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FOCUS

PUBLIC PARTICIPATION IN ENVIRONMENTAL PROTECTION

ENVIRONMENTAL INFORMATION DISCLOSURE IN CHINA: IN THE ERA OF INFORMATIZATION AND BIG DATA

ZHANG Lei[*], *Arthur P. J. Mol*[**], *YANG Shuai*[***]

Abstract The past decade has seen remarkable progress made in the field of environmental information disclosure in China. While the overall institutional changes and the motivation/willingness of the government to open up information are important conditions, China's encounter with revolutionary Information and Communication Technological (ICT) advancement and rapidly emerging big data quickly changed China from an "information poor environment" to an "information complex environment." While most previous studies centered on those drives/constraints that were recognized in established informational governance framework, recent advancement in ICTs and emerging big data posed new challenges, opportunities and research questions. When increasing information disclosure became a new game changer in environmental governance, China has had to cope with risks and pitfalls in a new technology-empowered information environment as well. This article updated previous studies on legislation/regulations/policies regarding environmental information disclosure in China and their implementation effectiveness, and paid special attention to China's recent informatization progress and emerging big data. Information disclosure was treated as a process that includes data/information generation/collection, disclosure, functional pathways of communication, and direct/indirect impacts. Changes in environmental information disclosure should be understood in a broader context of overall changing environmental governance and informatization in China. It is important to understand ICTs and information disclosure as a double-edged sword. Normative, substantive, and instrumental benefits of disclosure as well as collection and reporting costs, the issue of targeted transparency, and the risk of unintended use should be strategically considered. Principles

[*] (张磊) Ph.D. in Environmental Management, Environmental Policy Group, Wageningen University & Research, Wageningen, The Netherlands; Associate Professor, School of Environment and Natural Resources, Renmin University of China, Beijing 100872, China. Contact: leizhang66@ruc.edu.cn

[**] Arthur P. J. Mol, Ph.D. in Sociology, University of Amsterdam, Amsterdam, The Netherlands; Professor, Environmental Policy Group; Rector Magnificus and Vice-President, Wageningen University & Research, Wageningen, The Netherlands. Contact: arthur.mol@wur.nl

[***] (杨帅) Master Student in Environmental Policy and Management Program, School of Environment and Natural Resources, Renmin University of China, Beijing 100872, China. Contact: Charles930504@163.com

and guidelines need to be developed to avoid pitfalls while maximizing benefits.

Keywords environmental information disclosure, informatization, big data, China

INTRODUCTION

Since enacting the Open Government Information Regulations (OGIR) and the Environmental Information Disclosure Measures (EIDM) in 2008, China has made remarkable progress pertaining to the actual amount of environmental information disclosed to civil society actors, the diversification and pluralism of environmental information suppliers and users, and diversification in the methods of transparency and disclosure.[1] This has significantly changed environmental governance in China. While most previous studies centered on those drives/constraints recognized in established informational governance framework, recent advancement in Information and Communication Technologies (ICTs) and emerging big data posed new challenges, opportunities and research questions. China's informatization strategy and rapidly mounting demand/supply of environmental (big) data have already changed China from an "information-poor environment" to an "information-complex environment." This phenominon requires new analytical framework to capture opportunities and risks facing China's environmental governance in an era of informatization and big data. This article built on previous studies of environmental information disclosure in China with updates especially on ongoing informatization/big data development and implications for informational environmental governance. To this end, Part I first gives a brief review of the progress achieved thus far regarding legislation, policies, measures and implementations. Part II starts with a modified analytical framework and then applies it to understand the implications of informatization and big data on environmental information disclosure. The conclusion part reflects on the research framework and presents a future outlook.

I. INFORMATIONAL ENVIRONMENTAL GOVERNANCE IN CHINA

Although Articles 11 and 31 of the 1989 Environmental Protection Law (EPL) was the first piece of legislation in China that provided a legal basis for the production and public release of environmental quality and pollution reports, environmental accidents

[1] ZHANG Lei, Arthur P. J. Mol & HE Guizhen, *Transparency and Information Disclosure in China's Environmental Governance*, 18 Current Opinion in Environmental Sustainability 17, 17 (2016).

reports, environmental impacts assessment reports, and information on illegal discharges of pollutants by industries, environmental information disclosure was considered a one-way dissemination tool (as intra-departmental or government-to-public information flow), rather than a governance instrument. For a long time, environmental information disclosure and associated public participation remained merely a principle or slogan.

Environmental information disclosure really matured with the Environmental Information Disclosure Measures (EIDM), which only came into force in 2008 as the first sectoral operationalization of China's 2008 OGIR.[2] The main motivations behind the OGIR were to alleviate information asymmetry between actors, to gain political credit by improving transparency of governmental work, and to improve administrative performance.[3] And arguably, the environmental field is leading in a cautious move to bounded information pluralism and transparency, caused by at least two processes. Firstly, developments in information and communication technology have undermined the control of the state in information provisioning and dissemination in the Information Age.[4] Secondly, especially in the environmental field, the central government has allowed and even actively stimulated information disclosure and media openness, often with the idea of building countervailing power against local governments and powerful, local polluters.[5]

Currently, information disclosure has been well received and practiced as a complement to command-and-control and market-based modes of environmental governance and an important component of environmental governability in China. Relevant and major legislation and policies promoting environmental information disclosure are summarized to show that mandatory environmental information disclosure started with environmental agencies at all levels and has been extended to other relevant governmental agencies, state-owned enterprises, and listed and private companies (see Table 1). The actual amount and types of environmental information disclosed to civil society actors increased rapidly within one decade, including not only information on environmental state, monitoring data, environmental impact assessment, environmental management performances, environmental audits, and environmental public litigation, but also environmental inspections processes and results (conducted either by the Ministry of

[2] Id. at 18.

[3] Id. Also see ZHANG Lei, Arthur P. J. Mol & HE Guizhen et al., *An Implementation Assessment of China's Environmental Information Disclosure Decree*, 22(10) Journal of Environmental Sciences, 1649–1456 (2010); Arthur P. J. Mol, HE Guizhen & ZHANG Lei, *Information Disclosure in Environmental Risk Management Developments in China*, 40(3) Journal of Current Chinese Affairs, 163–192 (2011); TAN Yeling, *Transparency without Democracy: The Unexpected Effects of China's Environmental Disclosure Policy*, 27(1) Governance: An International Journal of Policy, Administration and Institutions, 37–62 (2014).

[4] Arthur P. J. Mol, *Environmental Governance through Information: China and Vietnam*, 30(1) Singapore Journal of Tropical Geography, 114–129 (2009); James F. Scotton & William A. Hachten eds. *New Media for a New China*, Wiley-Blackwell (New Jersey), (2010).

[5] See ZHANG, Mol & HE, fn. 2.

Environmental Protection (MEP) or State Council (SC) since 2015, according to Environmental Supervision and Inspection Work Plan (for Trial Implementation)), responses to environmental complains, accidents, etc. Concurrently, environmental information suppliers and users became increasingly diverse; the same applies to the methods of improving transparency and disclosure, with the aid of widely accessible ICT and infrastructures. At his first press conference during the National People's Congress (NPC) in March, 2015, as the new minister of environment, Mr. CHEN Jining annouced his reform package and work priorities, of which enhancing information disclosure was highly emphasized.[6] With the promotion of informatization, "internet-plus" actions and big data construction programs, both supply and demand of environmental big data were expected to soar. Part II provides a closer look at the last point.

Table 1 Environmental Information Disclosure Legislation and Policies in China

Legislation and policies	Specific requirements	Issued by	Enactive/ Issuing time
环境保护行政主管部门政务公开管理办法 (Administrive Measures regarding Opening Environmental Agencies' Management Information)	Stipulated principles, contents, forms, procedure, supervisions, etc. which environmental agencies at all levels shall follow when opening their management information	State Environmental Protection Administration	April 1, 2003
环境保护行政许可听证暂行办法 (Environmental Protection Administrative Permits Public Hearing Interim Measures)	Public hearing should be orgainized by environmental agencies to construction projects or plans that might cause negative impacts on the local population	State Environmental Protection Administration	July 1, 2004
中华人民共和国政府信息公开条例 (Open Government Information Regulations)	Specified the subjects, scope, methods, procedures, supervision, and guarantee measures for opening up government information	SC	May 1, 2008
环境信息公开办法(试行) (Environmental Information Disclosure Measures (for Trail Implementation))	Stipulated the contents, forms, procedures, supervision and responsibilities for environmental information disclosure by governmental agencies and enterprises	MEP	May 1, 2008
环境保护部信息公开指南 (Environmental Information Disclosure Guide)	Clarified the contents, scope, information application, supervision and confidentiality issues for the MEP	MEP	May 1, 2008
环境保护部信息公开目录(第一批) (Information Disclosure Catalogue of the Ministry of Environmental Potection (1st batch))	Listed the information for disclosure by the MEP	MEP	May 1, 2008
环境保护公共事业单位信息公开实施办法(试行) (Information Disclosure Measures for Environmental Public Undertaking Units (for Trial Implementation))	Stipulated information disclosure of environmental public undertaking units	MEP	October 1, 2010

(*To be continued*)

[6] CCTV, 环保部长陈吉宁答记者问 (*Press Conference by the Environmental Minister CHEN Jining*), available at http://news.cntv.cn/2015/03/07/VIDE1425719339499787.shtml (last visited Feb. 28, 2017).

(*Continued*)

Legislation and policies	Specific requirements	Issued by	Enactive/ Issuing time
关于进一步加强环境保护信息公开工作的通知 (Circular regarding Further Strengthening Environmental Information Disclosure Work)	Expanded information disclosure to major projects that might affect the public interests	MEP	October 30, 2012
国家重点监控企业自行监测及信息公开办法(试行) (National Key Enterprises Self-Monitoring and Information Disclosure Measures (for Trial Implementation))	National key enterprises were required to monitor and disclose environmental information	MEP	January 1, 2014
国家重点监控企业污染源监督性监测及信息公开办法(试行) (National Key Enterprises On-Site Inspections Information Disclosure Measures (for Trial Implementation))	Required to open information from on-site inspections to national key enterprises	MEP	January 1, 2014
建设项目环境影响评价政府信息公开指南(试行) (Construction Project Environmental Impact Assessment Information Disclosure Guide (for Trial Implementation))	Stipulated construction projects environmental impact assessment information disclosure	MEP	January 1, 2014
新环境保护法 (Environmental Protection Law 2014)	A completely new Chapter 5 in the new law was devoted to public participation and information disclosure	The Standing Committee of the NPC of China	January 1, 2015
企业事业单位环境信息公开办法 (Private Enterprises and Public Organizations Environmental Information Disclosure Measures)	Stipulated the subjects, scope, methods, procedures, and supervision measures for opening up environmental information of private enterprises and public institutions	MEP	January 1, 2015
2015 年政府信息公开工作要点 (2015 Governmental Information Disclosure Priorities)	Further stressed the enforcement of environmental information disclosure, especially information on responses to public complaints, environmental accidents, incompliances, etc. Also encouraged information disclosure of nuclear power plants	SC	April 3, 2015
全面推进政务公开相关实施细则 (Specifications for Comprehensive Implementation of Governmental Information Opening Up)	Aimed to standardize practices and norms for opening up administration information on policymaking, implementation, enforcement, services and results. These requirements will be experimented in 100 selected pilot cities/counties/districts. Environmental governance information was one of the priorities	SC	November 15, 2016

(*To be continued*)

(*Continued*)

Legislation and policies	Specific requirements	Issued by	Enactive/ Issuing time
“十三五”控制温室气体排放工作方案 (The 13th Five-Year Planning Green House Gases (GHG) Emission Control Work Plan)	About institutionalized green house gases emission information disclosure. Progress towards national low-carbon targets would be published regularly. GHG emission data and information platform would be established. Efforts would be made to establish communique system on national responses to climate change. Local governments and enterprises were encouraged to publish GHG emission data and information on control actions	SC	October 27, 2016
“十二五”国家政务信息化工程规划 (The 12th Five-Year Planning of National Governmental Affairs Informatization Projects)	As one of the 15 key informatization projects in the planning, “Ecological and Environmental Protection Informatization Project” aimed at realizing sharing of pollution sources data, pollutants data, ecological and environmental state information; to improve governance effectiveness of key water basins and regions; to improve monitoring, evaluation and services	National Commission for Development and Reform (NCDR)	May 5, 2012
国家环境信息与统计能力建设项目管理办法 (National Environmental Information and Statistics Capacity Building Projects Management Measures)	Supported projects that strengthened data transfer, exchange and sharing, statistical analysis, etc. To ensure science-based, precise pollution control	MEP	April 7, 2011
环境保护督察方案(试行) (Environmental Supervision and Inspection Work Plan (for Trial Implementation))	Institutionalized and routinized environmental supervision, inspection and information disclosure	CPC Central Leading Group for Overall and Further Reforms, head by President XI Jinping	July 1, 2015
生态环境监测网络建设方案 (Ecological and Environmental Monitoring Network Construction Plan)	Aimed to build a nationwide monitoring network, to conduct big data analysis, to support effective supervision and regulation	CPC Central Leading Group for Overall and Further Reforms	July 26, 2015
关于积极推进“互联网+”行动的指导意见 (Guiding Opinions Regarding the Promotion of “Internet plus” Actions)	Planned 11 key actions, including “internet plus environment and ecology”	SC	July 4, 2015
促进大数据发展行动纲要 (Action Guideline for the Promotion of Big Data Development)	Set objectives for the next 5-10 years, including realization of cross-departmental data sharing by end of 2017, and an open, unified platform for governmental information by end of 2018	SC	September 5, 2015
中共中央关于制定国民经济和社会发展第十三个五年规划的建议 (Chinese Communist Party Central Committee’s Suggestions on the 13th Five-Year Planning)	Strongly supported the implementation of national big data strategy and “internet plus” actions	CPC Central Committee	October 29, 2015

Source: compiled by the authors

Regarding the implementation and enforcement of these laws, regulations, and policies, one of our earlier assessments on the implementation effectiveness of OGIR and EIDM at the provincial level in 2008 concluded that EIDM was viewed by the majority of the local Environmental Protection Bureaus (EPBs) as a burden in its initial phase.[7] Information disclosure had been paid enough lip service but lacked real action. Although local EPBs had one year to prepare for information disclosure before May 1, 2008, insufficient resources were allocated to build up the needed capacities.[8] This, plus lack of motivation, had led to limited capacities at all levels to deliver quality services. In this situation, the ambiguity of some clauses in EIDM gave agencies great discretion to avoid disclosure.[9] Through reviewing the websites of all thirty-one provincial EPBs and the MEP, conducting actual information disclosure requests, and through interviews with all provincial EPBs, our study concluded that the implementation of the environmental information disclosure system still fell short of expectations.[10] Public data/information shared across different governmental agencies was even more rare. For instance, a lack of quality data/information and information disclosure/sharing was a weakness in China's environmental risk management.[11] Recent decades have witnessed an increasing impact of the accelerating expansion of chemical industries, and chemical accidents have become a major contributor to environmental and health risks in China. This called for the establishment of an effective chemical risk management system, which required reliable, accurate, and comprehensive data from multiple agencies. However, the current chemical accident-related data system was highly fragmented and incomplete, as different responsible authorities adopted different data collection standards and procedures for different purposes.[12] Information on chemical accidents is not yet systematically and fully collected and stored, which seriously undermines chemical accident management and policies. Hence, lessons from these chemical accidents — their causes, consequences and management — are not easily learned and disseminated. And new policies for preventing and handling chemical accidents and risks cannot rely on reliable information sources.[13]

While governmental evaluations of the implementation of EIDM from 2008 to 2013 documented the progressive achievements,[14] independent evaluations of EIDM revealed

[7] See ZHANG, Mol & HE et al., fn. 4.

[8] Id.

[9] Id.

[10] Id.

[11] HE Guizhen, ZHANG Lei & LU Yonglong et al., *Managing Major Chemical Accidents in China*, 187(1–3), Journal of Hazardous Materials, 171–181 (2011).

[12] Id.

[13] Id.

[14] See Information Center of the Ministry of Environmental Protection, 省级环保局(厅)政府网站绩效评估报告 2007–2013 (*Evaluation Report on Provincial Environmental Protection Bureas/Departments Websites Performance 2007–2015*), available at http://www.chinaeic.net/tzgg/tz/200801/t20080129_117750.htm (last visited Dec. 6, 2016).

also problems and failures: a meager track record of slow, incomplete, and sometimes unwilling implementation of EIDM by EPBs and polluting companies, often using Article 8 of OGIR (an exemption due to "national security, public security, economic security or social stability") as arguments for continuing confidentiality of environmental information.[15] Sanctions for lack of implementation or for violations of EIDM have also been reported recently.[16] Despite all the flaws, the landmark OGIR and the EIDM have made profound and long-term impacts on Chinese society. They contributed to the transition from traditional environmental regulation to more transparent, multi-actor involved environmental governance. Henceforth, continuous progress has been observed in several aspects. As part of ongoing institutional reforms toward ecological civilization, the overall environmental policy, technological capacities, attitude of EPBs and local officials became much more favorable for environmental information disclosure.

2015 was a turning point in environmental governance in China, with the implementation of the new EPL and a new environmental minister with his environmental reform package. The 2014 EPL approval by the Standing Committee of the NPC of China marked the end of a three-year, highly controversial and unique revision process and provided further, major momentum for information disclosure.[17] The drafting process has been unprecedented in China's lawmaking history and served as a successful example for information disclosure and public participation in lawmaking. Various drafts were publicly released and opened the door for critical discussion and comment by NGOs and scientists in the public sphere. The MEP disagreed openly on various EPL drafts, bringing internal power politics of the Chinese state into the open.[18] As one of the major achievements, a completely new Chapter 5 in the 2014 EPL is devoted to public participation and information disclosure.[19] According to the 2014 EPL, government agencies at the county level and above that are responsible for or involved in environmental protection must publicize information and data on environmental quality, management and supervision. Industrial polluters have to publish details of pollution discharge and construction and operation of environmental facilities. Evaluations of the environmental performance of local environmental agencies (and their responsible

[15] See ZHANG, Mol, HE et al., fn. 3; IPE & NRDC, *Pollution Information Transparency Index (PITI) 2008–2015*, available at http://www.nrdc.cn/info_library_1B.php (last visited Dec. 6, 2016).

[16] 理顺环境考核机制 多方发力严惩数据造假 (*Strengthening Environmental Assessment, Joint Effort to Punish Monitoring Data Fabrication*), available at http://www.hbzhan.com/news/Detail/114701.html (last visited Mar. 1, 2017).

[17] ZHANG Lei, HE Guizhen & Arthur P. J. Mol, *China's New Environmental Protection Law: A Game Changer?*, 13 Environmental Development 1, 1 (2015).

[18] ZHANG Lei, HE Guizhen & Arthur P. J. Mol et al., *Power Politics in the Revision of China's Environmental Protection Law*, 22(6) Environmental Politics, 1029–1035 (2013); Jost Wübbeke, *The Three-Year Battle for China's New Environmental Law*, in China Dialogue, available at http://www.chinadialogue.net (last visited Dec. 6, 2016).

[19] 中华人民共和国环境保护法 (*Environmental Protection Law of the People's Republic of China*), available at http://zfs.mep.gov.cn/fl/201404/t20140425_271040.htm (last visited Mar. 1, 2017).

officials) should be published and used for promotion of officials. Violations of environmental regulations as well as environmental performance will be recorded in the credit archive of organizations/individuals — a system-in-the-making that lists all achievements and performance of individuals/organizations, to be used for promotions and demotions — and the names of individuals/organizations violating environmental regulations will be made public.

The significance of the 2014 EPL lies not only in its achievements regarding information disclosure and public participation, environmental policy principles, environmental litigation and law enforcement, but also in the model it set for future law/policy making. Inviting the public to comment on draft laws and regulations is now becoming a "new norm." For instance, the public was invited during the making process of 2015 Food Safety Law, 2014 Interim Measures for Discharge Permit Management, 2015 Environmental Taxation Law (draft), 2015 Interim Measures for Public Participation in Environmental Protection, etc. With enforcing the 2014 EPL, the MEP and EPBs can push further environmental information disclosure by detailing procedures, mechanisms, and enforcement measures for effective public participation (see Table 1). 2014 saw intensive enactment of policy measures to guide information disclosure of different target groups.

The first year of implementation of the new EPL was thoroughly assessed and presented in the "New Environmental Protection Law Implementation Assessment Report." The Report concluded that progress had been made in terms of information disclosure and public participation, even though thirty-six percent of cities sampled for the report failed to provide a list of key polluters.[20] In addition, apart from environmental enforcement inspections by the MEP (MEP inspected more than thirty percent of the municipal governments in 2015), higher rank inspections directly organized by the central government also became routine.[21] In July 2016, within one month, inspection teams from Beijing had visited eight provinces and regions. The entire process of inspection work was also open to the public, imposing huge pressure on local governmental officials. The recently published Specifications for Comprehensive Implementation of Governmental Information Opening Up by the SC went further to demonstrate standardized practices and norms in 100 pilot cities/counties/districts.[22] The Specifications also emphasized the responsibility of policymakers for policy explanation

[20] 新环境保护法实施情况评估报告发布 (*Press Release on the Implementation Assessment of the New Environmental Protection Law*), available at http://legal.people.com.cn/n1/2016/0526/c42510-28380348.html (last visited Dec. 6, 2016).

[21] 2016 第一批中央环保督察工作 8 个督查组全部进驻 (*The 1st Round of 2016 Environmental Inspection Teams Are All in Places*), available at http://www.china.com.cn/cppcc/2016-08/02/content_ 39004186.htm (last visited Mar. 1, 2017).

[22] State Council, 全面推进政务公开相关实施细则 (*Specifications for Comprehensive Implementation of Governmental Information Opening Up*), available at http://www.gov.cn/zhengce/content/2016-11/15/content_5132852.htm (last visited Mar. 1, 2017).

and clarification, institutionalized participation of the public, experts, and media in major decision-making such as developmental planning, legislation and major construction projects. Evaluation of governmental information opening up will be routinized as well.

In regards to the mandatory or voluntary environmental and corporate social responsibility information disclosure by companies, studies show that overall, the levels and details of company environmental disclosure in China are low.[23] Information disclosure levels are related to the organizational characteristics of industries (larger companies, foreign or state-owned companies, and companies in polluting sectors disclose environmental information better) and to activities of other stakeholders (*e.g.* more pressure from governments, shareholders, creditors, and community groups result in increased and better environmental information disclosure of companies). This might change for larger companies, with the recent policies on Green Credit and Green Securities, where the MEP has published a blacklist of companies that are no longer entitled to financial credit, and listed companies on the Shanghai and Shenzhen stock exchanges have to disclose company environmental performance data for initial offerings or refinancing.[24]

The role of civil society in environmental governance in China has been increasing as well. Different statistics confirm the same trend: that the boom in the number of registered domestic civil society organizations (including NGOs) is spectacular and that environmental civil society organizations are a fast-growing sector.[25] Empowered with increasing information disclosure, from individuals to NGOs and media, the pathways through which it is possible to influence environmental policy have become more diverse. Such pathways include: the publication of independent reports, formulation of policy proposals to the NPC; commenting on released draft laws; applying for information from governmental organizations; administrative review and public hearings; environmental public litigation; environmental monitoring, etc. Meanwhile, the information and communication technology revolution has further expanded the ways in which civil society can obtain, produce, spread, and disclose environmental information, increasing its role in information governance in China.[26]

In general, within one decade, China has developed basic laws, regulations, and policies that have changed environmental information disclosure from a mere principle/slogan into a powerful instrument and new leverage of environmental

[23] See ZHANG, Mol & HE, fn. 2.

[24] LI Wei & HU Mengze, *An Overview of the Environmental Finance Policies in China: Retrofitting an Integrated Mechanism for Environmental Management*, 8(3) Frontiers of Environmental Science & Engineering, 316–328 (2014); WANG Hua & David Bernell, *Environmental Disclosure in China: An Examination of the Green Securities Policy*, 22(4) Journal of Environment & Development, 339–369 (2013).

[25] Ministry of Civil Affairs of the People's Republic of China, 2013 年社会服务发展统计公报 (*Social Services Development Statistics Bulletin 2013*), available at http://www.mca.gov.cn/article/zwgk/mzyw/201406/20140600654488.shtml (last visited Dec. 6, 2016).

[26] See ZHANG, Mol & HE, fn. 2.

governance. Alongside increasing information disclosure, transparency and internal democracy within the governmental system, social demands for justice, and accountability increased. According to the first *China's Rule of Law Index Report*,[27] which assessed the status of China's rule of law through the degree of public satisfaction, although environmental legislation and governance have improved in recent years, the area garnering least public satisfaction is enforcement of environmental laws. In future, further and effective environmental information disclosure would be crucial for breaking through the paradox of sophisticated environmental laws/policies on the one hand and poor enforcement on the other.[28] To this end, the ongoing revolutionary changes made with advancement in ICTs seem to offer a good opportunity.

II. ENVIRONMENTAL INFORMATION DISCLOSURE IN INFORMATIZATION AND BIG DATA ERA

The landscape/trends of environmental information disclosure can only be well understood in light of the changing context of environmental governance in China. Previous studies of environmental policy and regulation in China concluded that China has been transitioning from a conventional state-dominated, command-and-control, environmental regulatory approach to a mode of environmental governance that involves multiple actors, increased information disclosure and transparency, and employs market-based and voluntary policy instruments.[29] In the absence of the effective participation of civil society in environmental governance, environmental regulation in China used to be a cat and mouse game, leaving a lot of room for environmental agencies to engage in rent-seeking activities and for non-compliances by polluters.[30] Partly enabled by a larger "room to maneuver" and partly through endogenous development, China's civil society has been increasingly engaged in environmental governance.[31]

Since 2013, XI Jinping has pledged to do away with the implementation gap common to many policies in China. Among several issues, XI has stressed, on various occasions, that citizens' rights to information access and participation, quality of monitoring and statistics, evaluation and accountability systems and rule of law must be improved to ensure effective implementation. The Third Plenary Session of the18th National Congress of the Communist Party of China in 2013 was a critical moment for environmental institutional reforms, and impacted environmental governance in several ways, including

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[27] Renmin University of China Center for Evaluation of China's Rule of Law, 中国法治评估报告 (*China's Rule of Law Index Report*), 2015.

[28] RAN Ran, *Perverse Incentive Structure and Policy Implementation Gap in China's Local Environmental Politics*, 15(1) Journal of Environmental Policy & Planning, 17–39 (2013).

[29] HE Guizhen, LU Yonglong & Arthur P. J. Mol et al., *Changes and Challenges: China's Environmental Management in Transition*, 3 Environmental Development, 25–38 (2012).

[30] ZHAN Xueyong, TANG Shui-Yan, *Political Opportunities Resource Constraints and Policy Advocacy of Environmental Ngos in China*, 91(2) Public Administration, 381–399 (2013).

[31] See ZHANG, Mol & HE, fn. 2.

improved information disclosure and transparency, establishment of a social credit system, participation of local communities, working with new media, etc.[32]

Information disclosure should be understood as a process: The actual functional pathways to achieve improved transparency and environmental effects depend on the information characteristics and which information suppliers and users are involved in the process (see Fig. 1). Roughly, four phases can be identified in information disclosure process: (1) data/information generation: how a specific data/information is collected, handled, processed, etc.; (2) ways of disclosure: either mandatory disclosure like environmental reporting, blacklist published via official media, or voluntary disclosure like labeling/certification schemes, publishing scientific information and WE-media (refer to information technology-based self-created media); (3) functional pathways: government-government, government-public-business, public-government-business, public-business, business-business, etc.; and (4) impacts of disclosure: either direct policy/behavior change or indirect changes via improved transparency/empowerment. There are diverse actors involved in these processes, ranging from state authorities to value chain actors, competitors, individual citizens/consumers, social organizations, national/international NGOs, financial institutions, scientific institutions, etc.

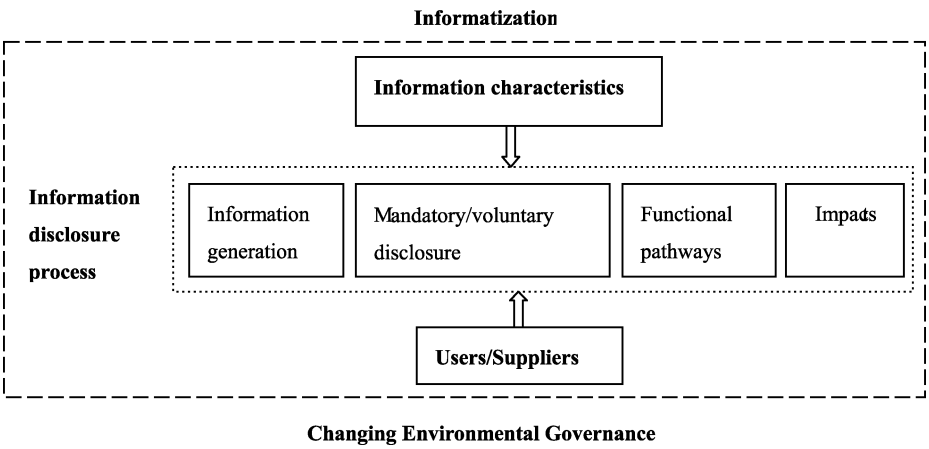

Fig. 1 Information Disclosure Process in Context of Informatization and Environmental Governance in China

Source: ZHANG Lei, Arthur P. J. Mol & HE Guizhen, *Transparency and Information Disclosure in China's Environmental Governance*, 18 Current Opinion in Environmental Sustainability 17, 17 (2016)

Such processes are constantly interactive with, among others, the environmental reform and informatization process in China. While progress in informatization improved the infrastructure and the methods of data generation, collection, processing, presenting and communicating by environmental agencies or other information suppliers/users,

[32] CHEN Xiangzhou & HE Siqi, 推进生态治理能力的现代化 (*Promoting the Modernization of Governance Capacity for Ecological Conservation*), available at http://www.qstheory.cn/laigao/2014-06/10/c_1111077258.htm (last visited Mar. 1, 2017).

internal demands from ongoing environmental reforms/pratices for more quality and shared data/information are also important drives. Improving the environmental regulatory system and governability has been the new focus in the 2010's. Between 2013, when XI Jinping took office, and 2015, China issued seven new laws and measures related to the building of the environmental law system: nine important policies on pollution control; six policies on energy conservation and emission reduction; eight policies and plans on ecological conservation and resource development; and thirteen policies on environmental supervision and administration. The importance of environmental monitoring and data management has also been increasingly stressed as part of environmental policymaking and enforcement.[33]

At present, apart from some policy instruments unique to China (*e.g.* the "zero hour clean-up" campaign in 1990's, "environmental impact assessment restrictions targeting regions" since 2006, ecological redlines control since 2014, and administrative warnings to local officials since 2014), a wide range of instruments one can find in industrialized countries exists, and new ones are continually being experimented with and adopted. The recent promotion of a series of regulations, decrees and measures as backup to the 2014 EPL shows the increasing role of the market, the judiciary, and the public in environmental governance. Examples include public-private-partnership schemes, environmental taxation law, carbon emission trading schemes, public participation measures, information disclosure by governments and enterprises, green finance, a pollution emission permit system, ambient air quality standards attainment planning, etc. The Pollution Emission Permit System Implementation Plan, which was issued by the SC on November 21, 2016, as China's first attempt to build a nationwide unified management system for pollution emission control, strongly recognized environmental information disclosure as a precondition for success of the permit system and pledged to create a national pollution sources information platform by 2017.[34]

In practice, joint policy formulation and enforcement are increasingly observed at both national and local levels. The National Sustainable Agricultural Development Plan 2015–2030 (jointly issued by eight ministries on May 20, 2015) and the Cooperation Memorandum for Punishing Those Who Violate Environmental Regulations (jointly issued by thirty-one ministries and organizations, 2016), are some examples. The effective implementation of all these instruments would require shared and quality

[33] Ministry of Environmental Protection of the People's Republic of China, 改革创新是环保事业发展的不竭动力——环境保护部开展"环评和监测工作"创新大讨论 (*Discussions on Environmental Impact Assessment and Monitoring Innovations*), available at http://www.zhb.gov.cn/gkml/hbb/qt/201506/t20150622_304146.htm?COLLCC=4140087099& (last visited Dec. 6, 2016).

[34] State Council, 控制污染物排放许可制实施方案 (*Pollution Emission Permit System Implementation Plan*), available at http://www.gov.cn/zhengce/content/2016-11/21/content_5135510.htm (last visited Mar. 1, 2017).

environmental data/informtion. There is an urgent need for a national environmental database and information disclosure platform.

The generation, processing, and distribution of information having to rely on necessary infrastructures/hardware has been often neglected. Willingness alone cannot succeed. ICTs, given its crosscutting nature, have been changing the entire economic and social horizons since the 1980's. Informatization, driven by ICT advancement, takes place in all sectors of modern societies, including public governance.[35] China is in urgent need of updating its informatization strategy. In the *National Informatization Strategy: 2006–2020* published in May 2006, the Chinese government reaffirmed that informatization was an integral portion of China's national strategies for moving toward modernization, and ICTs were believed to make government functions more services-oriented, efficient, and transparent, *e.g.* to support open access to government information.[36] Science-based, precise environmental management can only be realized with support of good data/information. In 2013, a group of twenty experts were invited by the MEP to form the Environmental Informatization Consultative Committee to serve policymaking. As an important component of the national informatization strategy, environmental informatization is also crucial for further modernizing China's environmental governance and capability.

The 2014 EPL also urged promotion of environmental informatization.[37] In response, the MEP issued a series of twelve standards in 2014 to specify environmental informatization work, including Technical Specifications for Environmental Information Sharing and Interconnection Platform Framework. The catchword "Internet plus" first appeared in the Governmental Work Report to the NPC in 2015. It also opened a new chapter for environmental informatization. The MEP organized open discussions on "Environmental Assessment and Monitoring Work Innovation" in June 2015. The minister reaffirmed that big data, "Internet plus" and other intelligent technologies were important means for improving environmental governance. Data integration, deep analysis and applications were to be strengthened to support policymaking and implementation. Several important documents issued in 2015 (see Table 1) aimed to realize the goals with concrete action plans.

In addition to the National Environmental Information and Statistics Capacity Building Project that started in 2011, ecological and environmental protection informatization was one of the fifteen priority programs identified in The 12th Five-Year

[35] Nagy K. Hanna & QIANG Christine Zhen-Wei, *China's Emerging Informatization Strategy*, 1(2) Journal of the Knowledge Economy, 128–164 (2010).

[36] State Council, 2006–2020 年国家信息化发展战略 (*National Informatization Strategy: 2006–2020*), available at http://news.xinhuanet.com/newscenter/2006-05/08/content_4522878.htm (last visited Mar. 1, 2017).

[37] See fn. 19.

Planning of National Governmental Affairs Informatization Projects in 2012.[38] Progress has been made across the country with the implementation of these key programs.[39] By 2014, a specialized network of the MEP was accessible to EPBs at all levels and most of the affiliated organizations, laying a good foundation for building an "environmental protection cloud" in the future.

In March 2016, the MEP announced the Ecological and Environmental Big Data Development Overall Plan, which aimed to realize unified data collection, analysis/processing, and applications in the near future.[40] The structure, functions and contents of such a big data platform, a major carrier of environmental information disclosure and inquiry system exist (see Fig. 2). This is just one of the many national big data platforms, covering sectors from transportation, public health, education, natural resources, statistics, etc. A unified, cross-sectoral national platform is supposed to be open to the public by the end of 2018.

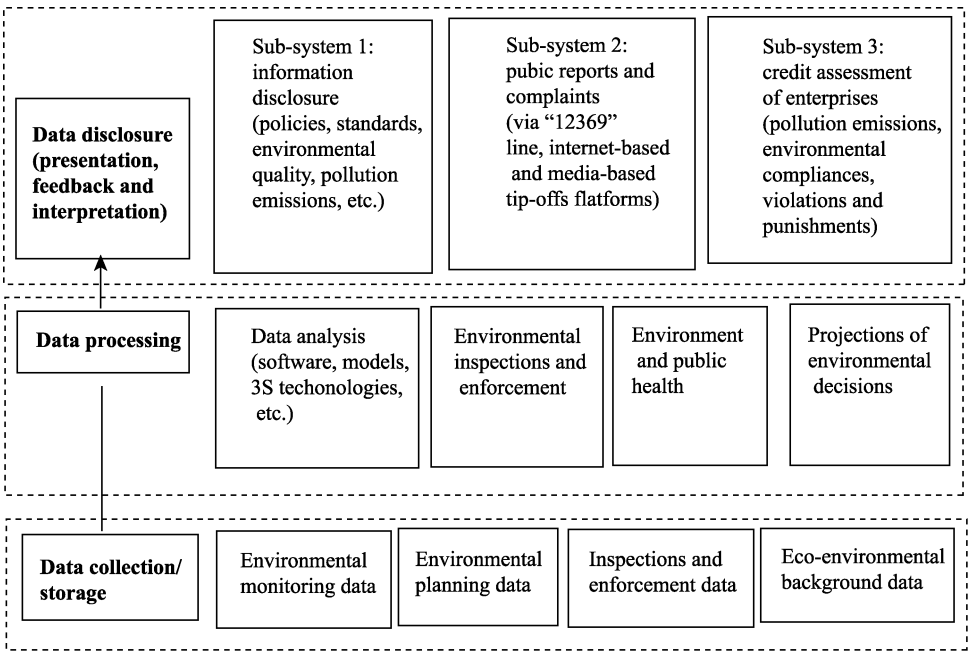

Fig. 2 Structure of China's Ecological and Environmental Big Data Platform

Source: summarized by authors

[38] National Development and Reform Commission, 十二五国家政务信息化工程建设规划 (*The 12th Five-Year Planning of National Governmental Affairs Informatization Projects*), available at http://www.gov.cn/gzdt/2012-05/16/content_2138308.htm (last visited Mar. 1, 2017).

[39] ZHANG Li, 环保信息化 2015 发展目标：整合·共享·畅通 (*Environmental Informatization Targets 2015: Integration, Sharing and Exchanging*), available at http://www.goootech.com/topics/72010375/detail-10247091.html (last visited Dec. 6, 2016).

[40] Ministry of Environmental Protection, 生态环境大数据建设总体方案 (*Ecological and Environmental Big Data Development Overall Plan*), available at http://www.zhb.gov.cn/gkml/hbb/bgt/201603/t20160311_332712.htm (last visited Mar. 1, 2017).

At local levels, efforts were made to build local environmental data centers. To date, nearly two thirds of the provinces have constructed their data centers or are in the process. Some cities have even started to integrate environmental data with data from transportation, energy, agriculture, meteorology sectors, etc.[41]

WE-media (information technology-based, self-created media) are reshaping the landscape of environmental information disclosure as well. By June 2016, there were 710 million Chinese netizens, of whom 176 million used online services provided by governmental agencies, including official WeChat account services, official websites, Weibo, etc.[42] With increasing numbers of users (active users reached 761 million in March 2016), WeChat is taking over blogs and Weibo to become a new instrument for environmental information disclosure and supervision. For instance, WeChat-based "12369 environmental protection tip-offs" platform received more than 20,000 reports within less than one year since its operation began on June 5, 2015.[43] In addition, varied WeChat-based public accounts that are devoted to environmental issues are mushrooming, covering topics ranging from air, water, soil, VOCs, policies, news, the environment and health, sustainable consumption, etc. Despite this, challenges remain regarding improving accessibility, reliability, and integration of environmental information. This is not primarily a technical issue of better digital information systems, or better and more widespread monitoring programs. Rather, challenges are first and foremost related to breaking down the political, social, and institutional barriers that hinder environmental information disclosure, and furthering the debate on quality and verification of environmental information.

New types of operations/businesses are emerging to meet varied demands. For instance, the U-Air project between IBM and the MEP helps forecast air quality in 48 hours for seventy cities.[44] China Sciences MapUniverse Technology Co., Ltd (MAPUNI) formed five industrial groups in smart map, smart environmental protection, smart water conservancy, public services and environmental governance, and established the Institute of Resources and Environment Science (IRES) and the Institute of Big Map.[45] The Beijing DigiShare Environmental Technology Institute is one of the first

[41] XU Lili, 以信息化推进环境管理转型 (*Environmental Management Transformation through Informatization*), available at http://www.qstheory.cn/zhuanqu/bkjx/2015-12/31/c_1117634645.htm (last visited Dec. 6, 2016).

[42] China Internet Network Information Center (CNNIC), 2016 年第 38 次中国互联网络发展状况统计报告 (*The 38th China Internet Network Development Report*), available at http://www.199it.com/archives/502934.html (last visited Dec. 6, 2016).

[43] 12369 环保举报微信公众号运行近一年办结 2 万余件 (*Nearly One Year Operation of 12369 Environmental Protection Tip-Offs, 20,000 Plus Complaints Processed*), 人民日报 (*People's Daily*), Apr. 16, 2016, available at http://news.xinhuanet.com/legal/2016-04/16/c_128900578.htm (last visited Dec. 6, 2016).

[44] XU Lili, 环境大数据应用"含苞待放"? (*Environmental Big Data Application Emerged?*), available at http://news.cenews.com.cn/html/2015-07/20/content_31409.htm (last visited Mar. 1, 2017).

[45] 中科宇图科技股份有限公司 (*China Sciences MapUniverse Technology Co., Ltd*), available at http://sp7330764.zjbiz.net/ (last visited Mar. 1, 2017).

providers of environmental economics databases, covering energy and environment related data at national, provincial, prefectural and county (city) levels, and providing consultancy on assessment, planning and analysis of energy and environmental issues.[46] The Alibaba Group Research Center focuses on consumption and macro-economy research based on its big data from retailers, picturing sustainable consumption patterns of Chinese consumers. Its *Chinese Green Consumers Report 2016* by Alibaba Group (2016) using its big data shows steady and rapid increase of green consumers (65 million by the end of 2015, 16% of the active online buyers), who spent on energy saving, environmental friendly or health products.[47] The Beijing Institute of Big Data Research is a more recent joint effort by Peking University, Beijing University of Technology, Administrative Committee of Zhongguancun Science Park and the Haidian District Government under the supervision of the municipal government of Beijing. Its mission is to create a world class research and education program that can serve both as the model for developing data science in China and as a platform for nurturing new enterprises in big data, including environmental big data.[48]

While these ambitions and progress are encouraging, difficulties and resistance should not be underestimated. Two parallel trends have been observed pertaining to accessibility to data: On the one hand, more environmental data was indeed made public. For instance, since 2014, under public pressure, environmental agencies started to report the air pollution index, from daily to hourly reports, and also shared it with other governmental organizations, such as the public health, education, and transportation entities. On the other hand, there was still a lot of other data controlled by different agencies that was crucial for scientific research and decision-making, but not open for sharing, such as emission data from movable sources.[49] This was partly the consequence of growing constraints on public-data exploration and sharing, because they were considered politically sensitive. Data fabrication by enterprises, environmental agencies and local governments are common, impinging on the quality and reliability of environmental data. When 95% of the equipment for simple gasoline-fuelled vehicles detection failed to obtain the metrology approval certification that is required according to Air Pollution Prevention and Control Law, vehicle emission data are highly unreliable, eroding the base for precise air pollution control.[50]

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[46] 北京数汇通环境技术研究院 (*Beijing DigiShare Environmental Technology Institute*), available at http://www.yjbys.com/gaoxiao/85708.html (last visited Mar. 1, 2017).

[47] Ali Research, 2016 年度中国绿色消费者报告 (*China Green Consumers Report 2016*), available at http://www.aliresearch.com/blog/article/detail/id/21025.html (last visited Dec. 6, 2016).

[48] 北京大数据研究院 (Beijing Institute of Big Data Research), available at http://www.bibdr.org/ (last visited Mar. 1, 2017).

[49] WAN Zheng, *China's Scientific Progress Hinges on Access to Data*, 520 Nature, 587 (2015).

[50] 检测不准 专家称假数据泛滥致大气污染治理失去支撑 (*Fabrication of Monitoring Data Made Air Pollution Control Baseless*), available at http://money.163.com/16/1030/18/C4L7E1GM002580S6.html (last visited Dec. 6, 2016).

Environmental information disclosure and informatization are mutually adaptive to each other. China is catching up in terms of hardware and software for informatization, which enables those interested in environmental information disclosure to participate in the process. However, effective informational environmental governance can only be achieved based on quality data, smart application, and equal access, which calls for development of environmental informatics, monitoring techniques and networks, institutional reforms, and last but not least rule of law.

CONCLUSION

In retrospect, environmental information disclosure has changed from mere rhetoric to an indispensable element in the current environmental governance mode of China and is gaining further momentum in the post-EPL 2014 era. Conclusions on China as an informational periphery in global environmental governance needs to be updated, yet there are plenty of challenges ahead.

Disclosure of environmental data/information can be a powerful instrument to empower the public and impose pressure on both regulators and regulatees. China's future environmental improvement must be based on precise management at all levels. Governments at all levels are currently busy preparing their 13th Five-Year Planning, in which green growth is an important theme. Ongoing reforms are trying to remove institutional barriers and move in the direction of more effective environmental governance. Both polluting industries and governmental organizations are under increasing pressure to properly enforce policy and be accountable. Recent work to remove air quality monitoring stations from local government control is a positive move to ensure the quality of monitoring data. The plan is to separate all 1,436 monitoring stations nationwide from provincial, city, and county bureaus and place them under the operation of companies that will report directly to the central government. This independent monitoring network will be expanded to cover water and soil by 2018.[51]

Strategic promotion and support from the Chinese government and increasing investments in networking and cyber infrastructure have turned China into an "information complex environment." It is important to understand information disclosure as a double-edged sword. As posited by Beierle normative, substantive, and instrumental benefits of disclosure as well as collection and reporting costs, the costs of public reaction, and the risk of unintended use should be strategically considered. Principles and guidelines need to be developed to avoid pitfalls while maximizing benefits.[52] Studies on China's environmental information disclosure should go beyond only conceptual

[51] ZHENG Jinran & MA Lie, *Air Monitor Stations Growing Independent*, *China Daily*, available at http://www.chinadaily.com.cn/cndy/2016-10/26/content_27173251.htm (last visited Dec. 6, 2016).

[52] Thomas C. Beierle, *The Benefits and Costs of Environmental Information Disclosure: What Do We Know about Right-to-Know?*, RFF Discussion Paper 03-05, Resources for the Future (Washington, D.C.) (2003).

discussions and pay more attention to operationalization of principles through the whole process of information disclosure. Evaluative tools need to be developed to assess the quality of information, their application/dissemination/"targeted transparency" effectiveness, cost and benefits, and identification of actual information needs, etc. Last but not least, environmental information science needs to be developed and integrated into education programs on environmental sustainability.