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Planetary Boundaries and Governance Mechanisms in the transition to the Anthropocene



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Anthropocene and Water

Isabela Battistello Espíndola*

Estevão Bosco**

Marcelo Fetz***

Abstract

The Anthropocene is the new and current geological epoch in which the human being has become an agent of planetary changes. This comes with several endangering consequences for the survival of the human species. This article primarily discusses the increasing environmental impacts of human activity since 1950, as well as issues related to water governance. Considering that such issues are usually integrated in the natural sciences but still largely escape human and social sciences, this article is a contribution to the latter fields of knowledge as it draws on international relations and geopolitics.

Keywords: Water; water resources; governance; Anthropocene.

*Department of Geography – Faculty of Philosophy, Humanities, and Human Sciences, University of Sao Paulo (USP)/Brazil (isaespindola@hotmail.com).

**Department of Geography – Faculty of Philosophy, Humanities, and Human Sciences, University of São Paulo (USP)/Brazil. Dr. Bosco's research is funded by the São Paulo State Research Foundation (FAPESP) (estevaobosco@gmail.com).

***Department of Social Sciences – Human and Natural Science Institute, Federal University of Espírito Santo (UFES)/Brazil (marcelo.fetz@ufes.br).



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Introduction

Water is an abundant natural resource, which is unevenly distributed on the planet. Considering the total quantity of water on the planet amounts to approximately 1.3 billion cubic kilometers, oceans account for 97% of water and the remaining 3% is divided between glaciers, groundwater, lakes, rivers and the terrestrial atmosphere. Bhaduri et al. (2014) and Pereira and Freitas (2017) argue that the current water situation, especially in terms of the anthropic impacts on water systems, is a matter of concern since human societies influence the hydrological cycle in significant yet uncertain ways, that affect water resources beyond their natural limit. This natural limit exceeding results from the patterns of consumption and production imposed and widely disseminated by global capitalism. Such patterns endanger the survival of human beings and indicate that concepts such as security and threat do not only regard wars and power struggles, but also the consequences of human actions on the environment.

According to Pereira and Freitas (2017), 11% of the global population (783 million people) does not have access to drinking water, while the use of fresh water has tripled over the last fifty years. This use of fresh water has brought the environment beyond its recovery capacity. The Worldometers database (2015 apud PEREIRA; FREITAS, 2017) shows another important fact related to this issue: while the demand for fresh water increases by approximately 64 billion cubic meters per year, many countries and regions still face water scarcity. These water-related issues do not only concern underdeveloped or developing countries, but also some of the wealthier states, such as the United States, Portugal and Spain that also face problems associated to access and use of water resources. Hence, contemporary societies do not only face challenges regarding ecological resilience but are also confronted to problems caused by their own political and economic instability and inequalities. This scenario therefore calls for changes in governance, especially in terms of developing global cooperation and defining a common agenda on water resource problems.

There is no doubt that problems related to water availability are highly relevant to national and international policies. However, the lack of adequate political commitment remains a challenge that contemporary societies need to face and overcome. Although the contributions of human and social sciences to the subject are still incipient, these specialized fields of knowledge would enable us to deal more efficiently with the governance of “climate change, saltwater intrusion into coastal areas, population growth, deforestation, land degradation, pollution, the unsustainable use of water and poor water management” (PEREIRA; FREITAS, 2017, p.1).

In what follows, the global water issue is analyzed by taking the Anthropocene social and biological conditions into account, which present new challenges and opportunities to the governance of water resources. Firstly, we will discuss the concepts of Anthropocene and planetary boundaries, presenting their core features when related to the use of natural resources. Secondly, we will specifically address the water issue in the Anthropocene and the



risks, consequences and challenges involved. Finally, we will present orientation for change in water governance.

Anthropocene and planetary boundaries

Since 1950, the effects of human activities on Earth, such as deforestation, mining, fishing, agriculture, use of nonrenewable energy sources, atomic bomb testing, and population growth, have increased and reached a global scale (Steffen et al., 2015). Given that the proportion of these changes is so significant, it is already possible to consider that the Earth has entered a new geological epoch. As stated by Dipesh Chakrabarty (2009), this means that the human being has become a geological agent.

The Anthropocene hypothesis was first presented by Paul Crutzen (CRUTZEN; STOERMER, 2000; CRUTZEN, 2002), 1995 Nobel Prize in Chemistry. Crutzen argues that the environmental impacts of human action are worldwide and modify soil, atmosphere composition and climate. The Holocene, a geological period that began 11 700 years ago, would be coming to an end and a new geological epoch would be emerging. If the Holocene is a period of relative environmental stability, the Anthropocene is characterized by exceeding planetary boundaries and ecological resilience (VIOLA; BASSO, 2016).

These planetary boundaries are related to the question of global environmental sustainability and "[discuss] safe operating limits for humanity in relation to critical issues arising from human occupation of the Earth" (ARTAXO, 2014, p. 17). Rockström et al. (2014) identify nine planetary boundaries: (1) climate change, (2) loss of stratospheric ozone, (3) acidification of oceans, (4) biogeochemical cycles of nitrogen and phosphorus, (5) changes in the integrity of the biosphere associated with biodiversity loss, (6) land use change, (7) use of water resources and freshwater consumption, (8) loading of aerosol particles into the atmosphere, and (9) introduction of new entities and chemical pollution. These limits surpass the local/regional scale and are viewed as global systemic threats, as they act as risks to the prosperity of human societies in the long run.

Artaxo (2014) and Veiga (2017) state that limits 1 (climate change), 5 (changes in the integrity of the biosphere associated with biodiversity loss) and 4 (biogeochemical cycles of nitrogen and phosphorus) have already been exceeded. Limits 2 (loss of stratospheric ozone), 3 (acidification of oceans), 7 (use of water resources and freshwater consumption), 8 (loading of aerosol particles into the atmosphere) and 9 (introduction of new entities and chemical pollution) are approaching their limits, whereas limit 6 (change in land use) has already been reached.

This diagnosis shows that anthropogenic actions are responsible for reaching and exceeding these limits. According to Veiga (2017), "[...] it is a fact that of all the carbon dioxide released in the atmosphere and produced by human activities, three quarters was emitted in the last seventy years" and "the amount of synthetic nitrogen (in particular from fertilizers in agriculture) increased from 4 million tons to over 85 million tons" (VEIGA, 2017, p. 236). The emission leap of these two chemical elements, coupled with the increase in water consumption



by extensive irrigation in countries such as China and India, coincides with the "Great Acceleration" thesis (STEFFEN et al., 2015).

Considering what we have seen so far, one can state that the Anthropocene hypothesis goes along with the awareness of planetary boundaries (CUNHA, 2012; ARTAXO, 2014). This demonstrates awareness of the fact that human beings "significantly influence the functioning of the earth system in many areas" and that the changes arising from anthropogenic actions "are clearly identifiable beyond natural variability and are equal to some of the great forces of nature in their extent and impact" (STEFFEN et al, 2004, p. 4). Pereira and Freitas (2017, p. 526) argue that the new world of the Anthropocene is dangerous, complex, unstable and uncertain, differing significantly from the Holocene. Consequently, "the central role played by humans in defining the physical frameworks that regulate major processes of the Earth System [...] poses major challenges to achieving water security. In this setting, local and global spheres are interconnected, working together to generate 'glocal' challenges" (PEREIRA; FREITAS, 2017, p. 522).

Anthropocene and water

The changes introduced by human beings in the environment directly affect the water cycle, which in turn, has an impact on the entire ecosystem. The increasing extraction of hydrocarbons and groundwater in coastal areas, the removal of rocks and sediments by mining activities, the modification of the coast and the construction of dams are some examples of interventions affecting the Earth's climate, chemistry and surface. Ocean volumes, and more specifically the water cycle, are also affected (CASADEVALL, 2016). Steffen, Sanderson and Tyson (2004) exemplify these impacts on the water cycle by taking into account the type of vegetation observed on the Earth's surface and its role in water transpiration into the atmosphere. Since vegetation roots store water, it is an important controller for environmental balance. Therefore, any changes in vegetation such as those caused by deforestation, can modify the flow of water between the Earth and the atmosphere.

Water cycle and Earth system dynamics are responsible for connecting terrestrial and marine ecosystems, transporting material and other components of the global environment (STEFFEN et al, 2004). Consequently, the water cycle connects ecosystems. Human societies are therefore vulnerable to any changes brought to the water cycle. As Casadevall (2016) mentions, the central point is that water issues have a global scale due to its transboundary nature. Ribeiro (2012, p.5) adds that while the importance of natural resources changes over time, this does not occur when it comes to water, since it relates to "the production of the material basis of existence, whether in the production of shelters or in the production of food". Artaxo (2014) develops a similar argument to the effect that water, its distribution, management and use, are capable of influencing food production, biodiversity, climate and water security.

According to Casadevall (2016), the Anthropocene epoch deepens the global water resource problem. Water availability and management on a regional and global scale are interconnected with the ways in which human beings developed their actions on Earth. He shows that international and regional cooperation are essential, especially considering that consequences of the Anthropocene are unknown. Admitting the unpredictability that the



Anthropocene brings to the Earth system and to its inhabitants becomes one of the first steps for changes to occur. These changes are initially individual and must spread to other spheres of social life.

Changes in terms of international cooperation between States are difficult to achieve (Viola; Basso, 2016). The difficulty is primarily political, since cooperation implies the transfer of state sovereignty in favor of more robust intergovernmental agreements. In a world still politically and theoretically designed for and by the nation-state, intergovernmental cooperation is seen as a threat to sovereignty, that is to the loss of "control over a territory, by the monopoly of the use of force, among other forms" (RIBEIRO, 2012, p.1). According to Ribeiro (2012), the conventional concept of sovereignty apparently lost its meaning in a globalized world. However, in the international system, sovereignty is present and includes discussions that support country positions in multilateral forums, as well as discussions involving neighboring states, such as transboundary water management. Although water is considered a global common good¹, its essentiality and economic value hinder the occurrence of necessary cooperation. This does not mean that we are underestimating the fact that, since the second half of the twentieth century, there has been a considerable improvement of cooperation between nation states. As Viola and Basso (2016) argue, during this same period, society has witnessed the emergence of new international regimes exemplified through international law, human rights, trade, the fight against the proliferation of nuclear weapons, public health and the environmental human imprint. All these subjects have become recurrent topics of international policy.

One can therefore identify a trend towards the emergence of a "global environmental order" – as coined by Ribeiro in the early 2000's (Ribeiro, 2001). Ribeiro (2010) advocates the consolidation of such an order, stressing the advance in international conventions on environmental problems mainly as a means of reflection, opportunity for cooperation and legitimation of environmental policies. The international environmental order would be driven by international meetings, treaties and documents, many of which would be coordinated by United Nations (UN) bodies. This is confirmed by Veiga (2013) who states that, between 2005 and 2011, 27 bilateral agreements, 22 agreements, 59 additives and 10 international environmental protocols were signed. These facts should be highlighted because, in an international society characterized by diversified agenda and national interests, the consolidation of international agreements represents a progression towards positive changes, even though they remain insufficient and far too slow considering the importance and scale of the problems faced by nations all over the world. Despite the progress in cooperation at all levels, when it comes to global commons such as water, the "discrepancy between unequal reality and normative equality becomes ostentatious and explains to a great extent the inability of the international regime to obtain efficient solutions to the problem" (VIOLA; BASSO, 2016, p.6).

The Anthropocene clearly demonstrates that the environment's stability is not to be taken for granted and that the current situation requires immediate policy reform. While water problems are not afforded the same publicity as international wars and armed conflicts, nor are

¹According to Viola and Basso (2016, p.3), "common goods are characterized by non-exclusivity - it is not possible to exclude their use from those who do not contribute to their provision".



on the same threshold as climate change, loss of biodiversity and changes in biogeochemical cycles, scholars such as Peter Gleick and Ismail Serageldin, an ex-World Bank vice-president, have already pointed out that water problems are likely to encourage international conflicts. Gleick (1995, p. 83) states that "water and water supply systems [have] been the roots and instruments of war". We must consider that there is a long history of conflict over access to this natural resource. Since water involves fundamental aspects for the survival of the human and other terrestrial species, any changes in their system and functioning can be considered to have an impact as relevant as the world wars, which justifies the argument that water governance is an effective threat to the stability of the international system.

Water governance in the Anthropocene

Rockström et al. (2014) distinguish four features related to water issues: (1) political, social, cultural and economic changes, (2) water security, (3) water accessibility, quantity and quality, and (4) vulnerability to extreme events. These spheres should not be taken separately but should rather be intertwined. To deal with them, according to Bhaduri et al. (2014), it is necessary to develop a multi-scale and interdisciplinary approach enabling us to understand the complex and interconnected nature of the global water system. Political, social, cultural and economic changes concern new social and ecological approaches capable of developing an integrated governance of water and terrestrial resources (ROCKSTRÖM et al., 2014). Steffen, Sanderson and Tyson (2004, p. 38) confirm this perspective by stating that "strategies for water management must increasingly take on regional integrative approaches".

The second feature relates to water security² and comprises a multidimensional and interdependent set of different factors which enable a population to ensure access to water and sustain both human and ecosystem health in the occurrence of water-related disasters – such as droughts, floods and landslides (UN-WATER, 2013). In this context, State and science are the main agents. According to UN-WATER (2016), ensuring water security means identifying critical issues related to water in a local, regional and/or global scale. Bhaduri et al. (2014) argue that although most problems and solutions to water security reside in governance, expert knowledge about the global cycle of water and its entanglements with the global environment is an essential aspect. Thus, water security depends both on political will and the scientific development of new methodologies and governance models.

The third feature concerns water accessibility, quantity and quality³. Ensuring these three aspects is a tangible need for any country, however this does not guarantee that inequalities and conflict over water use will be avoided. Therefore, new organizational mechanisms in water distribution must be developed, encompassing the entire population, in urban as well as in rural areas. Here, water issues interweave with economic, racial, cultural and historical aspects.

²Cook and Barken (2012) define "water security" in four main aspects. Water security takes into account the quantity and availability of water for consumption, covers the risks and consequences of floods, aims at conditioning and treating water quality and focuses on sustainability.

³Water quality is linked to its physical parameters (color, turbidity, temperature, taste and odor), chemicals (pH, alkalinity, acidity, hardness, chlorides, nitrogen, phosphorus, dissolved oxygen, organic matter, inorganic, and organic micropollutants) and organisms (indicator organisms, algae, and bacteria) (VON SPERLING, 1996).



Finally, the last feature addresses vulnerability to extreme events such as droughts, floods and contamination of water resources. Such events have a deep impact on water supply, global food production, biodiversity and human well-being in general. Addressing the vulnerability of populations to these events requires a better understanding of the underlying mechanisms and possibilities of improvement in global governance (BHADURI et al., 2014).

Final considerations

The Anthropocene brings multiple challenges to Earth system governance. Water availability problems, as argued in this article, are a central issue for this new epoch since it is directly related to the present and future of human activities, in all their complexity. Since water is a global scarce resource and a source of conflict, it has to be addressed by intergovernmental cooperation. This means that we need to develop new models of water governance on a global scale, which would enable us to deal with the growing water scarcity in various regions. This is one of the major challenges of the 21st century.

The inefficiency of the current water governance mechanisms stems not only from the still nationally-based political-legal systems, which are often unable to deal with increasing trans-territorial competitive uses of water resources, but also by increasing social pressures, changes in social needs and by environmental impacts of human action restricting access to it. Since water issues range from the individual to the global institutional system, public awareness is paramount. Based on this, the present article sought to emphasize some necessary changes in water governance. As mentioned previously, human and social sciences have a very important role in the development of a scientific diagnosis of the current global situation. Stakeholders engaged in the political decision-making process must take into account the complexity and the scale of cultural and biological relations created in the Anthropocene epoch. Since local boundaries have been exceeded in the last decades, water governance should thus rely on political approaches characterized by a multiactor and multifactor based process, leading to an increasing internationalization of water governance.



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