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WILEY WIREs WATER

OPINION

The neglected costs of water peace

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Referring to the analytical definition of water wars, several scholars have coherently argued against the "water leads to war thesis." There are four arguments that have contributed to successfully dispel the myths of water wars: (a) interstate cooperation prevails over conflict; (b) development of new technologies increases freshwater availability; (c) the intrinsic characteristics of water as a resource do not justify interstate military intervention; (d) virtual water trade provides the opportunity to circumvent local water scarcity. These arguments converge demonstrating that rather than water wars in the future, water peace will prevail. While we agree with these arguments on the low likelihood of future water wars, we find that hydropolitical theories have generally neglected the fact that the conditions for interstate water peace come with high socio-environmental costs. In particular, the central idea that virtual water trade resolve issues of local water scarcity and therefore reduces tensions and escalation of violence among different countries does not fully take into account the fact that dynamics of transnational water appropriation have serious socio-environmental impacts on the virtual water exporting countries. To conceptualize this phenomenon we introduce the notion of "hidden socio-environmental costs of virtual water transfer," which is understood as a specific form of environmental cost-shifting. The empirical support to our reasoning comes from the study of transnational large-scale land acquisitions which represent an expanding phenomenon central in the contemporary global agrarian transformation.

This article is categorized under:
Engineering Water > Planning Water
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1 | DRUMS OF WATER WARS

Freshwater, is a critical resource, renewable, yet finite, central for ecosystems, human well-being, and development. Several environmental indicators demonstrate that human water use is exceeding sustainable levels and we already entered an era of water scarcity with freshwater availability changing worldwide as a result of anthropic impacts and climate variations (Dell'Angelo, Rulli, & D'Odorico, 2018; Falkenmark & Rockström, 2004; Jägermeyr et al., 2016; Rodell et al., 2018).

It happens then, that when you speak about hydropolitics and water scarcity as your own research field, a common reaction is "well that's important, the next wars will be fought over water resources!" Taxi drivers, family and friends all seem to agree with this inescapable gloomy future. They are in good company. High profile representatives from international organizations such as the United Nations agencies, the World Bank and Generals from armies, like the one of the United States, have

recently made public statements about this highly possible scenario (Barnaby, 2009; Rahaman, 2012). The idea that freshwater resources rather than oil will lead sovereign States to escalate in formal military conflicts, the so-called future "water wars," impacts our collective imagination. This diffuse and uncritical belief that in a Gramscian perspective would be defined as "common sense" (see D'Alisa & Kallis, 2016; García López, Velicu, & D'Alisa, 2017), becomes a "truth" through rhetorical strategies of different key actors such as politicians, policymakers, journalists and non-governmental organizations (Katz, 2011).

Imagination became (quasi)reality on October 19, 2015. The British Navy Commander Tristan Lovering declared: "With desertification, dry aquifers, riparian disputes and an ever-diminishing resource, Kamon, the aggressor country in the region, refuses international arbitration and invades southwards in order to seize key dams in Lakuta, which was caught ill-prepared to counter the invasion." Following this statement, the NATO Joint Warfare Center coordinated the largest military intervention after WWII. Over 36,000 soldiers, 140 jets and 60 frigates from the 30 NATO Nations intervened. This was one of the largest warfare simulations ever conducted.[1]

But do hydropolitics scholars believe in the eventuality of future water wars? The answer is very simple and is a straight "no." There is a strong academic consensus on refuting the thesis that "water leads to war." What, precisely is the analytical definition of "water wars" though? To avoid analytical confusion, it is useful to distinguish between the formal definition of "water wars" and the broader category of "water conflicts" (Katz, 2011). In law and international relations scholarship, the definition of war is amply debated. Operational categorizations look at quantitative indicators such as the number of causalities, legislative processes related to the declaration of war, typology of actors involved and other case-specific factors (Prakash, 2007; Sarkees, 2010; Small & Singer, 1982; The Economist, 2013; Weede, 1984). A common characteristic of the formal definitions of war is that at least one sovereign state should be involved. Similarly, in a hydropolitical perspective, it is important to consider "water wars" as associated with state level violence, and even more specifically as interstate military confrontation (Wolf, 1998, 2007). This hydropolitical fundamental definition clears the discussion from the confusion between the general notion of "water conflicts" and the specific term "water wars."

2 | REFUTING THE "WATER LEADS TO WAR THESIS"

Referring to the analytical definition of water wars, several scholars have coherently argued against the "water leads to war thesis." Recent empirical research that addressed 14 research studies on hydro-conflicts in different countries synthesized the notion of "water wars" as a fallacy (Kallis & Zografos, 2014; Zografos, Goulden & Kallis, 2014). Referring to the broader literature, there are four main arguments. First, when it comes to interstate water affairs, cooperation prevails; second, technology will produce more efficient alternative solutions that will reduce human pressure on global water resources and mitigate water scarcity; third, the comparison of the intrinsic characteristics of oil and water as strategic resources highlights the unlikelihood that water will drive interstate military intervention. Last, globalization resolves water scarcity through international trade.

The first argument that "interstate cooperation on freshwater resources prevails over conflict" is supported by historical evidence. While there are some analyses indicating that sharing of international rivers might increase the probability of militarized disputes (Toset, Gleditsch & Hegre, 2000) it has been shown that the majority of water-related interstate conflicts have been resolved in a cooperative way (Wolf, 2007). The cost of warfare by far would hardly be justified by the appropriation of a resource that does not directly lead to high profits such as water (Selby, 2005). A systematic search for a water war with interstate violence produced only one result, pointing at the military conflict of the city-states of Umma and Lagash over the use of the Tigris river in 2,500 BCE, as the only water war that has ever happened (Gleick, 1993). The solid presence of cooperative interactions and the clear absence of formal wars over freshwater resources are also supported by the analysis of contemporary times. The relatively large number of water treaties among countries sharing water bodies can be considered as a compelling evidence of cooperation (Wolf, 1998). An exhaustive dataset on interactions between two or more states on water resources in the second half of the 20th century reveals that out of 1,831 interactions, conflictive or cooperative, ~67% were cooperative. Of the 507 more conflictive events, only 43 cases were associated with military acts while 414 were limited to verbal hostility. No events were categorized as formal war (Wolf, Yoffe, & Giordano, 2003).

The second argument that can be described as a form of "technological optimism," stems from the belief that the development of new technologies, the adoption of modern agricultural techniques, and the use of science-based methods of crop distribution will increase freshwater availability or enhance water use efficiency in agriculture, mining or other industries, thereby reducing competition for water and conflict. Although not explicitly formulated as an argument to dismiss the emergence of water wars, this confidence in future technological and science-based solutions to produce more with less, is motivated by research on the development of new cultivars that are more drought-adapted or have higher water use efficiency ("more crop per drop,", see Falkenmark & Rockström, 2004), the adoption of agricultural techniques that reduce nonproductive water consumption associated with soil evaporation and inefficient irrigation technology (e.g., Jägermeyr et al., 2016), the

selection of crops that are more suitable to the local hydroclimatic conditions (Davis, Rulli, Seveso & D'Odorico, 2017) and the reliance on strategies and technologies for waste reduction and reuse (Kummu et al., 2012). Technological advancements ranging from large-scale desalinization to new local systems of water purification have led to a widespread trust in techno fixes that can also improve drinking water availability. Collectively, technological advances can reduce the competition for water resources, however, some of these fixes may have detrimental environmental and social costs (D'Odorico et al., 2018; Palmer et al., 2015).

The third argument, describes how the anatomic differences between water and oil as strategic economic resources, are explicative of the fact that water, differently from oil, does not justify interstate military intervention. It is clear that oil is prevalently at the center of contemporary geopolitical tensions, violence, conflicts and interstate wars. Oil is associated with civil conflicts and can be a major cause of regional interstate conflicts. Water instead, while being increasingly associated with local violent conflicts in the global South, has practically never been systemically associated with interstate conflicts nor wars (Selby, 2005). The political economy of these resources is essentially different because of several intrinsic characteristics. Oil, for example, is a motor of industrial production while water is more of a key input for biological processes, including agricultural production; oil is geographically unevenly distributed and nonrenewable while water is a renewable and relatively widely distributed resource; oil leads to very high profits and tends to be oligopolistically organized, while water tends to be a public or common-pool resource which does not directly lead to high profits (Selby, 2005).

The last argument is about the strategic power of virtual water. Central to this argument is the work of Allan (1996, 1998, 2002) which elaborates on how water resources can be appropriated through the transnational trade of agricultural commodities. The adjective "virtual" is used to stress that such water is not physically present in the commodities that are traded. Some regions of the world, such as the Middle East, do not have enough water to produce all the food required to feed their populations. This situation could be expected to lead social tensions. However, according to Allan, reliance on international trade has allowed these countries to circumvent their chronic water scarcity and meet their needs. In this light, trade can be explicitly considered as a mechanism that has a water-saving function (Hoekstra & Chapagain, 2008; Konar, Hussein, Hanasaki, Mauzerall & Rodriguez-Iturbe, 2013). Allan (1998) noted that the importation of agricultural commodities and other goods is associated with the virtual transfer of the water resources used to produce those goods. More specifically, his work (Allan, 1996, 1998, 2002, 2003, 2005) described how countries' dependence on water for agriculture, which on average accounts for 70% of the entire global water consumption (Richter, 2014), is often satisfied by the import of agricultural commodities. He demonstrates his argument relying also on historical evidence. In the case of the Middle East and North Africa, Allan (1998) estimates that virtual water flows associated with the importation of grains from North America exceeds the actual water flows in the Nile River. It is by analyzing the virtual water trade phenomenon that Allan comes to the conclusion that it is much more logical and convenient to trade with foreign countries and import virtual water from them rather than going at war with them. Despite some analytical criticism (Ansink, 2010), virtual water trade remains at the basis of one of the key arguments used to refute the "water leads to war" thesis. Other studies, mostly on the industrial sector, are also supporting the view that trade reduces the likelihood of conflict, though their focus is neither on water resources nor on virtual water trade (De Angelis, Metulini, Bove, Ricaboni, 2017; Dorussen, 2006; Hegre, Oneal, Russett, 2010). The counterargument, could be that trade has sustained population growth in importing countries, thereby enhancing water scarcity, trade dependence and consequently increasing in the long run the risk of instability while reducing societal resilience (D'Odorico, Laio & Ridolfi, 2010; Suweis et al., 2013).

According to these four arguments and other, not less important, analytical contributions, there is consensus that water wars should be considered a dispelled myth (Barnaby, 2009). Practically nonexistent instead are recent scholarly contributions that actively support the water leads to war thesis. Gleick (1993) is often referred to in the context of water violence history. However, Gleick's accounts of water-related conflicts are not at the state level and, when organized national warfare happens, it is for water as a military strategic target, never for water as the primary cause of military intervention (Wolf, 1998, 2007). Also in the case of the Israeli-Palestinian confrontation over water in the West Bank, there have been many instances of conflicts but none that can be formally considered a water war (Zeitoun, 2007) as water, rather than being the reason for the conflict, is described as a strategic tool used for military purposes (Selby, 2003).

3 | IS THERE A HIDDEN STORY?

In sum, scholars from different analytical and ideological perspectives convincingly converge in dispelling the myth of future water wars. But is this the full story? The argument that countries do not go at war for water because it is more convenient to resort to cooperation, technology and international trade, is a partial description which does not take into account several critical elements. In particular, there is a dynamic that we believe has strong relevance, and yet is neglected: *as virtual water is imported by countries through international trade*, *a competition over water may arise or intensify in the exporting country*,

particularly if it affects regions with limited freshwater resources. This can be interpreted as if the competition were virtually exported to that country. In other words, the social costs and social tensions, that are thought to be resolved by virtual water imports, do not simply disappear. They are virtually transferred to and internalized by, the countries where water is appropriated. Therefore, we set forth the new hypothesis that, *as water is a limited resource—both in local and global terms—when competition over water is resolved by fetching it from abroad, the social tensions that can consequently emerge or escalate, are shifted elsewhere rather than being dissolved.*

According to the comparative advantage theories (Maneschi, 1998), we expect virtual water to flow from water-rich to water-poor countries, which should dissipate social tension (Suweis et al., 2013). While this might hold globally (other production factors such as land, and labor determine trade patters), it is not necessarily true regionally. Water-poor countries do, in fact, export virtual water. Here we argue that some of these virtual water flows occur from water scarce countries to more economically powerful nations—no matter whether they are in more or less severe water scarcity conditions—and that as a result of these water appropriations marginalized rural communities lose access to water resources that are crucial to their livelihoods. This way to think about the interdependency of the phenomenon is consistent with the notion of telecoupling, which refers to the socioeconomic and environmental distant interactions among coupled natural and human systems (Liu et al., 2013; Oberlack et al., 2018). More specifically, we need to be aware of the fact that virtual water trade may have socio-environmental consequences (costs) in the exporting countries. This aspect is not sufficiently addressed by the theories claiming that virtual water trade prevents the occurrence of water wars.

When Allan describes how "a ton of wheat when imported by a water short political economy enables those managing scarce water in such economies to escape the economic and political stress of mobilizing 1,000 t (cubic meters) of water" (Allan, 2003, p. 9) he is describing only a part of the picture. What is neglected is that the process (virtual water trade) that permits to escape from water scarcity and the consequent economic and political stress in the importing countries, is based on a dynamic of social "cost-shifting" (Kapp 1963, 1983), whereby the burden of water scarcity consequently emerging in the exporting country is borne by the weaker (i.e., less powerful) social groups within it.

Kapp explained how capitalist markets structurally socialize costs, in the sense that profits made by private corporations occur with costs that are transferred to society in its complex, particularly to its most vulnerable groups and future generations. Socio-environmental *externalities* that arise in capitalist modes of production are considered by Kapp, "cost-shifting successes," rather than market failures, as in the neoclassical economics tradition (Gerber, 2016). These social costs that include a wide range of social, ecological and institutional outcomes are produced in the pursuit of private gains. Because of asymmetries in power relations these social costs are shifted to the weaker and more vulnerable subjects and often produce conflicts (Gerber, 2016). Muradian and Martinez-Alier (2001a, 2001b) building on the concept of cost-shifting describe how the extractive feature of the political economic history between countries with different degrees of power and development, is structurally based on *environmental cost-shifting*, that is, the appropriation of resources, material, and ecological flows. This notion of environmental cost-shifting is consistent with the theory of *ecological unequal exchange* (Hornborg, 1998; Martinez-Alier & O'Connor 1996), the "disproportionate utilization of ecological systems and externalization of negative environmental costs by developed countries and, consequentially, declining utilization opportunities and imposition of exogenous environmental burdens within LDCs" (less developed countries) (Rice, 2007, p. 44). In relation to this, the idea that virtual water trade resolves issues of local water scarcity and therefore reduces tensions and escalation of violence among different countries does not fully take into account the fact that the dynamics of transnational water appropriation have profound socio-environmental impacts on virtual water exporting countries. To conceptualize this phenomenon, we propose the notion of "hidden socio-environmental costs of virtual water transfer," which is understood as a specific form of environmental cost-shifting (see Table 1 for a synthesis of the key definitions).

These flows of energy, materials, and resources are the fuel required by the expanding needs of contemporary capitalistic economies (both in high-income and emerging countries) and are derived from global dynamics of dispossession,

TABLE 1 Key concepts associated with the notion of hidden socio-environmental costs of virtual water transfers

Key concepts	Synthetic description	Focal level
Externalities (Coase, 1960)	Private production agent does not pay for its own socio-environmental impacts. Due to market failures society carries those costs	Private company
Cost-shifting (Kapp, 1963)	Private production socializes costs and privatizes benefits. This is seen as an intrinsic feature of markets exploited by capitalistic production rather than a failure	Private company
Environmental cost-shifting (Muradian & Martinez-Alier, 2001a)	Environmental degradation and waste production associated with extractive processes are shifted to exporting countries while the importing countries and companies benefit from these ecological and material flows	Private companies and "countries"
Hidden socio-environmental costs of virtual water transfers (this article)	In the globalized dynamics of virtual water trade there are countries that benefit from importing water intensive commodities while the exporting countries suffer from different types of socio-environmental costs. This is a specific form of socio-environmental cost-shifting	"Countries"

commodification, privatization, and contamination of nature (Demaria & D'Alisa, 2013; Harvey, 2007). The expansion of the operational space of capitalism and the paradigm of unrestrained economic growth that have dominated contemporary globalization (Sassen, 2010, 2014) are associated with the diffusion of social conflicts that arise over unequal distribution of environmental benefits and costs of the appropriation of natural resources (Homer-Dixon, 2010; Martinez-Alier, 2002, 2009; Martinez-Alier & O'Connor 1996; Scheidel et al., 2017).

4 | WHAT IS THE EMPIRICAL EVIDENCE?

If this is the real hidden nature of virtual water trade, how do the associated virtual social costs manifest themselves, then? How can the relationship between virtual water imports and "virtual exports of social conflict" be detected on the ground? The answer to those questions depends very much on the country where virtual water is initially appropriated. Countries that have plenty of freshwater resources, flourishing agricultural sectors, good standards of development and food security might be able to export virtual water without paying strong socials costs. This could be the case of the US, Canada, Brazil and Argentina, some of the major virtual water exporters in the world (Carr, D'Odorico, Laio & Ridolfi, 2013) But what happens to countries or regions affected by high levels of economic or physical water scarcity?[2] The ongoing transition from small-scale farming to large-scale commercial agriculture may jeopardize water and food security of local populations by making them dependent on food produced by agribusiness corporations (DeSchutter, 2011; Dell'Angelo, D'Odorico, Rulli & Marchand, 2017). Indeed, virtual water transfers occur not only through trade but also through large-scale land acquisitions (LSLAs), which entail an appropriation of water resources (see Figure 1). Foreign land acquisitions may constitute a water grab if they usurp water resources in countries affected by water and food insecurity (Dell'Angelo et al., 2018; Rulli & D'Odorico, 2013; Mehta et al., 2012).

The global process of LSLA has critical hydropolitical implications that often entails the appropriation of freshwater resources in regions of the developing world affected by food insecurity (Dell'Angelo et al., 2018; Rulli & D'Odorico, 2013, Rulli et al., 2013). It has been estimated that about 28% of the LSLAs documented by the Land Matrix (2017)—the largest available dataset on LSLAs—is occurring in countries affected by water scarcity and food insecurity (Dell'Angelo et al., 2018). These findings indicate that water appropriations often impact the poorest and most vulnerable rural populations in developing countries. Moreover, meta-studies show how land acquisitions preferentially target communal land and water resources rather than privately owned or leased commercial farmland. As a result, LSLAs and the associated appropriation of water are associated with the disruption of traditional common property systems, have negative impacts on local livelihoods, and become an impediment to the attainment of sustainable development goals (Dell'Angelo, D'Odorico, Rulli & Marchand, 2017; Dell'Angelo, D'Odorico & Rulli, 2017). Moreover, land and water grabbing are directly associated with social conflicts, forced evictions, and in many instances violent conflicts (D'Odorico, Rulli, Dell'Angelo & Davis, 2017; Grajales, 2011). A recent meta-study of the LSLAs literature synthesized that acquisitions are generally characterized by imbalanced power relations, coercion, and conflict. The type of coercion varies through different manifestations of conflict with situations that go from decisions implemented without consultation to physically violent evictions or confrontations. The study found that in 25% of the reviewed cases there were confrontations between actors involved in the acquisition that included protests and

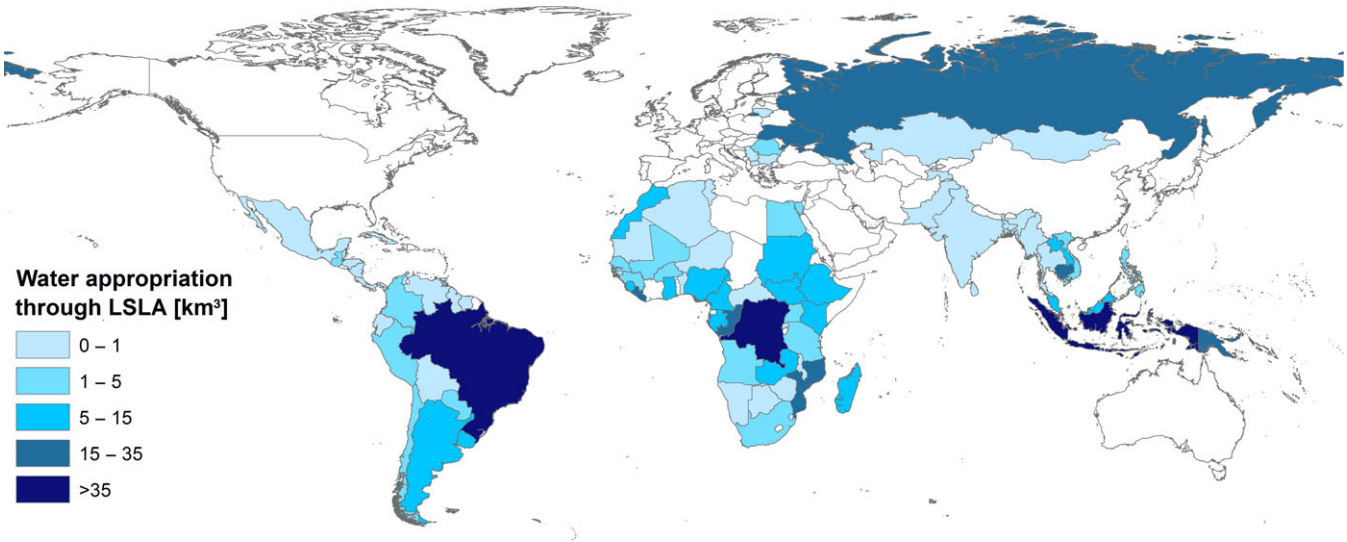

FIGURE 1 Freshwater resources virtually appropriated through LSLA. See Dell'Angelo et al. (2018) and Rulli et al. (2013) for details on the assessment methods

physical, but not explicitly violent, resistance. In 23% of the cases instead, there was violent conflict that involved violent reactions or oppression that resulted in violent physical actions (Dell'Angelo, D'Odorico, Rulli & Marchand, 2017).

5 | CONCLUDING REMARKS

So, what does this mean for hydropolitical theory? Who are the winners and the losers of the globalization of water resources in this world with no water wars?

There are few points that it are worth stressing. First, building on the tradition of thought that starts with Kapp and the elaboration of Martinez-Alier, we find that Tony Allan's notion of virtual water could be integrated with the analytical concept of hidden socio-environmental costs. The awareness of telecoupled socio-environmental distant connections and the analytical means that are available in the scientific community should be used to produce better accounts of the socio-environmental impacts of virtual water trade and the profound interdependencies of social and hydrological systems on multiple scales. The Planet Earth is a closed and interconnected ("globalized") systems with a high level of interdependence among different geographic regions, their environments, and societies (Oberlack et al., 2018). Trade and foreign land investments are major mechanisms of globalization and virtual water flow that distance societies from the water resources they depend on (Carr et al., 2013; Hoekstra & Chapagain, 2008; Hoekstra & Hung, 2005).

The concept of "hiding or shifting the socio-environmental costs of virtual water transfers" critically problematizes and raises new questions about the scholarly consensus on the fallacy of future water wars. This notion produces a more realistic hydropolitical account of the complex dynamics and interdependencies associated with the increasing pressure on globally scarce water resources. It also highlights that behind the optimist perspective that States will not go to war over water because of the positive social impacts of virtual water trade, there is a hidden story of increased local conflict, violence, dispossession and injustice. The fact that water is appropriated through international trade in areas that are water stressed and have high levels of malnourishment is a moral scandal that must be addressed. It also reveals that the analysis of water conflict should move away from the idea of States as the main actors in hydropolitical competition and understand the dynamics of conflict as related to different (subnational) categories of confrontation that make the less powerful groups (e.g., class, political group, or gender) more vulnerable. Global dynamics of water appropriation, independently of the geographical identification, disproportionally impact the poor and most vulnerable groups. The hidden socio-environmental costs associated with virtual water trade show how in this era of global water scarcity, the poor and more vulnerable people, are once again the ones carrying the burden of shifting dynamics that reproduce a structural process of hydrological unequal exchange.

Last, it is fundamental to recognize the role of the global land rush and the recent expanding dynamics of transnational LSLAs. Water is a fundamental element of this global agricultural transformation (Dell'Angelo et al., 2018; Rulli et al., 2013) and the analysis of the societal and hydrologic significance of water grabbing is crucial to a deeper understanding of hydropolitics in the 21st century. In fact, the neoliberal dynamics of transnational land and water appropriation produce profits for multinational corporations, while securing access to resources, such as water, that are strategic to the national interests of politically, economically or militarily influential countries. In this light, it is crucial to address the question of who benefits and who instead is negatively and unjustly affected by the interdependent dynamics of water appropriation in our blue planet.

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CONFLICT OF INTEREST

The authors have declared no conflicts of interest for this article.

ENDNOTES

[1]NATO media information center 2015 and NATO Public Diplomacy Division Fact Sheet 2015 (https://www.nato.int/nato_static_fl2014/assets/pdf/pdf_2015_10/20151008_1510-factsheet-tj15_EN.pdf). NATO newsroom (http://www.act.nato.int/sorotan-will-challenge-nato-against-hybrid-threats). Documents last accessed February 2018. NAT

[2]In a general sense, the difference between the two indicators is that physical water scarcity happens when there is not enough physical water to meet all demands in a certain place. It is also explained as when more than 75% of river flows are withdrawn

for industry, agriculture and domestic purposes (accounting for return flows recycling). Economic water scarcity instead occurs when the economic, financial, institutional and human capital constrains access to water even though there would be locally enough physical water to meet all human demands. For an analytical explanation of the difference between physical and economic water scarcity and other relevant indicators, see Brown & Matlock (2011).

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