



How to Improve Environment Performance? The Comparison of Stakeholder Perceptions on How to Improve Air Quality in China

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The air quality and carbon neutrality strategies in China has attracted the growing concern of multiple stakeholders. Through face-to-face surveys conducted in five major cities in North China, we compared the stakeholders' perceptions. Our research reveals conflicting perceptions among stakeholders. On the one hand, local authorities and academics prefer to focus on market-based regulation to prevent air pollution. Enterprise managers, however, do not want to be regulated. On the other hand, social groups expect more information about air pollution to be released, but local authorities do not see releasing that information as a top priority. These differences of perceptions can actually be useful in terms of policymaking.

Keywords: perception, air pollution, comparison, stakeholder, China

INTRODUCTION

Along with rapid urbanization, the air pollution problem in China has drawn wide concern from different social sectors. For example, the hazy weather that appeared in almost all provinces in 2021 has focused the attention of local governments, citizens, non-government organizations and other organizations. These parties assessed the damage caused by the hazy weather and made suggestions for improvements. However, we should know that the relationship between air pollution and its effects are mediated by people's perceptions (e.g., interpretation and response) of the air quality (Kasperson et al., 1988). This fact has driven the development of research into risk perceptions. In this instance, risk perception is a human being's evaluation of the level of risk in a situation, associated with the uncertainty of that risk. Air pollution causes risk perception. Essentially, air pollution affects the attitudinal process that tries to understand the gap between expert and lay perceptions of environmental risk. Pollution is also related to broader social factors and processes. These factors include locality, agency, trust and communication (Bickerstaff, 2004). However, assessing the quality of environment services for different stakeholders is difficult, because every person has his or her own risk perception and risk-bearing capacity. The attitudes of an individual toward risk can only be understood when associated within a specific context (Acedo and Florin, 2007).

We should know, however, that the perspective of a stakeholder's subjective perception is important, because that perspective and perception tells us the degree of awareness among people. That is important information for policy makers to have, as they attend to the problem of how to reduce air pollution. Stakeholders can also be seen as part of the problem. In many cases, a change in their attitudes and behavior is needed. Many studies have shown that the perceptions of stakeholders are useful with regard to policy development (Chanthawong and Dhakal, 2016). For instance, the

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existing approach to environmental policy-making in China is top-down. The existing approach also lacks integration across different government agencies and other stakeholders. This type of approach means governments cannot effectively address the complexity of environmental problems. In addition, the perceptions of experts and think tanks could make any new policy more scientific and objective. What needs to be pointed out, then, is that the stakeholders should be selected carefully. The wrong stakeholders' perceptions and participation may not result in greater environmental policy outcomes (Newig and Fritsch, 2009). One reason for this fact may be that some stakeholders' perceptions are non-scientific. However, even non-scientific perceptions can actually lead to a more democratic result (Maier et al., 2014). Democracy is also important in terms of policy-making. Therefore, we should incorporate different perceptions of both a scientific and democratic nature. Taking into consideration the perceptions of citizens is a democratic approach.

This paper aims to evaluate the perception of air pollution in order to improve air quality on the basis of a stakeholder perspective. The main research questions are: What are the perception differences between stakeholders? Also, what are the differences in their (the stakeholders') suggestions on how to improve air quality?

The remainder of this article is structured as follows: The literature review highlights the importance of using the stakeholders' perspectives to address the problem of air pollution. The following section presents the theory frameworks. The methodology section clarifies the methods of data collection and analysis. The subsequent section describes the research findings. Finally, the last section of this paper presents our conclusions, which concludes with the main contributions.

BRIEF HISTORY OF AIR POLLUTION PERCEPTIONS RESEARCH

The earliest studies of public attitudes to air pollution were conducted in the 1950s and 1960s. These studies used social survey techniques to research public perceptions, in order to investigate the possible relationship between air pollution and health. For instance, Smith et al. (1964) collected opinions from nearly 3,000 people to discuss their concerns about the possible adverse effects of air pollution on health. The Smith study recommended that governments should rely on purely technical solutions to solve the air pollution problem (Groot, 1967).

Owing to a dozen special television broadcasts, numerous magazine reports and environmental groups efforts, the spring of 1970 was a milestone in the effort to increase public awareness of environmental problems (Murch, 1971; Gray et al., 1973). The general thinking was that the public would play a major role in reducing air pollution. Therefore, multiple studies investigated the perceived damage from air pollution and the ways to reduce the associated problems. Proposed solutions included assessing people's willingness to donate money to support a public effort to combat air pollution. However, few studies continued to focus on air pollution during the 1980s. The studies during that decade

paid more attention to other environment issues, such as global warming and acid rain (Saksena, 2011).

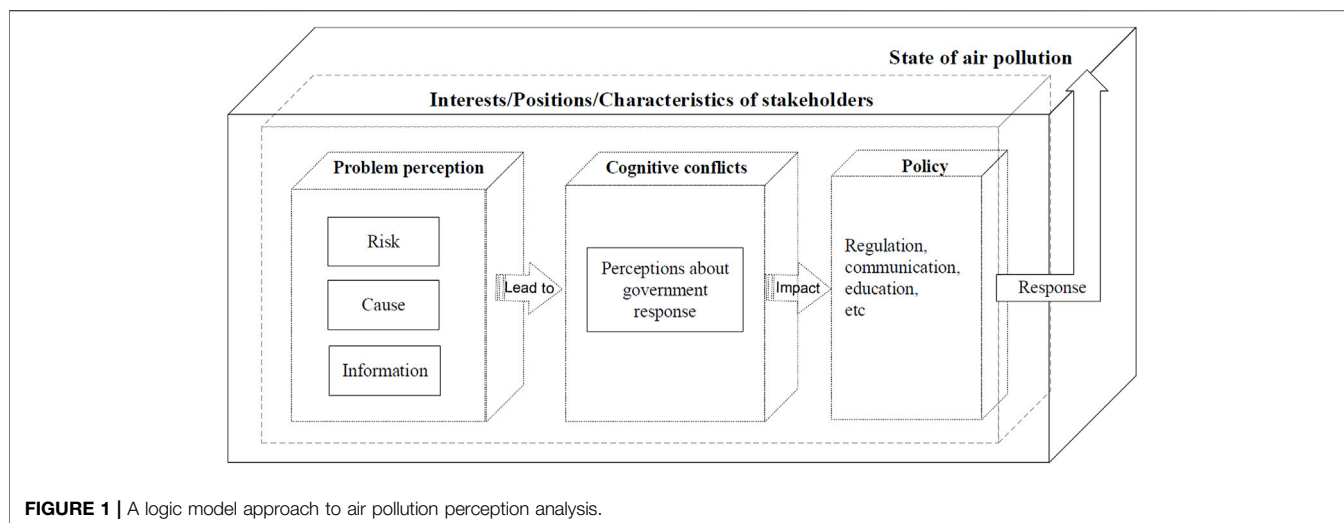
After 1990, there was renewed interest in researching the air pollution issue. Those studies, however, delved much deeper into the issue than ever before. The researchers realized that environmental indicators played an important complementary role in air quality observations (Cole et al., 1999). They were also aware of the fact that air quality information was an important means by which to effect perceptions and behavioral changes (Beaumont et al., 1999; Bickerstaff and Walker, 1999).

After 2000, more and more research focused on how the social, cultural and economic contexts (such as sex, age and education) could affect the public's experience of air pollution (Bush et al., 2001; Bickerstaff, 2004; Kan et al., 2008). For instance, Badland and Duncan (2009) showed those people who were more highly educated or who were living in major cities were more likely to recognize the fact that air pollution harmed their health. Kim et al. (2012) found that the degree of perceived air pollution was higher among those of a younger age, a higher level of education and a lower household income. In addition, Ngo et al. (2017) found that participation in solving the problem could help residents understand air pollution and help them develop a response to that pollution. Those facts indicate that the research of air pollution perceptions is a multidisciplinary study.

This paper argues that any effort to improve air quality should take into consideration the multiple and sometimes conflicting perceptions of all correlated stakeholders. These stakeholders may have conflicting viewpoints on how to improve air quality, because of their different social, cultural and economic backgrounds and experiences. Under such conditions, this paper uses the theory of cognitive conflicts to develop an integrated framework that describes the perception differences of academics, local authorities and local citizens.

ENVIRONMENT PROBLEM PERCEPTIONS AND COGNITIVE CONFLICT

From the above section, we know that stakeholders may have different perceptions of the air pollution problem. Their perceptions may vary with regard to the existing or potential future problems of air pollution (the consequences, causes and demarcation of the air pollution problem). Opinions may also vary with regard to the possible situation (possible changes and the availability of solutions to the air pollution problem), the desired situation and the yardsticks by which to evaluate the existing situation (Koppenjan and Klijn, 2004). The above facts clearly indicate that the stakeholders do not share a common problem definition. As such, their perceptions are difficult to change, because they are based on the frame of reference of each individual, organization or group involved. In reality, solving the problem of air pollution problem will require cooperation from all parties. However, many of the partners often hold different perceptions and measure the problem and potential solutions with different yardsticks. These different perceptions entangle the partners, resulting in an asymmetrical frame of mind. This condition, in turn, causes misunderstanding and conflicts. We call this cognitive conflict. Therefore, cognitive conflict occurs



when partners or stakeholders discuss and debate their various preferences and opinions about the same problem or task (Mooney et al., 2007).

Cognitive conflict makes cooperation difficult. However, this does not mean that this kind of conflict should be abandoned. Everything has two sides. The stakeholder debates may in fact promote better decision making, because these debates may force governments to synthesize multiple environmental views. Many studies have proved that cognitive conflict can promote the exchange of ideas, encourage the understanding and acceptance of each other, and then improve the quality of decision-making and democracy (Amason, 1996).

Those conflicting relationships are considered in the framework for analysis presented in **Figure 1**. *State of air pollution* represents the survey participants' perceptions of the state of air pollution. Here, air pollution means the physical, chemical and biological changes of air quality caused by haze. *Interests/positions/characteristics of stakeholders* describes the cultural and educational background of the stakeholders. Some studies have found that local knowledge (obtained through social interaction) plays an important role in shaping perceptions (Howel et al., 2003). *Problem perception* represents symptoms, which relates to stakeholders' perceptions of air pollution risks, effects, causes and so on. This category includes the perception relating to the causes and sources of pollution, the risk perception of stakeholders and the risk bearing capacity. *Cognitive conflict* represents the stakeholders' view on how the government should respond and intervene in the air pollution issue. The stakeholders' different perceptions of air pollution make up their cognitive diversity. *Policy* means the government's response to the air pollution symptoms. Any policy must address the perception risks, effects and causes that must be targeted by regulation, market instruments, communication, and/or education.

The above framework is based on a concept of causality that implies the public's experience of haze induces their problem perception. Different perception will lead to cognitive conflict. Those cognitive conflict may be useful for policy-making. In a wider sense, the framework forms an environmental policy cycle that includes experience perception, problem analysis and policy response.

METHODS

Study Areas

Our study areas focus on cities in the north of China (including Shanxi, Hebei, Liaoning, Jilin, and Heilongjiang provinces). The focus areas include *Taiyuan* city, *Shijiazhuang* city, *Dalian* city, *Changchun* city and *Harbin* city, which are located in Shanxi Province, Hebei Province, Liaoning Province, Jilin Province, and Heilongjiang Province, respectively. The North area is an important center of heavy industries and the coldest region of China. winter temperatures can dip to around -40°C in *Harbin* and *Changchun*. This area has more air pollution problems than other areas of China. Especially in the winter, the north area has no choice but to consume more coal for heating purposes. Both the concentration of heavy industries and the burning of extra coal in the winter make the air quality of the north cities a serious problem.

Survey Development

Our survey consisted of questions on people's perception of the level of air pollution, their perception of the risk to health posed by air pollution, and their perception of how governments should respond to the pollution. We expected the respondents to complete the survey in about 30 min. We adopted a mixed-methods design, which included a survey of the stakeholders. The survey was followed by semi-structured interviews with the stakeholders. The first part of the questionnaire captures each respondent's information. From this, we learn the context of each stakeholder. The second part includes 12 questions (see **Table 1**). These questions are used to test our framework in **Figure 1**. From questions 1 to 9, we conducted a structured interview. These questions have only a limited number of possible answers. From questions 10 to 12, we conducted a semi-structured interview. These are open questions.

Participants and Data Collection

The data collection for the five cities was completed through face-to-face interviews, from 2018 to 2020. The social construction

TABLE 1 | Illustration of stakeholders' survey.

| Information of Respondents | — | Questions |
|-------------------------------|-----|--|
| State of air pollution | Q1 | How is the air pollution in your living city? |
| | Q2 | Do you think the air quality is more serious than 3 years ago? |
| | Q3 | How much attention have you paid to air pollution? |
| Problem perception | Q4 | Do you think air pollution poses a health risk to your body and your family? |
| | Q5 | What are the air pollution sources in your living city? |
| | Q6 | From which channels can you get information on air pollution? |
| | Q7 | Do you think the information about air pollution prevention is adequate? |
| | Q8 | What actions have you taken to reduce the risk of air pollution? |
| | Q9 | Do you know of some policies for the prevention of air pollution? |
| Cognitive conflict and policy | Q10 | How do you think you could prevent air pollution effectively? |
| | Q11 | Could you give some advice to the Department of the Environment? |
| | Q12 | Which departments do you think should be responsible for air pollution? |

theory addresses the ways we think about and use categories to structure our experience and analysis of the world. Similarly, we used this theory as a principle by which to select two scientifically and presumably objectively-oriented stakeholders (local authorities and academics), in contrast with two more subjectively-oriented stakeholders (enterprise managers (lobbying groups) and social groups) (Lim et al., 2016).

The term *local authorities* refers to the Commission of Development and Reform (CDR), and the Department of Transport (DT). The former is in charge of the affairs leading to the approval of investment. Therefore, the CDR is related to and responsible for the solving the problem of air pollution from industry. The latter (DT) is related to air pollution from transport. Some studies have focused solely on air pollution from industry and traffic (Geelen et al., 2013). *Enterprise managers* refers to the managers who work in the machinery and energy industries. These businesses will, of course, be affected by the outcome of any new and relevant environment policies (Althoff and Greig, 1974). *Academics* refers to the scholars who carry out research related to the environment. We believe that these academics have the necessary expertise in air pollution prevention. *Social groups* refers to media, and the media refers to people who work in local newspaper offices, TV stations and radio stations. Local authorities and academics have objective information on air pollution and the associated risks. These authorities must also uphold public health standards. Enterprise managers, as the interest groups, care more about the economics of production, while the language of the public and media may show the most subjective and varied perceptions of air pollution (Lim et al., 2016).

As Lim et al. (2016) describes the stakeholder role in policy changes and debate (as outlined above), we have some expectations about what types of language will be used by each stakeholder.

- Expectation 1: Local authorities have professional departments to monitor air quality. These authorities have the ability to acquire pollution information. We suppose that their perceptions are objective.
- Expectation 2: Enterprise managers' perceptions may vary across different industries. The machinery and energy industries in the north of China are highly polluting. The

enterprises are also profit-oriented. We suppose that the enterprise managers' perceptions on how to reduce pollution are subjective.

- Expectation 3: Academics would present objective information on their air pollution perceptions. We suppose that their perceptions are objective.
- Expectation 4: Social group perceptions generally care about the risks and effects of pollution. However, these groups do not have enough information. We suppose, therefore, that their perceptions are more subjective.

All the interviewed stakeholders are working and living in the five cities. As such, they are familiar with the state of their local air quality. The entire sample group consists of non-probability sampling selected. We adopted the method of snowball sampling, i.e. asking the initial interviewees to suggest other important participants for further interviews (Hysing, 2015). In these interviews, we obtained more detailed information regarding the perception of air pollution. We interviewed 105 respondents over 2 years period.

RESULTS

Stakeholder Perception of the State of Air Pollution

Question one is "How is the air pollution in your living city?" From our investigation, we can see that 75% of respondents think their city's air pollution varies on a seasonal basis. They say the air pollution will be serious in the winter. Furthermore, we can see that the percentage of enterprise managers who feel air pollution is a problem is the highest, followed by the academics and social groups. No one thinks the air is clean. Question two is "Do you think the air quality is more serious than 3 years ago?" Here, 69.4% of respondents think air pollution is more serious than it was 3 years ago. For this question, the percentage of local authorities who feel pollution is worse is the highest. Question three is "How much attention have you paid to air pollution?" Here, 54.2% of respondents care about the air pollution problem, especially the enterprise managers. Other respondents also show great concern about the air pollution problem. These results show that, even though stakeholders place difference emphases on the state of air pollution,

most of them share the same perception (that air pollution is especially serious in the winter).

Stakeholder Perception on the Risk of Pollution

Question four is “*Do you think air pollution poses health risks to your body and your family?*” Most of the interviewees think air pollution poses health risks. Nearly all stakeholders have similar opinions on this question. Question five is “*What are the air pollution sources in your living city?*” For this question, 83.3% of the interviewees selected the heating and generating answer. They argued that a high energy-consuming industry makes the air pollution more serious. This was especially true of the enterprise managers. Likewise, additional research showed that none of the socio-demographic variables had significant differences in their perception of air pollution causes and effects in Mexico City (Landeros-Mugica et al., 2014). Question six is “*From which channels can you get information on air pollution?*” Most of the respondents selected the media as their major source. In the age of the internet, people can easily collect information more widely and rapidly. Question seven is “*Do you think the information about air pollution prevention is adequate?*” Here, 84.7% of the interviewees said they do not have enough information to prevent pollution. From this result, we can see that none of the enterprise managers currently receives enough information to prevent air pollution. Other stakeholders can, more or less, obtain enough information through various channels. Some studies have shown that open communication and/or stakeholder involvement are the keys to improving the perception of safety (Geelen et al., 2013). Question eight is “*What actions have you taken to reduce the risk of air pollution?*” Most stakeholders elect to wear masks and reduce outdoor activities. A few have taken steps to reduce emissions, such as driving less. Question nine is “*Do you know of some policies for the prevention of air pollution?*” Here, 44.4% of the respondents said they know of some policies relating to the prevention of air pollution. Other interviewees say that they want to know the policies, but they do not know how to obtain the information relating to those policies. Just as with the interviews conducted by Chen et al. (2017), many Chinese people expressed their sense of powerlessness when faced with air pollution.

Stakeholder Perception of How to Improve Air Quality

All of the surveyed academics think the most effective way to reduce air pollution is to reduce emissions. Most of the other stakeholders also think that emission reduction would be effective. However, from the answers to Question 8, we know that most of the stakeholders wear masks to protect their personal health, not to help in the reduction of emissions. We do not get the same answers to Questions 8 and 10. Therefore, gaps exist between the respondents’ perceptions and their actions.

To discover the similarities of and differences between stakeholders’ advice to the environment department, we used the content analysis method to study word frequency during the interviews. The local authorities argue that air pollution stems from a lack of regulation and education. They also think that emission reduction and energy

conservation methods will play vital roles in the future prevention of air pollution. As such, they think the government should regulate the market and reduce emissions. At the same time, the public should be educated on how to save energy. The enterprise managers think that heating and car exhaust are the main sources of air pollution, followed by dust pollution and burning straw. In their opinion, the government should reduce pollution from those sources. For example, some managers stated that “*governments could disseminate the knowledge of how to prevent air pollution, and they should encourage the public to travel by public transport.*” Another stated, “*To save energy, government should replace decentralized heating with central heating in winter.*” The academics share the local authorities’ opinions. They also see government regulation as the most important means to reduce air pollution. In addition, the academics advocate green travel, media exposure and public participation. As one professor said, “*Governments should regulate the enterprises. The public, the media and others can take part in the process of regulation.*” All of the social groups emphasize the importance of media exposure. Education is also seen as having an important role, as agree by the local authorities and enterprise managers. Then comes public participation, an opinion shared with the academics. “*Governments should release air pollution information to the public in time. They could organize the public to regulate the market and encourage citizens to reduce their exposure to pollution.*”

We again find some interesting results. Market-based regulation is seen by local authorities and academics as the most important way to prevent air pollution. However, such regulation is seen by enterprise managers as the least important way to prevent air pollution. This is clearly because the enterprise managers would be the ones to be regulated. They do not want to be supervised by regulators. In the eyes of the social groups, media exposure is the most effective way to reduce air pollution. However, only a few of the local authorities see media exposure as being important. Perhaps local authorities are afraid of having to deal with a crisis. Unexpectedly, all participants see punishment as the least important way to prevent pollution.

The last question is about which department should be responsible for reducing air pollution. It is often assumed that all relevant stakeholders agree that the department of the environment should be responsible. The reality, however, is more complex. Most of the respondents have given us their choices. Most enterprise managers selected the environment department. Half of the local authorities and the social groups also selected the environment department. Less than half of the academics think the environment department should be responsible for reducing air pollution. The main reason given by the academics for this opinion is that “*The environment department is good at the management of the environment, and they already have the right to punish the market (polluters) according to the Environment Protection Law.*” However, some of the stakeholders believe that multiple sectors should take responsibility for reducing air pollution. In addition to the environment department, the commission of development and reform, the department of transport and others were listed as potential contributors to the reduction of air pollution. The sources of air pollution are varied, and are related to multiple sectors. For example, one respondent stated, “*The environment department is responsible for industrial air pollution. The housing department is responsible for dust pollution*

from building construction. The police department is responsible for the transport emissions." In addition, a few respondents suggested that local mayors must take responsibility for reducing air pollution. After all, mayors in China have decision-making power with regard to industrial development and urban planning. Their philosophies and strategies determine the fate and future of a city. For instance, one respondent advised, "It is necessary to set up a cooperation committee. The mayor is the leader and coordinator of the committee, with the multiple sectors as the members of the committee."

CONCLUSION

Due to the rapid rate of urbanization in China, people face more air environmental risks than during any other period in history. The public perception of air pollution is one of increasing concern. O'Connor et al. (1999) showed that knowledge increases people's willingness to take the necessary actions to address environmental problems. However, people grasp the necessary knowledge in different way, from different sources and at different levels. In addition, different people have a wide variety of backgrounds and social experiences. As such, many people have different perceptions of pollution and the related hazards. In this context, we construct a framework and take the case of north China to discuss stakeholder viewpoints and cognitive conflicts on the subject of air pollution. Some interesting findings follow.

Firstly, all of the stakeholders admit the reality of air pollution and its risks. Most of them choose to wear a mask to protect themselves from air pollution. Why is their behavior not consistent with their perceptions? One possible explanation is the behavior motivation. If an individual holds a egoistic motivation, his/her actions would not match his/her words. Conversely, if an individual holds a altruistic motivation, his/her behavior may consistent with his/her words. To help citizens "walk the talk," Litvine and Wustenhagen (2011) showed that providing information and communication can positively influence stakeholder actions in terms of achieving a green environment. Communication can reduce uncertainty or information asymmetry. Thus, communication would increase the possibility of altruism. However, our findings show that most stakeholders do not know how to get the requisite information about pollution prevention.

As well as the issue of consistent stakeholder perceptions, we also discovered cognitive conflicts between them. On the one hand, these findings show conflicts between local authorities and the market. The former takes the view that market-based regulation is the most important means to reduce air pollution. They emphasize that the market should be regulated (e.g., price and production). However, enterprise managers do not want to be regulated. They attribute air pollution to car exhausts and heating. On the other hand, our findings also show the conflicts between local authorities and social groups. The former group states that media exposure is the least important means reduce air pollution, while the latter group sees media exposure as the most important way of obtaining information to reduce pollution. Local governments are also reluctant to release air pollution information to the public.

In our opinion, there are a number of contributions our study could make to environmental policymaking. The first is that

policymakers should consider the participation of stakeholders, simply because the stakeholders have cognitive differences on the causes of and solutions to air pollution. Those cognitive conflicts are useful to policymaking (Jehn, 1997). The second contribution is to consider which department should be responsible for the air pollution problem. In May 2010, the State Council of China issued the *Joint Prevention and Control of Air Pollution* (Zhang et al., 2016). This is the first comprehensive policy document aimed at improving air quality through government department cooperation. Local governments should weigh the air pollution matter seriously. In most Chinese cities, the environment department is responsible for environmental services. This system, however, does not work well. According to our study's conclusions, multiple-sector cooperation may be a better choice. The last contribution of our study is to consider which types of environment management tools are most effective. Our research finds that market regulation, media exposure, education and emission reduction attract a great deal of attention from stakeholders. However, the punishment tool is not seen as important by any group of stakeholders, which is inconsistent with existing policy instruments or previous studies. Existing policies and studies focus on intensifying penalties (Feng and Liao, 2016), but few of them discuss the importance of communication in policy-making and implementation. Environmental protection is a complex, wicked problem, with substantive, strategic and institutional uncertainties (Koppenjan and Klijn, 2004). These uncertainties can increase cognitive conflicts. Communication or negotiation can reduce these uncertainties. Communication can be defined as information exchange, which then increases transparency. Transparency in this case is the availability of information about one participant that allows other participants to monitor the performance of the first participant (Meijer, 2013). From this point of view, communication (or transparency) is an effective way to reduce cognitive conflicts.

Nevertheless, some limitations in this research do exist. The first limitation is the object of our study, which only has four categories. Some non-governmental environment organizations should be included in our future research. Moreover, due to time restrictions, our research samples only covered five cities in north of China. We also interviewed only 105 respondents. In a future study, we will make up for these inadequacies.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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