as a separate category. While sewage services are listed under environmental services, there is no entry for water distribution services in WTO classification tools. Since such tools do not define the scope of the GATS and are for voluntary use only, the absence of an entry does not in itself prevent countries from undertaking commitments in this area. The GATS allows members to either maintain the service as a monopoly, public or private; to open the service to competing suppliers, but to restrict access to national companies; to open the service to national and foreign suppliers, but to make no GATS commitments on it; or make GATS commitments covering the right of foreign companies to supply the service, in addition to national suppliers (WTO 2001).

In practice, some 50 WTO members have undertaken commitments in water and sewage services, sometimes with specific conditions attached (Cossy 2010). For example, some limit the commitment to advisory and consultancy services (i.e. not the provision of the service itself). Others exclude public networks, with the provision of the service allowed only to private customers. In contrast, no country so far has made GATS commitments on water distribution services[21] but trade liberalisation in this area has been raised as an option by some members in the early stage of the Doha negotiations—a move which proved highly controversial.

Under the GATS, specific commitments and the MFN obligation do not apply to government procurement of services, even though in cases of public-private partnerships, the definition of what constitutes government procurement might not always be clear. Article XIII.2 of the GATS establishes a multilateral negotiating mandate on the procurement of services but these negotiations have made very limited progress so far. Several services-related commitments, including some water-related ones, are however covered under the plurilateral Agreement on Government Procurement (GPA) implemented among 45 WTO members. The text of the Agreement establishes rules requiring that public procurements are open to foreign suppliers and that these suppliers are treated under fair and transparent conditions of competition. However, these rules do not automatically apply to all procurement activities of each party but only to the sectors listed in the country-specific schedules. Furthermore, only those procurement activities that are carried out by covered entities purchasing listed goods, services or construction services of a value exceeding specified threshold values are covered by the Agreement.

Finally, water-related services have also been covered under regional free trade agreements (RTAs). In some instances, such agreements have adopted a so-called "negative list" approach where all services sectors are included by default unless explicitly excluded (in contrast with the "positive list" approach

20 Members are allowed, however, to maintain a measure inconsistent with the MFN principle provided that such a measure is listed in, and meets the conditions of, the Annex on Article II Exemptions.

21 If such commitments were made however, they would not affect the right of governments to set levels of quality, safety, price or any other policy objectives as they see fit, and the same regulations would apply to foreign suppliers as to nationals.

of the GATS where commitments only apply to sectors listed explicitly). In these cases, several exclusions have focused on services provided over collective networks. Some members have explicitly excluded water distribution services and, less often, sewage services. For example, Mexico has systematically excluded public utility services (including telecommunication, transmission, water and energy services) from its free trade agreements with the European Free Trade Association (EFTA), the EU or Japan. In other cases, though, no particular reservations have been listed for water-related services.

Concerns have also arisen around the implications of bilateral investment agreements. These usually oblige the host government to provide foreign investors with a negotiated degree of market access (pre-establishment obligations, the issues associated with which are similar to those under GATS) and a number of guarantees, including of fair and equitable treatment, once the investment is in place (post-establishment). In particular, there have been concerns that unless specific provision is made, investment agreements that provide an umbrella for foreign private provision can restrict national ability to regulate water supply in the public interest after an investment is made.

4.3.3 Water supply services—issues and evidence

Overall, existing empirical evidence on private provision of water supply services tends to suggest that results have been mixed, with increased efficiency of private operators not always mobilising finance or serving more people (Marin 2009). Private investments in provision of water supply is one of the few water-related areas in which there has been significant international investment litigation with 21 reported cases in 20 years (Chaisse and Polo 2015). The record of litigation reported by Chaisse and Polo is mixed. Some decisions support concerns about private sector provision being difficult to roll back, as a result of investment agreements. The Argentinian and Bolivian governments were held liable for contract cancellation due to disputes, linked to political opposition to privatisation. In the Philippines, international tribunals overrode the decisions of local courts in favour of the concessionaires. However, in other cases where contractors have failed to make agreed investments for service expansion and contracts have been cancelled by governments for poor performance, tribunals have found in favour of the government concerned. In Maputo, Mozambique, a company that was performing poorly simply abandoned its contract. In Dar es Salaam, Tanzania, two international tribunals differed on technical culpability but agreed that the private provider had performed poorly and awarded no damages for contract cancellation.

An earlier review of the impact of liberalisation of environmental services (including water and sanitation services) recommended that developing countries with weak regulatory capacity should consider sequencing liberalisation of their services sector with strengthening of their regulatory capacity and institutions to ensure they could capture the benefits of that liberalisation and contribute to social objectives including poverty alleviation (Kirkpatrick 2006).

Over the past decade, developed-country multinationals have tended to withdraw from full-service contracts to focus on more targeted interventions, such as the development and operation of specific plants. Veolia, one of the market leaders in this field, explained when they terminated their contract in Morocco that this was part of a strategy to focus on higher added value activities (Veolia 2013). While the company still maintains some overall concessions, its business focus is increasingly to support industry and provide specialised services to municipalities, current activities (Veolia 2015) including:

- 4,532 drinking water production plants managed, 94 million people supplied with drinking water

- 3,442 wastewater treatment plants managed, 62 million people connected to wastewater networks.

The retreat of global companies like Veolia from full-scale service privatisation is accompanied by continued civil society opposition to privatisation. Proponents of the re-municipalisation of services claim that 180 locations were re-municipalised between 2000 and 2014, the majority in developed countries (Lobina *et al*. 2014). Interestingly, World Bank data suggests that as market share (measured in the number of people served) of developed-country service providers plateaued between 2002 and 2007, developing-country providers of water supply and treatment services gained market share. Some of these providers were providing services locally, as well as in other countries within their region (Marin *et al*. 2010).

There is also some concern around local content requirements (LCRs) attached to investments. LCRs, some kinds of which are prohibited under WTO agreements, are in fact frequently used by both developed and developing countries to ensure that investment, including in large infrastructure projects, generates domestic benefits, including employment. Their impact on these objectives is ambiguous, although they can in some circumstances raise the costs of projects, including water-related infrastructure (Hufbauer *et al*. 2013).

Finally, access to intellectual property for the technologies involved in water supply services is less contentious. Water services provision requires access to technical expertise and equipment in which significant intellectual property is often embedded. However, many core technologies in the water sector are generic and there are alternatives. Although there are niches such as improved membranes for desalination, a venture capital firm that focuses on the sector finds innovation opportunities coming from beyond the sector as in the water utility market, "end users tend to be risk averse and often each want to run their own trials that may extend over a number of years" (Lal 2015). In this context, multi-sector application technologies offer a bigger opportunity and a quicker time to market and may eventually benefit from the potential offered by the scale of the utility business (Lal 2015).

4.4 Industrial Pollution and Wastewater Management

The disposal of waste from economic and domestic activities is one of the most extensive non-consumptive uses of water resources. This has historically been considered as pollution rather than as a deliberate use of water. However, emerging practice recognises that hydrological systems can remove and purify a limited quantity of pollutants without damaging the aquatic environment. This is an important economic function that enables industries and human settlements to minimise the cost of disposing of their waste streams.

The effective and sustainable exploitation of this environmental service requires the determination of the capacity of the receiving water body to absorb impacts from waste discharges and the regulation of the discharges within these limits. This then enables regulatory standards to be set for the treatment of individual streams of industrial and municipal wastewater—the industrial environmental service that complements and sustains the natural environmental service.

Trade has an obvious role to play in the provision of the specialised goods and services required to treat, in particular, industrial wastewaters as well as to determine the capacity of water bodies to dispose of waste. Environmental regulations can encourage exports in environmental goods such as those used in the water sector (Sauvage 2014) but wastewater and its treatment also have wider trade implications, including issues relating to technical barriers to trade and sanitary standards.

4.4.1 Wastewater management services—the nature of the market

Waste discharges from manufacturing and mining industries as well as domestic wastewater flows are usually focused at single locations and are referred to as "point-source pollution." Water quality impacts from agriculture are also a serious problem in many jurisdictions; these are typically generated across extensive areas, referred to as "diffuse pollution," and are more difficult to control. Diffuse pollution also often runs off from urban areas that lack adequate wastewater and storm-water infrastructure.

The nature of point-source pollution varies greatly according to the industrial processes involved and often requires specialised treatment processes to manage. Municipal wastewater with a high proportion of domestic wastes is typically simpler to treat and generic processes can be used. The expansion of water supplies, particularly in densely populated urban areas will generate increasing volumes of wastewater and wastewater treatment requirements will thus grow rapidly with increasing urbanisation.

Where full household services are provided, the cost of wastewater management is often higher than the cost of water supply. The global aspiration to halve the proportion of wastewater that is untreated, as proposed in the sustainable development goals, will require substantial investment—one early estimate suggests that US$56 billion will be required annually to 2030 to meet SDG goal 6 (UN Water 2014) in addition to existing investment flows. The size of and trends in the industrial wastewater treatment sector are more difficult to determine since, for many industries, the priority is to reduce waste streams rather than simply to treat them. As an example, the global chemical industry reported a 35 percent reduction in the use of water per tonne of production in the decade 2003–2013 (ICCA 2015). This efficiency gain will have reduced the wastewatertreatment requirement. Similarly, in agriculture, the priority is to reduce the flow of waste into water resources rather to treat it.

4.4.2 Trade-related challenges emerging from wastewater management issues

Wastewater management requires access to and investment in technology as well as institutions to set standards and enforce regulatory protection. Since waste management often involves specialist processes (more so than for water supply), it is often supported by technical service providers who may also be involved in the operation as well as provision and construction of process plant. This raises issues of access to markets for combinations of goods and services. In relation to services, one concern is that extensive foreign service provision may crowd out domestic technical capacities and ultimately reduce independent national expertise. On the positive side, provision of foreign services may contribute to bringing in adequate expertise in situations where the relevant independent national expertise is too weak or non-existent.

In relation to the goods required, wastewater treatment equipment may be composed largely of generic components, even where specialised processes are involved. There is also a wide variety of treatment processes available; the challenge for clients is usually to choose between technological options and then select from the available alternatives rather than the cost of the intellectual property concerned. Trade in services and goods can facilitate this access to state-of-the art technologies and generic issues relating to their market access have not been identified as a particular concern.

Box 3: Promoting market access for wastewater treatment goods, services and technologies: The EGA and TISA negotiations

WTO negotiations on the reduction and potentially elimination of tariff and non-tariff barriers to trade in environmental goods and services (EGS) have been struggling for several years. In the absence of a clear definition of environmental goods, members have considered different approaches, such as defining a list of goods for deeper liberalisation, reducing tariffs on a temporary basis in the context of specific environmental projects, engaging in a request and offer process or a combination of those different approaches. At the core of the controversy is the concern about multiple-use products that have both environmental benefits but also non-environmental end-use. In early 2015, however, a group of 14 WTO members including the EU, US and China announced their plan to take those negotiations out of the WTO and negotiate a plurilateral deal based on an initial list of 54 products developed by the Asia-Pacific Economic Cooperation (APEC) group. Assuming that the so-called Environmental Goods Agreement (EGA) can mobilise a critical mass of countries, the proponents envisage bringing the deal back to the WTO in members' schedules and applying the tariff cuts on an MFN basis to the rest of the membership.

In the context of those negotiations, several goods related to wastewater treatment have been identified as being potentially of environmental benefit and may be included in a final EGA list, while others might be added in future negotiating rounds (see ICTSD 2015a). These include goods ranging from power, pumping, transmission, process and automation equipment to consumable chemical and analytical materials. Some are clearly dual-use products, with application in both industrial production and water treatment. Overall tariff protection tends to be already low on most of these products. Many of these technologies are also generic technologies with little intellectual property protection. In specialised fields (notably automation and process design and control for larger installations), developed countries still have significant advantages and in a few frontier fields, such as desalination, access to the best technologies is still proprietary and protected. Services are not yet part of the EGA negotiations but there are strong links, with many environmental goods delivered though providers of services.

In the meantime, 25 WTO members (including 14 developing countries but excluding China) are negotiating a plurilateral Trade in Services Agreement (TISA), which includes environmental services, although it is not clear if water services are being discussed (ICTSD 2015b). Water-related services include a wide range of generic functions such as design and construction as well as the sector-specific provision of operational water supply and sanitation services. The classification of environmental services does not include however a systematic review of those that are water related, making it difficult to assess the potential impact of their liberalisation.[22]

22 For further details, see Steenblik *et al*. 2005 regarding goods and services in the water and wastewater treatment sub-sector.

Overall, there is little evidence of much controversy about the trade in goods and services related to wastewater management. It is rather in relation to the wastewater treatment standards that have been set and applied to imported food products that issues have arisen. While it is reasonable for importing countries to require that products entering through trade should not cause health risks, the cost of meeting high standards may disadvantage industries exporting to demanding jurisdictions.

As with the concept of water scarcity, desired levels of environmental protection have both objective and subjective dimensions. The variation between countries both in the standards set for water quality and the extent to which they are actually enforced reflects, in part, different social priorities and preferences. These standards may become contentious in a trade context if countries seek to impose water quality standards on the production and processing of imported goods (see US Food Safety Modernization Act example in section 4.1.1 above).

While food safety is a critical concern, and irrigated crops have been associated with disease outbreaks, trade measures can be abused. As an example, a food-poisoning outbreak in Germany in 2011, which killed 54 people, was initially attributed to contaminated cucumbers produced, under irrigation, in Spain and imports were restricted. It was later found that the outbreak originated in seed sprouts, produced in Germany, eaten as salad. Spanish farmers successfully claimed compensation of over Euro200 million for lost export sales as a result of the initial incorrect attribution of cause (Karch *et al*. 2012).

4.5 Hydropower: Environmental Standards and Financing

The production of hydroelectricity from flowing water is another major economic use for water resources with significant trade implications. Water is not directly consumed in the production of hydropower although some additional evaporation and seepage may occur from reservoirs that store water to maximise power generated and enable generation to be flexible. Hydropower is also a renewable source of energy, effectively harnessing the solar energy which drives the hydrological cycle. Since electricity can be transported economically over long (and increasing) distances, trade in electricity is expanding rapidly. The particular characteristics of hydroelectricity make it an attractive source for such trade. Where hydropower is generated on rivers shared by more than one country, there is a further incentive for regional cooperation and trade. Although Europe and North America are the regions that have developed the largest proportions of their hydropower potential, governments from these regions have often opposed the expansion of large-scale hydropower in other regions on environmental grounds. Conditions introduced in climate financing instruments, for example, have arguably discriminated against large-scale hydropower, notwithstanding the fact that it remains the world's largest source of renewable electricity.

4.5.1 Hydropower generation—the nature of the market

An estimated 16.2 percent of the world's electricity in 2013 came from hydropower, accounting for 13 percent of the OECD's electricity production in 2013, against 5.6 percent from other renewables (IEA 2014). Hydropower can be an important component of countries' energy mix because, unlike most other renewable sources, it offers a flexible and predictable source of power that can be produced on demand, helping to manage variations in supply from other sources. By storing water in reservoirs, hydropower systems effectively store energy, the only large-scale energy storage technology in widespread use. This property is also applied in pump storage systems which store low value "off-peak" electricity from coal, nuclear and increasingly solar and wind sources and

release it for use at peak times, when it is far more valuable.

Because hydropower depends on topography its potential is unevenly distributed. It is the major source of electricity (> 50 percent) in countries with favourable conditions such as Austria, Canada, New Zealand, Norway, and Switzerland and developing countries from Angola, Brazil and Colombia to Venezuela, Zambia and Zimbabwe (World Bank 2015). According to the International Renewable Energy Agency: "Where untapped economic resources remain, these mature technologies can provide some of the cheapest electricity of any source" (IRENA 2015). At 5 US cents per kWh, (IEA *et al*. 2010) hydropower's average levelised cost is not only the cheapest of all sources but its commercial value (as reflected in electricity prices on spot markets) is greater, due to its demand-responsive energy storage capability, and its carbon neutral status. There is still a significant potential for further development. On a conservative estimate, only one-third of the world's potential hydropower capacity has been developed, mainly in Europe (World Energy Council 2015).

Electricity is increasingly being traded between countries through regional power pools and bilateral arrangements. Cross-border trade capacity in Europe trebled (from 10GW to 30GW) between 1995 and 2011 (OECD 2013) while in 2011 12.6 percent of electricity production was traded across national borders, although the contribution of hydropower to this is not given. The development of hydropower projects is capital intensive (although once built, the power is produced with minimal operating costs). The feasibility of projects in smaller developing countries is thus often determined by the quality of the offtake agreements that they can achieve with their neighbouring-country customers. The trade arrangements vary, from long-term power purchase agreements to auction-based prices in regional power pools with prices often set on an hour-by-hour basis.

The sale of hydropower into regional networks raises questions about the impacts of public subsidisation of national suppliers to the disadvantage of providers in other jurisdictions; thus solar and wind power subsidies in Germany are reported to be undermining the sustainability of Swiss hydropower.[23] A further challenge in this regard is to distinguish the sectoral components of multi-sectoral projects where dams that generate hydropower provide flood control, irrigation and water supply functions as well (GSI 2009).

4.5.2 Trade and investment challenges in hydropower

The primary challenge for hydropower development lies in its initial finance requirements, which means investment-related conditions are critical for its successful implementation. Aid for Trade to help develop regional power trading agreements that in turn unlock finance could make a significant contribution in developing countries.

The availability of the technologies and associated investments required to develop hydropower is also supported by trade. While capacity for civil construction is generic and widely available, there is a limited pool of technical service providers with the required design and supervision capabilities for large projects and an even smaller pool of suppliers for the major hydro-mechanical equipment.

There is ample evidence that environmental concerns have impacted on the ability of developing countries to expand their hydropower potential for both domestic and export purposes. Support for hydropower projects from the United Nations Framework

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23 See "German Sun Beats Swiss Water" by Ray Smith at: http://www.ipsnews.net/2013/08/german-sun-beats-swiss-water/ . Accessed 29 July 2016.

Convention on Climate Change (UNFCCC) Clean Development Mechanism, a market for carbon credits, has been challenged on the grounds that they do not need additional finance to be viable but also that they receive government subsidies (Spalding-Fecher *et al*. 2012). The EU also imposed, as an additional requirement on all large hydropower projects funded from its carbon credit market, that the guidelines of the World Commission on Dams be applied. Those guidelines were not adopted by the World Bank because many of its member countries rejected them. The 2013 US Budget Act instructed US delegates at global development institutions to oppose loans for large dam construction (Briscoe 2014). Insofar as these conditions have constrained the construction of hydropower that could have been traded, the conditions contribute to unbalanced markets for trade in the goods and services related to hydropower generation, and for the energy itself (see the example in Box 4). Reluctance to support large-scale hydropower investments has also affected environmental goods negotiations (see Box 3) as the negotiations focus on the liberalisation of small hydropower equipment only. Since the expansion of renewable energy production is part of a key SDG target (7.2), the balance between the environmental, social and economic impacts of hydropower development needs to be reviewed.

Box 4: Environment vs development? The case of large-scale hydropower

In their choice of projects, donor governments have arguably given excessive weight to environmental standards that are not based on international standards and restricted the deployment of large-scale hydropower through financial conditions attached to development finance. This has in some cases constrained the energy options of developing countries and potentially distorted their trade of, and investment in, energy related goods and services.

An example of the impact of such efforts is the history of Uganda's Bujagali hydropower project (Muller 2014). Intended to double Uganda's electricity production and reduce its dependence on hydrocarbon imports, the project was delayed for more than five years, primarily by challenges to development finance organisations that also blocked finance channels. Claims that the project would prejudice downstream water users or local residents were unfounded since water releases were already controlled by an existing weir and power station upstream. Social disruption was minimal with only three families having to be relocated from the dam site.

Delay to the project, identified by the International Monetary Fund (IMF) as critical to the country's economy, had a substantial impact on employment and poverty. Resulting electricity shortages were estimated to have reduced gross domestic product (GDP) by as much as 2 percent per year over five years while fuel and energy expenditures were substantially higher than they needed to be. The documented poverty increases that resulted from the additional unemployment caused by industry shutdowns are associated with a significant increase in under-5 child death rates over the period, given the documented relationships between electricity supply, GDP, unemployment, poverty and child mortality in Uganda (see IMF 2007, Ssewanyana and Younger 2008, and UBOS 2013).

There is clearly a policy tension between the social and environmental impacts of large-scale hydropower projects and their economic and development benefits that needs to be balanced. Multilateral development institutions such as the World Bank, which are often asked to fund hydropower projects, are attempting to strike an appropriate balance between their environmental, social and economic risks and the development benefits that they can bring as a flexible source of renewable energy (World Bank 2009).

4.6 Agriculture

Many food production activities, including agriculture, aquaculture and livestock, depend to a large extent on adequate and reliable supplies of clean water. The impact of those activities, both on water use and on water quality through pesticide and fertiliszer run-off and livestock effluent, is considerable: Steffen *et al*. (2015) estimate that phosphorus and nitrogen flows into the environment, in particular from the use of fertilisers, has already reached the planetary boundary. This section focuses on one of the most widely discussed issues at the intersection of agriculture, water and trade policy: the use of subsidies to agricultural irrigation and their relationship to international trade rules.

4.6.1 Subsidies for operating costs of agricultural irrigation

It is widely believed that subsidies for irrigation contribute to the overuse of water or, at the least, to its misallocation. However, in the many developing countries where the majority of the population is still rural, support for agriculture as the main economic activity and source of food must reflect its social dimensions. Government agricultural policies and support programmes often aim to sustain rural livelihoods as well as to improve productivity and this is reflected in policies for water use in agriculture. The immediate consideration from a trade policy perspective is the extent to which public support for irrigation and related activities is consistent with trade rules; the longer-term concern is whether trade policy could play a role in supporting more sustainable use of water in agriculture.

Agricultural subsidies are subject to trade rules of the WTO Agreement on Subsidies and Countervailing Measures (ASCM) and the Agreement on Agriculture (AoA). Both agreements are cumulative and simultaneously applicable unless there is an explicit exclusion.[24] According to the ASCM, a subsidy must (a) entail a financial contribution or revenue foregone, (b) it must be made by a government or any public body within the jurisdiction of a member country, and (c) it must confer a benefit. To fall under the full disciplines of the ASCM agreement, a subsidy must be specific—which excludes most consumer subsidies. Specific subsidies are divided into two categories: those that are prohibited, namely subsidies contingent on export performance (i.e. export subsidies) and subsidies granted for the use of domestic inputs over imported goods (local content subsidies). And those that are allowed but potentially subject to challenge (actionable subsidies). Any WTO member can initiate remedial measures if it can prove that actionable subsidies cause serious prejudice to its interests, either because it displaces imports or exports, because it generates significant price suppression or because it results in an increase in world market share of the subsidising country. In addition to a challenge based on serious prejudice, a subsidy can be countervailed if it causes injury to domestic producers.

24 For example while export subsidies are prohibited under the ASCM, certain WTO members still benefit from export subsidies entitlements in their schedules of commitments under the AoA allowing them to have recourse to such instruments. The December 2015 WTO Nairobi ministerial decision on agricultural export subsidies addresses this issue by imposing a standstill and gradual phase out of such entitlements.

Under the AoA subsidies are divided into different categories or boxes, reflecting a different potential to distort trade. Measures that are considered non- or, at most, minimally trade distorting fall under the so-called green box as described in Annex 2 of the AoA and are not constrained by the WTO disciplines. Such measures include among others infrastructure (e.g. electricity reticulation, roads, water supply facilities, dams and drainage schemes) environmental payments, Research & Development (R&D) or extension services. They essentially refer to measures that are decoupled from production and designed to serve broader public policy objectives.[25] By leaving the amount of such support unconstrained, the Agreement implicitly encourages members to adopt policies that fall under this category. Other subsidies fall either under the blue box which includes production-limiting programmes or the amber box which includes payments linked to production such as market price support, input subsidies or certain insurance schemes. Both blue and amber boxes are subject to a ceiling negotiated during the Uruguay Round and reflected in members' specific schedules of commitments. However, regardless of the specific entitlements of each individual member, amber box payments not exceeding a *de minimis* level (fixed at 5 percent of the value of production for developed countries and 10 percent for most developing countries[26]) are allowed for both product-specific and non-product-specific amber box support. Finally, as an exception to the general rule limiting input subsidies, developing countries are allowed to provide input and investment subsidies without any limitation under Article 6(2) if these specifically target low-income or resource-poor producers.[27] In summary, any subsidy provided beyond the limitations established under the AoA can be challenged. In addition, any actionable subsidy—as defined under the ASCM—can be challenged or countervailed if it causes injury to domestic producers even if it does not exceed the AoA ceilings.

Overall, subsidies to build irrigation infrastructure and facilities are likely to fall under the green box. As arguably non-specific subsidies, they may also be difficult to challenge under the ASCM. However, the treatment of operating cost subsidies for this infrastructure could be more problematic. Subsidies "to inputs or operating costs, or preferential user charges" related to infrastructure would fall outside the green box exemption. As input subsidies they may still be allowed in an unrestricted manner under Article 6(2) if they are generally available to low-income or resource-poor producers. Operating cost subsidies to other recipients would however be limited to the maximum ceiling negotiated during the Uruguay Round.

India illustrates some of the challenges posed by these subsidies. In India, there is only minimal control over the use of groundwater, and the resource can be cheaply accessed by individuals (demonstrating the often non-excludable nature of common-pool resources). But where administrative regulation has failed to curb overuse, a successful intervention introduced an electricity subsidy targeted at irrigation that allowed electricity use for pumping to be better controlled. Here, trade policy and sustainable water management are potentially in tension (see Box 5).

25 For more details see Annex 2 of the AoA.

26 In the case of China, this *de minimis* level is capped at 8.5 percent of the value of production.

27 Other categories include export subsidies which have recently been prohibited by the December 2015 WTO Nairobi ministerial decision over a certain transition period (see WT/MIN(15)/45).

Box 5: India's electricity subsidies for irrigation—trade distortion or miracle cure?

It is often difficult to find water management instruments that can achieve sustainable water use in places such as South Asia where groundwater pumping by millions of smallholder farmers is over-exploiting the water resources on which their livelihoods depend. Formal regulatory control of the millions of boreholes that have been drilled in arid parts of India has proved to be almost impossible. As water depths increased (and oil prices rose), farmers switched from diesel to electrically-powered pumps, exploiting subsidies for domestic consumption. In many places, this overtaxed the electricity distribution systems, leading to frequent blackouts.

To manage over-exploitation of groundwater and restore the viability of urban and domestic electricity supplies, the Gujarat state's *Jyotirgram* scheme built separate agricultural electricity supply grids. Supply was subsidised and time-based power rationing introduced, guided by water availability. This controlled both power and water use, which dropped 37 percent between 2001 and 2006:

> *Jyotirgram* pioneered real-time co-management of electricity and groundwater of the kind found nowhere else in the world. It created an on-off groundwater economy that is amenable to vigorous regulation at different levels. Arguably, there is nothing that the IWRM instruments—water laws, tradable groundwater rights, groundwater cess—can do that *Jyotirgram* cannot do better and quicker. (Shah 2010)

These electricity operating cost subsidies, expressly targeted at agriculture, are "subsidies to inputs or operating costs, or preferential user charges." As long as they are provided to "low-income and resource-poor producers," they are exempt from reduction commitments under Article 6(2) of the WTO Agreement on Agriculture. However, they may also be provided to other users, and since irrigation and electricity subsidies are the largest elements in Delhi's declared subsidy package, they could in theory be vulnerable to challenge under the WTO.

Overall, India's agricultural electricity use subsidies referred to in Box 5 have been notified as Article 6.2 subsidies being provided to "low-income and resource-poor" producers (see G/AG/N/IND/10). In practice, two functions are being performed by the same instrument simultaneously: the management of electricity supply and the regulation of water extraction. Electricity discounts enable water use allocations to be monitored and enforced; they also improve payment for electricity. Since previous electricity supply and water use controls were ineffective (achieving neither cost recovery for electricity nor control over water use) *Jyotirgram* discounts are a cost-effective alternative, controlling both over-pumping and electricity pilfering. Their removal would cause extensive economic and environmental losses. The current approach could be presented as a cost-effective system for electricity and water administration, and one that arguably should not be subject to reduction commitments, to whomever it is provided.

However, this argument may not have general application. While targeted and managed electricity subsidies helped India achieve sustainable water management (at least in Gujarat, for a limited time period), traditional economic modelling continues to suggest the opposite outcome is more likely (Smith *et al*. 2015). In Mexico, gains from a similar scheme were reversed when farmers lobbied for discounts for pumping at off-peak times. This saw them increase pumping, reversing important water and electricity conservation gains achieved (Scott 2013). While this may be a more likely outcome, given the political realities in many developing countries, the Indian example offers a different perspective

on inter-sectoral problems and how they may be viewed through a trade policy lens.

A further issue related to irrigation subsidies is their effectiveness. In India, subsidies for the operation and maintenance costs of canal-based irrigation schemes are as high as those for electricity subsidies. Trade rules would require the irrigators (again, other than the low-income and resource-poor), as the putative beneficiaries, to pay full costs or for the subsidy to be included in India's allowable subsidy pool. However, it is not clear that benefits are actually going to farmers. Hoda and Gulati (2013) report that, of a potential 46 million hectares, only 35 million are being irrigated, with extensive ineffective expenditure incurred for reasons ranging from perverse institutional interests to outright corruption. Trade policy-sensitive operating subsidies provide over 90 percent of operational costs for these schemes. Yet these expenditures often fail to provide services to farmers who, because of unreliable canal supplies, resort to groundwater.

A better design of farmer support would give a proportion of the declared subsidy to the water users, perhaps as support to water user associations; the remainder redirected, or reclassified as public works welfare expenditure or to recharge groundwater (which is often what wasted canal water does). While this need not be included in trade subsidy calculations, policy arguments framed in terms of compliance with trade rules could in theory help Indian governments to reform water management institutions and improve the effectiveness of their expenditure.

Many governments provide explicit or implicit subsidies to irrigation. Another jurisdiction with challenges of water overuse and misallocation is California, USA where large volumes of water are used for the production of nuts, fruits or wine, while it is becoming increasingly difficult to meet the state's urban needs and to sustain aquatic ecosystems. The drought that started in 2012 has seen small town water supplies fail and extensive restrictions placed on urban water use more broadly while farmers continued to irrigate. One commentator (Kibel 2014) suggested that this dilemma could be resolved by addressing it as a subsidies issue in the trade arena. In just one scheme, subsidies worth an estimated US$416 million flowed annually to the farmers of the Central Valley Project (CVP), as cities and the state's Environmental Water Account (which purchases water for environmental purposes) paid substantially higher rates than the farmers (EWG 2004). Since WTO jurisprudence explicitly recognises "government revenue foregone" as a form of subsidy, this tiered water pricing is evidence of subsidisation. So Kibel suggested that a WTO member country could challenge such measures through the dispute settlement system.

In both the Indian and US cases, however, formal challenge in the WTO is unlikely. If such support does not exceed the limits established under the AoA, it would require evidence of "adverse effects" under the ASCM to challenge them. More importantly, such a move could lead to tit-for-tat reactions not least because most countries tend to provide some irrigation subsidies (even if implicit). As a result, no such challenge has been made to date (Ahmad 2015).

These examples show that, while there may be formal trade remedies that could help to address egregious cases of unsustainable water management, WTO member countries may be reluctant to use them simply to promote broader environmental and water management objectives. But they also suggest that there is potential for space to be developed for "good" subsidies that support sustainable development objectives in agriculture, as tentatively suggested by Josling (2015). Further discussion of possible options might help both to design more useful trade instruments and to support better water management. A first step in this direction may consist in enhancing transparency by improving government notifications to the WTO of their water-related subsidy schemes

(Ahmad 2015 and Bernasconi-Osterwalder 2005).

4.6.2 *Trade policy and climate change adaptation in agriculture*

The biophysical impacts of climate change—including long-term changes in temperatures and precipitation and the increased likelihood of extreme weather events—may alter water availability, crop and animal productivity and ultimately global trade flows. Assessing the scope and magnitude of these changes is challenging, not least because of the large uncertainties regarding future climatic conditions and their effects on production. The impacts of climate change are also likely to vary greatly depending on agro-ecological conditions prevailing in different countries, the types of crops produced, existing agricultural systems—rainfed or irrigated—and international trade profiles. As highlighted above, international trade can provide an important mechanism to offset climate-induced production shocks in certain regions, and improve access to and availability of food where domestic production is insufficient. The diffusion of technologies for climate change adaptation may also play a key role in this respect by helping countries coping with water stress and the higher frequency of extreme weather events.

As countries seek to access new climate-resilient crops, while safeguarding farmers' traditional rights to use, save, and share seeds, the debate on technology transfer and intellectual property rights (IPRs) has been particularly controversial. For some, IPRs play an essential role in promoting innovation in climate-resilient agricultural practices while others argue that IPRs constitute a possible barrier to technology transfer by increasing the cost of technology acquisition. Some reports have documented an increase in patenting of climate change adaptation crops (e.g. drought-resistant seeds) leading to concerns about whether farmers and communities in developing countries will have access to the seeds (Agrawala *et al*. 2012). However, a gap persists in data and analysis of patenting and licensing trends in the development of new crops and seeds for climate change adaptation. Overall, the role of patents in impeding access to agricultural technologies is less clear than in other sectors, such as the pharmaceutical sector. Not all the new varieties currently protected by IPRs are valuable for smallholder, resource-constrained farmers. Furthermore, much of the needed improvement in agricultural production can be achieved through enhanced practices and may not require the latest biotechnology (Campbell *et al*. 2011).

Beyond IPRs, financing mechanisms established under the trade regime could provide complementary resources, particularly in areas where there are synergies between trade capacity development, water management and climate change adaptation objectives. Such synergies are particularly obvious in projects designed to build more resilient socio-economic and ecological systems and promote climate-smart agriculture, for example through enhanced productivity, diversification or infrastructure. More specifically, the Aid for Trade initiative, a coordination mechanism through which significant resources have been channelled since its creation in 2005, may serve as a co-financing mechanism to implement projects that integrate components of water and climate change adaptation. For instance, climate change-induced water stress can adversely affect agricultural yield, leading to a fall in exports. Adaptation measures aimed at tackling this situation, like building irrigation infrastructure and promoting the production of drought-resistant crops, have potential impacts on exports and can be supported through trade-related financing (Campbell *et al*. 2011).

4.6.3 *Water and large-scale agricultural land acquisition*

Localised scarcity of water for agricultural use in rapidly growing economies and economies with limited renewable water resources is

one of the major drivers of international investment in agricultural land (Woodhouse 2012). The most recent wave of large-scale investments was precipitated by the 2007-8 food price spikes, in response to which several governments and private companies began investing in foreign agricultural land as part of a long-term strategy to ensure food and energy security. The price spikes themselves appeared to reflect the immediate impact of weather on production, against a backdrop of high energy prices, growing use of crops for the production of biofuels and sustained demand from a rapidly growing middle class in urban areas. The magnitude and frequency of these price spikes hit low-income food-deficit countries particularly hard, with significant effects on undernourishment. Unsurprisingly, as food import bills increased, confidence in global markets as reliable sources of affordable food diminished, and attention turned to support for domestic food production in an attempt to enhance self-sufficiency including through the acquisition of foreign land.

This acquisition of large-scale productive agricultural land—often referred to as "land grabbing"—has prompted a range of concerns, including that the associated use of local freshwater resources would reduce the availability of irrigation water in the surrounding and downstream farmland areas, with the potential effect of causing water stress, poor water quality, and social unrest (Rulli *et al*. 2012, see also Smaller and Mann 2009).

However, the broader picture is more complex and less clear-cut than the land-grab headlines suggest. As Woodhouse (2012) explains, the recent wave of foreign investments in agricultural land in Africa, for example, are also part of long-term efforts by African governments to attract foreign investment capital to increase the productivity of domestic agriculture, either through large-scale production and/or upgrading subsistence farming into small-scale commercial production. The critical questions in this context include whether foreign agricultural investments will lead to investments in water infrastructure (dams, canals) that benefit both the investor and small-scale (local) agricultural producers, or whether foreign investors' use of water will displace existing users. Many of the crops to be grown under recent foreign direct investment (FDI) projects in Southern Africa, Woodhouse concludes, are likely to involve greater water use, but the wider impact of this use is still very unclear. Small-scale water users could potentially stand to benefit from new infrastructure that helps to provide sources of water when normal sources are scarce, but there are also risks that large-scale agricultural investments could damage existing production systems (Woodhouse 2012). Trade in agricultural products, as noted above, can help to buffer the impact of climate change-induced local water shortfalls. The movement of agricultural activity, through foreign investment, to areas where both land and water are more plentiful is arguably a necessary part of this broad climate change adaptation effort. The challenge is ensuring that this investment also supports sustainable domestic agricultural production and water use in the host state.

From a trade and investment perspective, the terms and conditions for the acquisition and use of agricultural land (and water) should be settled in the first place through investor-state contracts. At the international level, this relationship is governed by international investment law, including international/bilateral investment agreements and investment chapters in free trade agreements. Such agreements define certain standards of treatment that governments agree to accord to foreign investors and, in the case of disputes, often give the investor the possibility of bringing a claim against the host state before an international arbitration tribunal. Striking the right balance in investment treaties between the investor's use of land and water and domestic users' needs will be challenging, in particular because in many

cases information about water resources and consumption patterns is extremely scarce. A further concern in this context has been that international investment law, in its mainstream understanding, has largely focused on protecting the rights of investors, and this emphasis has sometimes come to the detriment of the authority of the host state and the public interest; particularly in cases against developing countries.

5. CONCLUSION: FURTHER WORK ON TRADE POLICY AND SUSTAINABLE WATER MANAGEMENT

Calls have been made for a more global approach to water use and management and for trade policy instruments to be deployed in support of it, but a coherent and consensual case has yet to be made for such interventions. While there is extensive academic interest in the role of trade in supporting water-related sustainable development objectives, like food security, the issue has not yet been picked up by broadly based trade policy institutions like the WTO, although the role of trade in underpinning food security in the face of global change is widely appreciated. The report of the OECD/Global Water Partnership taskforce on water security and sustainable growth (Sadoff *et al*. 2015), for example, makes only passing reference to trade mechanisms as being helpful to address transitory food shortages caused by climatic variability. The primary interest in the role of trade policy with water management appears to come more from the environmental policy domain and from the water policy community than from the trade community.

In the first case, this reflects a frustration among environmental actors at the failure to achieve action on what are considered to be pressing issues of water resource sustainability at local and national level and the desire to mobilise other actors in support of the sustainability agenda. In the case of the water sector, there is an interest in approaches that locate water and its management more centrally in the domain of economic policy, since it is believed that this would help to address what some consider to be a marginalisation of the sector, leading to financial constraints on its activities.

Although water is not scarce at a global aggregate level, its uneven distribution and limited transportability mean that, in many regions, countries and localities, social and economic life is influenced, if not constrained, by limited water availability. While the resource itself is not generally tradable beyond local scales, it is a factor of production in most traded goods and its supply is enabled by a wide range of services. Many public and private initiatives seek to improve water management and to promote norms for its protection, management and use, some of which have clear, trade-related implications. The question addressed in this report is whether and how trade policy and related interventions can impact on sustainable water management. There are many intersections between trade policy and water management; those in the areas of agriculture, hydropower generation, water services and wastewater management have been considered here in some detail. Table 1 summarises the main interlinkages between those sectors and relevant international trade and investment governance frameworks, most (but not all) of which have been discussed in the text.

Overall, the management of water resources is a complex and often very local affair, not always amenable to generic administrative or technical interventions. The localness of water sub-systems also makes the global hydrological cycle very different to the global atmospheric system in which CO_2 emissions from any local source immediately impact on the behaviour of the global system. There is little evidence to suggest that changes in local hydrological sub-systems significantly affect the global system. So unsustainable water management practices in one country seem, based on current evidence, to be unlikely to generate significant negative externalities or spill-over effects on water use in another unless they share water flows in a river basin.

This is not to say that water-related events do not have wider impacts. Droughts can spark famine and migration, and floods have disrupted global industrial supply chains. But water management practices themselves do not often generate such global cross-border impacts. There is thus no clear imperative

to address water-related challenges through a single global approach enshrined in multilateral policy frameworks such as the WTO. In this context, the immediate challenge is to ensure that international trade rules and disciplines do not unduly affect countries' ability to manage their water resources sustainably and according to their respective social preferences. In most cases, existing international disciplines provide reasonable space for non-discriminatory policies aimed at promoting sustainable water management. A more pertinent question may thus be how trade rules and agreements could be designed to help countries access the goods and services they need to achieve water security.

Table 1. Summary of interlinkages between water and international trade frameworks

	Bulk water trade	Virtual water trade	Water supply & sanitation	Wastewater treatment	Hydro-power	Agriculture & irrigation
Multilateral Agreements						
GATT	Export restrictions/ general exceptions	Like products/ general exceptions	Market access for associated goods	Market access for associated goods	Energy export restrictions during water shortages	Food export restrictions
GATS	n.a.	n.a.	Market access public service/ privatisation	Market access public service/ privatisation	Market access & regulations	Agriculture related services
Agricul-ture Agree-ment	n.a.	Market access for goods / subsidies	n.a.	n.a.	n.a.	Market access for goods / subsidies
ASCM	n.a.	n.a.	Subsidies not controversial	Subsidies not controversial	Market distorted by energy subsidies	Irrigation subsidies
TBT/SPS	n.a.	Water-related standards & regulations	n.a.	Water-related standards & regulations	n.a.	Water-related standards & regulations
TRIPS	Generic/ proprietary technologies	n.a	Generic/ proprietary technologies	Generic/ proprietary technologies	Generic/ proprietary technologies	Seeds, irrigation, desalination
TRIMS	n.a	n.a	Local content requirements	Local content requirements	Local content requirements	n.a

Table 1. *Continued*

	Bulk water trade	Virtual water trade	Water supply & sanitation	Wastewater treatment	Hydro-power	Agriculture & irrigation
Preferential Trade Agreements and Plurilateral Approaches						
GPA	n.a	n.a	May cover distribution services	May cover sewage services	Non-competitive procurement	n.a
EGA	n.a	n.a	Goods considered for liberalisation	Goods considered for liberalisation	Only small scale hydro. considered	Ag. products currently excluded
TISA	n.a	n.a	Market access **public service/ privatisation**	Market access **public service/ privatisation**	Market access & regulations	Agriculture related services
BITs	n.a	n.a	Pre/post establishment provisions may affect ability to regulate	Pre/post establishment provisions may affect ability to regulate	Local content requirements, concession, purchase agreements	Regulation of foreign agricultural investments
FTAs	Coverage of bulk water varies	n.a	Goods/ services WTO+ commitments	Goods/ services WTO+ commitments	Goods/ services WTO+ commitments	Subsidies usually excluded Regional trade in agricultural products

In practice, almost all the instruments proposed to promote sustainable water resource management that could be supported by trade policies or related measures require effective policy and governance in the water sector, whether to establish administrative systems and enforce regulations or simply to collect information. In the water sector itself, much emphasis has been placed on good management supported by effective governance. The guiding principles for good water governance recently produced by the OECD, emphasise in their preamble, that "there is no one-size-fits-all solution to water challenges worldwide" (OECD 2015a). What is offered is a menu of options that reflects the diverse legal, administrative and organisational systems within and across countries because "governance is highly contextual, water policies need to be tailored to different water resources and places, and governance responses have to adapt to changing circumstances" (OECD 2015a).

The OECD's conclusion and cautious recommendation is reinforced by the outcome of the inventory collated, as part of its water governance initiative, of all indicators that have been proposed to monitor the governance of water (OECD 2015b). This effort records almost 30 different sets of indicators as well as a range of related tools intended to be used to assess governance practice, illustrating the difficulty of developing international standards related to water. What the proliferation reflects

is the difficulty of engaging with a sector and a resource which manifests itself in so many different ways in different places and whose management and use reflects different institutional histories and cultural values. The implications for trade policy are clear. First, it is inappropriate to prescribe and enforce through global trade instruments a detailed approach in an area as complex and diverse as water management. As important, it is unlikely to be possible to promote a specific normative approach if it does not have the support of the intended participants.

In water services, although the pressure to privatise water services has lessened, restrictions on reversing liberalisation in the services sector, together with the constraints imposed by externally adjudicated investment agreements on the policy space of developing countries, will remain a sensitive issue. This could inhibit efforts to experiment with new models of service provision, including liberalisation, for fear of "lock-in." There may be opportunity for further work to establish options for a more effective framework for cooperation in water services, although the appetite of corporations, governments and financial agencies for this has diminished markedly in recent years. However, involvement in the more limited business of operating specialised treatment plants for both supply and waste has been less controversial. While the WTO has correctly pointed out that countries are not compelled to include water services in their GATS offers, bilateral negotiations often present difficult decisions. Aid for Trade could support the development of regulatory mechanisms that allow experimentation in services liberalisation and draw lessons from these.

A review of approaches to market access and regulation within the GATS and RTAs and of the rules around post-establishment investor protection in international investment-agreement frameworks would be helpful. This could include a review of the relevance of the rules in the WTO Agreement on Government Procurement and the WTO Agreement on Trade-Related Investment Measures. A framework is needed that allows cooperation without requiring full liberalisation in a sector for which the public sector will always be held accountable. The way in which investment agreements balance investor protection with the regulatory flexibility needed to facilitate adaptation to change, notably in climate but also in other environmental and social dimensions, could also usefully be reviewed since this is a specific concern in water reform (Sax 1990). As commentators have said, "governments must design water related policies that comply with fair and equitable treatment, expropriation regulation, and full protection and security, since not doing so can be costly and deter foreign investors from providing high quality services. Or, if policy makers do not agree with such a reality, they must redesign and re-engineer the applicable international law" (Chaisse and Polo 2015).

Industrial pollution and wastewater treatment generally offer significant opportunities for trade because of the growing need to address them effectively, the specialist nature of the services involved as well as the broad desire to promote a green economy. Several wastewater treatment-related goods have been identified in the context of the APEC initiative on environmental goods or in the current plurilateral negotiations for an environmental goods agreement. There is however a risk that core development principles of local (human and industrial) capacity development may be undermined if liberalisation results in a hollowing out of domestic technical capacity. Aid for Trade could also be used to strengthen domestic technical capacity as part of liberalisation efforts.

With hydropower, there is a case for engagement to assist in the removal, or rationalisation, of barriers to investment in large-scale hydropower in comparison with other renewables, particularly insofar as they involve development financing. Hydropower offers substantial benefits in

the configuration of new electricity supply systems, development of which is likely to be given further impetus by ongoing climate negotiations and the implementation of the SDGs. This will provide an opportunity to engage with the social and environmental challenges inherent in hydropower development. Aid for Trade could also be targeted to support cooperation to promote intra-regional energy trade.

In agriculture, it is suggested that the focus on virtual water and water footprints is a distraction from a policy-making perspective, although they represent a useful public awareness-raising tool. Given the wide variation in the distribution of global water resources, it is not surprising that goods which require substantial volumes of water to produce come disproportionately from countries with generous water endowments, and that these are distributed, through trade, to countries with lesser endowments. But water endowments only represent one factor of production and production decisions are still determined primarily by endowments of capital or labour.

Furthermore, many countries with limited water resource endowments are likely to continue to produce certain water-intensive goods, notably food, which they regard as essential to their national security. While this may conflict with the objectives of trade liberalisation, it reflects a concern with the ability of the trade system to meet national needs should exceptional circumstances arise. That will remain one of the constraints on the contribution that trade can make to addressing water shortages. On the other hand, increasing the purchasing power of people in poor countries by helping (and not inhibiting) their products to gain access to global markets could make an important contribution to overall welfare. The trade sector could usefully consider ways of designing agricultural subsidies (and supporting rules) that ensure social, economic and environmental goals can be achieved together. Improved transparency of irrigation subsidies could be a first step. Measures to facilitate access to technology and finance to deal with climate change-induced water stress should also be explored. This would contribute to both trade and water management goals.

Support for regional trade cooperation may complement sustainable water management initiatives. There are opportunities for regional cooperation between countries that share water resources but these are often not realised. In South East Asia, the development of the region's energy potential is advancing in a haphazard and arguably socially and environmentally sub-optimal way (Foran *et al*. 2010). In Southern Africa, the potential to develop a sugar/energy complex (which would include ethanol and electricity production from biomass) is hindered by the absence of a supportive regional trade framework that covers all relevant sectors (in this case, liquid fuels are not included while regional sugar is itself contentious). Trade cooperation could help to address some of the barriers (Wood 2013). Countries in the Nile river basin remain net food importers, in part because they have failed to optimise the productive use of their shared water resource in the absence of active efforts to create demand by promoting intra-regional trade (Hilhorst et al. 2011). One of the few water-related disputes over the past decade has been about trade-offs between regional navigation and other water uses on the Zambezi river (Lalbahadur 2013), again an area that could helpfully be addressed through regional trade initiatives.

A global review of water in development? Finally, at a general level, the challenges of developing effective interfaces between trade and water policy are mirrored in other sectors. As a result, there may be some appetite to review approaches to water and its management in the context of the transition to a green economy and sustainable development more broadly. It is almost 40 years since the last UN Conference on Water (UN 1977) which addressed water resources and their management at a formal, inter-governmental

level. The eagerness with which the issues of virtual water and water footprinting have been raised by the water sector and the enthusiasm of the corporate sector for engagement in water risk management are indicative of a desire to give the sector the recognition it merits as central to economies and societies. For the trade policy community as for many others, a review of the role of water in development could assist policy makers in identifying where further interactions and partnerships may be productive.

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