# From "Concealment" to "Deconcealment":

## Lay Knowledge and Its Generation Mechanism for Issues of Environmental Risk in China

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**ABSTRACT: In this paper, lay knowledge challenges the authoritative discourse on environmental risk and promotes the transformation of the traditional governance model to a cooperation-based model adapted to a risk society. We utilise texts and interviews to explore the complexity and systematisation of the lay knowledge mechanism based on a case study of waste incineration in China. Our findings indicate that lay knowledge generation involves collaboration between risk-takers, non-core experts, and communication "alerters." Additionally, they reveal the driven module and a cyclic process that integrates resource integration, knowledge shaping, dissemination, and empowerment, ensuring the visibility and utility of lay knowledge. This study assists in understanding civil environmental society in China and provides a new perspective for policymakers to comprehend associated risks.**

**KEYWORDS: lay knowledge, generation mechanism, environmental risk issues, waste incineration, knowledge generation.**

### *Introduction*

Modernisation, while bringing about technological progress and socioeconomic development, also pushes humans toward a risk society. Unlike the well-known impact of natural disasters on the ecological environment of a traditional society, the essence of the impact of the environmental crisis on a risk society is a new uncertainty brought about by the application and development of science and technology (Giddens 1990). To ensure the unimpeded advancement of environmental decision-making, the authoritative community, which is jointly formed by governments, experts, and enterprises, consolidates one portion of knowledge, effectively marginalising or even concealing other portions. Such actions heighten the public's anxiety regarding risks and their quest for the truth. Hence, members of the public form lay communities to actively learn, understand, and generate professional and technical knowledge, thereby creating a domain of lay knowledge that rivals authoritative knowledge. The aim of such communities is to promote the "deconcealment" (*jiebi* 解蔽) of abandoned knowledge. Deconcealment is an important concept in Heidegger's

philosophy of technology and refers to shining a light on that which is concealed to illuminate it (Heidegger and Kästner 1986). Thus, the deconcealment of knowledge refers to the revealing or displaying of marginalised knowledge propositions and making visible "dark zones" of knowledge that have been deliberately or unintentionally ignored.

Such concealment (*zhebi* 遮蔽) is particularly prominent in the application of waste incineration technologies. In the past decade, authoritative experts and lay persons have maintained clearly divergent attitudes toward the advisability of incineration. The former group comprises experts and scholars who are recognised by the industry and are engaged in research on waste incineration. They focus on establishing knowledge propositions associated with incineration technologies such as safety, economy, and low-carbon emissions to alleviate people's doubts and anxieties. The latter are simply "experts," though their expertise has not been recognised by certification (Collins and Evans 2002). Regarding incineration, they expound on the multiple risks from environmental, managerial, and ethical perspectives and promote alternatives. However, lay knowledge on the subject has not received much attention compared with the widespread dissemination of official knowledge.

Based on this foundation, we study the struggle in the field of waste incineration from the perspective of knowledge politics rather than the traditional collective action perspective, focusing on describing the actors and action logic that generate lay knowledge in this field. On one hand, we can understand the social and political attributes of knowledge as well as the mutual reference and production between knowledge and authority in the process of knowledge generation (Hook 2007). This shows how social forces expand expression space and enhance discourse effectiveness under authoritarian regimes. On the other hand, the lay knowledge mechanism can be used as a case to explore the growth of China's environmental civil society and understand its new path of "science against science," which brings environmental rights protection into the legal track and promotes the expansion of the issue from "environmental rights protection" purely in the pursuit of personal interests to "environmental protection" that concerns all of society.

## *Literature review*

When Beck wrote about a risk society, he stated:

> Accordingly, as scientization proceeds, the systematically produced uncertainty spreads to external relations, and conversely turns the target groups and appliers of scientific results in politics, business and the public into *active coproducers* in the social process of knowledge definition. (Beck 1992: 157)

These arguments were confirmed by the sustained development of the comprehensive research path of science, technology, and society (STS). Scholars in this field advocate duly recognising the limitations of technology, emphasising the importance of lay persons who have switched from passive to active behaviours in knowledge generation and risk management.

STS has adopted a two-dimensional approach to expand and strengthen its concepts. The first dimension involves questioning scientific and technical determinism. In terms of the characteristics of knowledge, most social science studies suggest that scientific work is not free of political content; rather, such knowledge production is a contextual cultural practice (Leach, Scoones, and Wynne 2005). That is, hidden individual, professional, and institutional biases can affect knowledge dissemination and production (Ascher, Steelman, and Healy 2010). In terms of the role of experts, they do not represent purely neutral facts because they are themselves affected by their own inherent interests and values. For scientific knowledge production to become public space, the opinions of different social subjects must be valued and coordinated. In terms of the production path of knowledge, the output of scientific and technical knowledge is shifting from the "ideal type in the laboratory" to the "ideal type in the field." These sites of scientific practice, where experts and litigants interact and legitimate scientific knowledge is produced, are widely distributed in the process of social and technological applications (Rip 2003). Additionally, lay persons categorise the external world (including the scientific world) based on their knowledge of daily life. When they transform unfamiliar scenarios into familiar situations in daily life, they endow society with a sense of reality and order, generating valuable lay knowledge in the process (Bertilsson 2006).

With the above perspective as its basis, the second dimension arises accordingly: the possibility, value, and path of lay knowledge generation. Collins and Evans (2002) noted that although lay persons have the right to participate in political decision-making, they do not have expert qualifications. Many scholars have proposed different opinions regarding this issue and argue that overemphasising expert authority and excluding the public from the small circle of scientific and technological decision-makers is taking a step backward. They have stated that alternative knowledge can supplement the mainstream scientific knowledge presented by scientists. For example, Wynne (2003) highlighted that only when experts and the public jointly participate in consultations, are the social risks of toxic waste fully understood. Several studies indicated that working-class and minority residents living in at-risk communities could conduct neighbourhood health surveys, carry out "body burden" studies, and monitor air, water, and soil quality (Irwin 1995; Fischer 2000; Frickel 2004). Scholars have pointed out that making a judgment on risk is an action in which different enterprises, institutions, and other actors compete and negotiate with each other to jointly define an acceptable interpretation (Clarke 1988). According to the "social drama theory," these actors include risk-takers, propagandists, researchers, and alerters (Palmlund 1992).

This view is also evident in the practice of environmental conflict, which has been a powerful force spurring citizens using lay science to challenge technologies deemed beacons of modernity and development (Leach, Scoones, and Wynne 2005). According to Frickel (2004: 449), "A major focus of social research on mobilizations for environmental justice in the US has been a cataloguing of the various ways in which citizens' groups are adopting the methods and language of science to wage a grassroots offensive against industrial polluters and their allies in government." The Love Canal controversy is a notable case in which residents became convinced that a toxic waste site was causing serious health problems. They organised a grassroots environmental

movement and took it upon themselves to canvas cases, gather data, and draw conclusions to challenge the complacency and arrogance of the government, industry, and scientific elite (Fan and Chen 2019). Residents who were involved in the process of knowledge production and equipped with this newly generated knowledge "were more sophisticated than mere NIMBY [not in my backyard] campaigners and became 'qualified supporters' of incineration" (Zheng and Liu 2018: 68). Zhang and Li (2019) trace the knowledge production dispute between different actors in the waste incineration dispute, and point out that the public can integrate scientific discourse with local knowledge and shape themselves as "permanent experts." In the case of opposition to the incineration plant in Asuwei, Beijing, "stakeholders, including both decision-makers and residents, 'knowledgablized' themselves by absorbing scientific knowledge from different sources" (Zheng and Liu 2018: 68). These references illustrate how science knowledge has been used in environmental conflict as a weapon to oppose public policy actors and how it has become the tactic of choice for protesters.

In summary, existing results – with the support of logical speculation, case analysis, and other methods – reflect the limitations of scientific knowledge in environmental disputes, accentuate the value and characteristics of lay knowledge, and demonstrate the gap between techno-centrism and democratic consultation. While these conclusions strongly support this study, further discussion is required. First, whether for the whole environmental field or focusing on the topic of waste incineration, past scholars have mostly failed to further analyse lay persons as a "network" and examine internal diversity and the logic of collaboration, despite recognising lay persons' knowledge propositions. Second, the dynamic production logic of lay knowledge has not yet been abstracted and condensed, making it difficult to systematically grasp the phenomenon. Third, this issue has mostly been discussed by Western scholars; thus, the existing theories, which were formed in the context of democratic societies, have limited explanatory power when applied to China.

Thus, we selected the application of waste incineration technology as a subject to describe the collaborative anti-incineration knowledge network to develop a dynamic mechanism that runs through the whole process of knowledge production. We constructed a three-dimensional framework to assess the knowledge production of lay persons in terms of environmental risk issues, including structure-action-function, which is analysed in the following three steps. First, in the structural dimension and based on the "social drama theory" (Palmlund 1992), we discuss the multiple risk subjects included in the lay community of Chinese waste incineration to analyse the lay characteristics of knowledge. Secondly, in the action dimension, through analysing knowledge generation, content elements, and skills for attaining legality by lay opponents during the process of applying, disseminating, and disputing science and technology, we present the hidden dynamic mechanism of lay knowledge generation. Finally, in the function dimension, through systematic reflection and dialogue with existing theories, we discuss the positive and negative impacts of lay knowledge generation on traditional environmental risk management that provides a new perspective for policymakers to comprehend associated risks.

## Methods and materials

We utilised an exploratory case analysis method, wherein the anti-incineration phenomenon in the field of waste incineration risks in locations B, F, P, and C[1] were regarded as a case study for diachronic observation. The representative parties in this process – anti-incineration environmental nongovernmental organisations (ENGOs), experts and scholars, and rights defenders – were taken as specific research objects. With the general ideas of content analysis and discourse analysis as the basis, the acts of knowledge production and the discourse texts were sorted and interpreted. This led to a summary of the knowledge production subjects, mechanisms, and results related to the lay community.

Research data were acquired through three methods. The first method was participatory observation. The research team actively participated in different types of seminars and sharing sessions on various waste incineration topics. Additionally, we volunteered with some ENGOs from February 2016 to December 2019, joining their daily operations to gain an in-depth understanding of their value orientation and knowledge propositions. Second, this article draws on in-depth interviews with 45 activists, ENGO representatives, officers, and specialists. We conducted the interviews from February 2016 till November 2020. The minimum length of an interview was one hour and the longest three hours. We also organised six focus groups. Third, we performed a literature review. We compiled government documents related to the development of incineration projects, such as project planning, an abridged version of environmental impact assessment (EIA), and public notices soliciting comments; reports on the anti-incineration movement published on *Sina.com.cn* (*xinlang wang* 新浪網), *Tencent.com.cn* (*tengxun* 騰訊), *Xinhua.net.cn* (*xinhua baike wang* 新華百科網), and other major web portals; media articles posted on community forums, WeChat groups, and blogs; and related academic papers. The aim was to create a multi-faceted discussion of the issue by comparing primary and secondary data, as shown in Table 1.

## A continuum: The lay community and their knowledge propositions

The anti-incineration movement in China was initiated by residents living in the vicinity of incineration facilities. Over time, the social impact of the movement has far surpassed the actual geographic coverage of the incineration facilities, expanding to the broader field of public opinion, and attracting the attention and support of many intellectual elites and ENGOs. Among them, those playing the roles of risk-takers, non-core experts, and communication alerters (the three core roles) generate knowledge propositions of varying nature from different angles and through multiple methods. In doing so, they formed lay communities with common environmental governance goals and established a continuum of anti-incineration knowledge transitioning from the experiential to the professional (Figure 1).

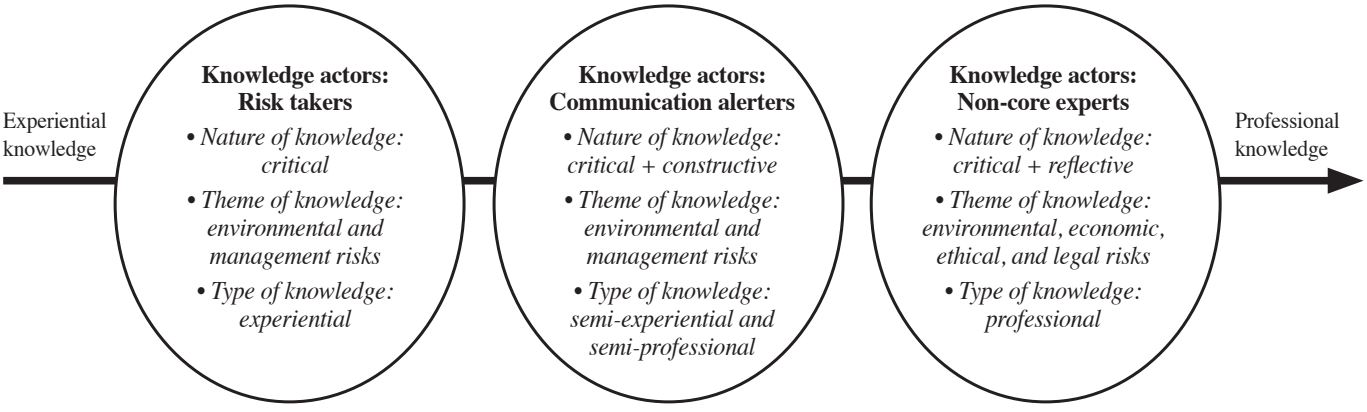
1. Location B is a district in the northwest of Beijing, where anti-incineration campaigns occurred in 2009; location F is a district in the south of Beijing where campaigns occurred in 2021; location P is a district in southern Guangzhou where campaigns occurred in 2009; location C is a county in Hainan Province where campaigns occurred in 2019.

**Table 1.** Methods of acquiring some of the primary data

| Method | Name | Date |
|---|---|---|
| Participatory observations | ENGO W's seminar on the supervision of waste incineration | 6 July 2016 |
| | Nongovernmental forum on national urban and rural domestic waste management and development planning under the 13th five-year plan | 5 January 2017 |
| | ENGO L's 2017 annual national conference | 9 December 2017 |
| | ENGO L's 2018 internal concluding conference | 8 December 2018 |
| | ENGO Z's seminar to disseminate information on waste incineration | 28 October 2019 |
| | Delegation's visit to City S's waste incineration plant | 22 December 2019 |
| One-on-one interviews | Mrs L, representative of the anti-incineration campaign | 24 May 2016 |
| | Mr H, representative of the anti-incineration campaign | 29 June 2016 |
| | Mr B, representative of the anti-incineration campaign | 11 November 2016 |
| | Secretary-general, ENGO L | 5 January 2017 |
| | Project officer, ENGO Z | 12 January 2017 |
| | Head, ENGO A | 25 April 2017 |
| | Mr W, representative of the anti-incineration campaign | 4 May 2017 |
| | Head, Environmental Health Division, District J of City S | 1 July 2017 |
| | Mr Z, environmental historian | 26 April 2018 |
| | Ms Q, representative of the anti-incineration campaign | 10 October 2020 |
| | Project officer, ENGO S | 23 April 2021 |
| Focus group discussions | Resident representative of community B's anti-incineration campaign | 3 November 2016 |
| | Resident representative of community P's anti-incineration campaign | 4 June 2017 |
| | Staff, urban administrative and law enforcement bureau (*chengshi guanli xingzheng zhifa ju* 城市管理行政執法局), District H of City G | 16 May 2018 |
| | Staff, urban administrative and law enforcement bureau, District P of City C | 2 August 2018 |

Source: authors.

**Figure 1.** Continuum of lay knowledge on the waste incineration issue




Source: authors.

### *Risk-takers: Providing experiential "soft" knowledge*

Risk-takers are the local residents who are directly exposed to the potential environmental risks of a waste incineration plants. After a long-term struggle to protect their rights against the government and plants, they realised that the primary resources for the legitimacy of resisting risk are risk information, scientific communication, and risk assessment and debate, which go beyond direct forms of resistance such as strikes, voting rights, and political influence (Beck 1992). The residents who live around incineration plants and are directly exposed to the risks realised that knowledge is the key medium and weapon with which to gain the right to speak during the dialogue process with government and enterprises. Therefore, they combined their own field observations and life experiences to construct their own knowledge.

Since verbal statements cannot serve as evidence, the first step taken by the anti-incineration activists was to conduct on-site visits to collect information. Through observing existing incineration plants and communicating with the residents living in the surrounding areas, they confirmed the actual existence of risks with their visual and olfactory senses. Mr B, representative of the anti-incineration campaign, stated: "It is only after having personally visited some operational incineration plants that we realised that many villagers living in the surrounding areas suffer from cancer. The lead content in the children's blood is also relatively high" (interview materials, 11 November 2016). Narratives from the anti-incineration faction frequently include evidence, such as foul smells, the number of people diagnosed with cancer, incomplete combusted residues found among ashes in the incinerators, and black smoke as seen and reported by villagers. This evidence is also repeatedly shown during public talks and arguments in court. Consequently, risks perceived by individuals are disseminated, and private testimonials are made public. Simultaneously, a new bargaining chip against mainstream views such as "technical compliance and incineration safety" is gained through the discourse from an anti-standardisation perspective.

> They repeatedly use Japan as an example, insisting that there is no issue with building an incinerator in the city centre there. However, we are not the same as them! How does Japan carry out waste sorting, compared with what is done here? If things thrown inside [referring to the incineration facility] are different, can the stuff coming out [referring to the emissions] be similar? (Interview with Mr W, representative of the anti-incineration campaign, 24 May 2017)

Behind that series of rhetorical questions is the knowledge proposition that measures should be adapted to local conditions. The public believes that the dietary structure and waste disposal mode of the Chinese people cause waste entering the incinerator to be more complex in composition and high in water content, thereby creating more risks during the incineration process. This means that generalisations cannot be made using uniform standards. Despite experts repeatedly emphasising that safe incineration of wet waste is totally guaranteed under current technological levels, the anti-incineration activists have maintained:

> Among the ashes, [the volunteers] even found shoes and plastic bags that have not been completely burned. Since these objects combust even without reaching the temperature of 850 degrees, how can we be convinced when they say that dioxins can be broken down? Are our waste incineration technologies really that well-developed? (Interview with Mrs L, representative of the anti-incineration campaign, 4 March 2016)

Although the above findings and doubts may not be from professionals, they align with common sense and with most people's life experiences. However, "the value proposition embodied in the discourse is usually constructed and described by knowledge, and it is the participants' knowledge that determines the level of the discourse structure" (van Dijk 2014: 90). Professionals utilise experiments to prove their propositions and then publish their results. In comparison, the persuasive power of experiential knowledge is indeed weaker. Considering this, the public decided to put in more effort and further enhance the level of discourse so that their knowledge propositions could be presented more effectively. For example, the rights defenders for location B consulted dozens of professional reports and legal documents from China and other countries. They compiled and prepared an almost 80-page report covering a wide range of content on waste incineration, including development trends, setting of standards, health risks, social costs, experiences of other countries, and alternative proposals. The defenders for locations F and C opened WeChat public accounts to write articles based on professional data analysis and participatory observation, with the aim of conveying the environmental risks of waste incineration to society and supervising the government's waste incineration policies.

These lay discussions and proposals may not be fully developed when critiqued from the perspective of an industry insider; however, they sufficiently illustrate that lay knowledge expressed by the public, based on their own experiences, value orientations, and emotional perceptions, should be regarded as important types of knowledge. Under certain circumstances, experiential knowledge with contextual and local characteristics can be utilised to make more effective judgments compared with professional knowledge (Wynne 1992).

More importantly, the defenders say that "producing and disseminating knowledge" is not a temporary or accidental act, but a rational choice after careful consideration. For example, after the conflict subsided, the anti-incineration activists of location F established an ENGO and devoted themselves to the alerting and governance of waste incineration risk for a long time. This has been seen in other cases as well:

> As the defenders for location B said, anyone can criticise, and frequent criticism is not welcome. So we are constantly learning, looking at a lot of literature on waste incineration, analysing the pros and cons, so that we can reach conclusions and make suggestions. (Interview with Mr B, representative of the anti-incineration campaign, 11 November 2016)

> As defenders for location S said, the account was originally set up to oppose incineration facilities, and it gradually became a project. Now it has become their career. It has

> also changed our relationship with the government, who previously believed us to be troublemakers, for opposition's sake. Until we provide our lay knowledge and arguments, the government believes that we are not ordinary people. (Interview with Ms Q, representative of the anti-incineration campaign, 10 October 2020)

### *Non-core experts: Producing interdisciplinary "hard" knowledge*

Core experts refer to the practitioners of the waste incineration industry, most of whom are experts in the field of natural science or engineering. The non-core experts work in humanities and social sciences fields, including economics, history, law, and philosophy, but pay close attention to waste incineration. They are well-versed in scientific research methods and skilled at searching for evidence and unearthing the nature of problems. However, because of the significant differences in their disciplines, methods, viewpoints, and attitudes, they are often regarded as lay persons by industry insiders and accused by the latter of "not knowing but pretending to know." They can be regarded as "special" lay persons.

One example is Dr M, who has been working in the field of environmental history. He is deeply involved in many anti-incineration campaigns and has written many documents at professional standards to warn administrators of the potential risks of incineration. Professor Tian approaches the issue from broader perspectives, such as the paradox of development and ethical justice. He wrote that "Incineration only transfers wastes from the solid to the gaseous state, which causes secondary pollution (...). Landfills and incineration facilities are also issues of environmental justice."[2] Environmental lawyer X, who discusses negligence in the management of decision-making from the perspectives of procedures for setting up projects and social equity, has proposed many suggestions on the construction process of facilities, including administration in accordance with the law, public participation, and innovations in the mechanisms for EIA. Compared with the public, non-core experts are as skilled at producing "hard" knowledge with field research, data analysis, and logical reasoning as core experts. By supplementing the fragmented and empirical soft knowledge, "hard" knowledge confronts authoritative knowledge by struggling against the scientization of science.

### *Communication alerters: Grafting together soft and hard knowledge*

The robustness and acceptability of knowledge are enhanced when the viewpoints of both the elites and the public are accommodated. The communication alerters uphold this ideal and actively propagate and demonstrate incineration risks that are often neglected or underestimated. Most of them are committed in ENGOs focusing on waste treatment. They are sensitive and worried about environmental risks beyond the risk-takers, and regard risk popularisation and warning as their own responsibilities. They are committed to integrating and touching up the soft and hard knowledge of risk-takers and non-core experts to participate in environmental justice conflicts by "providing information on mobilizing members, running meetings, using scientific data, talking with the media, pressuring policy makers, and dealing with stress" (Tesh 2000: 105).

One example is ENGO W, which focuses on urging waste incineration plants across the country to engage in clean operations. It categorises and organises complex operating data regarding incineration plants, which are available on the Internet, and then uses the report format to concisely and vividly present the situation in which the incineration industry is managed. Another example is ENGO S, which is committed to improving society's awareness of the risks associated with waste incineration. It combines the personal experiences of residents living around incineration plants with academic findings from China and other countries and posts blog articles titled "Health risks of heavy metal pollution in the surrounding environment of waste incineration plants cannot be ignored."[3] These articles contribute to the establishment of a database on incineration risks. Separately, ENGO Z relies on its abundant political resources to produce highly professional and normative documents. These documents are submitted to government departments advocating implementation of policies for safe and reasonable incineration practices. Using their specialised knowledge, processing, and communication capabilities, the ENGOs are a bridge to the different actors, and they promote the integration and display of heterogeneous knowledge. In the process of risk communication, the ENGOs consider both rationality and sensibility.

## *Knowledge deconcealment: The mechanism for generating lay knowledge*

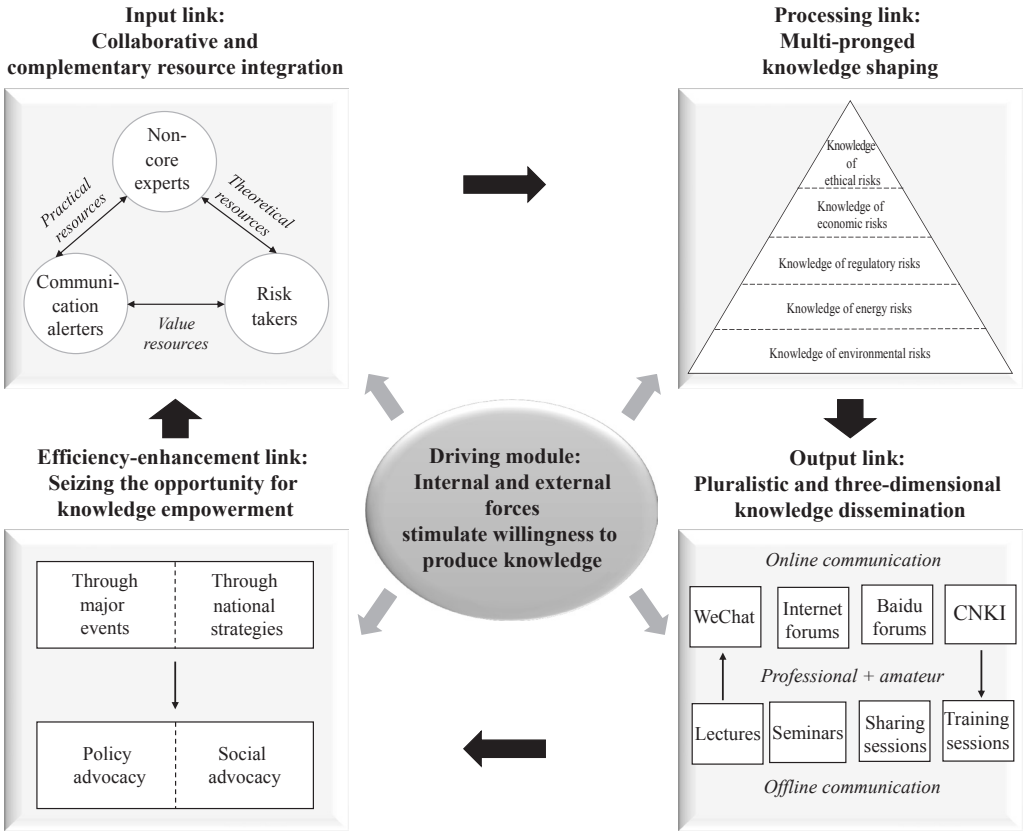
In the authoritative community's knowledge system, waste incineration is not only the preferred strategy to realise waste processing that is harmless, minimalist, and recyclable but is also an effective way to transform energy and reduce carbon emissions. With the driving module and through the input-processing-output-efficiency-enhancement links, the lay community completed the four major tasks of resource integration, knowledge shaping, dissemination, and empowerment (Figure 2). This promoted continuous enhancement of the diversity, completeness, visibility, and effectiveness of lay knowledge, thereby challenging the official discourse that only highlights the advantages of incineration. The process is a mechanism for generating lay knowledge.

### *Driving module: Internal and external forces stimulate willingness to produce knowledge*

Willingness is the precursor of action. The "driving module" in the lay knowledge system undertakes the function of inspiring the public to adopt a knowledge production strategy. Specifically, including two forces, an "internal drive" and an "external pulling," helps individuals form a willingness to produce knowledge for self-defence and self-protection and continue to power the other four links.

2. Tian Song 田松, "垃圾問題: 從文明的視角" (*Laji wenti: Cong wenming de shijiao*, The waste problem: From a civilised perspective), *Sohu.com* (搜狐), 16 December 2019, https://www.sohu.com/a/360782725_472886 (accessed on 30 May 2023).
3. Wudu xianfeng 無毒先鋒, "不可忽視的垃圾焚燒廠周邊環境重金屬污染健康風險" (*Buke hushi de laji fenshao chang zhoubian huanjing zhongjin shu wuran jiankang fengxian*, Health risks of heavy metal pollution in the surrounding environment of waste incineration plants cannot be ignored), 28 May 2018, https://mp.weixin.qq.com/s/c4Pyvh7VbZD7n7qoMm6P5Q (accessed on 1 May 2023).

**Figure 2.** "Four-in-one" mechanism for lay knowledge generation




Source: authors.

In terms of internal drive, firstly, it includes the awakening of Chinese public rights and environmental awareness. In recent years, with the transformation of China's social structure, the desire of ordinary citizens to participate in public decision-making has increased day by day. Environmental issues, as issues closely related to individuals and the best experimental objects for participatory democracy, have naturally become spaces where the public actively intervenes. Second, it comes from the rationalisation of public expressions of rights protection. In early environmental disputes, the public often used methods outside the system such as sit-ins, marches, and demonstrations to defend their rights. As a result, they were negatively judged. To eliminate these stigmas, the public had to use more persuasive methods in the process of resistance, which forced them to gain knowledge and use the concept of "rationality" to construct their arguments and express their demands (Zhang 2014: 51-2).

The external pulling force is manifested in four aspects. First is through the uncertainty of scientific knowledge. This provides a centre for knowledge disputes, reveals the possibility of debate among all parties, and prompts the community of ordinary people to strive for the right to define risk through knowledge production. Second is the trust crisis of the expert system. In a risk society, the authority of the expert system is always challenged by uncertainty, especially in terms of management expertise. The experts themselves once said frankly: "Our technology is the most advanced, but our management capabilities may only be in the third level" (interview with Mr Z, environmental historian, 26 April 2018). These all have weakened the trust of ordinary people in professionals; they therefore have a sense of insecurity and try to directly participate in risk decision-making through knowledge learning and construction. Third is the imbalance of power in risk communication. The government is the organiser and coordinator of risk communication and has relatively rich power and resources. Thus, the public is at a natural disadvantage in the communication process. The imbalance of power drives and forces the public to seek new developments and use knowledge as a powerful weapon for negotiations on public power. Fourth is the diversification of channels for knowledge acquisition and dissemination. The advent of the era of media convergence has brought unprecedented changes in the breadth and depth of information acquisition, knowledge sharing, and dissemination. This has also laid the foundation for knowledge production by communities of ordinary people in the field of waste incineration. Ordinary people obtained relevant information about incineration technology by searching and sharing in various media platforms, and also attained knowledge learning among each other. This promoted knowledge integration.

## *Input link: Collaborative and complementary resource integration*

With the willingness to produce knowledge, specific actions for knowledge production need to rely on the coordination of various subjects in the lay community (Law and Wong 2003: 57-66). When generating lay knowledge on waste incineration, risk-takers, non-core experts, and communication alerters formed the lay community and were able to integrate theoretical, experiential, and value resources through exchanges and other complementary actions. Their approach ensured that the knowledge system is rational, sensible, reasonable, and legitimate.

First, as communication alerters, ENGOs often invite researchers in related fields to participate so that sufficient theoretical resources are amassed. For example, ENGO W has organised several seminars. At these seminars, non-core experts expressed their respective opinions on technical and management issues such as "information disclosure by the waste incineration industry" and "paths for public participation in the field of waste incineration." These serve as professional material for the ENGOs to use to formulate their actions and strategies or craft policy recommendations. Further, when ENGOs conveyed the risks of incineration, they would often quote cases and data related to pollutants, such as dioxins and heavy metals, by Chinese and foreign scholars. This allowed ENGOs to consolidate the academic foundation of social media articles and increased their credibility. Simultaneously, ENGOs and lawyers also transmitted knowledge and technical abilities related to incineration facilities and environmental participation to the public. With the support of professional knowledge, the public was able to successfully produce research reports, complaint materials, and policy recommendations.

Second, non-core experts depend on the waste management practices of the communication alerters and the public's local knowledge to prepare their academic output. The data, images, and videos collected by ENGOs during their supervision of incineration facilities can serve as research material. Field visits to interview residents living around the incineration plants can give researchers an in-depth understanding of local geographic structure, environmental changes, and residents' perceptions. Such first-hand information adds vivid experiential constructs to the foundation of theoretical constructs, thereby fully demonstrating the perspective of being cautious about incineration.

Third, the risk-takers provide a valued resource for unique knowledge generation. As the direct bearers of all risks resulting from technical decision-making, the public's opinions are a collection of value orientations, political aspirations, and policy evaluations. This value set has become increasingly important, because for any knowledge system to be stable and reliable, it must be generally recognised by the public.

### *Processing link: Multi-pronged knowledge shaping*

The processing link aims to integrate and reorganise the rich but scattered lay knowledge so that waste incineration risks can be presented systematically and hierarchically. After processing, the following five risk interpretation dimensions are formed.

The first perspective is knowledge of environmental risks. The lay community produced various documents, including "A life-or-death choice for China's urban environment: Waste incineration policies and the public's wishes,"[4] "Concern behind the smokescreen: A survey of the social and environmental impacts of the Chengdu Luodai MSW incineration power plant,"[5] and "The truth about waste incineration."[6] These documents, which incorporated data, diagrams, and examples from experiments in China and other countries, rationally demonstrated that environmental pollutants (such as dioxins and fly ash) produced by incineration are harmful to human body and environment. The points presented were in sharp contrast with the official discourse that incineration is "safe, green, and low in carbon emissions."[7]

The second perspective involves knowledge of energy risks. There have been disputes over whether power generation through waste incineration should be regarded as an energy utilisation method with low-carbon emissions. In response, many ENGOs issued documents, including "Wrong incentives: A study on domestic waste incineration power generation and subsidies for renewable energy in China"[8] and "European Union: 'Renewable energy' labels to be removed for the incineration of mixed wastes."[9] ENGOs noted that it was far-fetched to grant full subsidies for such projects simply by treating incineration as a means of renewable energy and power generation.

The third perspective is knowledge of economic risk. Non-core experts wrote and published the "Evaluation report on the social cost of municipal solid waste incineration in Beijing." After evaluating the financial and social costs, as well as the health impact of incineration power plants, they concluded that "the incineration of domestic waste has a huge social cost. First, huge amounts of public financial subsidies are required. Second, dangerous air pollutants (such as dioxins) persist even after emission standards have been reached, causing significant damage to human health."[10]

Fourth is knowledge of regulatory risks. The lay community issued a series of civilian observation reports on supervisory monitoring of domestic waste incineration plants[11] over five consecutive years to remind decision-makers of the management risks related to incineration plants. The community also wrote a series of articles, such as "Searching for online data of waste incineration plants,"[12] to attract the attention of more people who can focus on and mitigate the related management risks.

Last is knowledge of ethical risks. Scholars have repeatedly described various philosophical issues related to the new technology

4. Albe Volunteer Study Group 北京奥北志願者研究小組, "中國城市環境的生死抉擇: 垃圾焚燒政策與公眾意願" (*Zhongguo chengshi huanjing de shengsi jueze: Laji fenshao zhengce yu gongzhong yiyuan*, A life-or-death choice for China's urban environment: Waste incineration policies and the public's wishes), 10 June 2012, https://jz.docin.com/p-420166844.html (accessed on 8 June 2023).
5. Rock Environment and Energy Institute 磐之石環境與能源研究所, "煙羽下的憂慮: 成都洛帶生活垃圾焚燒發電廠社會與環境影響調查" (*Yanyu xia de youlü: Chengdu luodai shenghuo laji fenshao fadian chang shehui yu huanjing yinxiang diaocha*, Concern behind the smokescreen: A survey of the social and environmental impacts of the Chengdu Luodai MSW incineration power plant), 14 December 2015, www.reei.org.cn/publication/653 (accessed on 1 October 2020).
6. Wudu xianfeng 無毒先鋒, "垃圾焚燒真相, 你值得擁有!" (*Laji fenshao zhenxiang, ni zhide yongyou!* The truth about waste incineration), 4 April 2018, https://mp.weixin.qq.com/s/EJG3SEAm80NGIrp0a30seg (accessed on 8 June 2023).
7. Interview with the head of Environmental Health Division, District J of City S.
8. Rock Environment and Energy Institute 磐之石環境與能源研究所, "錯誤的激勵: 中國生活垃圾焚燒發電與可再生能源電力補貼研究" (*Cuowu de jili: Zhongguo shenghuo laji fenshao fadian yu ke zaisheng nengyuan dianli butie yanjiu*, Wrong incentives: A study on domestic waste incineration power generation and subsidies for renewable energy in China), 1 July 2016, http://www.reei.org.cn/upload/file/20210301/1614577661352795.pdf (accessed on 1 October 2020).
9. Wudu xianfeng 無毒先鋒, "歐盟: 去掉混合垃圾焚燒的'可再生能源'標籤" (*Oumeng: Qudiao hunhe laji fenshao de "ke zaisheng nengyuan" biaoqian*, European Union: "Renewable energy" labels to be removed for the incineration of mixed wastes), 10 December 2019, https://mp.weixin.qq.com/s/OdFVw0ht-gXBZVR9nEAufw (accessed on 1 October 2020).
10. Song Guojun 宋國君, "北京市城市生活垃圾焚燒社會成本評估報告" (*Beijing shi chengshi shenghuo laji fenshao shehui chengben pinggu baogao*, Evaluation report on the social cost of municipal solid waste incineration in Beijing), Beijing: Renmin daxue guojia fazhan yu zhanlüe yanjiuyuan, 2017.
11. Wuhu Environmental Protection Volunteers Association 蕪湖市生態環境保護志願者協會, "428座生活垃圾焚燒廠監督性監測民間觀察報告" (*428 zuo shenghuo laji fenshao chang jianduxing jiance minjian guancha baogao*, Report on nongovernmental supervision of 428 waste incineration plants), 9 March 2021, www.wuhueco.org/uploadfile/2021/0309/20210309024155731.pdf (accessed on 1 October 2022).
12. Interview with an expert in Wuhu Environmental Protection Volunteers Association.

of power generation through incineration, such as ecological, technical, and social ethical risks. They noted that:

> even if engineers with the best technologies can solve the problems regarding the treatment of nanoparticulate matter and fly ash emitted by incineration plants, they will not be able to make waste incineration acceptable. It is ethically and economically absurd to expend huge amounts of time, money, and effort to destroy material resources that we should be sharing with future generations.[13]

These words extend and elevate the current issues of waste disposal and construction of related facilities to the level of human socioecological construction and intergenerational environmental fairness and justice.

### *Output link: Pluralistic and three-dimensional knowledge dissemination*

The function of the output link is risk knowledge dissemination through multiple channels, including uplink, downlink, and parallel directions to improve the radiation surface and dissemination forces. Here, the lay community has created a three-dimensional mechanism for knowledge dissemination.

The main front for communication is social media. Using the official WeChat account of ENGO T as an example, we found that it has published 351 posts related to various types of knowledge on waste incineration (Table 2). Half of the posts were about knowledge popularisation, which cited the findings of non-core experts to demonstrate incineration risks based on scientific data. Foreign experiences encapsulate the existing situations, research, and experiences of core experts on waste incineration, with the aim of increasing the breadth and credibility of local lay knowledge by borrowing from other countries. Information disclosure of core and non-core experts focuses on the supervision status of incineration facilities and raises concerns over substandard technologies, non-compliant enterprises, and inappropriate systems. The themes of policy response and advice and suggestions introduce and interpret new national policies and put forward constructive opinions on waste management, respectively.

**Table 2.** Themes and content of WeChat official account of ENGO T

| Themes | No. of posts | Percentage | Examples of reports |
|---|---|---|---|
| Knowledge popularisation | 175 | 49.85% | "What are the impacts of domestic waste incineration on the environment and human health?"<br>"Wrong incentives: A study on domestic waste incineration power generation and subsidies for renewable energy in China." |
| Examples of resistance | 61 | 17.38% | "Jiujiang City of Jiangxi Province: An incineration plant that everyone says 'not in my backyard' to."<br>"EIAs of incineration projects in two Hainan cities accused of having violated regulations on garbage classification and protection zone." |
| Foreign experiences | 47 | 13.39% | "What is it like to live in the surrounding areas of the Gangnam waste incineration plant in South Korea?"<br>"European parliamentarians call for an end to granting subsidies for power generation through waste incineration." |
| Information disclosure | 30 | 8.55% | "Monitoring of atmospheric and soil dioxins around waste incineration plants: Summary of the first round of information disclosure."<br>"First national monitoring report on dioxin emissions from waste incineration plants." |
| Advice and suggestions | 23 | 6.55% | "It is true! Garbage classification can reduce incineration hazards."<br>"A brief discussion on the deficiencies of the three regulations for domestic waste incineration plants to disclose emission data." |
| Policy responses | 15 | 4.27% | "Ministry of Ecology and Environment issues 'Rules for automatic monitoring and data marking of domestic waste incineration plants used for power generation.'"<br>"Ministry of Ecology and Environment issues 'Standards for controlling fly ash pollution caused by domestic waste incineration.'" |

Note: the statistics were prepared based on the content of the public WeChat account.
Source: authors.

13. Paul Connett, *The Zero Waste Solution: Untrashing the Planet One Community at a Time*, White River Junction: Chelsea Green Publishing, 2013, p. 63.

**Table 3.** Examples of offline activities related to waste incineration

| Type of activity | Theme | Examples of activity names |
|---|---|---|
| Lectures | Popularisation of knowledge on waste incineration | Civilian supervision of waste incineration plants<br>Supervision of waste incineration is a task that must be done |
| Seminars | Discussion on management of waste incineration | Seminar on the current status of the waste incineration industry<br>Seminar on information disclosure by the waste incineration industry |
| Sharing sessions | Sharing of information on waste incineration | "Do not burn garbage near my house": Briefing on the findings from the previous phase<br>Sharing from the Zero Waste Forum: Experiences of Shenzhen and Shanghai on garbage classification |
| Training sessions | Teaching ways to carry out garbage classification | Training for the organisers of community waste management<br>Skills training on urban garbage classification |

Note: prepared by the authors based on their own observations and records.
Source: authors.

While online communication is ongoing, offline and face-to-face communication activities also occur. Through various lectures and seminars on waste incineration (Table 3), non-core experts on various subjects conduct face-to-face exchanges of knowledge, information, and management methods related to incineration. These dialogues echo what social and natural science scholars have identified as the development of "hybrid forums," where scientists, experts, activists, and concerned citizens are brought together to form a collective. Consequently, the efficiency of knowledge dissemination is improved and knowledge innovation is facilitated.

### *Efficiency-enhancement link: Seizing the opportunity for knowledge empowerment*

The essence of environmental risk communication is the struggle of different actors to generate knowledge and gain the right to speak. Compared with the authoritative community, the lay community is at a disadvantage. The efficiency-enhancement link aims to provide a venue for the dissemination of information on incineration risks, seize the opportunity to endow lay knowledge with more power through the leverage effect, and enhance influence in environmental communication and decision-making. This is manifested through two strategies. First is leveraging the power of major events to stir up social concern. When the NIMBY movement against incinerators received widespread attention as a major event, the lay community ingeniously leveraged it to jointly present knowledge on incineration risks and stories on protests. Rationality becomes more powerful when packaged using sensibilities. Simultaneously, it attempts to shift the short-term focus of the people's resistance to long-term attention by promoting waste sorting and holding waste management seminars. This facilitates the exchange of knowledge and lays the foundation for further improving the lay knowledge system. Second is leveraging national strategies to maintain political correctness. Waste sorting has been highly valued since 2016, with a waste-free society as a national strategy. Hence, a point of intersection exists between civilians being anti-incineration and the official authorities being pro-incineration. The lay community firmly grasped this opportunity and adjusted its knowledge standpoint and chosen discourse. For example, it no longer directly criticises; the focus of discussion has shifted to the relationship between incineration and waste sorting to respond to the national strategy. Several articles and reports have mentioned that encouraging incineration may hinder the waste separation process.

The knowledge-enabling mechanism has allowed lay knowledge to gain public support. Furthermore, it has also received official recognition to a certain extent, contributing to the optimisation of policies on incineration management. In recent years, the Ministry of Ecology and Environment has repeatedly invited ENGOs to attend discussions on the supervision of pollution caused by incineration plants and the prevention and control of NIMBY incidents. The ministry has also actively responded to relevant proposals that ENGOs have entrusted to representatives of the National People's Congress and Chinese People's Political Consultative Conference for submission on their behalf. It has also successively issued policy documents to lend support at the national level for the clean operation of incineration plants. Separately, the Ministry of Finance issued the "Implementation plan for improving the construction and operation of biomass power generation projects."[14] These plans clearly state that subsidies from the central government for power generation facilities based on waste incineration should be gradually reduced and further subsidies redirected toward waste sorting and transportation.

14. National Development and Reform Commission 中華人民共和國國家發展和改革委員會, "完善生物質發電項目建設運行的實施方案" (*Wanshan sheng wuzhi fadian xiangmu jianshe yunxing de shishi fang'an*, The implementation plan for the construction and operation of biomass power generation projects), 11 September 2020, https://www.ndrc.gov.cn/xxgk/zcfb/tz/202009/t20200916_1238868.html (accessed on 16 September 2020).

## Discussion and conclusion

In this study, lay persons were regarded as a diversified community. A systematic analysis of their knowledge generation around the issue of technological risks of waste incineration comprised various aspects, including the main structure, paths of cooperation, shaping mechanism, and content system, which offers an interesting contrast to STS studies and literature in the West. This led to a demonstration that within a risk society and with increasing technological reflexivity and overall improvement in the public's scientific literacy, discussions on environmental risk and decision-making are no longer the prerogative of experts and scholars alone. The public can build knowledge within the community through continuous learning, mutual support, and leveraging one another, thereby becoming experts themselves (Epstein et al. 1996). By making concealed information visible, they can use various means of communication to influence and convince a larger group of people. More importantly, from interviews with the lay community and continuous development in anti-incineration processes, we can see that "using knowledge to fight knowledge" is not a temporary or individual action, but an action choice of lay persons from "freedom" to "self-consciousness" and "self-determination." It is increasingly becoming a trend in environmental protests and environmental risk governance in China.

Theoretically, three contributions have been made by this study. First, it supported the research conclusions of existing literature (Wynne 1993); thus, knowledge is recognised as being scattered, and it is observed that expert knowledge is not the sole property of the experts (Wynne 2004). If bureaucratic and institutional hurdles are crossed, lay knowledge can serve as a guideline for official regulatory science to identify pollution hotspots and monitor the environment with a more holistic view (Tu 2021). Therefore, incorporating the public into the environmental decision-making process is a means of ensuring that "diverse voices" are heard and recognised (Irwin 1995; Blowers, Boersema, and Martin 2005). Noting such, we should introduce an expanded peer community involving the participation of all stakeholders who are profoundly affected by the consequences of scientific and technical decisions. The process of transforming the environmental governance model from a bureaucratic to a collaborative one must be hastened. Second, further attention was paid to the inherent diversity and heterogeneity of lay persons and their networks. Focus was placed on explaining the ways non-core experts examine the social risks inherent in technological applications from an interdisciplinary perspective and the ways that ENGOs as risk alerters facilitate dialogue and complementarity between different forms of knowledge. This will improve the scientific knowledge system and enhance the robustness of environmental decision-making. Third, a detailed analysis was made of the mechanism for knowledge generation, content elements, and skills for attaining legality by lay opponents during the process of applying, disseminating, and disputing science and technology. This enriched and expanded the structural system of lay knowledge. A new path to express dissent against policies in contemporary Chinese society was also presented, contributing to an in-depth understanding of the true nature of environmental conflicts.

Practically, this study presented a picture of hope mixed with fear regarding the new phenomenon of public participation in environmental risk management in contemporary China. Positively, the possibility of shaping environmental citizens has been demonstrated. In the process of doubting and resisting environmental risks, they moved from downstream to upstream in the information flow. They acquired and even generated knowledge by traversing barriers between various disciplines, thereby making visible environmental problems that have been concealed. Further, the balance of power between stakeholders involved in risk communication was restored. We confirm that the public can use knowledge as a medium to express their opinions to push the government to reconsider its own prejudice that public knowledge is ignorant and irrational. Hence, the government will pay attention to social voices. Last, the quality and acceptability of environmental decisions was improved. Jasanoff (2003) noted that the public participates in decision-making not because a certain mystery surrounds that process, but because doing so can help ensure that expert knowledge meets the broad cultural standards of society and help optimise decision-making.

Negatively, above all, there is the possibility of creating a new crisis of confidence. When lay persons apply risk knowledge to deconcealment, they not only unlock the "knowledge black box" that the authoritative community strives to simultaneously ignore and conceal, but they also reveal the government's strategic decision-making skills. This inevitably arouses public doubt about their knowledge, commitment, and professional ethics, leading to a systemic crisis of trust. Moreover, social conflicts may intensify. The comprehensive display of technical risks has given the public new evidence when defending their rights that prompt different actors to evolve from pure disputes over their respective interests to deep divergences of interests, security, and ethics. All parties regard victory as their main quest and attempt to suppress the other parties. It easily intensifies the contradictions between social groups, causing the relationship between all parties to be as taut as a rubber band that can snap with the slightest wrong movement. Finally, the efficiency of public decision-making may be compromised. Deliberative democracy can cultivate refined and tolerant citizens, while the adjudication of expert knowledge, assurance of mechanisms for participation, and inclusion of public wisdom help increase the robustness of environmental decision-making. However, these results are not automatically generated; various obstacles must be overcome, and time and financial costs must be invested (Ryfe 2005). This runs counter to the current pursuit of rapid development in China.

Given the dichotomy of contributions and limitations, we cannot help but ask ourselves: to what extent can environmental decision-making be disputed in the public domain, and to what extent are such disputes beneficial to decision-making? How do we facilitate the flourishing of the positive aspects of lay knowledge while suppressing, or even eliminating, the negative aspects? From the perspective of this research, the conundrum cannot simply be expressed as one or the other. Politics is no longer able to hide behind scientific controversy (Sarewitz 2004). We need proper democracy to protect the citizens' environmental rights and absorb people's wisdom. Simultaneously, science cannot disappear

from the scene since professional knowledge must adapt to the requirements for the modernisation of environmental governance. The crux is finding the appropriate proportions of the two to be allocated under different scenarios or for various issues. Doing so promotes mutual acceptance and inclusion between both parties, which can lead to a humanistic and rational equilibrium between power and knowledge, and between thinking and analysis. It will also be interesting to see further studies and more cases to continue analysis of different scenarios or for various issues in lay knowledge generation.

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