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E-participation for environmental sustainability in transitional urban China

Guizhen He¹ · Ingrid Boas² · Arthur P. J. Mol² · Yonglong Lu¹

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Abstract Using information and communication technologies (ICTs), e-participation is a tool that promotes the inclusion of the public in participative and deliberative decision-making processes, thus contributing to a transformation of the interaction between government and citizens in environmental governance and sustainable development. In a number of Chinese cities, citizens increasingly draw on ICTs to promote environmental sustainability and to encourage community-based actions aimed to address various environmental concerns. The potential success of e-participation and the role of ICTs in China has, however, not been well explored. The objective of this study is to understand the role that ICTs can play in promoting public participation about environmental sustainability issues in urban China. Based on an online survey with 630 respondents, the study aims to: (1) analyze what public motivations, perception/attitudes and actions drive environmental e-participation; (2) identify barriers to e-participation, and (3) assess the different applications and functions of ICT for citizen participation in environmental sustainability. The analysis illustrates how ICTs have helped the public to obtain sensitive information about sustainability issues, to mobilize people and to gain media coverage for their actions. The central finding is that new technologies have taken citizen engagement to new heights

online. More specifically, the age of ICTs has unleashed a stronger public voice on environmental governance and sustainability issues in urban China, which does not go unnoticed by the Chinese state authorities.

Keywords Information and communication technologies · Environmental movement · E-participation · Sustainable development · China

Introduction

The active use of ICTs and the Internet has given rise to a new form of public participation, called e-participation. E-participation promotes the inclusion of a wider group of stakeholders in participative and deliberative decision-making processes, thus contributing to a transformation of the interaction between politics and citizens (Bohman 2014; Macintosh and Tambouris 2009; Panopoulou et al. 2014; UN 2007). ICT enables a wide range of users to access, store, transfer, manage and disseminate huge amounts of information, and has the potential to reach a large audience given that globally over 3.2 billion people are using the Internet, of which 2 billion from developing countries (ITU 2015). ICT is, thus, seen as an enabling engine for achieving sustainable development by creating new forms of public engagement (Bond et al. 2012; Chiabai et al. 2013). Despite these positive participatory dimensions, the wider influence of ICT on sustainable development is still not well understood and strongly disputed (Berkhout and Hertin 2001). For instance, some societal groups (e.g., young people) are better represented via e-participation than those less digitally savvy, creating new socio-political inequalities and democratic deficits.

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✉ Guizhen He
gzhe@rcees.ac.cn

¹ State Key Laboratory of Urban and Regional Ecology, Research Centre for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, China

² Environmental Policy Group, Wageningen University, Hollandseweg 1, 6706 KN Wageningen, The Netherlands

China is sometimes called a society in transition, in which public (environmental) activism is emerging and the relationship among various public and private stakeholders is increasingly tense (Jing 2000; Johnson 2010; He et al. 2012a, b; van Rooij 2010). For example, a number of public protests have taken place against proposed projects such as the Panyu waste incineration plant in 2009, and the toxic chemical paraxylene (PX) plants in Xiamen, Ningbo, and Dalian from 2007 to 2014 (He et al. 2011, 2013a, 2014, 2015, 2016; Li et al. 2012; Thibaut 2011; Wu 2013). In these protests, citizens actively relied on ICTs—such as texting and social media—to raise concerns and to organize themselves. To ensure China's sustainability and to enhance levels of democracy and transparency, public participation with respect to the environmental consequences of economic development should be a necessary part of decision-making and policy formation (Carter and Mol 2007; Mol and Carter 2006). Interestingly, China is taking steps to make better use of public participation in its environmental decision-making. Since 2002, China's environmental authorities have promulgated the Environmental Impact Assessment (EIA) Law that requests more public participation in the EIA processes. The new Environmental Protection Law enacted on January 1, 2015 also contains an extensive chapter on environmental information transparency and public participatory rules (He et al. 2013b; Zhang et al. 2016). Despite these developments, however, there are still restrictions on public participation in China such as arbitrary licensing of NGOs and strict Internet censorship policy (Moore and Warren 2006; Yang 2011). A law on Administration of Foreign NGOs Activities within China was issued on April 28, 2016 and will be enacted on January 1, 2017. Activists worry that these new regulations could severely restrict NGO activities and cause a large number of organizations to withdraw from China. Also the obstruction of Google, Facebook and other internationally important instruments of e-participation resulted in limited public participation because of the extensive internet censorship implemented by the Chinese government (Feng and Guo 2013). The United Nations has been surveying its member countries to measure the degree of e-participation using E-participation Index that consists of indices for e-information sharing, e-consultation, and e-decision making. In 2014, the E-Participation Index of China was 0.6471 and ranked 33 out of 192 countries (United Nations 2014).

Not unlike other industrialized countries, the most recent trend in Chinese environmental governance is that citizens—in particular those living in cities—use e-participation tools as opposed to traditional forms of offline public participation to promote environmental actions and to encourage community-based actions (He et al. 2016; Li

et al. 2016; Yang and Calhoun 2007). Chinese citizens are using ICTs to raise awareness of, and to act on, problems of environmental sustainability (e.g., mobile phone, micro-blog in Xiamen chemical plant event). However, the potential of e-participation in China has not yet been well explored. This paper reflects on the role of ICT in increasing public awareness and participation in the promotion of environmental sustainability in urban China. In this context, the specific objectives of this paper are: (1) understanding the public motivations, perceptions/attitudes and actions in environmental e-participation; (2) identifying barriers to e-participation; and (3) assessing the different applications and functions of ICT for citizen participation in environmental sustainability. In order to achieve these goals, we have conducted an exploratory social survey in Beijing with 630 respondents, focusing on the role of ICT in public participation in the realm of environmental sustainability.

The remainder of the article is structured as follows: The next section reviews existing research on e-participation. The methodology is described in Sect. 3. Then, Sect. 4 is devoted to the analysis of survey results. Section 5 provides a discussion of the results in relation to the key objectives of this study. Finally, we conclude in Sect. 6.

E-participation and ICT use

The OECD (2003: 55) defines e-participation as “ICT-supported participation in processes involved in government and policy-making”. It is seen as “the extension and transformation of participation in societal democratic and consultative processes mediated by ICT, primarily the Internet” (Sæbø et al. 2008: 402). Ideally, e-participation involves technology-mediated interaction between civil society on the one hand and formal politics, and the public administration, on the other. E-participation is hence closely related to e-government and e-governance participation. A fully functional e-government website should include, for instance, an e-participation framework which offers online information on government policies and programs, budgets, laws and regulations, e-consultation mechanisms and tools, and e-decision making (Gil-Garcia and Martinez-Moyano 2007). The advent of ICT allows for citizens to gather information, hold consultations, vote online and as such express their political opinion. It aims to support active citizenship with the latest technology developments, increasing access to information and availability of participation in order to promote fair and efficient society and government (Medaglia 2012). E-participation has been implemented in different countries as part of e-Governance and e-Democracy for policy-relevant issues, such as communicating information on legal issues, trying

to actively engage citizens in politics, and attempting to raise awareness of specific concerns such as sustainability, post-disaster recovery, food production and consumption, renewable energy planning, sustainable energy, flood risk management, and climate change adaptation (Barrios-O'Neill and Schuitema 2016; Bojovic et al. 2015; Cheng et al. 2015; Danielle and Geertje 2016; Gary et al. 2008; Higgs et al. 2008; Schäfer 2012; Wehn and Evers 2015; Wehn et al. 2015).

Studies clearly have shown that there is a connection between the development of ICT and e-participation (Jho and Song 2015). Now, a whole range of ICTs have the potential to serve e-participation purposes, e.g., from eVoting, data mining, the semantic web, geographic information systems (GIS) and other visualization technology, and virtual meeting places (such as chat rooms and online fora) (Wehn and Evers 2015). In the early 2000s, only a few countries had begun to experiment with online tools to engage citizens actively in policy-making. In a handbook, the Organization for Economic Co-operation and Development (OECD 2001) listed a number of technologies in three broad categories: tools for information, tools for consultation, and tools for active engagement or participation in policy-making. Among the suggested tools, we find several that have become common today including websites, portals, e-mail, web fora, online chats, surveys, games, and virtual workspaces (Brossard and Scheufele 2013; Fløttum et al. 2014; Usikov 2013). Fraser et al. (2006) list 25 e-participation tool categories divided in three clusters: core tools, tools extensively used in, but not specific to, e-participation and basic support tools. Tambouris et al. (2007) carried out an e-participation tools assessment, identifying 17 technologies and 17 tools. In their review of the e-participation field a dozen technologies were identified by Sanford and Rose (2007). Ten technologies that underpin e-participation include online forums, geographic information systems, blogs, semantic web, ontologies, data mining, security and encryption algorithms, digital signatures, automated textual analysis, and computer supported visualization.

Despite these technological developments enabling e-participation, the role of ICT in public participation remains controversial. On the one hand, many criticize the view that ICT has strong potential for increasing participation by citizens (Lunat 2008; Salter 2004). Internet and media have been identified as having a prominent influence in shaping people's perception, framing issues, affecting public behavior in potentially misleading ways (Barrios-O'Neill and Schuitema 2016; Cheng et al. 2015; Susa and Grönlund 2012; Wehn and Evers 2015). Instead of enhancing participation and levels of democracy, the digitalization of environmental governance and beyond risks

adding to a 'society of control' in which surveillance is spreading into daily lives in fluid and heterogeneous ways (Bauman and Lyon 2013). States often use data technologies to their own benefit, to monitor and mitigate risks by surveilling their populations and by attempting to exclude abnormalities to reaffirm and maintain the societal order (Bigo 2002; Smith 2016). Furthermore, fundamental concerns relate to access to technology and individuals' skills in using it. The gap between individuals that benefit from the digital technology and those who do not is known as the digital divide, emphasizing inequalities in Internet access (Castells 2001; Murdoc and Golding 1989). Citizens that are less digitally and technologically savvy, such as the elderly or those who cannot afford a smart phone, may lose out and actually risk becoming less well represented in decision-making processes.

On the other hand, literature also points to several opportunities related to the role of ICTs in stimulating public participation. ICT attracts new participation by citizens who are not represented in the current political system (Jho 2009; Coleman et al. 2008). Fraser and Dutta (2008) claim that social network services expand the scope of political participation and establish both cooperative and interactive networks, shifting from an elite democracy to a participatory democracy. Overall, the main advantages of the Internet for participation can be summarized in four main points: (1) improving access to information; (2) facilitating engagement in (protest) action; (3) encouraging wider participation through online platforms and social media networks; and (4) facilitating activism at a global scale and complementing the social repertoire of collective action (Anduiza et al. 2010; Norris 2001; Vicente and Novo 2014). In particular, the widespread use of the Internet has opened up great possibilities for public participation that were not possible before by facilitating a "self-mass communication system" (Castells 2009, 2012).

Most defendants of ICT-based public participation systems stress that these should not replace current participatory practices; rather, ICT should be seen as a way to enhance participatory practices as it creates opportunities for more people to participate (Kingston 2002). Several studies claim that there is a connection between e-participation and offline participation and that strengthening e-participation will increase offline participation over the long-term (Perri 2004; Clift 2004; OECD 2003). Research for instance points to similar types of reasons explaining both offline and online participation: (1) individual resources and socioeconomic characteristics (i.e., age, gender, education level, income, and employment status, among others); (2) personal/political views and attitudes; (3) group resources (i.e., networks of friends and colleagues); and (4) the institutional and political environments (Vicente and Novo 2014).

However, compared to offline participation, e-participation can not only be explained by examining traditional participation-related variables/resources (i.e., socio-economic characteristics). It has to take into account digital skills, social networks and the online development of public administrations (Anduiza et al. 2010; Dutton and Blank 2011; Hansen and Reinau 2006; Jho and Song 2015; Krueger 2002; McCarthy and Zald 1977; Smith 2013; Vicente and Novo 2014). Several authors have highlighted the fact that some specific resources are required for citizens to participate online (Effing et al. 2011; Kling 1999; Van Deursen and Van Dijk 2009). The complexity of e-participation processes results from several aspects, including the large number of different participation areas, involved stakeholders, levels of engagement, and stages in policy making (Fraser et al. 2006; Siau and Long 2009). In a government-to-consumer context, various studies have found characteristics that affect attributes of e-participation, such as government organizational structure, quality of government website, technology, access to e-government, measurement and assessment of benefits infrastructure, informational policy, and intention to use e-participation (Bertot et al. 2012; Carter and Bélanger 2005; Nam et al. 2012; Sharma 2014; Zheng et al. 2014).

To sum up this discussion, while substantive research progress is being made in understanding e-participation, a number of questions are left unaddressed (Medaglia 2012; Sanford and Rose 2007; Sæbø et al. 2008)—including how big of an impact e-participation actually has on society: Which groups of citizens actually participate online? What do these citizens aim to achieve? Do they have an influence on policy-making and what is the most effective ICT tool to gain such influence?

Over the last two decades, China has seen the advent and growth of public participation in sustainable development. More specifically, a stronger public voice in China has been propelled by independent NGOs, such as Friends of Nature, the first officially recognized NGO in 1994 (Ho 2001; Mol and Carter 2006). Influential cases in which NGOs have been involved include efforts protecting the Tibetan antelope, campaigns to oppose hydropower station construction on the Nu River and a public hearing on a controversial project to place an impermeable membrane on the bed of the Old Summer Palace lake in Beijing in 2005 (Wang 2006). Initially, most environmental campaigns were largely based on face-to-face communication and relatively less on computer-mediated communication, and their success was highly dependent on the role of heroic individuals fighting for a good cause. Whilst emails and webpages were also used in the above mentioned campaigns to disseminate information, the role of ICTs was still much smaller in terms of scale, especially when it involves organizing public protests. Accompanying an

explosive growth in Internet infrastructure and access, the number of Chinese Internet users exploded from 620 thousand to 688 million in the period 1997–2015 (CINIC 2016).

This emerging digital society and access to new digital technologies has advanced citizen engagement in environmental issues. There has been growing online participation on environmental topics, especially in urban centers (Li et al. 2012; Wang et al. 2012). The “walking” protest against a PX chemical plant in Xiamen, a city in south China, in 2007 is perhaps the most famous example. The public organized itself via internet forums and mobile phones (Hung 2013), marking the dawn of a new participation mode among the wider public. In the context of China, we use e-participation as a hybrid concept, referring to citizens’ spontaneous activities on the Internet aimed at voicing and influencing government decision-making, while also pointing to a set of online and offline institutional structures that have been established by government organs or semiofficial agencies, e.g., the state-owned news media, in order to accommodate citizens’ spontaneous activities on the Internet (Ming 2012). At the same time, the Chinese government takes e-participation very seriously and seeks ways to contain and control it so that it would not endanger governmental authority. The central government has placed a stiff control on the Internet since it was first introduced in early 1990s (Paltemaa and Vuori 2009). There has been constant tension among Chinese government’s censorship measures, the roles of foreign Internet technology companies (such as Yahoo and Google), and the rights of ever-increasing Chinese Internet users (Feng and Guo 2013; Yang 2011). In early 2010, Google decided to stop censoring its online Chinese-language search engine service and redirected its users to its Hong-Kong site. However, fast economic growth in the past decades has fostered a growing segment of citizens that are getting more conscious of their own civil rights. A survey by the Global Communication Association, in collaboration with two local Chinese websites, reported that 94 % of survey participants ($N = 1702$) were aware that information available to Chinese is censored and government is implementing censorship or filtering software to better control its citizens to access true and accurate information (Chinascope 2007).

Given these complexities, China seems an intriguing case to study the role of ICTs and its relation to questions of governance and democracy. Nonetheless, only few detailed studies have delved into this. Our analysis adds to this debate by examining e-participation in China’s urban environmental governance, with a focus on three key questions: First of all, by assessing motivations and perceptions, we will examine whether e-participation stimulates a more active relationship between civil society and

governmental environmental decision-making in the Chinese context, or whether e-participation only remains a tool of self-organization of the public: e.g., to organize protests, to mobilize others, and to raise awareness of environmental sustainability?

Secondly, our study will focus on not only the constraints but also the potential of e-participation in the Chinese context. The success of e-participation depends on whether or not the government will take public voices seriously, and enable rather than restrict them. China has invested in online government facilities and various types of environmental data have been made publicly available online (Mol 2008, 2009). Thus whilst such ‘democratic innovations’ (Smith 2009) face serious constraints (e.g., through Internet restrictions), there are also opportunities for greater usage of e-participation in China; at least in urban settings with a high concentration of environmental NGOs, universities, and high national and international political visibility, providing a more stimulating environment for public environmental participation.

Thirdly, the analysis will assess the potential, role and popularity of e-participation in environmental sustainability governance in the Chinese urban context. How often is e-participation used compared to offline participation; for what reasons do Chinese citizens want to engage in e-participation in the field of environmental sustainability; and what ICTs do they apply for these purposes? This will help to shed light on new developments in environmental governance in transitional urban China.

Research methodology

Data collection

To examine the role of e-participation in urban China on environmental sustainability, our exploratory study combines multiple methods—we triangulated data collection by organizing an online survey of 630 online questionnaires in November and December 2015 conducted in Beijing, and by conducting media data analysis of 12 public protest examples in 2011–2014 that took place in several cities within China. Combining multiple methods provided an opportunity to gain more insight into e-participation features, motivations, ICTs applications, and impact factors. Moreover, literature review and government websites were used for related information collection.

We used a web-based platform developed by GR Survey Company to support and manage our online questionnaire survey. The Website of GR Survey Company has about 2 million registered online members. It sends mailings to its members and invites them to attend the online survey. Because of the Web-based survey platform, our study

excludes people who have no access to the Internet and only people interested in the survey and questions are included in the survey. This has certain limitations, as our analysis will for instance not identify barriers to e-participation identified by those with limited access to ICTs. The survey and subsequent analysis will, instead, focus on the role of e-participation in environmental sustainability governance amongst those citizens already engaging or experimenting with ICTs and e-participation tools. This provides insight into the potential usage, constraints and benefits of e-participation in urban China, which can in turn inform efforts by the Chinese government or by civil society to further embed and promote e-participation among a wider community.

Conducting an online survey enabled the collection of a large number of responses in a short period of time with limited efforts. The survey on individual e-participation and ICTs usage was conducted in Beijing. Beijing is leading among 31 provinces/municipalities/autonomous regions in mainland China with respect to Internet use: 76.5 % of the city’s population uses Internet. Several important public environmental protests were reported in Beijing, such as those concerning the 2012–2014 Jingshen high-speed railway, the 2007 Beijing Liulitun waste incineration power plant, and the 2005 coating Lakebed of Old Summer Palace. Many citizens have knowledge of and experiences with public participation, both online and offline. Thus, whilst Beijing may not represent widespread trends of e-participation in China, it does act as a role model case when e-participation on environmental controversies is concerned, given the high percentage of Internet access and citizen engagement. Analyzing the case of Beijing can, thus, help to signal emerging trends and developments that could also come about in other creative, well-connected and innovative spaces in China, such as in other urban centers. The questionnaire consisted of 32 questions divided over 4 sections: demographics; motivation for and perception on participation in environmental movements (e.g., concerns and reasons); online participation action and behavior; and perceived functions and impacts of different ICTs for e-participation. Two pre-tests were conducted before data collection, leading to refinements in the questionnaire. The first was done with colleagues and two professional investigators to check the understandability and logical flow of questions. A revised questionnaire was pre-tested by the authors with six citizens living in the study area.

The survey was conducted between December 1st and 30th, 2015. The staff of GR Survey Company sent e-mails to its randomly chosen online members in Beijing about the survey. Potential respondents were welcomed to access and answer the online questionnaire. A questionnaire providing complete answers to all questions was regarded

qualified. According to statistics, approximately 10.2 million people between 16–65 years of age live in the selected six districts in Beijing (Beijing Statistical Bureau, 2015). Around 76.5 % of them will have access to Internet. With a survey of 700 individuals our sample reached about 0.01 % of the Internet users in that age group, striking a compromise between limited available resources and the need to collect a representative sample from the six districts. However, our final valid sample for analysis consisted of 630 (90 %) individuals due to the absence of some socioeconomic background variables. Responses were collected in Microsoft Excel to generate descriptive statistics to inform the analysis. Qualitative and open-ended responses were coded and post-coded to summarize the data.

Data analysis

SPSS 17.0 was used for statistical analysis of the survey data. Table 1 shows the social and demographic information of the respondents. Based on existing studies, we defined independent variables (gender, age, employment, education, and income) and dependent variables (ICT roles and functions). Descriptive statistics and correlation analysis were applied to analyze how perceptions of and attitudes towards e-participation, as well as the applications and functions of ICT in e-participation, were associated with independent variables. There was a small bias in our sample towards certain categories such as age, education, NGO membership. According to Beijing census data in

2010, the number of people with education at primary/middle school, high school, and university and over is 43.1, 22.1, and 32.8 %, respectively. The people at the age of 15–19, 20–29, 30–39, 40–49, and 50–64 are 3.5, 25.2, 20.1, 17.4, and 16.6 %, respectively. Based on the statistical data of Beijing Bureau of Civil Affairs (2015), there are 9721 NGOs, of which 85 are the environmental NGOs. NGO's workers account for about 1 % of urban employees in Beijing. NGO members' percentage is much less than found in our survey. Based on the CINIC data (2016), national Internet use among middle/high school and university education levels is 86.2 %. The Internet users are mainly young people between 10 and 39 years old (85.1 %). A possible explanation for the small bias is that NGO members, younger people and those with higher education level are more active on the Internet, and thus more likely to take part in the online survey.

Results

Motivation to participate

We measured motivation to participate by asking two questions: (1) self-reported levels of concern about environmental sustainability issues; (2) the primary reason(s) for participating in public environmental actions.

Our survey asked respondents to rank their concerns of environmental sustainability issues, using a Likert scale (1–5 with 1 being not at all concerned and 5 being very

Table 1 Social and demographic background of the respondents ($n = 630$)

Item	Sub-group	Percent	CINIC statistics ^a	Item	Sub-group	Percent	CINIC statistics
Gender	Male	55.2	53.6	Education	Middle school and below	3.8	37.4
	Female	44.8	46.4		High school	16.8	29.2
Party member	Yes	33.3			University	72.2	19.6
	No	66.7			Graduate school	7.2	
NGOs member	Yes	31.4		Age	15–19	7.5	11.4
	No	68.6			20–29	53.3	29.9
Religion	Yes	23.7			30–39	30.2	23.8
	No	76.3			40–49	6.7	13.1
Monthly income per person (Yuan)	<2000	12.7	34.3		50–64	2.3	8.2
	2001–3000	26.7	18.4	Employment	Government	9.7	5.3
	3001–5000	23.0	23.4		Enterprise	35.9	24.9
	5001–8000	17.1	10.3		Self-employed	24.4	22.1
	8001–10,000	10.2	6.2		Institute and university	17.4	26.2
	10,001–15,000	5.7	NA		Media and IT	8.9	NA
	>15,000	4.6	NA		Agriculture and retirement	3.6	9.8

^a Data sources China's Internet Network Information Center (CINIC). The 37th Statistical Report on Internet Development in China (January 2016). Available at <http://www.cnnic.cn/hlwfzj/hlwxbzg/>

Fig. 1 Self-reported levels of concern for environmental sustainability issues in China ($n = 630$). Respondent score ranged from 1 (indicating “not at all concerned”) to 5 (indicating “high concern”)

concerned). Our selection of variables followed the Sustainable Development Goals of the 2030 Agenda for Sustainable Development adopted by the UN in 2015, although we modified our variable list to better represent the Beijing environmental context. Our variable list included 10 environmental items drawn from the 17 sustainable development goals (Fig. 1). Respondents were most concerned about clean water and sanitation (mean 4.9), good health and wellbeing (4.7), and land use (sustainably managing forests, combating desertification, halting and reversing land degradation, halting biodiversity loss) (4.6). People were least concerned with climate change, life under water (conserving and sustainably using the oceans, seas and marine resources), and sustainable consumption and production.

For the reasons to participate, respondents could select between nine options: personal reasons (such as defending personal benefits, being affected by the event), professional reasons, concern for the environment, exercise right endowed by law, educational opportunity, meet new people and build new social networks, concern about social justice, and opportunity to spend time on public affairs. Survey respondents reported three primary reasons for participation: personal (61 %), concern for the environment (54 %), and opportunity to spend time on public affairs (46 %).

Public perceptions and attitudes towards e-participation

About 48 % of the respondents knew or heard about the concept of environmental e-participation in the past. Pearson correlation analyses indicate that younger respondents ($p < 0.001$), and respondents with higher levels of education ($p < 0.05$) and higher income

($p < 0.001$) had significantly more knowledge of e-participation.

Public perceptions and attitudes on environmental e-participation were investigated using 15 statements, divided into four categories: (1) public assessment and satisfaction of the current state of e-participation in Beijing; (2) the effect of governmental regulation and control on e-participation; (3) information supply and access by using ICTs; and (4) how well ICTs support public e-participation. Reworking a 5-point Likert scale into three scales (combining strongly agree and agree, strongly disagree and disagree), 36–73 % of respondents agreed on all statements (Fig. 2).

Over 66 and 48 % of the respondents (strongly) agreed that e-participation and public offline participation played an important role in environmental sustainability, respectively. The statement about high level of e-participation in China got the lowest level of agreement (36 %). NGOs members and respondents with higher level of education ($p < 0.01$) had significantly more positive attitudes towards the role of public e-participation for the environmental sustainability.

Only 36 % respondents were satisfied with the official attitude towards environmental e-participation. Though governmental laws and regulations were perceived to have an important effect on e-participation (nearly 60 % respondents), many respondents still had concern over governmental control on public e-participation (about 42 %) and media/information disclosure (50 %). Respondents with higher levels of education ($p < 0.05$), higher income ($p < 0.01$), and NGOs membership ($p < 0.01$) had significant concerns over governmental control on media/information and public e-participation.

Though some efforts have been made by the Chinese government to improve information disclosure, these still

Fig. 2 Respondents perceptions on and attitudes towards public e-participation for environmental sustainability issues ($n = 630$)

do not live up to the expectations of the public. Most respondents (71 %) consider information disclosure as an important driver of public environmental e-participation. Less than half of the respondents were satisfied with the current information openness including information availability (44 %), quantity (45 %), and accessibility (49 %). Pearson correlation analyses showed that higher levels of education ($p < 0.001$) and NGOs members ($p < 0.01$) had significant negative effect on the respondent's perception on information transparency.

Most respondents had positive perceptions and attitudes regarding the role of ICT and new media for public participation. Over 73 % respondents agreed that new media played important roles in public e-participation. Here new media refers to the Internet, accessible on any digital device, usually containing interactive user feedback and enabling creative participation. Common examples of new media include websites, blogs, and social media. The hardware development (computer itself and support equipment including input and output devices, storage devices and communications devices) could also facilitate e-participation (69 %). The digital skill levels of the respondents also played a major role in promoting public e-participation (about 67 %). Nearly 65 % respondents are optimistic about the role of ICTs for public participation in the future. Pearson correlations analyses showed that the male and better educated respondents had more positive attitudes towards the role of new media for public participation ($p < 0.01$). Younger people ($p < 0.05$), respondents with higher levels of education ($p < 0.01$), and NGOs members ($p < 0.05$) had more positive attitudes

towards the role of hardware development and ICT on e-participation in the future.

Online participation behaviors and actions

Out of all valid respondents, 585 individuals (85 %) reported having used the internet last month and, therefore, are thus considered Internet users in this survey. Individuals classified as Internet users were asked about their engagement in social and environmental participation on the internet. In particular, they were asked whether they had given opinions about social and environmental issues through the Internet and whether they had signed online petitions or taken part in online public consultations and actions. Among them, 23.2 % had given opinions about social and environmental issues, 13.2 % had signed online petitions or taken part in online public consultations, and 5.6 % had participated in both ways. Pearson correlations analyses indicated that younger people ($p < 0.05$), respondents with higher levels of education ($p < 0.01$) and income ($p < 0.05$) were more likely to be active in online activities. Also media and IT staff were more active than respondents from other professions ($p < 0.05$). Respondents that participated in NGOs and social organizations were more likely to give opinions about social and political issues ($p < 0.05$). Gender, nationality, and places where they live in the city showed no significant differences in online participation of the respondents.

With the development of ICT, the public is becoming more active in online participation activities. The mean scores of online public participation activities indicated

that respondents conducted online activities between once in a few months and a few times per month. The general score of online public participation activities is more than that of offline public participation activities (Table 2). Respondents indicated to be most actively engaged in online discussion with family/friends/colleagues, followed by disclosing illegal activities regarding environmental sustainability, and sharing latest information and news. Requesting government authorities to pay attention to an environmental problem was the most mentioned offline public participation activity. Chi-square analyses showed a significant difference ($p < 0.05$) between the number of respondents participating in online and offline activities.

The results showed that there is quite a large group frequently e-participating in environmental sustainability. One possible bias is that there were more young Internet users, high-educated people and NGOs/associations/groups members taking part in our survey. The high percentage of citizens with frequent Internet access (76.5 %) also enabled high levels of e-participation on environmental sustainability. And online participation often involves less effort and time than offline participation.

The swift emergence of a global “information society” and the subsequent e-participation based on ICT has created new choices and opportunities in some of the most vital realms of environmental sustainability. We asked the respondents two questions in the survey: “Do you know any of these public environmental e-participation events?”

and “Did you participate in any public environmental e-participation events?” The results show that 11–44 and 2–10.7 % of the respondents knew and took part in any of these events, respectively (Fig. 3). The Liulitun waste incineration power project, the Jingshen high-speed railway, and the Xiamen PX chemical plant project are the most known public participation events in China. The first two examples took place in Beijing, and the third was amongst the most influential public participation events in China.

Due to its politically less sensitive nature, environmental issues are relatively often debated in the Chinese media, and by NGOs and the public. Online and offline media, and journalists covered the public environmental movement exhaustively, amongst others in the 12 examples of public environmental protests mentioned in Fig. 3 that all took place in Chinese cities. Using these 12 public environmental protests as key words in the Baidu search engine on May 20, 2016, more than 3.8 million records from online newspaper, videos, microblogs, BBS, fora, and social media could be displayed. It is noted that we can only use restricted data through the Chinese Baidu because the international popular search engine such as Google is not available in China. Internet restrictions in China clearly limit what citizens can achieve via social media; nonetheless, as discussed below, their online activities did successfully influence governmental decision-making.

Table 2 Online ($n = 585$) and offline ($n = 630$) public participation activities by the respondents

Questions	Range	Mean	SD
1. Online Public Participation Question: How often did you utilize the Internet, e.g., Homepage, Blog, BBS, Social network service (SNS) etc. to perform the following activities to support the environmental sustainability?	1–5, 1 = Never, 2 = once a few months, 3 = a few times per month, 4 = a few times per week, 5 = daily		
(1) Share latest information/news		2.01	1.20
(2) Discuss with family and friends		2.54	1.32
(3) Express opinion to environmental agencies		1.58	0.99
(4) Encourage others to engage in the events		1.52	0.94
(5) Promote and organize volunteer/protests		1.04	0.87
(6) Make donation online		1.25	0.78
(7) Disclose the illegal activities		2.31	1.43
2. Offline Public Participation Question: How often did you do following activities to support the environmental sustainability?	1–5, 1 = Never, 2 = once a few month, 3 = a few times per month, 4 = a few times per week, 5 = daily		
(1) Join volunteering/protest/demonstration		1.44	1.07
(2) Join charity activities		1.62	1.13
(3) Participate NGOs and social organizations		1.31	0.93
(4) Request government authorities to concern the problem		2.15	1.25
(5) Take part in discussion, debate, hearing, and negotiation with governmental authorities		1.75	1.22
(6) Participate in the environmental impact assessment		1.86	1.18

Fig. 3 Respondents' knowledge and e-participation of 12 major public environmental events in different cities, China ($n = 630$)

On June 1, 2007, thousands of Xiamen residents went to the streets for a “mass stroll” protesting against plans to build a PX chemical plant in the city. This protest was not led by environmental campaign groups, but was ‘organized’ by the public via internet forums and mobile phones. On 16 December 2007, the provincial and city governments partly gave into public opinion and relocated the project to Zhangzhou city. Xiamen PX marked the dawn of a new phenomenon among the wider public: the realization that it must act to counter environmental risks for which it can rely on ICTs. In this and other examples, Internet/web/online media were frequently used communication tools, including QQ (similar to Twitter in other countries), NGO or personal websites/webpages, Twitter, microblogs, virtual communities, and mobile phone text messages. Mostly, ICT is employed for data and information gathering, transforming, and communication about the projects’ environmental impacts, protesters organization, governmental actions, and public responses. In few cases, ICT facilitated the public to conduct online surveys and participate in the decision-making.

Many factors affect online participation in these environmental events (Fig. 4). ICT hardware convenience (22.5 %), legal and institutional conditions of using ICT (about 19 %), and the digital skills of citizens (about 17 %) were the most important factors promoting public e-participation. Other people’s involvement (5.8 %) and benefits to society (4.2 %) were considered least important.

Assessing roles and functions of ICT in e-participation

ICT can play various roles in environmental governance. According to our survey, nearly 26 % of the respondents thought ICT could play a big role when there are conflicts

Fig. 4 Factors affecting the respondents' online participation in environmental sustainability activities ($n = 630$)

of interests among different groups over the location of industrial or infrastructural projects, for example in cases of planning of waste incineration plants, large-scale chemical projects, or high-speed railways. Other applicable environmental issues are those of high risk requiring a large amount of information and expert knowledge such as in the case of nuclear power projects (22 %), major public health and safety issues such as haze governance (18 %), environmental conflicts and disputes across regions and watersheds (11.4 %), issues related to the long-term interests of a country and the entire public, such as the 13th Five-Year Environmental Plan of China, and finally professional issues such as environmental standard setting (11 %).

ICTs have a wide application at different levels of environmental public participation. In our survey, ICTs were considered to play a major role in activities at the organization/association level (31 %), national level (26 %), community/groups level (16 %), individual level (15 %), local level (9 %), and at the global level (3 %). Pearson correlation analyses indicated that the demographic characteristics (such as age, gender, education, income, and profession) of the respondents had no significant positive effects on the roles of ICT at different levels of public participation.

We invited respondents to rank the role of different information and communication media in environmental public participation. Eight media, including ICTs and printed newspapers, have been included in the analyses (Table 3). If the role of an information and communication medium was ranked highest, it would get 8 points. The one ranked on the eight's place would get 1 point. The ranking score is calculated by total points over the total survey sample (630). Table 3 presents the statistics. The results show that the ranking scores of the various media ranged from 4.17 to 5.82. is computer-based Internet > Video and Documentary > Government/community bulletin > Magazine (print) > Service of smart phone > TV programs > Newspaper (print) > Radio. The Internet received by far the highest score. Over 37, 16,

Table 3 Ranking of different ICTs' roles for promoting environmental public participation

ICTs	Rank					Score
	No. 1	No. 2	No. 3	No. 4	No. 5	
Internet	37.15	16.26	11.02	5.51	5.18	5.82
Video and documentary	15.33	18.64	9.4	3.81	4.33	4.78
Government/community bulletin	12.75	6.68	10.01	16.34	20.61	4.58
Magazine (print)	8.69	18.54	11.1	12.18	8.89	4.53
Service of smart phone	10.10	13.71	15.2	15.33	12.12	4.50
TV programs	6.09	8.92	10.81	19.80	14.01	4.35
Newspaper (print)	5.10	8.35	16.71	13.58	16.15	4.30
Radio	4.79	8.90	15.75	13.45	18.71	4.17

Unit percent, % ($n = 630$)

and 11 % of respondents selected it as the No.1, 2, or 3 out of the full ranking, respectively. Overall, radio received the lowest score with 4.17. Pearson correlation analyses showed that higher levels of education ($p < 0.01$), higher levels of income ($p < 0.05$), and NGOs membership ($p < 0.01$) had significant positive effects on the respondent's perceptive role of Internet. Respondents with higher levels of education ($p < 0.05$) and higher levels of income ($p < 0.05$) also gave significantly higher scores to video and documentary.

The respondents also ranked seven communication and organization functions of ICTs in public environmental participation (Table 4). If a function was ranked highest, it would get 7 points, and the least important function would get 1 point. Total points (and thus final ranking) equaled to multiplying the number of respondents by points per function, using the total survey sample (630). The final ranking, shown from the most important function to the least important one, is: Obtaining real time information > Releasing and presenting personal opinion > On-line vote and survey > Communicating ideas and information > Organizing the collective actions > Engaging in the counseling conference > Participating in the governmental decision-making. Obtaining real time information on environmental sustainability was by far

considered the most important function of ICT in public participation on the environment, while participating in the governmental decision-making was considered of little importance. Pearson correlation analyses indicated that respondents with higher levels of education ($p < 0.01$) and NGOs members ($p < 0.001$) had significantly more positive attitudes toward obtaining real time information by ICTs.

ICT can have various impacts on public participation in environmental sustainability (Fig. 5). Changing public environmental values and awareness (for example being in favor of environmental protection, spending more time on and paying more attention to environmental issues) was perceived as the most important impact (22 %), followed by promoting transparency of governmental decision-making (16 %), expanding public participation (15 %) and reducing cost of communication and action (14 %). Supervising companies and businesses (2 %) was not considered to have changed much through the use of ICT. Pearson correlation analyses indicated that respondents working in government, institutes and universities ($p < 0.05$) and respondents with higher levels of education ($p < 0.05$) had significant positive correlations with perceptions of influence of ICTs on environmental public participation.

Table 4 Ranking specific functions of ICT in public environmental participation

Function	Rank							Ranking score
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	
Obtain real time information	39.39	16.21	10.82	10.19	7.49	4.60	4.59	5.05
Release and present personal opinion	13.21	22.47	18.30	14.61	15.35	8.58	8.61	4.53
Online vote and survey	11.60	15.08	18.56	18.38	16.31	11.40	11.39	4.28
Communicate ideas and information	9.41	11.12	19.22	23.02	15.68	12.49	12.48	4.06
Organize the collective actions	9.68	9.79	15.20	13.68	24.02	15.59	15.58	3.76
Engage in the counseling	6.72	13.18	11.04	11.28	11.72	32.51	32.49	3.58
Participate in the governmental decision-making	10.21	12.11	7.03	8.91	9.40	14.82	14.79	2.86

Unit percent, % ($n = 630$)

Fig. 5 ICTs impacts on public participation in environmental sustainability ($n = 630$)

Discussion

Through this survey, we examined the role of ICTs in the realm of environmental sustainability participation in urban China. Based on the above results, we can formulate two key findings. Firstly, by the use of ICTs, citizens are becoming more aware of, and vocal on, environmental problems affecting their quality of life. Our respondents indicated a more frequent engagement in online public participation activities than offline public participation activities. About two-thirds of the respondents agreed that ICT-usage facilitated public participation in environmental controversies. They gave new media a higher ranking with respect to promoting environmental sustainability than traditional media. Several famous environmental protests about industrial and infrastructural projects occurred almost entirely in the realm of online activism and engagement, taking the form of citizens signing online petitions and issuing online statements in support of alternatives.

Secondly, the survey also highlighted a number of constraints in e-participation. Crucial are the necessary digital skills needed to take part in e-participation, and the accessibility to Internet. As discussed, only those on the internet took part in our survey, and these were largely higher educated and young groups. This suggests that the elderly, lower educated groups, those with insufficient resources to own a smart phone or with limited internet connections, are excluded via e-participation as they do not have possibilities for their voices to be heard online. However, the number of internet users in China is rising rapidly, so is access to Internet, which suggests that this barrier will pose less of a concern in the recent future (CINIC 2016). And some of these are constraints are

equally valid for offline participation, for instance in relation to levels of education.

The most vital barrier, however, concerns the role of the government in Internet regulation and information disclosure (Cui and Wu, 2016; Feng and Guo 2013; Yang 2011; Zittrain and Edelman 2003). Already quite early in the ‘digital age’ the central government of China enacted three regulations on Internet censorship, including Ordinance for Security Protection of Computer Information Systems in 1994, Temporary Regulation for the Management of Computer Information Network International Connection in 1996, and Security Management Procedures in Internet Access in 1997. In the early 2000s China’s Internet regulation and more control was transformed and a wide range of official and non-official institutions, rules, and practices were implemented in tandem in order to achieve synergy effects in regulating Internet use (Mol 2009; Yang 2013).

These concerns of governmental control were also reflected in the survey. Whilst the respondents expressed an interest to become more engaged in public affairs via e-participation, ICT was not yet valued as a proper tool for participation in decision-making. Related to that, the respondents indeed raised concerns regarding the high levels of governmental control on e-participation and information sharing. The rise of a well-educated middle class and social elite has nonetheless strengthened demand for public participation in policy-making processes. As discussed, the Chinese government partly gave into the mass ICT-enabled protests against plans to build a chemical (PX) plan in Xiamen by relocating the site. But China is just starting to learn how to cope with environmental protests against infrastructural projects through experimenting with citizen consultation, participation, and widespread, two-way information provisions. The goal of public

e-participation is to achieve a transparent, balanced, and widely supported decision through greater input from stakeholders. In China, the often criticized Decide-Announce-Defend (DAD) approach to industrial and infrastructure policies and projects, which lacks such participation, still prevails (He et al. 2016).

Public environmental participation rights found a sound legal basis in the 2015 Environmental Protection Law. However, the detailed procedures for public involvement in environmental decision-making are still not fully defined and operationalized. Actual practices show that the proposed participation options are often not fully permitted and are not implemented by (local) governmental authorities. A new Law on Administration of Foreign NGOs Activities within China was issued on April 28, 2016 and heightened the scrutiny on these NGOs activities. Public involvement (especially for NGOs) in development planning has faced widespread suspicion by the Chinese state because it tends to go against the long entrenched bureaucratic culture of China's authoritarian state. The new law has also raised comments by national and international NGOs, as they perceived the law as limiting their possibilities for (e-)participation and access to environmental information. A further detailed Chinese Internet strategy is announced to be developed during the 13th Five-year Plan on Economic and Social Development of China (2015). China will implement a national cyber development strategy, a national big data strategy, and an "Internet Plus" action plan in 2016–2020. Ideally, this can provide guidance to policy makers, scientists, and volunteer organizations who are working to engage citizen participation in environmental controversies online. But it can also jeopardize and restrict the sprouts of e-participation on sustainability issues, moving towards environmental authoritarianism (Zhu et al. 2015).

This analysis, thus, shows how ICTs can both pose opportunities and risks to the democratization of environmental governance. On the one hand, internet usage is being regulated by the Chinese government, who may also use the data society to monitor its users (see also Smith 2016 on national surveillance). On the other hand, ICTs have shown to have a transformative potential in urban China as well, by providing citizens with more opportunities to raise awareness of environmental problems and to pressurize the government to take action. In that respect, digital technology can also be used in such a way that supports sustainable development and new ways of creating societal dialogue and open democratic forms of governance (Seele 2016). It shows not just how the government can "watch" its citizens, but also how citizens can "watch" the government and can monitor how sustainable it behaves. The dilemma continues how to balance Internet freedom, national security, and public (e-

)participation in environmental affairs, especially in complex political contexts such as in China. Ways out of this dilemma are to be found in more flexible and pragmatic policies, rather than in rigid national laws and plans.

Conclusion

Demand for environmental sustainability and calls for enhanced public participation have led researchers to explore a number of different collaborative approaches to solving problems. However, as Ellis et al. (2007) suggest, such "public engagement should be viewed as an interactive, rather than one-way, process, with the aim of changing the attitude of developers as much as objectors". This paper contributes to ongoing debates on the role of ICT in environmental engagement, by investigating how in urban China this civic environmental engagement is facilitated by ICT. The analysis demonstrated that the use of ICT has unleashed a stronger information disclosure and public voice in urban China. The survey results suggest that, compared to offline, online information disclosure and citizen engagement through new media tools and the Internet is much more valued by respondents in promoting environmental public participation. E-participation has great potential in urban China and possibly beyond, because of lower administration costs and a faster turnaround time, allowing easy and rapid collection, dissemination and communication of data/information, and most important, mobilization and effective organization of the public.

These findings need to be qualified in two ways. Firstly, not all Chinese citizens use and profit equally from these online possibilities of civic engagement on the environment. Younger, better educated, richer and members of environmental NGOs are clearly leading. Secondly, although discussion with family, friends, and colleagues was the most engaged online activity by our respondents, the findings also highlight the role of ICT in the creation of new discussions, collaborations and alliances among stakeholders whose environmental voices were previously not captured or at least not sufficiently amplified or taken into consideration. Earlier cases in Xiamen, Beijing and other cities marked the role and 'power' of ICT and demonstrated how it is helping Chinese citizens to stand up against planned industrial projects and to actually influence governmental decision-making.

That being said, this study unavoidably has its limitations. Despite the sample size being sufficiently large and taken at random, it was collected via the Internet on a voluntary willingness-to-participate basis. Besides this sampling bias (with more younger and higher educated respondents), a survey of 630 citizens in Beijing cannot be

generalized for China. Beijing's political and social context, with a high concentration of environmental NGOs and high national and international political visibility, provides unique situation for public environmental participation. It does, however, signal key trends of e-participation in the domain of environmental sustainability that may emerge in well-connected and creative cities in China. Future research could be replicated using face-to-face interviews and applying similar surveys in other cities and regions.

The possibilities and future of online citizen participation and engagement in China's sustainability agenda is not only dependent on these factors and individual characteristics, but even more on governmental internet censorship and limitations in information sharing policy. Governmental interest in public opinion, environmental information disclosure, and public engagement is essential for any future of e-participation. Further research should address the potential impacts of the Internet regulation policy on ICTs application regarding environmental controversies.

Compliance with ethical standards

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