The global water security: an approach for multilevel governance on hydric resources

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Abstract: Water has been ranked first among the top five global risks in terms of social impact. Yet, the vision of water as a sustainability variable has lost strength to the detriment of the security concept. This paper proposes an approach of global water governance based on water security (WS) to respond to the increasing water shortage on the planet. The method involved the usage of qualitative procedures, the analysis of regulatory documents related to international water management, and the interviews of five experts within the management and regulation sectors. The process was useful in determining five main scopes and to articulate the framework to promote WS*: first* – risk as water management paradigms; *secondly* – review of the international regulatory framework and creation of a United Nation specialised agency for WS; *thirdly* – transversal link for WS between different actors; *fourthly* – applying WS mechanisms in river basins; *fifthly* – adoption of new analytical methods.

Keywords: global risk; water security; water security; governance; international regulatory; actors; methods; mechanisms.

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1 Introduction

The planet does not control the hazards generated by modern life anymore (Beck, 2015) and security is the objective of the risk society. To achieve this goal efforts from different agents are necessary and, in that sense, the complex and multidisciplinary nature of sustainable development (SD) and its different splits for countries, civil society, and companies require horizontal coordination and a multi-sectoral governance (Capaldo, 2011).

Governance refers to the instrumental aspects of such exercise, in response to several participants. The quality of the governability – the ability of the society to exercise power – is based on the governance's degree of institutional development, which happens when there is a certain level of development in a community (Bevir and Rhodes, 2016; Carvalho, 2015).

In this way, a standard of global governance of nature has not yet been implemented, concerning to the collaboration vision, focused on synergy and the sharing of resources, as well as rewards between different agents (Pattberg and Widerberg, 2015). Even so, there are positive experiences that portray a global articulation on specific environmental issues:

- the Montreal Protocol on Substances that Deplete the Ozone Layer, in the 1980s
- the global extinction of leaded gasoline usage
- the combined action, between the World Meteorological Organization (WMO) and the respected Intergovernmental Panel on Climate Change (IPCC), regarding the implications of the rising of greenhouse gases, which played a key role in the United Nations Climate Convention (United Nations Environment Programme, 2012).

All of those experiences involved multilevel articulation. In the case of water, a one-size-fits-all approach is not appropriate either (Doorn, 2016). A worldwide coalition may be considered ambitious if contrasted with the rise of water calamities in many countries. Droughts and floods have threatened economic production, human welfare and the survival of ecosystems. Hence, the concept of security has been introduced into the water sector, as a crosscutting issue that has had many interpretations in organisational studies. Water security (WS) deserves the utmost attention because the risk and uncertainty scenario has had an increasing impact on organisations and countries. The concept was proposed for the first time at the World Economic Forum (WEF) in 2009. In this forum, the connection between water, climate, energy and food security was recognised, covering aspects related to risk, involving agriculture, energy, trade, national security, cities, people, business, finance, climate, economy and innovation (World Economic Forum, 2011). Different topics have been integrated into this new framework, such as ecosystems and public access to water.

On the other hand, the governance dimension of international WS is still lacking in this debate (Bakker and Morinville, 2013). Although water questions have an important local approach, they may not be as local as they look. Numerous local stressors and effects are result of worldwide scenarios, mainly clime (water availability) and economy (water use). Global water governance has not established its space among other structures. Current regimes are normatively fragmented and controlled by local actions. Large-scale governance emphasises predominantly transboundary courses of water and

groundwater, failing in reconciling disparities between river basins and aquifers and administrative jurisdictions, hardly considering any encouragement for sustainable global use of water (Vörösmarty et al., 2015).

Thus, this paper thrives to link these two concepts – water governance and security – in order to set a global articulation for this resource. Considering the research question, "which approach of global water governance based on WS could respond to the increasing water shortage on the planet?", this paper's main goal is to propose an approach of global water governance based on WS to respond to the increasing water shortage on the planet. Secondarily, the study presents a brief review of the international regulatory framework, assesses the current global freshwater management structure, and makes proposals for new management mechanisms, both at a global level and at a more regional perspective. The study is divided into four parts: this introduction; a literature review related to water (its crisis, governance and security), methods, results, discussion and conclusions.

2 Literature review

2.1 The global water crisis and its ecological, human and business splits

The transversal characteristics of the subject of water and the crisis of this resource have repercussions in different areas that require planning in all of them in order to reduce risks. This can be better understood through a brief analysis of the Earth's hydrography. Only 2.5% of the water on the planet is fresh water. Out of this, 68.9% is in the North and South Poles, 30.8% is groundwater and 0.3% is in rivers, lakes, ponds (surface water) (Cisneros et al., 2014). Such availability of fresh water is being changed in quantity and quality of water resources because of destruction of ecosystems.

Economic activities and population growth in countries are important determinants of water scarcity. Most of them use water in agriculture, followed by industrial use. The current situation tends to become worse due to population growth and rapid urbanisation of cities. Human interference is redesigning the planet, especially concerning food production (Rockström et al., 2012) and domestic use, exacerbating the very human access to the resource.

Worldwide, 663 million people – 1 out of 10 – do not have access to safe drinking water (WHO, 2015). Some predictions indicate that by 2030 more than 3.9 billion people (half the population of the planet) will face serious water access problems and that context will be intensified with ongoing climate change (IPCC, 2014; OECD, 2016). There are projections that many countries in the Americas, Europe, Africa and Asia will face significant water stress in the upcoming years. Until 2025, the range of countries with this situation will be extend to all of North Africa, the Middle East, India and Southeast Africa. Amongst the major world powers, the USA, France and China should get into a deep freshwater crisis. Water scarcity will generate significant changes in the flow of international trade. The population of South Asia and the Middle East, and large parts of China and North Africa population will have to import more food and agricultural products (United Nations Organization for Education, Science and Culture, 2012a).

Business activities are compromised. Only a small number of global companies are taking measures to manage the water lack risks through their operations and broad supply

chains, even though the water crisis is already impacting many business groups. Drought has had an expressive influence in the results of giant companies in sectors such as agribusiness and beverage (Iol Independent, 2015; Roberts and Barton, 2015). However, not only big transnational corporations have suffered with shortages but also companies of all sizes are facing difficulties in critical areas.

The water crisis in 2014–2015 in the Southeast of Brazil, in a survey done by the Federation of Industries of São Paulo State (FIESP) reported that 67% out of the 413 industries surveyed feared rationing and 54% reported that they do not have alternative sources. Food, pharmaceutical and chemical industries were most affected because they are the ones which generally use more water as an input (Martins, 2015).

How people will cope with calamities of different scales is mainly stated by public politics, socioeconomic development and education (Nobre et al., 2016). The decreasing availability has generated a new stage in the relationship between man and water. The shown data reaffirms that companies have a strong strategic sense of survival and point to the need of including water issues on the organisational research agenda. The question that remains is which approach and coordination would be adequate to deal transversely with this emerging scenario.

2.2 Water governance: previous concepts, regional experiences and global obstacles

Organisational studies have marked the notion of governance's strengthening as a rising model. Among different possibilities, the concept has been represented by the idea of interdependencies between different agents and complex networks made up of public and private sectors, and civil society, which adjust themselves according to the environment (Bevir and Rhodes, 2016). Governance is more than institutions and involves relations between state and people. It offers the instruments through which cooperation can be produced across segments (UNDP, 2014).

Environmental governance would be the ability of society to implement environmental protection and recover a form of articulation between civil society, institutions and companies, including regulations and compliance mechanisms. Regarding water governance, it could be defined as the set of rules, actions and processes that are bases for decisions and decision-makers in order to manage water resources and services. In fact, the vagueness of this expression has been an obstacle, reflected in the poor results in different factors, such as participation support, choosing decision-makers, free access to information, harmonisation (of policies, institutions, procedures, mechanisms and information), conflict resolution, consensus and results control (Bosselmann, 2015; OECD, 2016). Though science informs that climate change will raise the incidence of droughts and floods, government policies to droughts and floods have been fragmented, which obstructs adaptive governance (Hurlbert and Gupta, 2015).

Nevertheless, there are some positive regional experiences of what could be called international governance of water, especially in economic integration processes. As prime examples, one can cite the Association of Southeast Asian Nations (ASEAN) for the Mekong River Basin; the European Union; and the East African Community (EAC) regarding the Lake Victoria.

The Mekong River Commission was created in 1995 with the purpose to pursue regional water management, disaster prevention and to exchange information/programs involving agriculture, climate change control, hydropower production and non-polluting

productive navigation. Therefore, the countries of the 'Greater Mekong' signed the ASEAN-Basic Development Cooperation Framework Mekong Basin based on the following axes:

i development of infrastructure in transportation, telecommunications, irrigation and energy

ii development of commercial and investment activities

iii development of agriculture, forestry, mineral resources, industry and tourism

iv development of human resources and technological cooperation (ASEAN, 1996).

The European Union (EU) has more than 30 years of a common policy for drinking water, seeking consumer and health protection. Shared freshwater was one of the first topics of policy established in this bloc. Some pillars of the EU policy should be highlighted such as the following:

i drinking water quality through control based on the latest scientific evidence standards

ii monitoring, evaluation and implementation of water quality

iii information management

iv contribution to the broader water and the EU health policies.

Additionally, the normative base safeguards for inland surface water, groundwater, transitional waters and coastal waters, preventing and reducing pollution, promoting sustainable water use, protecting the environment, improving the status of aquatic ecosystems and reducing the effects of floods and droughts (EUR-Lex, 2000).

The EAC was founded in 2001 in Tanzania. It is a regional intergovernmental organisation of five Partner States, involving Burundi, Kenya, Rwanda, Tanzania and Uganda. This bloc instituted the Development Program Lake Victoria (DPLV) in 2001 as a mechanism for coordination of interventions in the lake and its basin. The program is established on the followings activities:

i harmonisation of policies and laws regarding environmental management in the lake and its influence zone

ii environmental management

iii management and conservation of aquatic resources

iv development of fisheries, industry, agriculture and tourism

v infrastructure improvements, including the modernisation of the transport system around the lake (EAC, 2001).

Even considering these positive approaches, there are significant obstacles that hinder the formation of an effectively global governance:

i The water issue has been a difficult agenda due to geopolitical and sovereignty reasons, and it is becoming a security affair (Ceka, 2014).

ii The institutional disarticulation, especially considering the United Nations (UN). The United Nations Environment Programme (UNEP) would be the most subject-related

institutional sector, but its actions have not been effective concerning governance (Biderman, 2012).

iii Institutionalisation of the confrontation between the vision of water as a public/social or a private good (Bohoslavsky and Justo, 2011).

iv The multiple uses – bottled water, bulk water, providing water and sanitation service, environmental services, energy production, mining use, oil, tourism, religious use, agriculture, transportation, water rights and so on.

v The fragmentation of the regulatory framework that standardises the resource (Cosens and Stow, 2014). This last obstacle will be examined in some documents in Section 4.

2.3 Water security: the rise of a new approach

Water is achieving increased international attention. It has been ranked first among the top five global risks in terms of societal impact (World Economic Forum, 2015). Risks to worldwide WS are accelerating due to quick demographic, climate and economic alteration. Within 20 years, the world will experience intense drought levels, and in 50 years, it could be devastating, even considering moderate climate change scenarios (Dai, 2013). An important question is how people, ecosystems and business itself will be if this scenario is confirmed. The vision of water as a variable of sustainability has lost strength to the detriment of the security approach. This new conceptual paradigm is overcoming the idea of 'sustainable water', common in the first decade of the millennium, for being more practical and for worrying about the issues of acceptable access for all users (Staddon and James, 2014), including non-humans.

The concept has been characterised by the following topics:

i human aspects (access, protection of livelihoods, cultural and recreational values)

ii preservation and protection of ecosystems

iii water availability for economic development

iv the ability to face the uncertainties and risks of water-related hazards (floods, droughts and pollution, among others)

v good governance, accountability, adequate and effective legal regimes, transparent, participatory, and accountable institutions, infrastructure, and capacity building (United Nations, 2013).

It could be summarised as the regular accessibility of water for human utilisation, agricultural, leisure or industrial application, combined with a suitable level of water-related social, environmental and economic risks (Pahl-Wostl, 2016).

In this way, risks and threats have been the core of the updated vision of WS. They could be divided into four perspectives:

i threats to drinking water supply systems (contamination, human impacts, lack of water access and terrorist attacks)

ii threats to economic development and human habitations due to water-related hazards, water stress and scarcity, particularly regarding food and energy security

iii threats to water-related ecosystem services observing pollution as well as increased water utilisation, concomitant to increase usage of ecosystem services and biodiversity damage

iv hydrological variability in the perspective of climate change (Bakker, 2012).

These complex views denote WS cannot be limited to one set of conventional theory, because water is a multi-purpose resource of high economic and social significance (Magsig, 2015).

3 Method

In an epistemological view, risk and security can be studied objectively from a realist perspective, which is independently measured, and scientifically calculable. Additionally, it can be examined in an interpretative perspective that is socially constructed by aspects such as experiences, emotions, attitudes and knowledge (Hurlbert and Gupta, 2015).

This study is established on the interpretative side of social reality. It can be classified as descriptive and the approach was developed in a qualitative perspective. This procedure was fulfilled in two stages. The first stage was accomplished through the analysis of the ten (10) following documents related to international regulatory basis of water: Ramsar Convention (D1), Convention to Combat Desertification (D2), UNECE Convention (D3), Convention on the Law of the Non-navigational Uses of International Watercourses (D4), Basel Convention (D5), Rotterdam Convention, (D6) Stockholm Convention (D7), Convention on Biological Diversity (D8), Framework Convention on Climate Change (D9) and UN Resolution 63/124 (D10). The selection criteria for including these covenants into the study was the quantity of Members and indication by the United Nations portal on multilateral environmental agreements (INFORMEA, 2016), exception to the UN Resolution 63/124 that was chosen for its importance in transboundary aquifers policies (United Nations Organization for Education, Science and Culture, 2012b).

The collected information was classified and categorised in the following twenty (20) variables:

i conservation/rational use/optimum utilisation/technological innovation for rational and less polluting use

ii quality

iii habitat protection

iv different uses

v extension to shallow marine waters

vi aquifers

vii protection of aquatic biodiversity

viii reducing discharges of pollutants/discharge control/reporting pollution obligation

ix eco-systemic vision

x precautionary principle

xi disaster management

xii governance structure

xiii environmental education

xiv economic value

xv related to agriculture/industry

xvi related to land management/desertification/drought

xvii incentive to a better internal regulation/concerning with prevention actions in the place of origin

xviii hydrological cycle

xix human variable

xx enforcement mechanisms.

They allowed visualising the extent of the regulations assessed with regard to the variables within the water issue (Table 1). From the mentioned documents and the stated variables, a case study was discussed considering the integration of the secretariats that monitor these regulatory documents, in a joint action with Matogrossense Wetlands (Brazil). It would be an example how international legal instruments should be structured in an organisational perspective.

The second step aimed to collect the perspective of acting water specialists both within the public and private management sector and in the regulation area, in Brazil and France. This qualitative step was based on two stages:

i Firstly, selection, contact and send semi-structured questionnaires to 25 experts, selected from academic databases, such as Lattes Platform, in Brazil, and web pages of the leading universities in both countries. At this stage, 13 responses were obtained, with answers and some suggestions of improvements in the data collection instrument.

ii Finally, five specialists were selected according to the depth of their previous contributions to a new and definitive round of interviews.

The interviews were carried out by observing a script that was based on the topics 'risk', 'WS' and 'governance'. Spontaneous comments were encouraged in order to obtain the most relevant patterns and respective themes concerning to the objectives of this study. For ethical issues and in order to not identify the views expressed, the names were omitted and replaced by a sequence from E1 (interviewee 1) to E5 (interviewee 5).

For the data treatment and analysis, a content analysis (CA) was proceeded with a set of communication analysis techniques that use the following systematic procedures:

i pre-analysis

ii exploration of the material

iii treatment and interpretation.

In this way, a categorical analysis was used through a classification of constituent elements of a set. From differentiation and regrouping by analogy patterns were produced and, amongst them, some themes also emerged. Based on coding word-based themes, representative contributions were selected to be discussed (Bardin, 1977; Becker and Lissmann, 1973).

4 Results

In this section, the results of interviews and documental analysis will be outlined. Regarding the responses from interviewees five major patterns emerged from the data:

i risk approach

ii water security and global governance

iii regulatory basis

iv mechanisms at basin level

v methods.

From these patterns appeared specific themes (Ts) that will be discussed in Section 5.

Table 1 shows the water protection variables present in the legal instruments that directly or indirectly are related to water.

4.1 Risk approach

Utterances

Generally, there is no international management preparation to avoid a global risk. Avalanches, droughts and other natural phenomena, like tsunamis, have hardly prompted precautionary joint actions as a precaution. It appears, however, that this has been changing lately, due to the rapid increase of these phenomena and the advantage of science and technology. There are now more and more sophisticated ways in foreseeing events with increasingly reliable indicators. As an example, the World Bank has been acting in the forefront, proposing probabilistic modelling-based analysis for nature disasters (E2).

The international guidance for risk is already something quite common in private corporations and it has a preventive connotation in the financial management of investments. In the sense of environmental governance, one should bear in mind a number of important variables, based on the formation of alliances, increased capacity to respond to disasters, access to information and specialised work planning (E3).

Emerged themes:

- *Rising of risk orientation due to*: intensification of catastrophes (T1.1) and strength of science/reliable indicators (T1.2).
- *Risk approach and environmental governance based on*: alliances (T1.3), flexibility (T1.4) and planning (T1.5).

4.2 Global governance and WS

Utterances

International water programs are mostly dependent on database constructions for water use. There is no real shared international management for water, at least not one which is finite. We are going to have a conflict scenario quite possibly in a few years unless there is a capable executive body. The lawsuit between Argentina and Uruguay over the case of a polluting company in the Rio de la Plata; the issue between Israel and Palestine on the use of shared fountain-heads; the progressive reduction in water availability in many countries; the African nations situation; the world's population growth; global warming, which will leave millions of people with no water access; all of these facts show the urgency for an organisation that could effectively handle a sense of water management. And we are talking about global management for rationality, for the optimal use of the resource, and to help countries better fulfil their populations' needs (E1).

It is noteworthy that there is a process of fragmentation in the UN with regards to global water governance (E5).

Similar to project management, the transversal management of water appears as an adequate response to this complex challenge that involves water. Because of the fact that it includes a multitude of actors, situations and interests that require an outline of different actions and organisational arrangements. I believe it is the only way to feasibly wish to have water governance (E4).

Emerged themes:

i *Current insecurity for water because of*: inexistence of international management/fragmentation in governance (T2.1), conflictive scenarios (T2.2), reduction in water availability (T2.3) and population growth (T2.4).

ii *Water governance based on security means*: rationality/optimal use (T2.5), focus on people's need (T2.6), cross-cutting and complexity approach (T2.7).

4.3 Regulatory basis

Utterances

International water law has a particularism determined by a permanent fragmentation. On the one hand, the universalisation of large conventions with a universalist tendency has not been successful in terms regarding to the limited number of countries that have ratified them (Barcelona 1921 on waterways of international concern only had 20 ratifications and Madrid 1923 on hydraulic power affecting more than one State had only 11 ratifications). Regarding the New York Convention of 1997, although its effect was granted from the 35 ratifications earned that year, important regions like Latin America were left out. All current water treaties show a tendency to universality but there are clearly recognisable particularities that are nothing more than ruptures. On the other hand, the development of general principles of International Water Law and its reception into the conventions has been taken into account by the International Court of Justice in order to recognise the existence of certain universal principles, although these are not absolute in practice. This movement towards universal rules is not free of obstructions, as noted in the controversial case between Argentina and Uruguay regarding the Uruguay

River. Actually, we could say there is an expressive fragmentation in law and a relative disconnection in justice (E1).

The effectiveness of a treaty, especially for the water issue, depends on some complex factors: international, geopolitical and economic scenarios; the technical capacity of the countries concerned to implement the provisions; internal willingness of Members to carry out the agreement, involving institutional, political, economic and legal issues; scope of the agreement, or the number of country Parties; sanctions and the operational nature of its economic regulation mechanisms; cooperation tools between the Parties and the secretariats of other agreements. This is why it is so difficult to reduce the fragmentary feature of international regulation on water (E5).

Emerged themes:

i *Causes of fragmentation*: Weak adhesion of countries (T3.1) and relative efficiency of universal principles for water (T3.2).

ii *Success factors that influence the effectiveness of international regulation*: Politic (T3.3), economic (T3.4), technical (T3.5), institutional (T3.6), adhesion of countries (T3.7), sanction (T3.8) and cooperation (T3.9).

4.4 Mechanisms at basin level

Utterances

Most river basin management committees establish a kind of debate forum, but the problem is in the approach; usually the concern for using water concession is economic, disregarding that the view of risk involves the causes and not the consequences, regarding water safety (E4).

At the river basins level, the investment in grey infrastructure (basic sanitation, reuse and so on) and green infrastructure (identify critical points and intervene with reforestation) can be important factors to ensure the expansion of WS. In the last mentioned aspect, woodland degradation reduces the ability for water springs to produce, and it also reduces the natural filtering against pollutants, increasing the WF. There is a tangle of analysis linking ecological factors to economic ones in an inseparable way (E5).

Emerged themes:

i *Difficulties at basin level*: too much focus on economic approach (T4.1) and less attention on causes (T4.2).

ii *Profitable programs*: green engineering (T4.3); ecological and economic nexus (T4.4).

4.5 New analytical methods

Utterances

To measure the water footprint there are some drawbacks. The first one is the amount of water used in production processes, the water source, and the subsequent water use. What happens is that the same issue also occurs with the carbon footprint, because the water footprint respects many production processes that are related not only to the amount of

water used but also a number of other things. There are difficulties, at times, to water access in many countries, and it makes it difficult to measure the amount of water used and the origin of this water. Then, you have to see the whole process of how the water footprint is measured. Indeed, it is linked to the carbon footprint because water use involves the use of energy and water transport. The water footprint and carbon footprint, themselves, are the basis of the ecological footprint that eventually leads to more inquiries, such as the water that is exported in products (E2).

The energy required to pump water depends on the process. There is a carbon footprint of transport, which has a major impact. There are places where the water footprint is larger than the carbon footprint because production is very close to the water source, but that changes with distance, because of the necessary energy. Not to mention that you could also consider the carbon footprint of the entire process of using virtual water. That is not counted (E5).

Emerged themes:

i *Difficulties*: Measure the amount of water used (5.1); disconnection between complementary methodologies (5.2).

ii *Important methods to promote WS*: Water footprint (T5.3); carbon footprint (T5.4); virtual water (T5.5).

4.6 International legal instruments

Table 1 denotes the water protection variables present in some of the agreements that directly or indirectly are associated to water.

Table 1 Cross-sectional analysis on freshwater in international legal instruments

	Instruments									
Water related variables in conventions	*D1*	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*D10*
Conservation/ rational/optimal use/ technological innovation for rational and less polluting use	X		x	x	x	x	x	x		x
Quality			x		x	x	x			
Habitat protection	x		x					x		x
Different uses	X									x
Extension to shallow marine waters	X		x	x						
Aquifers			x	x	x	x	x			x
Aquatic biodiversity protection	X				x	x	x	x		
Reducing pollutants discharges/discharge control/obligation to report pollution	X		x	x						
Eco systemic vision	X	x	x					x		x
Precautionary principle			x		x	x	x		x	x
Disaster management		x	x		x	x	x		x	x
Governance structure	X	x	x					x	x	
Environmental education	X	x								
Economic value	X									

Table 1 Cross-sectional analysis on freshwater in international legal instruments (continued)

Water related variables in conventions	*Instruments*									
	D1	*D2*	*D3*	*D4*	*D5*	*D6*	*D7*	*D8*	*D9*	*D10*
Regarding agriculture/industry		x	x		x	x	x		x	
Relation between land management/desertification/drought		x							x	
Incentive to a better internal regulation/concern with prevention at the place of origin			x		x	x	x		x	
The hydrologic cycle		x								
Human variable		x	x	x	x	x	x		x	x
Enforcement mechanisms			x		x	x	x	x		

Source: Document-based variables (author's elaboration)

5 Discussions

With everything that has been reviewed in this effort to converge the vision of governance with the WS perspective and even though there is a long way ahead, a scheme that minimises risks to people, private initiative and ecosystems, through a new organisational articulation has become imperative. For organisational studies, water must transcend the field of corporate environmental responsibility to the perspective that considers it to be one of the bases for survival itself (Staddon and James, 2014). For a better development of the argument, it was decided to discuss the results through scopes, which are interconnected without maintaining an order of importance or priority, since all points are essential links in the proposed structure.

5.1 Scope 1: risk as the water management paradigm

The process of securitisation is a deliberate strategy for managing the stakeholders' risk perceptions (Soltani et al., 2015). Building a global water governance oriented towards risk and to reduce uncertainty is unavoidable.

Some insights can be highlighted:

i the increase of risk orientation because of the intensification of catastrophes and the strength of science and reliable indicators (T1.1, T1.2)

ii risk approach and environmental governance based on alliances, flexibility and planning (T1.3, T1.4, T1.5).

In fact, an institutional linkage to risk requires a sense of information-based monitoring and it is connected to a governance orientation. Furthermore, as revealed in T2.1, T2.2, T2.3 and T2.4, the current insecurity for water occurs because there is no international management (fragmentation in governance) and a conflictive scenario, possibly caused by reduction in water availability and population growth. The finding about water availability is probably related to the most indicated variable in the examined documents

(Table 1), such as conservation, rational/optimal use, technological innovation for rational and less polluting use, that are also linked to the needs of future generations.

There are some experiences that might be observed. The contributions of the Canadian Centre for Management Development are remarkable examples of risk-based public management. It proposes the need to public structure responses regarding increasingly complex environments, with continuous and unpredictable changes, and limited resources. Canada, by the way, internally implanted an Agency for WS, even though this country is the third richest planet in water resources. Additionally, there is already a specific international certification for risk already in place, which is the ISO 31000. It can be defined as the systematic application of management policies, procedures and practices for communication activities, consultation, and establishment of the context to identify, evaluate, treat, monitor and review risk (International Organization for Standardization, 2015).

The WS approaches should take into account some documents that consider risks and uncertainties. A paper examined 289 agreements signed between 1857 and 1999. As main results, it was identified that 60% of the documents cited some kind of uncertainty and risk (especially related to water flow, infrastructure and environment; Drieschova et al., 2011). It points out that there is already some previous guidance that supports a global pact directed to the mentioned approach.

5.2 Scope 2: crosscutting normative approach and UN specialised agency for WS

Table 1 has come to a conclusion that the international normative basis for water denotes ecocentric and anthropocentric approaches, expressing habitats, ecosystems, rational use, risk orientation, leisure, agriculture, industry and others. It also faces a fragmentation process, representing a major bottleneck. Furthermore, among instruments that are specific to the water, UNECE Convention (D3) seems to be the most complete and suitable in terms of protection and coercion, maintaining an expressive relationship regarding pollution with the Basel, Rotterdam and Stockholm, which are also very restrictive. It expresses the precautionary principle and has connection points with the Convention to Combat Desertification and the Framework Convention on Climate Change, which also have a precautionary nature.

There are some possible causes of fragmentation in the international regulatory structure for water:

i weak adhesion of countries to current norms (T3.1)

ii relative efficiency of universal principles for water (T3.2).

Moreover, some success elements that influence positively the effectiveness of international regulation were identified: specific policies for water; economic, technical and institutional environment; adhesion of countries; capacity of coercion of treaty and cooperation between countries and secretariats of other agreements (T3.3, T3.4, T3.5, T3.6, T3.7, T3.8, T3.9). Actually, as it was showed in Table 1, the UNECE Convention covers most of these features, even with not having an expressive number of Parties (which has been rising due to the campaign being done by the UN).

However, it does not have a global legal instrument that in a situation of weather worsening would facilitate water management, considering its complex and multifaceted

perspective. A basic line of reasoning would be that it is possible to define a regulatory structure based on risk to reduce fragmentation and face the situation that was discussed in this paper, maybe a new treaty converging efforts towards a human, ecological and economic orientation, in a desirable global document to WS. There are international precedents to do this. In Africa has occurred one of the pioneering experiences of international cooperation that used the idea of WS: the 'Cooperation Framework of the Nile Basin Agreement' (International Water Law, 2009), with a strong focus on a water intelligence system between Sudan, Egypt, Ethiopia, Congo, Burundi, Kenya, Rwanda and Tanzania. Internally, some countries have already adopted this paradigm. Australia has adopted it considering its serious water shortages (Australian Government, 2015). Canada has also used this approach even being the third richest country in water resources on a global scale (Canadian Water Network, 2015). These experiences point to the possibility of using risk and WS in a more global dimension approach.

To assemble the scattered efforts among countries, in addition to the proposal of a risk and a more integrated global regulatory basis, it is believed that the fragmentation could also be mitigated by the creation of a UN Agency specialised in WS (T2.1). It is necessary to grant institutional power to a specialised body, establishing a centralised organisational thread on the water issue between the current actions of UNEP (which is simply a program with no enforceability), UNESCO, FAO, the World Bank (which are specialised agencies), and others. This new institution could coordinate efforts to WS in a harmonic way, converging statistics, programs, policies and global guidelines for water, balanced with risk-safety guidance (T2.5, T2.6, T2.7). It is believed that the qualifying discussion on water would not complicate much the formation of a settlement between different actors. Especially because the idea of WS is embodied in countries with the two orientations, for example Canada and Australia, that consider water as a public and private good, respectively.

The agency would maintain intensive dialogue with the water treaties secretariats and would work together with governments and international institutions related to water as a human right, as a key element for ecosystems, and as a strategic survival basis for economic groups.

5.3 Scope 3: transversal link for WS between different actors

For a more integrated normative coordination with the global pact and the creation of a specialised agency for WS, it is necessary to think about how structures would be orientated. It is urgent a transversal and complex approach (T2.7).

According to T2.1, T2.2, T2.3, T2.4, T2.5, T2.6, T2.7, T3.3, T3.4, T3.5, T3.6, T3.8, T3.9, it is possible to strengthen the integration between Multilateral Environmental Agreements (MEAs), through conducting thematic forums. Each international environmental rule has an internal management structure, called secretariat. From MEAs that deal, directly or indirectly, with protection of fresh water, a network action program could be established between the secretariats that would enable discussions from the perspective of management. This would involve the formation of specific working groups in which each one could contribute within its scope. There are different issues that could be addressed together: water pollution, WS, climate change, aquatic ecosystems recovery and so on. That would strengthen the less effective international rules and the Pact for WS itself.

One example that could be mentioned would be in the area of the Matogrossense Wetland, in Brazil, which is considered the largest wetland in the world and where there is a Ramsar site. This region could be better monitored against risks if there was a plan of joint action between the secretariats of the following agreements:

i the Rotterdam Convention, because it uses different mechanisms, as previous consents for dangerous pesticides use, in addition to including a bigger penalty structure

ii the Convention of Biodiversity, considering that economic activity may involve different aquatic species in the area

iii the Framework Convention on Climate Change

iv the Ramsar Convention itself.

The combination of these MEAs with more participation of governments, civil societies, and environmentally friendly businesses, could reduce the destruction process of the cited wetland. A similar strategy to this proposal already happens between Basel/Stockholm/Rotterdam Conventions, which assert the joint realisation of conferences of the parties (COPs), assembling joint management for reducing pollutants in different sectors and with great inner strength in the countries.

In another field of transversal management, it is necessary to extend the integration between MEAs secretariats with institutions and stakeholders related to it. Vieira describes the case of the formation of an international organisation to deal with hazardous chemicals, the so-called "Inter-Organization Programme for the Sound Management of Chemicals (IOMC)", which has involved the World Health Organization (WHO), the Organization for Economic Cooperation and Development (OECD), the UN Food and Agriculture Organization (FAO), the International Labour Organization (ILO), UNEP, the United Nations Development Programme (UNDP), World Bank and so on (Vieira, 2013).

The governance structure of the IOMC, which actually converges actions of different institutions, provides risk reduction, knowledge and information, capacity building and technical training, in addition to combat against illicit trafficking.

5.4 Scope 4: applying WS mechanisms in river basins

The river basin (RB) orientation should be strengthened. The RB is defined as a territorial unit in which precipitation gathers, on the surface or underground, and drains to a common point or flowing across the same river, lake or sea. The development ground of a WS system must consider the needs of each basin, its biodiversity, its population, climate, economic actors, as well as cultural, regulatory, economic and technological aspects. Therefore, in order to increase WS it is necessary a restructuring process at basin level involving businesses, citizens, and countries, in order to achieve some goals such as the following:

i reduce consumption and waste

ii measuring the water availability of each river basin

iii diversify supply sources – rain, reuse, aquifer, apart from rivers (this generally dilutes risk)

iv conduct ongoing education programs for water

v seriously invest in hydro-sustainable innovation (T4.3, T4.4).

These tools, generally, can be significant allies for public and private actions to reduce water risks (INBO, 2015).

The search for the causes of risks in the river basin committees should transcend the debate focused solely on concession for economic use (T4.1, T4.2). From the aforementioned orientation it is highly rational to expand the vision from WS to RBs due to the following arguments:

i basins are the most important terrestrial structures within the hydrological cycle, because they capture and converge precipitations

ii non-renewable natural resources and ecosystems interact in the river basins area in a system of dependency, permanent and dynamically

iii there is also an interaction in the river basins area between the socio-economic systems made by its own users.

Therefore, WS is achieved with different possibilities of joint organisation at the level of RB in regards to the maintenance and recovery of ecosystems (in key areas for the water system) plus the participation of different actors (civil society and business). Environmental aspects necessarily involve economic and organisational issues. That point of view shows that the public-private partnership in water management is very close.

5.5 Scope 5: adoption of new analytical methods

In recent years, new concepts and mechanisms have achieved evidence and could make progress in local agendas within the river basins management approach. The first model to be discussed is the water footprint (T5.1), which is a consequence of theoretical movement of the ecological footprint (EF), which was introduced by William Rees and Mathis Wackernagel in the beginning of the 1990s as a measure of human appropriation of biologically productive areas. Hoekstra and Huang launched the concept of the water footprint to measure human appropriation of fresh water on the planet. The EF provides for the land use (hectares) while the water footprint (WF) measures the total use of water resources (in cubic metres per year). The WF is defined based on actual water use per consumption unit and integrates use and pollution from the production chain (Hoekstra et al., 2011).

It is noteworthy that the concept of WF is being inserted into policies, programs, and publications of international organisations such as the UN (especially FAO) and even the WTO (UN, 2013; World Trade Organization, 2010). At the local level, it is being adopted by the regulatory basis in some countries. The breadth of the concept also permits it to be used by a group of consumers, allows segmentation by cities, states, or countries (Chapagain and Hoekstra, 2011), and there is already a specific certification for it, known as ISO 14046. WF sustainability depends on local factors such as the hydrological characteristics of the region and other factors. For example, a large WF can become sustainable in areas with abundant water resources while a small WF may jeopardise areas with water scarcity. Deforestation, reforestation, pollution (pesticides in agriculture, industrial waste) are factors that also come into debate (Van Oel et al., 2009).

Some analysis can be made from some themes that emerged from the commentaries of interviewees:

i even considering that WF is an innovative theoretical model, it is not easy to be measured and it should not disregard the role of reuse and water treatment, with its subsequent return to the ecosystem (parameters not accounted by the method) (T5.1)

ii measuring WF necessarily means to measure the carbon footprint (T5.2)

iii the WF has a close relationship with another model, which is virtual water (VW), which also involves the production of a carbon footprint (T5.3, T5.4, T5.5).

VW represents the amount of water used to produce a product or service and it results from the indirect measurement of water resources consumed by some goods in their production processes. The math is relatively simple, as it relates the total quantity of water used and the production obtained (m^3/ton). Therefore, it is possible to make a water inventory for each stage of the production chain, for obtaining the final product. The understanding of VW flows in economic activity can shed some light on organisational studies related to water scarcity (Hoekstra, 2010; Allan, 2015).

The relationship between water, energy, and production systems inspires a complete overhaul in the way organisations deal with this issue. With this conceptual revolution, WS would be based on the reduction of the WF and percentages of VW in products and services.

6 Conclusions

Different social protagonists are becoming more conscious regarding the urgency of instituting a global water governance. The scenario that has been drawn in many regions with intensive shortages and floods, has highlighted that new articulations between stakeholders is the only way to minimise this emerging situation. Water insecurity has been one of the most evident expressions of global warming and the human presence on the planet. In this way, this paper contributes for debating possibilities still not considered by governments, civil initiatives and companies.

In order to respond the research question "which approach of global water governance responds in a better way to the increasing water shortage on the planet?". This paper purposed five main scopes*: first* – risk as water management paradigms; *secondly* – review of the international regulatory framework and creating a United Nation specialised agency for WS; *thirdly* – transversal link for WS between different actors; *fourthly* – adoption of new analytical methods; *fifthly* – applying WS mechanisms in river basins. These suggestions implicate a paradigm change, especially in these following aspects:

i risk approach would be more observed in public policies, involving different stakeholders

ii transversal understanding of laws, institutions and methods is the only condition to get a proper WS scenario.

Probably, a new international agency in the UN, mainly dedicated to WS, and a worldwide law that considers this new perspective for water are possibly the most

challenging recommendations to be achieved and these proposals fit a lack in the current literature. As a qualitative contribution, the suggestions of the paper cannot be generalised and need to be refined and replicated in different levels to be enhanced. The outcomes were obtained in an interpretative dimension of reality, in order to address the research question. The insights obtained to rethink in the same approach for global governance and WS express opportunities for new research. How to link institutions in a detailed arrangement in different levels and regions? Which variables in each method mentioned in the results could be more considered? Which public policies are suitable to implement these methods at river basins?

A part from these, new topics could be explored in new research, such as ecosystem needs, environmental services, conflicts for water, violence against nature, the needs of future generations, etc. (Carvalho, 2015), in regard to the perspectives of global governance and WS, regulatory basis, transversal articulation, mechanisms at river basins and new methodologies.

Finally, in attention to the SD approach, this paper brings some reflections to institutional and policy-making actors, pointing out opportunities for a new vision of legislation and partnerships. Facing a future with risk and uncertainty concerning water, there is no time for paralysis in this crucial subject for the survival of businesses, ecosystems, and people. Undoubtedly, the biggest risk to postponing the debate on global WS is the rise of the current scenario of calamity that has become increasingly less questionable.

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