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EDITORIAL

Information, technology, and digitalization in China's environmental governance

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Research on the relationship between information, technology, and environmental governance in the current Information Age has gained momentum in recent years. Nevertheless, much theoretical, empirical, and normative issues remain seriously under-explored. Existing studies also tend to be predominantly based on contexts, experiences, and lessons in advanced democratic societies. What the rapid developments in new information technologies, data, and information networks might mean for environmental politics and governance in non-democratic contexts remains even more elusive. This special issue brings together some of the latest research in the context of contemporary China to shed light on some of these fundamental issues. We argue that the role of information has evolved over time as dominant approaches to environmental regulation have shifted. Yet, findings in this special issue show that how it has manifested in China thus far has been anything but straightforward. While a few parallels can be drawn between advanced democratic countries and China, many of the predictions made about the effects of data and information technologies have not been borne out in China. We raise several questions as a fruitful avenue for further research.

Keywords: informational governance; China; environmental governance; state-society relations; regulation

1. Introduction to the special issue: environmental governance in the information age: data, technology, and digitalization in China

That information plays a key role in environmental regulation and governance is hardly debatable. Most, if not all, environmental issues are essentially issues of public goods that require collective action (Olson 1965; Hardin 1968), and lack or asymmetry of information has always been a formative factor in determining collective action problems.[1] In fact, the importance of information and knowledge in precipitating good environmental outcomes is arguably the only incontrovertible aspect in the broader debates on environmental regulation, regardless of the discipline or paradigm. Informational issues tend to be trickier in environmental regulation than in other public policies also because human–environmental relationships are complex and multi-faceted, fraught with temporal lags and spatial discrepancies between sources and effects (Underdal 2010). Yet, the centrality of information and the kind and degree of

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its role have not always been stationary or unitary. Rather, they have evolved dramatically in the short history of environmental regulation since it became an area of public policy since the 1960s. The evolution can be linked to the overall changes in the structure, form, and mode of environmental governance.

2. Evolution of environmental regulatory approaches

In broad strokes, we can identify three distinct paradigm shifts in environmental governance (cf. Gunningham 2009). According to most accounts, the early stage of environmental governance (i.e., 1960s to early 1980s) was dominated by the legal compliance regulatory approach, predominantly enacted through "direct" or "command-and-control" mechanisms. The underlying principle of this direct, top-down regulation was for the state authority to specify socially acceptable environmental targets, such as a limit on emissions (i.e., "command") for private actors, as well as penalties for the failure to comply with them (i.e., "control"). Specific forms of this direct regulation were myriad, and differed across jurisdictions or countries. Yet, most involved the state regulators identifying specific environmental standards and requirements that were to be uniformly imposed on broad categories of activities (e.g., all coal-fired power plants subjected to a certain maximum emission level or adoption of a particularly technology). Popular policy instruments often included permits, licenses, and "best available technology." In this binary structure, not only were information and data scarce, but they were also severely asymmetrically distributed between the regulator and the regulated. It was extremely difficult for the state authorities to know exactly whether or not, and to what degree, the targeted private actors were complying with the relevant laws. In fact, one of the core theoretical underpinnings of the necessity of state coercion to elicit environmental improvement was the endemic market failure due to limited and asymmetric information (Hardin 1968; cf. Olson 1965). Moreover, by and large, environmental information relating to laws, policies, standards, implementation, and compliance was the exclusive prerogative and monopoly of the state authorities and select experts. This does not mean that the public or civil society was completely out of the picture. For instance, environmental protests and public right-to-know movements were already very much present. Nevertheless, actors outside of the state-market dichotomy were largely marginalized, and utilizing information as a form of resource or capital to make claims on regulatory policies by those actors was all but absent.

By the 1980s, notwithstanding some significant achievements in mitigating environmental damage (Gunningham, Kagan, and Thornton 2003), direct regulation fell into disfavor as market approaches increasingly gained political saliency. There were several forces behind this institutional turn. The first was the political and ideological ascendency of neo-liberalism and deregulation, spearheaded particularly by the Reagan and Thatcher administrations in the US and UK, respectively. Second, as regulators sought to deal with increasingly complex environmental issues, the limitations of direct regulation became more and more obvious. As neo-classical economists have been quick to point out, direct regulation often proved to be extremely costly and inefficient (Stavins 2005), especially when it comes to complex environmental problems or heterogeneous contexts (Gunningham and Sinclair 2005). In addition, as globalization began to accelerate, capital flight to low-tax, lax regulatory environments put extra pressure on policymakers to come up with less intrusive approaches across a range of

regulatory issues, including the environment. As a result of these forces, there was a major regulatory shift throughout the late 1980s and early 1990s toward using the market as the dominant institution to solve environmental problems. Creating a market for a whole set of environmental goods via economic instruments (e.g., Acid Rain Program in the US) was perceived to be far more efficient and flexible. The dominant discourse and practice was that given the "right" economic incentives, the industry will voluntarily and independently "self-regulate" its own behavior without government oversight or public involvement. Underlying these changes was the idea that state actors had limited knowledge, capacities, and resources to regulate directly. In contrast, private actors were believed to know best and had the best information to make the least costly decisions, which need not be shared with the state authority or general public for better environmental outcomes to arise.

There is now a growing consensus that we have been witnessing a new kind of environmental regulation and governance in the last two decades that has outgrown the earlier bi-partite, dualistic interactions between the state and market. Since it is still relatively new and evolving, precise definition or form remains open to debate, and various concepts and interpretations have been proposed by different scholars, including: (global) "civil regulation" (Vogel 2010; Bendell 2000), "community-based" (Meyer and Konisky 2005; Newell 2005) or "community-driven" (Shin 2017; O'Rourke 2004) regulation, "polycentric governance" (Ostrom 2010), "post-regulatory" (Scott 2004) governance, and simply "new governance" approaches (Sabel and Zeitlin 2010; Trubek and Trubek 2007). Yet, broad contours and features are generally recognized. First, as globalization accelerated and the organization of production became increasingly fragmented across national borders—especially for multi-national corporations—environmental regulation that used to be largely a local or national matter could no longer remain as such. This also meant that instead of responding to a single-state authority, industry had to answer to a wider range of state, non-state, and supranational "stakeholders," including consumers, international and domestic civil society organizations (CSOs), and international institutions. Second, even though some continue to insist on confrontation (e.g., "naming and shaming" of firms)—partly because they are frustrated with its limited impact in earlier decades (Murphy and Bendell 1997)—many non-state, civil society actors have chosen to partner and cooperate with firms and industry associations to develop and enforce environmental standards. Some have argued that civil society actors' willingness to enter into alliance with private firms has been critical to the emergence and relative effectiveness of various kinds of participatory and collaborative regulation (Gereffi, Garcia-Johnson, and Sasser 2001; Pattberg 2005). As a result, on the one hand, broader frameworks of governance underwritten by social capacity and agency (Ruggie 2004) that did not exist previously came to extend state authority horizontally or "sideways" (Haufler 2003). On the other hand, the traditional private self-regulation of the earlier era, which was exclusively governed by firms themselves, gave way to an increasing level of scrutiny and oversight by societal actors, such as independent certification by third parties (Conroy 2007), external monitoring (Locke, Qin, and Brause 2007), and peer reviews (Sabel and Zeitlin 2010). Finally, the ushering of the "Information Age" (Castells 1996) contributed significantly to the above structural and process changes. Powered by the revolution in information and communication technologies (ICT), the landscape of availability, distribution, and flow of information and knowledge and access and claims to them have been fundamentally altered. In short, capacities, resources, and

space for environmental governance are far more dispersed and diffused in the current era of governance than ever before.

3. The emergence of new technologies in environmental governance

It is in this historical context that the ever-growing centrality and significance of information in the current era can best be understood. Needless to say, the availability, ease, and speed of environmental information and data have dramatically accelerated in this decade, thanks in no small part to the widespread use of more powerful ICT, social media, mobile and digital technologies, and information networks. Direct observation of various environmental data—e.g., even toxicity in daily life—are now increasingly within the reach of consumers and other civil society actors (e.g., by wearing a silicone wrist band). Yet, today, information is not merely a matter of passive "right-to-know" or labeling. Rather, it can have profound implications for, and a substantive impact on, the very principles, norms, and institutions of governance themselves (Mol 2010). As no one can truly claim monopolistic control over them anymore—at least in non-authoritarian countries—information and knowledge are intimately related to transformative powers for a variety of actors (Mol 2008). Accountability, legitimacy, and participation in environmental governance are increasingly contested via the production, collection, distribution, use, and transparency of information and knowledge (Sabel, Fung, and Karkkainen 2000; Mol 2010; Karkkainen 2001). It is no coincidence that some scholars have emphasized "transparency-based" (Gupta 2010; Florini 2010) governance or "information-based" (Sabel, Fung, and Karkkainen 2000; O'Rourke and Lee 2004) or "informational" (Soma, Termeer, and Opdam 2016; Mol 2010) governance to denote new modes of environmental governance, all of which tend to place democratic principles of transparency, accountability, participation, and empowerment at the center.

In spite of the growing attention to the centrality of information and knowledge, perhaps surprisingly, there remains a real and serious paucity of research dedicated to their role in environmental governance. It is recognized that governance through information is intimately interconnected with wider developments in various areas of environmental politics and governance. Yet, outside of a handful early attempts (e.g., Esty 2004; Mol 2006; Fung, Graham, and Weil 2007), few have yet to analyze and understand systematically how they are structurally interconnected and institutionalized, not to mention what they mean for governance outcomes. For instance, in a recent review, Soma, Termeer, and Opdam (2016) were able to identify only a handful of studies focusing on informational governance in environmental issues. Answers to fundamental questions of whether or not, in what direction, and to what extent governing through information matters for substantive outcomes, for the architecture of governance, and for institutional changes and normative outcomes all remain underexplored (Soma, Termeer, and Opdam 2016).

4. Information and environmental governance in contemporary China

This special issue brings together a number of contributors who attempt to shed light on some of these fundamental issues by studying the role of information, technology, and digitalization in the context of environmental governance in contemporary China. Studying these issues in the context of China arguably brings numerous challenges, for we need to take into account a number of new dimensions that are less relevant or

even non-existent in other contexts. For one, once considered an information-deficient country, information of all kinds, including that related to the environment, became rapidly abundant in China in a short space of time. It was not long ago that even basic statistics about China, such as GDP, were routinely questioned for accuracy and reliability. Less than a decade ago, it was not uncommon to observe big discrepancies between the Chinese government's official environmental statistics and those produced by others (e.g., PM2.5 readings by US Embassy during the Beijing Olympics). Even though the validity of official statistics can still be debated, it is also true that average citizens have never had more direct access to science-based environmental information and knowledge than now (e.g., satellite data). Relatedly, environmental regulation and governance in China have not gone through the major paradigm shifts delineated above in a linear fashion. Empirically, it is questionable whether or not major shifts in governance modes and processes have even occurred at all. Even if it matters more than before, precisely how information matters in today's China is, thus, far from clear. Finally, to the extent that it has been explored, the role of information in environmental governance in previous studies has been almost entirely explored in a democratic political context. They have largely started with a basic assumption that the more information and transparency, the more likely it is for bottom-up civil society engagements and the better it is for environmental outcomes (Mol 2010). The same assumption cannot be so easily made about authoritarian—especially authoritarian developing—countries such as China.

In particular, the political economy of China is significantly distinct from most countries on which studies on information-based environmental governance have been conducted. Generally speaking, public–private relations frequently take a back seat to higher government-lower government (principal-agent) relations in China's environmental regulation. Two institutional realities reinforce this tendency. The first is the resilient authoritarian political system. Conventionally portrayed as operating in an ostensibly highly Weberian—and highly decentralized—organizational structure, the local government is assumed to be held accountable by higher authorities for the "mandates" instituted by the latter (Birney 2013; Edin 2003). Second, the boundary between the government and private sector in China is fuzzier and their relationship more intimate, because the state's presence in the market is still much greater than in other advanced capitalist countries. The heaviest polluters in China are usually state-owned enterprises (SOE) in key pillar industries (Eaton and Kostka 2017). This leads to tricky situations for environmental governance. Often, the local government and polluters are synonymous, as managers of SOEs hold equivalent ranks in the government personnel system. Even if not, they are still intimately tied together in prioritizing growth-at-all-costs. What follows is that so long as the interest of the local government actors are aligned with the center—who is assumed to have the will to protect the environment—malfeasant behavior by polluters would be rectified. Hence, the conventional wisdom has tended to heavily favor information's role within the government hierarchy: so long as the central government has accurate information about local performance, good regulatory outcomes would ensue (Economy 2007; Edin 2003).

Against this backdrop, what implications the recent explosion of information and digital technologies have for environmental regulation and governance in China remains highly elusive. Of the very few existing studies on China around these issues, findings have been inconclusive and idiosyncratic at best, and at worst contradictory. Some have been quick to note the rise of "rights consciousness" amongst Chinese

citizens who often hijack state discourse to advance their own social justice issues (Lorentzen and Scoggins 2015; Li 2010; Gallagher 2006; Yang 2005). Likewise, other studies have emphasized that, powered by new opportunities for participation via the internet and new digital technologies, environmental CSOs are able to form a "green public sphere" to produce critical challenges against the state and industry (Sima 2011; Yang 2009). With better publicized and more "open" information and disclosure (Wang 2018a), such an emergence has been portrayed as a new conduit for enacting social regulation of the environment and precipitating "non-democratic political pluralization" (Mertha 2010). On the other hand, there is evidence that shows that, by and large, the new digital technologies have predominantly expanded and solidified the Chinese state's capacity to control the production and flow of information (King, Pan, and Roberts 2017, 2014). Similarly, recent studies have shown—and even lauded—the coming of "environmental authoritarianism" (Beeson 2010) in China. A greater command over information and data has rendered the Chinese state able to rely on quantifiable targets and incentive mechanisms within the political hierarchy more exclusively than ever, largely at the expense of a deep engagement with, or participation by, non-state actors. While some studies have shown positive environmental outcomes from such (re-)centralization of environmental governance (Heberer and Trappel 2013; Zhao *et al.* 2014), others have also noted serious pitfalls and limitations (Shin 2018). Other findings have suggested that the green public sphere in China is, in fact, shrinking in spite of the recent proliferation of information (Kostka and Zhang 2018). Some scholars have even gone further to characterize environmental disclosure and transparency in China as a political gambit to manufacture largely discursive and impressionistic "symbolic legitimacy" (Wang 2018b; cf. Ran 2017), without a meaningful promise of actual substantive improvements in environmental governance (Seligsohn, Liu, and Zhang 2018). In short, even the basic questions of who is controlling flows of information and data and for what and for whom are yet to be answered in the case of China's environmental governance. This is not to mention whether or not, to what extent, and through what mechanisms information matters for substantive environmental outcomes.

5. Contributions in this special issue

Contributors in this special issue are at the forefront of environmental studies on China. Their latest research shows a number of findings which help to answer some of these thorny issues.

Several authors directly grapple with the issues of data, new technologies, transparency, and citizen participation, and what they mean for environmental outcomes. The empirical study by Hsu, Yeo, and Weinfurter (2019) provides useful insights on the effects of digital data and citizen participation on the environmental quality in local China. The Black and Smelly Waters Program, which was launched in February 2016, enlists citizens nationwide to help identify and monitor black and odorous water bodies through a smart-phone application on the WeChat messaging platform. The researchers analyzed a unique set of citizen-generated digital data in combination with the publically available water quality data published by the Guangzhou municipal government. Their regression analysis finds that negative citizen reports submitted through the app were associated with statistically significant reductions in chemical oxygen demand (COD) in Guangzhou's water bodies. This result indicates the potential of ICT to enable citizens,

as well as relevant government agencies, to improve environmental outcomes when the issues in question—in this case the black and smelly waters—are easy to identify, capture, and report. Nonetheless, since the black and smelly water issue is relatively less sensitive and the Guangzhou government is known to be more open to public participation, the documented effects of citizen-generated digital data on environmental outcomes need be interpreted with caution. In addition, with the Chinese state's increasingly tight control of civil society, particularly CSOs, in recent years, it may also be the case that individual citizen-based participation in environmental governance is now more welcomed by local governments than participation by CSOs.

Contrary to what Hsu, Yeo, and Weinfurter (2019) have found, after evaluating a number of China's citizen science practices against the core tenets of "transformative change" developed in the field of sustainable studies, Brombal (2019) argues that although citizen-generated data may have the potential to improve the coverage, frequency, and quality of environmental monitoring in China, they alone are inadequate to bring about radical, substantive changes in environmental governance. Furthermore, the author finds the current practices of citizen science in China to be merely serving the state's vision of anthropogenic and technocratic domination of the environment and nature. Instead, the author proposes a framework to understand citizen science that moves beyond such a vision, which essentially requires cognitive and normative turns. This is not an easy proposition. Yet, Brombal finds hope and optimism in recent trends emerging in China that are more consistent with such ideational shifts, and documents several cases and examples in the article.

The contribution by Flatø (2019) further looks at citizens in China. It investigates citizens' attitudes and propensity to voice their desire for better environmental protection from their local governments. The analysis uses the 2014 National Survey of Inequality and Distributive Justice ($N = 2{,}507$), provincial statistical yearbooks, and PM2.5 estimates from various sources, including NASA satellite data and China's domestic pollution monitoring data. The findings are largely consistent with our expectations. For instance, 75% of the respondents reported that they believed their health was harmed by environmental pollution, and 47% desired their local governments to increase the level of environmental protection services. The probability of expressing such a desire was higher for individuals who belonged to higher occupational classes. However, there was little correlation between class differences and differences in awareness. This suggests that information alone may not be sufficient to bring about broader public engagement in environmental governance. Another important caveat is that the data used in the study are from 2014, shortly after Xi Jinping declared a "war on pollution" as a national policy. Since air quality seems to have improved to a certain degree—at least according to some new research (e.g., Aunan, Hansen, and Wang 2018)—it is plausible to wonder whether citizens' environmental policy desires might now be decreasing, eclipsed by other material issues such as economic risk management. Such an implication is consistent with the pitfalls highlighted by Brombal (2019), and does not bode well for the future of sustainability in China.

The process of data collection and production is fundamentally political. Thus, it is critical to understand it to better understand the power dynamics between different institutional actors. Yet, for some reason, scholars have often overlooked it. In this respect, the article by Tarantino (2019) makes an important contribution by turning his attention to CSOs in China. More specifically, Tarantino's unique study reveals different kinds of obstacles CSOs routinely encounter when collecting and processing digital environmental

data in China. Based on a case study of the CSO, the Institute of Public and Environmental Affairs (IPE), conducted through ethnographic fieldwork spanning several years, Tarantino details how a large volume of two types of digital data are collected and publicized: environmental violation records published by Chinese Environmental Protection Bureaus (EPB) and real-time water and air pollution emissions of enterprises. Tarantino's analysis shows how overwhelmingly complex and costly it is for a CSO in China, such as the IPE, to collect and process environmental data, even in this age of information. In particular, identifying, programming, and processing complex and large volumes of environmental online data are often accompanied by significant "hidden" and new labour costs. The article provides interesting insights on a unique set of technological, human and financial challenges faced by CSOs in a non-democratic context. It is an important reminder to us that theories and debates developed in democratic contexts may not be readily applicable to other contexts, and greater sensitivity to local nuances is needed if we are to advance our understanding.

Finally, the remaining two articles directly challenge the conventional wisdom that with better and more data, improved monitoring, and augmented technology—not to mention the apparent stronger political will—the Chinese government's environmental performance will automatically improve. The article by Goron and Bolsover (2019) critically examines how Chinese environmental authorities use microblogs to dominate online spaces and shape online discourses about the environment. In their content analysis of local EPBs' microblogs in Shandong province, they find limited evidence of meaningful flows of environmental information or genuine interactions between EPBs and local citizens. EPBs' online communication often seems to be diversionary and superficial, if not outright obfuscating. Goron and Bolsover conclude that increased online engagement by EPBs should be viewed as propaganda tools or greenwashing publicity stunts, and do not necessarily lead to enhanced environmental disclosure or citizen participation. These findings cast serious doubt over the prospect of state-society synergies or "co-production" (Evans 1996; Ostrom 1996) in China.

As a part of its drive toward recentralization of environmental governance, the Chinese state has recently increased political will, resources, and incentives for local actors (Kostka and Nahm 2017). One may then expect the current information-rich environment to be conducive to better central–local environmental control. The findings in Lo, Li, and Chen's (2019) work on one of the most prominent centralized climate policy experimentations in China question this conventional wisdom. Through in-depth analysis of two pilot regions—Guangdong and Jilin—they show that willingness to conduct experimentation and actual performance still vary significantly between different regions. In their cases, Guangdong Province (the "pioneer") engaged in substantive policy innovation, while Jilin Province (the "laggard") continued to stay with conventional policies and showed risk-averse behavior and engaged in opportunistic behavior to secure as many pilot-related grants as possible without implementing long-term changes. In other words, in spite of the uniform set of standards, monitoring, and evaluation—not to mention improved technologies to measure and evaluate these—a significant level of information asymmetry still exists between and across different levels of Chinese government. This leads to a provocative implication: perhaps our emphasis on data, information, and technology is misplaced. They may be a necessary, but not a sufficient, condition for better environmental governance. Instead, Lo, Li, and Chen identify three key local factors that may be more critical: alignment of interests, leadership support, and communities of practice.

6. Conclusion and outlook

Even though it is widely recognized that information and knowledge are critical for environmental regulation and governance, and in spite of the rapid developments in the quantity and quality of data and technologies in the last two decades, serious research on their precise role has only recently begun. Moreover, those that exist have predominantly been based on lessons from developed, democratic contexts. By studying the role of information, technology, and digitalization in the context of environmental governance in contemporary China, the contributions to this special issue seek to advance our understanding, both theoretically and empirically, in a non-democratic context.

Certainly, there are developments and advances in China that are parallel to those in advanced democratic countries. As made evident by all of the research in this special issue, China has also seen sharp increases in the form, range, and quality of environmental information. Mobile apps tracking environmental conditions, factory pollution discharges, and even individual carbon footprints are now within reach of most of the population. In addition, similar to governments in democratic countries, it is now difficult to say that the Chinese state is able to completely monopolize information like it used to in previous decades. Nevertheless, how information, data, and technology manifest in environmental politics and governance seems to be far from straightforward. Empirical evidence in the studies in this special issue seem to be mixed at best, and one broad conclusion one can make is that the lessons from democratic countries do not seem to travel unambiguously to non-democratic or developing country contexts such as China.

For instance, although there is some evidence to show that new information technologies are enabling local communities to participate more in local regulatory space (Hsu, Yeo, and Weinfurter 2019), on balance, most contributors show various limits to the new instruments. Tarantino (2019) informs us that better technology does not necessarily mean that the barrier to entry for non-state actors is lowered. Similarly, Brombal (2019) and Flatø (2019) caution us that the availability of data and even transparency do not necessarily precipitate an automatic increase in environmental awareness, not to mention the collective actions of citizens and communities. Furthermore, several contributions show that the state continues to be the biggest presence in environmental governance in China. In fact, scholars such as Goron and Bolsover (2019) show that the latest technological advances have increased the capability of the Chinese government far more than that of the civil society, tipping the power balance away from—not closer to—the latter. Finally, virtually all of the contributors show that notwithstanding the major developments in the availability, transparency, and quality of data, information asymmetry between different institutional actors remains deeply entrenched in China. Their findings leave us to wonder whether such asymmetries will ever decrease significantly without meaningful and substantive political reforms. Better delineating and making sense of these disparate findings, especially theoretically, will be a critical intellectual challenge in the coming years.

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Note

1. See also Akerlof (1970) and Rothschild and Stiglitz (1976) for problems of information asymmetry in market failures.

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