From State to System: Financialization and the Water-Energy-Food-Climate Nexus

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Abstract

The water-energy-food-climate nexus has risen rapidly in global water governance over the past decade. This paper examines the prominent role played by global financial networks in articulating the nexus and in connecting it in operational terms to sustainability programs. In so doing, it provides new insights into critical engagements with the nexus that, to date, have focused predominantly on issues of water security and governance. The paper examines how global financial networks conceptualized and concretized the nexus towards two ends: First, the nexus was used to effect the transition from state-oriented development models to financialized approaches to water development and sustainability. Here, the nexus was formulated in critique of, and as a solution to, the previously dominated approach to water development, integrated water resources management (IWRM). Second, the nexus was deployed to connect water, energy, food, and climate to the global economy in terms of complex systems. The identification of risks to the resilience of environmental and economic systems provided a new form of integration across the supply chains affected by the governance and security of water, energy, food, and climate. In both cases, the nexus mobilizes technologies of global finance, such as credit-risk ratings, to construct and defend new strategies for governing water security that enable sub-sovereign actors, such as municipalities, to be incorporated into systems of global finance. The paper concludes that alignments of the nexus with sustainability programs, and the Sustainable Development Goals, must be reconsidered in view of the constraints posed by financial orientations towards the risks and resilience of economic and environmental systems.

1. Introduction

Since the 2008 financial crisis, one of the most significant shifts in global water governance has been the rise of the water-energy-food-climate nexus (hereafter: nexus). In 2009, Ban Ki-moon focused attention on the nexus when, as Secretary General of the United Nations, he asked the global financial community to prioritize water security at the annual meeting of the World Economic Forum in Davos (UN Water, 2009). Two years later, the World Economic Forum (2011a) delivered its report. Entitled *Water Security: The Water-Energy-Food-Climate Nexus*, the report argued that water, energy, food, and climate crises are linked to the structural

mismanagement of water across the global economy. This article examines the role of global financial networks in articulating and positioning the nexus astride UN agendas. Indeed, by 2017, UN publications noted the "most commonly discussed interactions" regarding the Sustainable Development Goals (SDGs) lie "…in the nexus between food, water and energy, as reflected in the links between SDG 2 [food], SDG 6 [water] and SDG 7 [energy], with potential conflict in water use for energy production and generating hydropower with residential and industrial water use and for irrigation for food production" (Nikolova et al., 2017: 15).

This article argues the nexus helped pivot global water governance discourse from state-oriented development models to the governance of globally interconnected economic and environmental systems. It proceeds in three steps to theorize, situate, and explicate the shift from 'state to system' in global water governance: First, it reviews how the nexus has typically been understood—as a frame for integrating water security and governance at multiple scales and across sectors. Neither nexus discourse nor its critiques, however, have attended to the de-territorializing role of global financial networks in articulating the concept. To address these concerns, we position our methodological approach toward the nexus in reference to the financialization of nature—the processes by which the material and energetic throughput of the Earth system are drafted into processes of capital accumulation wherein financial profits are proportionally greater than those of industrial production. Second, the article situates the nexus with respect to how it realigned previous sustainable development programs, notably Integrated Water Resources Management (IWRM). Third, the article explicates how global financial networks retooled—at times rejected—IWRM as the nexus took shape. Analyzing key publications on global water finance from the World Bank and the World Economic Forum's *Global Risk Reports*, the article shows how financial technologies shape the kinds of connections

that are to be governed and secured as development agendas are re-scaled from state-centered modes of industrial production to financialized systems of accumulation. One caveat: the analysis prioritizes water even though other nexuses (i.e. food-energy) are also important (see Field and Michalak, 2015). As becomes evident, the rationale for emphasizing water is its foundational role in notions of the nexus (Allan et al., 2015).

2. The Nexus: Water Security, Governance, and Financialization

At a 2011 conference in Bonn, the nexus was advanced as a tool for transitioning from the traditional concerns of sustainable development to a framework befitting an increasingly globalized world (Hoff, 2011). A "nexus approach" was defined in terms of "integrating management and governance across sectors and scales" so as to achieve water, energy, and food security (Hoff 2011: 7). Timed to inform the Rio+20 conference in 2012, the Bonn gathering forwarded the nexus as key to the "green economy" (Ringler et al., 2013; Finley and Seiber, 2014). At Rio+20, however, the "green economy" was contested by developing countries worried it may prove a vehicle by which, "industrialized countries slip out of their commitments to promote and fund sustainable development, while imposing new forms of environmental conditionality on resource use" (Conca 2015a: 169). Despite these contests, scholarship on the nexus has focused on water security and governance with comparatively little attention to what is at stake in transitions towards the "green economy" or to contests over funding conditions.

Prior to Bonn, Hellegers et al. (2008) argued governance gaps could create or compound water security challenges across interconnected water, energy, food, and environmental systems. Subsequent accounts of the nexus followed suit by assessing basin-scale interactions among

water security, governance institutions, and ecosystem functions (Lawford et al., 2013; Ringler et al., 2013; Scott et al., 2011). This focus on basin-scale, or watershed interactions was designed, at least in part, to retain fidelity with previous sustainable development programs, notably the concept of integrated water resources management (IWRM) that dominated the 1990s (see Conca, 2006). As explored below, however, IWRM was criticized for being too "water-centric" whereas the nexus remained committed to coordinated, sustainable development but focused on governing connections across interconnected sites affecting water, such as energy and food production and climate change (Hussey and Pittock, 2012; Benson et al., 2015). Since, in a globalized world, interconnected concerns extend beyond the watershed, the nexus offered a framework to connect watersheds to the institutional, political, and economic scales that govern global supply-chains of water, food, and energy—from Spain, India, China, and Mexico to the United States (Hardy et al., 2012; Malik, 2002; Scott, 2011; Scott et al., 2011; Shah et al., 2003; Wang et al., 2012). Especially after Rio+20, the nexus offered a way to recognize the interdependence of water with other sectors, yet not require conformance to a single management framework such as IWRM (Howells and Rogner, 2014). Further, by attending to multiple scales of governance and water security in the context of global environmental change, the nexus could alert decision makers to unanticipated consequences that arise in entangled social-economic-ecological systems (Leck et al., 2015; Scott et al., 2015; Smagl et al., 2016). As new programs of global governance emerged, such as UN Water and UN Energy, the dual focus on water security and governance mobilized the nexus to show how the uneven effects of global environmental change required flexibility in dealing with the non-linear dynamics of complex systems (Schubert and Gupta, 2013; Grenade et al., 2016; Rockstöm et al., 2014).

Perhaps unsurprisingly, the rapid ascent of the nexus has not been without critique: Leese and Meisch (2015) argue the 'securitization' of the nexus reduces complex social and environmental dynamics to metrics (i.e. risk calculations) that marginalize distributive concerns. Biggs et al. (2015) argue the nexus overemphasizes security at the expense of livelihoods, thereby ignoring a central democratic aim of sustainability. Allan et al. (2015) contend that reducing security to supply-chain risks may produce or exacerbate social inequalities while undervaluing ecosystems that do not fall with the remit of supply-chain considerations (cf. Allan and Matthews, 2016). Finally, Williams et al. (2014) argue the nexus is not a significant departure from previous sustainable development programs, such as IWRM, but rather retains neoliberal logics where capitalist modes of production create and shape spaces for accumulation.

Missing from both constructions and critiques of the nexus, however, are considerations of finance. This is surprising; the nexus gained prominence in the wake of the 2008 financial crisis and amid calls to address the deep structural connections between the global economy and the Earth system (cf. Homer-Dixon et al., 2015; Dietz et al., 2016). In fact, neither the literature cited above, nor book-length appraisals of the nexus give sustained (if any) attention to finance (e.g. Pittock et al., 2015; Webber, 2016). On the rare occasions finance is mentioned, it is not with respect to how the nexus was conceptualized but, rather, with respect to what financial commitments nexus solutions require (e.g. Dodds and Bertram, 2016). The nexus, however, must be understood with respect to the fundamental role of global financial networks not only in promoting the concept, but in extending technologies of finance to forge the kinds of connections among water, energy, food, and the climate that are to be governed to achieve water security.

2.1 The Financialization of Nature

Financialization describes patterns of accumulation that accrue profit, "primarily through financial channels rather than through trade and commodity production" (Krippner, 2005: 174). While the relative weights of industrial versus financial profits wax and wane (Arrighi, 1994), the past several decades have witnessed a significant increase in the proportion of economic activity driven by financial markets relative to industrial production (Epstein, 2005). As finance drives a greater proportion of economic activity, financial products are also entangled with the material aspects of complex human-environment systems (Cooper, 2010). For example, weather insurance derivatives proliferated in the 1990s in response to regulatory shifts on climate change in the US energy sector (Pike and Pollard, 2010). Critically, financial notions of governance, security, and risk are not simply descriptions of economic or empirical dynamics, but rather influence how impacts are defined, known, and responded to (Langley, 2016; Riles, 2011). For instance, metaphors of financial risk, such as the "subprime bubble" in the U.S. mortgage sector, convey notions of intrinsic instability that affect governance and security (Krippner, 2012).

Financialization can also create new sites of accumulation as investments mobilize water, and nature generally, in ways that befit global finance (Bayliss, 2014; March and Purcell, 2014; Merme et al., 2014; Loftus and March, 2015). Corporations, for instance, may hedge against water risks by purchasing futures or insurance products, or they may introduce calculative techniques for governing and securing water based on financial assessments (Hepworth, 2012; Larson et al. 2012). Frequently, infrastructure is a site where financial products (i.e. loans, bonds, securities) meet the material mobilization of 'nature'. For instance, investment in urban water utilities or desalination facilities are increasingly entangled with circuits of global finance both as capital is raised and as debts and securities are traded (Castree and Christophers, 2015; Loftus

and March, 2016; Bresnihan, 2016). Conca (2015b) argues that examining connections among risks to finance and infrastructure as well as those to water, energy, food, and the climate requires attending to how existing institutions compel and constrain approaches to water security and governance.

This article follows Conca's (2015b) suggestion to show how state-oriented development programs, such as IWRM, were realigned with understandings of the nexus shaped by global financial networks. Methodologically, this notion of 'showing' follows Stenger's (2010) distinction of making perceptible, not of proving. As Cooper (2011) likewise shows, in the aftermath of the 2008 global financial crisis, there was a perceptible turn towards complex systems science to jointly frame economic and environmental crises. To examine similar entanglements in the water sector, we draw on Maurer's (2005: 17) notion of lateral reason, a technique oriented not to "description as such, nor explanation as such." The aim, instead, is to make perceptible the ways that financial practices forge dense connections—lateralizations—that both disclose the objects of the world and provide accounts of their dynamics. As Kar (2018: 302) points out, lateral reasoning is effective for identifying relationships among space, security, and finance that may not always intersect, but where "it is impossible to speak of one without the other." In this study, and to anticipate, as global financial networks crafted a political and conceptual vocabulary—the nexus—that could shift state-oriented, industrial development to financialized approaches to sustainability they rejected the idea of immutable nature in favor of an approach to the Earth system as complex and adaptive. To do so, they appealed to notions of resilience. This was a concrete possibility owing to a dense set of connections forged in the crucible of neoliberal governance and complex systems science that began in the late 1970s; so, even though the ecological and economic approaches to resilience align haltingly, and not always

in lockstep, scholars have found productive tensions in how they identify and characterize the dynamics and fragility of complex systems (Walker and Cooper, 2011; Connolly, 2013). So too in our account, which makes these dense lateralizations perceptible in order to account for how, by 2018, the World Economic Forum's Global Risk Report could move seamlessly between references to Elinor Ostrom's accounts of institutional resilience and interconnected risks to water, food, energy, climate, and global finance.

3. IWRM, 'Industrial Societies,' and Development

The 1977 UN Conference on Water in Mar del Plata is often used to mark the start of international water management and which, after the 1992 sustainable development conference in Rio, shaped global water governance and IWRM (e.g. Woodhouse and Muller, 2017). Critically, Mar del Plata forged two links that conditioned how IWRM was connected to state-oriented sustainable development programs. The first linked water to industrial production; throughout the Cold War, competing views of industrialization significantly shaped water development as soft-power contests played out through development infrastructure projects (Ekbladh, 2010; Sneddon, 2015; Swyngedouw, 2015). The Aswan High Dam in Egypt, for instance, was slated for World Bank funding until the United States refused to finance it, at which point the Soviet Union provided a loan (Mitchell, 2002; Barnes, 2014). Cold War contests over industrialization were not only politically important, however, they were also test sites for technologies of economic calculation and representation, such when graphs connecting absolute economic growth to resource consumption were replaced with logarithmic scales that measured

growth *rates* in order to side-step concerns that industrial growth would exceed environmental limits (Mitchell, 2014).

Second, Mar del Plata naturalized the Bretton Woods financial institutions to global hydrology. By 1977, the constellation of World Bank projects and large-scale urban water utilities was a key, if contested way through which 'public' water was developed alongside state programs of industrialization (Bakker, 2013). At Mar del Plata, however, "industrial society" became the key register for integrating global hydrology with international water management (Biswas 1978). Using the outcomes of the International Hydrological Decade (1965-74), White (1978) compiled the first world assessment of water resource and needs for Mar del Plata; his universal and objective account of the hydrological cycle helped broker policy ideas in Mar del Plata based on the notion that the water system was balanced at the scale of the Earth, yet inequitably distributed in time and space for states (Biswas 1978). This had several implications (see Schmidt, 2017): first, all industrializing nations—capitalist or communist—needed to incorporate the expected variability of water's distribution into resource management calculations. Second, water was no longer to be considered "free" but rather a scarce input to industrial production. Led by a World Bank study at Mar del Plata, the use of water pricing to render an objective value for water was seen as central to industrial development (see Warford, 1978). Third, comprehensive and holistic management, or Rational Planning, was forwarded as the model for connecting limited water resources to industrial production.

Linking 'industrial society' to global hydrology, state economies, and water management provided the basis for the Mar del Plata Action Plan to retain an apolitical guise when the UN called for an international decade on drinking water and sanitation in the 1980s. The decade ran parallel to emerging sustainable development programs that culminated in the World

Commission on Environment and Development's 1987 report, *Our Common Future*. The WCED report barely mentioned water, which prompted rebuke from water professionals (see IWRA 1991) and catalyzed a meeting in Dublin to ensure that water would be on the sustainable development agenda in Rio in 1992. The resulting Dublin Principles (1992) became central to integrating water, environment, and development in ways that would meet development aims regarding the environment, gender, and participation, and also treat water as an economic good. After Rio, IWRM rapidly ascended as networks of scientists, policy makers, NGOs, the World Bank, and professionals linked water development, management, the environment, and the Dublin Principles (Solanes and Gonzalez-Villarreal, 1999; Conca, 2006).

Through the 1990s, global economic institutions, such as the World Bank (1993), shaped how IWRM connected the infrastructure required for industrial development to concerns over water scarcity and water security. These dynamics fit IWRM within what Bernstein (2001) calls the "compromise of liberal environmentalism," wherein economic tools are touted as those best suited for addressing environmental concerns. But concerns over water scarcity and water security also created new spaces as IWRM programs were used to re-regulate state development programs in ways that later facilitated shifts to a systems approach for governing the link of water management to the global economy. In 1996, the World Bank partnered with the United Nations Development Programme to form the Global Water Partnership (2000), which later provided the core definition of IWRM as a process of coordinating development and water management for maximum human well-being without compromising vital ecosystems. Also, in 1996, the World Water Council was established as an umbrella organization linking water and development experts to global economic networks such as the World Bank and the Global Environmental Facility (Goldman, 2005). In context, the rise of IWRM was shaped by the ways

these actors connected the re-regulation of resource sectors, liberalized trade, and enhanced use of market instruments; and this despite complaints from developing nations that the programs of structural adjustment these connections entailed had little to do with the environment and were more aptly seen as 'integrating' developing countries into the global economy (see: Goldman, 2005, 2007; Bakker, 2010a). Parallel to liberalization, the 1990s witnessed a precipitous drop in government aid for development and a significant relative rise in development capital raised on global financial markets. In 1990 finance capital amounted to half of official development assistance for water—by the end of the decade finance capital dwarfed it by 500% (Briscoe, 1999a, 1999b).

As IWRM rose to prominence, industrial demands on water were increasingly connected to climate change. In 1989, quantitative calculations connected Global Circulation Models of the climate to potential hydrological shifts and effects on water availability (Gleick, 1989). These connections among hydrology, anthropogenic climate change, and water management led Gleick (1994) to examine the nexus between water demands and industrial energy production. It was an intervention that anticipated assessments of human appropriations of global freshwater, calculated to be nearly half of the total annual available supply in the mid-1990s (Postel at al., 1996). Growing industrial demands for energy and its implications for water scarcity, security, and ecological systems led to calls for new approaches to sustainability given the overlapping security concerns among water, food, and the environment (Falkenmark and Lundqvist, 1998). By the mid-1990s, the World Bank (1995) was also looking to move from "scarcity to security" in its efforts to respond to, and to shape, how water crises were managed in integrated fashion.

By the turn of the millennium, declining government investments in development and the growing influence of finance capital on development funding combined with cumulative human

impacts on Earth's freshwater system to challenge IWRM on every front of sustainable development's environment-economy-society triad. Environmentally, human impacts on global water system were linked to risks affecting the resilience of social-ecological systems (Meybeck et al., 2003; Vörösmarty et al., 2004). Socially, critics argued IWRM's model of holistic water management favored technical orientations that were inadequate for addressing cultural difference, gender norms, or institutional contexts (e.g. Blomquist and Schlager, 2005). These challenges were compounded by widespread contests over neoliberal programs of structural adjustment and efforts to privatize water service provisioning (see Goldman, 2005; Bakker, 2010b). As the 21st century got underway, even the World Bank (2004) abandoned the version of IWRM tied to 'industrial societies' and searched for a more pragmatic approach to integration.

Perpendicular to critical appraisals of IWRM were empirical reappraisals of the hydrological basis that underpinned it. Hydrologists began noting, in this regard, that IWRM was primarily concerned with visible "blue" water flows (i.e. rivers, lakes), often at the exclusion of the invisible "green" water flows (i.e. evapotranspiration) affected by land cover change (Falkenmark and Rockström, 2004). Because blue and green water flows were *already* connected, the aim of 'integration' seemed somewhat misplaced. A better starting point would be to recognize these deep interconnections across social and ecological domains, a project for which complex systems science was well positioned (Folke, 2003). Recognition of these kinds of global interconnections was then underway in the Millennium Ecosystem Assessment (2005), which brought the resilience-based approach of adaptive management to sustainability. The approach was explained by Folke (2006) as emerging from an appreciation of how coupled social-ecological systems were characterized by change—not stability—and that a system's

resilience was its capacity to respond to disturbances while maintaining its functions and feedbacks.

The introduction of resilience to global water governance led to calls for adaptive, experimental forms of management to augment IWRM in recognition of complexity and connectivity in complex human-hydrological systems (e.g. Galaz, 2007). Water experts pushed for transitions toward adaptive management as a way to retain the goal of integrated management but with deeper appreciation of existing social, ecological, and planetary dynamics at stake in sustainable development (Feldman, 2007; Pahl-Wostl et al., 2008). The potential of adaptive management was the retention of IWRM's holistic goals in a register that connected the 'blue water' of industrial inputs to the 'green water' effects of land-use change, energy production, and climate change (Falkenmark, 2004). By 2008, Milly et al. (2008) argued that global hydrology's presumption of a stable 'nature' could no longer be retained owing to anthropogenic forcing on the Earth system. Instead water management needed a new framework in which to deal with a form of "integration" between people, water, and planet that had already been established—albeit not on the terms sustainable development programs had envisioned (Schmidt, 2017).

4. The Nexus and Global Financial Networks

At the second World Water Forum in The Hague, the World Water Council (2000) successfully installed governance as central to achieving a 'water secure world' (Cosgrove and Rijsberman, 2000). In the decade that followed, competing views of how governance and water security articulated with notions of IWRM characterized global water governance discourse and the study of it (e.g. Cook and Bakker, 2012; Zeitoun et al., 2016). Less attention has been paid, however,

to what happened the year after conference in The Hague, when the World Water Council put water finance for infrastructure at the top of its priorities. The techniques and logics of finance did not simply apply discourses of water security and governance. Rather, they deployed them to forge the nexus as a register that could not only attend to existing interconnections of water, people, and planet, but which could also shift state-oriented models of water development towards a systems approach that recognizes actors within the state and beyond it, such as municipalities and global financial institutions.

In 2003, the World Water Council released the Report of the World Panel on Financing Water Infrastructure, arguing that international aid for water and sanitation was falling and substantially declining for irrigation, drainage, and hydropower (Winpenny, 2003). Critically, the financial needs associated with achieving water security were repositioned to identify an "Exposed Segment" of international development that "…probably contains the majority of prospective projects" (Winpenny, 2003: 12). This 'exposed segment' was comprised of projects ranging from $10 000 to $50 million (USD) that existed in credit compromised counties with BB ratings or lower (See Figure 1). On the low end, these projects were too small for corporate interest. At the high end, they exceeded capacity for microloans or Official Development Assistance and, yet, would unlikely be candidates for corporate investment without political guarantees. According to the Camdessus Report—named after the former executive director of the International Monetary Fund and chair of Financing Water for All—an additional component of the dilemma is that the credit ratings of countries in which these projects were located was often too low to guarantee creditworthiness (Winpenny, 2003).

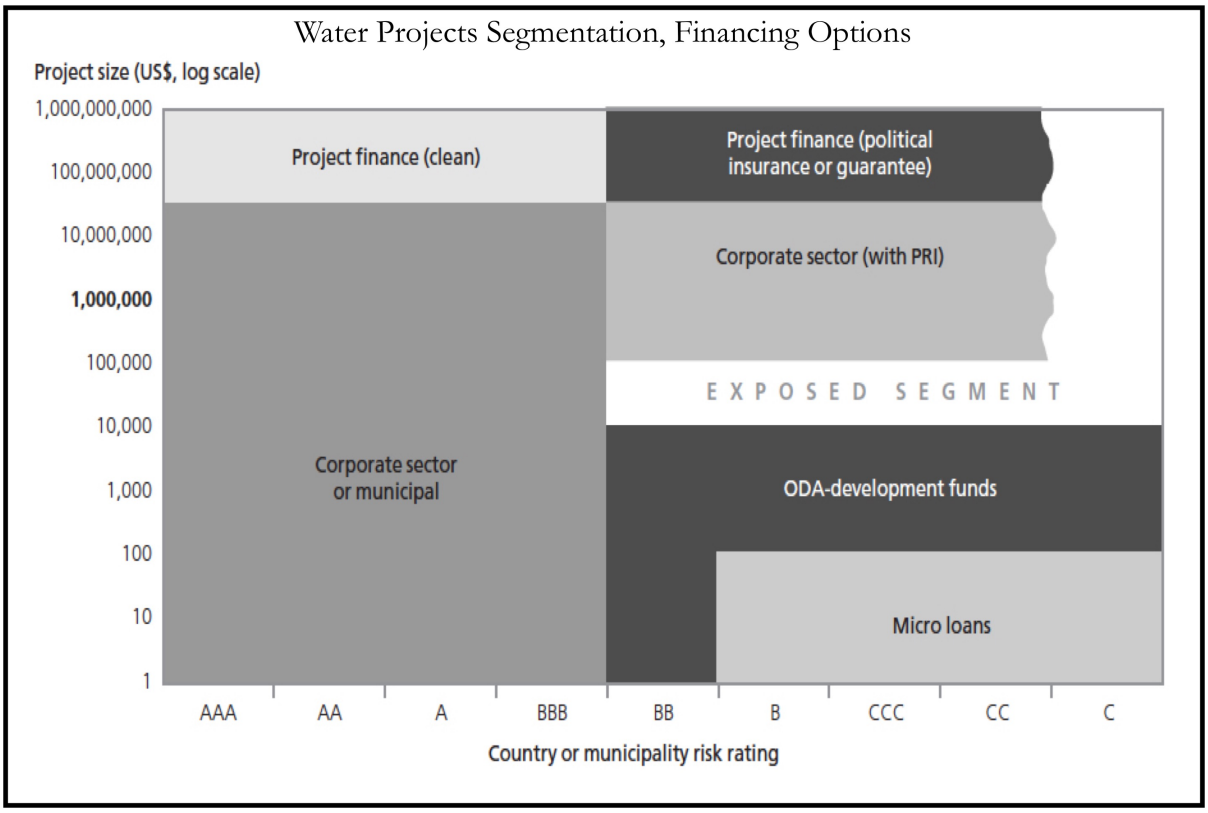

Figure 1: Calculation of Water Projects Segmentation and Financing Options through project economic size and financial risk rating. Reproduced from Winpenny (2003: 12).

As Figure 1 indicates, the "exposed segment" in which the majority of water development projects were to be found was identified along two axes: infrastructure financing requirements and credit ratings. This combination, and the identification of an 'exposed segment' in an area that could not be reached through either the corporate banking sector or official development assistance led global financial networks to court "sub-sovereign" actors, such as

municipalities and regional agencies, as key sites and scales for investment (Winpenny, 2003). Sub-sovereign actors had, as the result of efforts to devolve water management from states to include local actors—such as in IWRM programs—become key decision points for sustainability and yet lacked the "equivalent powers to raise finance" and, often, the expertise to do so (Winpenny, 2003: 11). Framing development finance in these terms normalized the financial techniques used to identify development needs and situated these techniques astride concerns over governance and security. The combinations mirrored exercises in development elsewhere, such as in projects that render social and political challenges into technical discourses that isolate local actors—in this case the "exposed segment"—from the structural factors that drive poverty or low creditworthiness in the first place (cf. Li, 2007).

Parallel to the World Water Council's "Financing Water for All" program (see Goldman, 2007), the World Economic Forum (WEF) began establishing itself as a key player in connecting the governance of water security to the nexus. Like other emerging networks in global environmental governance, the influence of the WEF arose through its success in the "social reconstruction of interests…through repeated discursive interactions," such as through its annual gatherings in Davos and its annual Global Risk assessments (Pigman 2007: 4). The WEF began targeting environmental governance in 2003 through its Global Governance Initiative, which was created to provide independent monitoring on the Millennium Development Goals with the aim of ensuring "good governance" across "developing countries and economies in transition" (Pigman 2007:17). At that time the WEF also began aligning its member firms with the World Trade Organization's agricultural trade liberalization position with an eye to potential profits in developing countries.

In 2004, the WEF began publishing annual surveys on perceptions of economic risks. The next year, the WEF (2005) established four criteria that made risks truly *global*: (1) The risk must affect at least three regions of the world on at least two continents and have a cross-industry impact affecting three or more industries; (2) The risk must either exceed $10 billion (USD) or have a major social impact (e.g. loss of life); (3) It must be uncertain as to how the risk will manifest over the next decade; and, (4) The risk must demand a multi-stakeholder response that, for instance, links public, private, and civil-society actors. As the WEF refined its global risk reports, it increasingly articulated risks in terms of how ecologists and adaptive management theorists understand resilience. In its 2005 report, the WEF (2005: 5) defined resilience as simply "tolerance to risk." But from 2006-8, the WEF (2006, 2007, 2008) elaborated its definition of resilience to include the ability to tolerate surprise, and as a "downstream" capacity to respond to risks that cannot be predicted or controlled. The evolving notion of resilience, and need to consider global risks, echoed calls by the ecological founder of resilience, C.S. Holling (2004), to move beyond appreciating 'regional complexity' to consider 'world complexity' and the potential for transformation and surprise in a globally complex system.

In 2006, the work of the World Economic Forum and the task force on "Financing Water for All" began to align. That year, the "Financing Water for All" project released the Gurria Report (chaired by Angel Gurria, Secretary-General of the OECD), which argued that, "the main obstacle to increasing…financial flows is local capacity" (Hofwegen, 2006: iii). The report made numerous recommendations, such as "debt for project swaps" that offered financial relief in exchange for new financial inroads to local development contexts. Local, sub-sovereign units, such as municipalities, remained a principal target for finance as the Gurria Report argued that the creation of demand-side conditions within local, sub-sovereign units were key to balancing

the needs of financial suppliers—banks and international finance institutions—with the need for security at the local level. For example, ensuring that loans were not denominated in foreign currencies could stem risks for municipal agencies in the event of currency fluctuations. The Gurria Report emphasized that success depended on improved water management at the basin level. Yet, by this point, IWRM was not an obvious or default approach for basin-scale management. In fact, institutional economists such as Elinor Ostrom (2007) argued that there were no "institutional panaceas" to be had generally, or for water in particular (see also, Meinzen-Dick, 2007).

By 2008, aligning good governance, finance, and integrated water management was the central topic of a Global Water Partnership study seeking to connect the "multi-purpose and hydrologically interconnected" nature of water resources to new financial realities (Rees et al., 2008: 6). The Global Water Partnership's renewed focus on integration aimed to "embed" finance within governance reforms that would enable previous programs of IWRM to act as vehicles that retained the institutional inertia of sustainable development while incorporating new mechanisms of development financing. As Rees et al. (2008) argued, neither of the previous reports—the Camdessus and Gurria reports—had given appropriate attention to water management institutions. It was necessary, therefore, to connect water management institutions to sub-sovereign sectors so that water finance could pace shifts towards decentralization in water governance. By connecting governance, finance, and an adaptive, collaborative management approach to IWRM, Rees et al., (2008: 30) argued that multi-lateral financial institutions, like "the World Bank, the International Finance Corporation and the regional development banks" could take leadership roles in backing local efforts to raise finance capital, such as through bond issues or by tailoring credit rating schemes to share risks in ways that match local hydrological

demands with targeted financial interventions. In short, just 12 years on from its formation, the Global Water Partnership now argued that local water governance institutions needed to be integrated into global circuits of finance capital (Rees et al., 2008).

Until 2008, it remained pressing, though unclear, how global financial networks would connect to sub-sovereign actors. That year, however, food and energy price shocks combined with the global financial crisis to rattle global markets. That year also marked the first time the nexus appeared in the WEF (2008a) global risk reports. At first, two competing constellations of a water-food-trade nexus and an energy-climate nexus shaped the WEF's approach to connecting global economic risks with those to water, food, energy, and climate (Allan et al., 2015). By 2009, however, water assumed central place in a single nexus because of its fundamental role across energy and food production (see WEF, 2009a). In addition, the WEF (2009a) identified gaps in governance as a global risk. These global risk projections bolstered the findings of an earlier report from the WEF's (2008b) Energy Industry Partnership, which argued that, because global water markets did not exist, energy companies must pursue governance strategies at local (i.e. sub-sovereign) levels in order to "integrate" water management across the "value chain" of production (WEF 2008b: 17). By the time the UN Secretary General called for more attention to water security in Davos in 2009, the WEF (2009b) was circulating a draft report on water entitled, "The Bubble is Close to Bursting." The "bubble" metaphor—then widely circulating to describe the U.S. sub-prime mortgage crisis—conveyed the intrinsic instability and geopolitical risks associated with the structural undervaluation of water in the global economy.

4.2 The New Nexus for Sustainability

In the context of the financial crisis and global risk assessments, members of the World Economic Forum formed the 2030 Water Resources Group (WRG) to examine shared concerns of security, governance, and finance within the nexus. Comprised of the International Finance Corporation, private companies (e.g. PepsiCo, Coca-Cola, Nestlé) and NGOs (e.g. the World Wildlife Fund), the WRG (2009) argued the financial sector should play an enhanced role in meeting supply-demand gaps in the nexus. Increased water prices and regular loan payment schedules, it claimed, would incentivize financial institutions to supply capital for infrastructure projects. The 2009 WEF global risk report had also identified infrastructure investment as critical to sustainable resource management and, with this momentum, the 2010 WEF (2010) global risk report linked systemic financial risks to institutional, political, and infrastructural resilience. By 2011, the WEF global risk report argued that achieving resilience required positive and negative trade-offs to be linked to the effects of both industrial development and global finance in a nexus of global systems where resource demands in one area may have unanticipated effects in others (WEF 2011b).

When the WEF (2011a) published its response to Ban Ki-moon's request, it explicitly linked water security to the nexus not only in title—*Water security: the water-energy-food-climate nexus*—but in mobilizing supply-chain governance as key to connecting risks among global finance, sub-sovereign actors, and the material inputs for production. On this model, reaching the "exposed sector" of development put water security and governance to work within connected economic and environmental systems of supply-chains reaching from local, sub-sovereign units through to global economic dynamics. States mattered critically for governance tasks regarding the rule of law, regulatory frameworks, trade agreements, and rights (to name a few key factors), but they were only one element of complex systems in which new actors, such

as cities, sought forms of security in global networks (cf. Hodson and Marvin, 2014). In this context, the nexus provided a discursive framework for 'integration' of a sort different than development models indexed to 'industrial societies.' Conceived of in terms of resilience, the nexus formed the crux of intersecting water security issues as supply-chains were governed across economic and environmental systems. Indeed, the core metaphor that the WEF (2011a) report used to describe water security was "gossamer," a web-like, yet delicate set of connections across multiple sectors and scales.

Advancing the nexus took special form when sub-groups of the World Economic Forum, notably the Water Resources Group (2012), reinforced the concept of the nexus as central to its key horizon—2030—which overlapped its financial interests with the Sustainable Development Goals (SDGs) then being negotiated. After the 2011 conference in Bonn, the nexus ascended in global discourse, while the WEF (2013) began to identify the core elements of supply-chain resilience: (1) a shared risk vocabulary, (2) effective data flow, and (3) agility and flexibility in supply chain systems. By 2014, the nexus was the theme for World Water Day and being examined as the vehicle through which to deliver on the SDGs (Weitz et al., 2014). Shortly after the SDGs were agreed to in 2015, Ban Ki-moon and World Bank President Jim Kim convened the High-Level Panel on Water. Comprised of 11 sitting heads of state, the panel is tasked with effectively delivering on the water-related SDGs through specific attention to finance, water values, and implementation. With the SDGs focused on finance, the 10th WEF (2015: 21) global risk report ranked water crises as the highest risk for potential impact on the complex connections in the nexus among food, energy, and climate.

In 2015, the World Water Council and the OECD released a report on making water "fit to finance," arguing that, "the close interrelationship of water, food, energy and environment is

symbolized by the *Nexus*" (Winpenny, 2015: 8, original emphasis). The report was designed to inform the High-Level Panel on Water and linked a common language of societal, hydrological, and financial risks to implications for governance and water security. The risks mirrored the traditional areas of sustainable development—environment, economy, and society—yet outfitted them to financialized approaches to development. The World Bank also targeted "exposed segments" of development by linking credit worthiness and access to commercial finance in a development cycle that demanded appropriate governance and institutional arrangements as well as technological and financial efficiency (see Figure 2). According to the World Bank, "Infrastructure, with its long life cycle, is ideally suited for long-term investors such as insurance companies and pension funds, which have long-term liabilities and therefore seek long-term investments" (Kolker et al., 2016: 6). The year after the SDGs were agreed to in 2015, the World Bank (2016) emphasized that an "expanded water nexus" sat at the heart of concerns that connected finance, climate change, and urban adaptation to industrial production across food, energy, and trade, and water resources management. The WEF (2016), for its part, published a primer on "Resilience Insights" that used water to connect issue climate, economics, and migration to discuss common risks across scale and space—from climate change, to Syria, to Brazil.

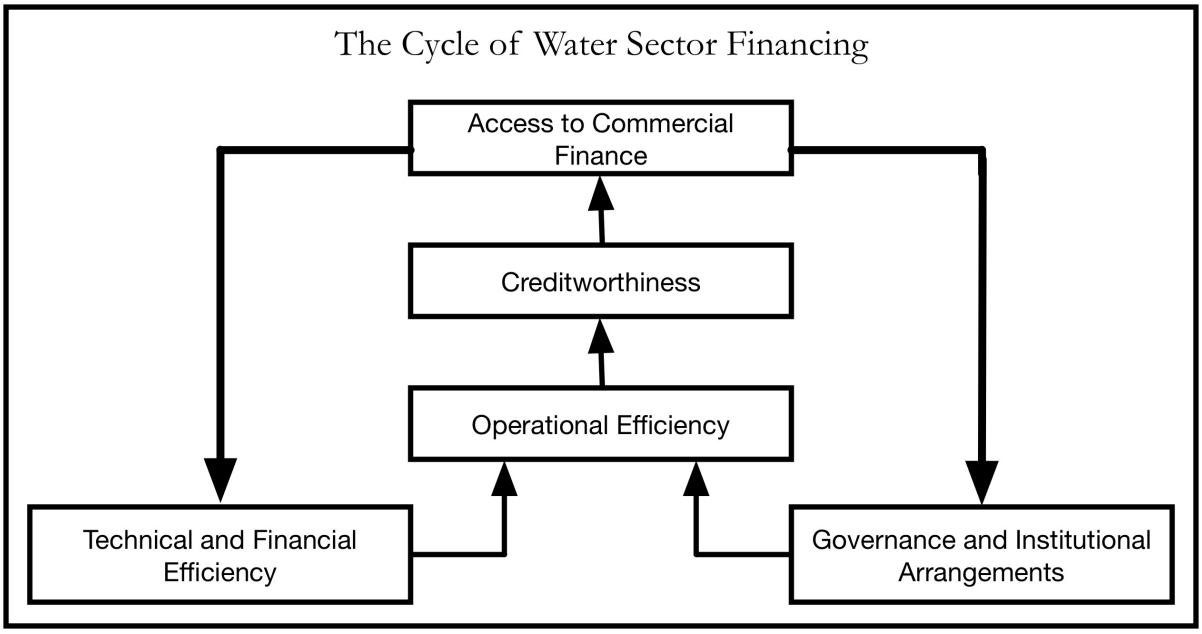

Figure 2. The Cycle of Water Sector Financing. Reproduced from Kolker et al (2016: 6).

With the SDGs in place, the OECD (2016) calculated water spending requirements at 500 billion (USD) annually. In November 2016, the World Bank estimated the financing for SDGs related to water at $1.6 trillion (USD) (Kolker et al., 2016). As the common language of risk, resilience, and the nexus connected water security and governance to the SDGs, techniques of finance provided the channels of accumulation for drawing sub-sovereign actors into global circuits of capital. The nexus should be seen in this light, particularly as programs for "green growth" are used to shape the kinds of risks identified, and the mechanisms available for governing, water development challenges (e.g. Min et al., 2015). The perceptible shift from industrial to financial orientations to development uses financial technologies to construct both development targets (i.e. 'exposed segments') and financial pathways (i.e. supply-chain management) through which the governance of water security works serves financialized forms of development. This new discursive alignment can be seen in how institutional networks, such

as the World Water Council, now argue that the ensemble of crises affecting water, food, energy, and the economy must be understood in contexts where the challenges of global environmental change demand new forms of 'integration' (Smith and Clausen, 2015). In this context, and with a consolidation of what kinds of connections are to be governed, an emphasis on infrastructure financing for water and development offers a way to connect multiple types of risk to more predictable patterns of return.

5. From State to System

In 2014, global hydrologists argued the "unfolding water drama of the Anthropocene" demanded a resilience-based response to challenges facing the nexus, where "stewardship of water in support of human prosperity is pursued within the safe operating space of a stable planet" (Rockström et al., 2014: 1257). Planetary stewardship, in this sense, derives its *raison d'être* from the dynamics of an Earth system subject to human forces accelerating unevenly and inequitably. It is also this context in which the nexus is forwarded by institutions of global water governance and global financial networks to provide evidence regarding the facts of 'integration' between people and planet and, critically, an account of how that integration should be governed to improve water security. In so doing, the nexus relies on financial understandings of risk, resilience, and supply-chain security to facilitate the shift from 'state to system.' In the process, dense lateralizations are at work disclosing both the objects of the world and explaining their connections. The different objects and explanations do not mirror one another cleanly. Yet, by understanding their connections, the work they accomplish is made perceptible. In 2018, for instance, the WEF's (2018) global risk report again included water among the top global risks.

Then, in an excursus on resilience, the risk report connected water, food, finance, and energy with both the work of Elinor Ostrom on institutional economics and with studies of risk and resilience in an Earth system dominated by anthropogenic forcing—the Anthropocene—influenced significantly by leading Earth system scientist Johan Rockström (see WWF, 2016).

What is being made perceptible as the nexus takes shape and moves laterally across economic and ecological notions of risk and resilience? It is a set of relationships projected not against a spatial imaginary of states at varying levels of industrial development, but rather projected within a set of already existing connections between states, the global economy, and the Earth system. Here, it becomes critical to consider the politics of how these connections are identified, calculated, and represented; the financial technologies at work to connect the global economy to the environment make claims about the structural deficiencies that lead to interlinked water, energy, food, and climate crises. In this regard, the nexus facilitates the shift from 'state to system' by shifting both the objects of governance and the techniques used to disclose connections among them. But these are not the only, or even primary stakes in the webs of life and livelihood linking water, food, energy, and climate. Indeed, financial techniques of calculation have ethical components that often go unacknowledged, but which are key to understanding water challenges (Ballestero, 2015; see Schmidt and Peppard, 2014). Further, the corporate governance of supply-chains involves decision-making that is frequently beyond the purview of democratic accountability (Ahlers and Merme, 2016).

Financialized approaches to sustainability must be critically examined for how they engender new spatial, temporal, and scalar relationships among economies and environments. It was in the aftermath of the 2008 global financial crisis that Escobar (2012: viii) revisited his classic work, *Encountering Development*, and took an optimistic stance that converging crises

linking "food, energy, climate, and poverty," might prompt more open epistemological and ontological understandings of the world—a move away from globalization and toward a planetary orientation. Such a transition is indeed underway, but the opportunities to open up understandings of the world are being foreclosed upon by monological languages of planetary risk and resilience as rapidly as financialized approaches to sustainability identify opportunities to accumulate profits that outpace those derived from the traditional aims of sustainable industrialism. This is not a defense of industrial capitalism. It is a harbinger of how, as the nexus structures shift from 'state to system,' it draws on the repertoire of financial techniques that delineate facts of the world—descriptions of complex, adaptive systems—and makes accounts of the integrated dynamics linking economies, environments, and societies.

Global financial networks have mobilized water security and governance to articulate the nexus as central to development projects able to reach across multiple sites and scales, from sub-sovereign actors in poor, credit challenged regions, to the risks posed by global environmental change. The nexus, however, should not be parsed from the governance technologies at work to identify, forge, and secure connections amendable to emerging forms of development in which global financial networks align their temporal horizons with global goals, such as the 2030 Sustainable Development Goals. These alignments depend critically on the spatial work of the nexus—the transition it affords, and the politics it carries, in reconfiguring integration within state-led modes of development towards the politics of risk and resilience within an integrated Earth system now dominated by uneven and inequitable anthropogenic forcing. As the nexus rescales integration from 'state to system' the governance technologies it employs capture and direct both the facts of an interconnected world and explanations of its dynamics in ways critically important to politics, equality, and the democratic aims of sustainability.

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