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Domestic Constraints of Sino-South Korean Environmental Cooperation: the Case of Trans boundary Air Pollution

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Abstract

A transboundary environmental problem refers to an environmental problem that goes beyond a country's territory and damages neighboring countries. It is a difficult problem because, basically, it is a natural, rather than intentional, effect, and it is extremely hard to make a scientific consensus on the cause-effect relations between upstream and downstream nations. Air pollution, especially PM 2.5 and PM 10, is one of the typical cases of transboundary environmental problems in the Northeast Asia. This paper analyzes the constraints of environmental cooperation between China and South Korea to address transboundary air pollution issue. It argues that lack of trust and ideological hostility, rather than, scientific uncertainty, is the biggest obstacle for effective cooperation, and these hostile discourses and ideas are mostly generated by media in the downstream nation, the South Korea. In order to identify how South Korean media frames this issue, this paper searched newspaper articles in the six representative South Korean newspapers during the period of 2014 and 2020, and analyzed about 2,000 articles selected. It finds that South Korean media has framed the transboundary air pollution as a China bashing and related domestic political cleavage issue, while it neglects to show the cooperation attempts that the two countries have made to date. Also, while the media focuses on

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China hate frame, it has never reported the Chinese government's domestic policies to reduce air pollution and their results. Media's overuse of hate and blame frames not only has disrupted trust building but also it will delay a possible turning point of environmental cooperation between the two countries in the future.

Keywords
Air Pollution, China-South Korea Relations, Environmental Cooperation, Transboundary Environmental Problems, Media, Hate/Blame Frame

Ⅰ. Introduction

Transboundary environmental problem refers to an environmental problem that goes beyond a country's territory and damages neighboring countries. This is a difficult problem because, basically, this is a natural, rather than, intentional phenomenon. Air and water pollution has transboundary nature and their movement is affected by topographical and meteorological conditions. Moreover, it is a hard case in terms of technical and legal judgement because states often do not make consensus on the results of scientific research on the creation and movement trajectories of transboundary pollution. Even in the case of upstream-downstream situation where the 'source' and 'receptor' countries are clearly identified, it is very difficult to figure out the exact amount of damage caused by the source countries in a scientific manner, and therefore, the source countries often do not accept the scientific results and are reluctant to take the responsibility.

In spite of these scientific, technical, and legal difficulties, however, there are some cases, although very limited in number, in which states attempt to cooperate and establish a regional environmental treaty to cope with transboundary environmental problems. For example, the Convention on Long-Range Transboundary Air Pollution (CLRTAP) was agreed in 1979 among European countries to address acid rain problems caused by air pollution travelled from neighboring countries. They cooperated for information sharing, joint research and investigation, and establishment of sulfur dioxide reduction plans in each member country. From 1984 to 1999, they successfully adopted 8 protocols containing specific reduction targets, methods and deadlines, and implemented most of these

agreements. In this process, the role of European Monitoring and Evaluation Program was decisive. It played a role of a scientific community in which scientists and specialists from member countries shared data and conducted joint scientific research projects.

The haze is the typical transboundary environmental problem in Southeast Asia. It is caused by burning biomass in the palm tree plantation regions such as South Sumatra and Kalimantan in Borneo, Indonesia, and to a less extent regions in Malaysia and Thailand. The haze (high concentration of airborne particulate matters) moves to Singapore, Malaysia, Thailand, and generates serious air pollution even in palm oil producing countries themselves as well as neighboring countries. In 2002, the ASEAN Agreement on Transboundary Haze Pollution was adopted to promote regional environmental cooperation to tackle the haze problem. Although Indonesia, the most important country (the biggest source country), ratified this agreement later in 2014, and the agreement has no legally binding obligations, the establishment of an institution in a region is a very important first step towards a deeper interactions and cooperation among member countries.

In Northeast Asia, the biggest and the most representative transboundary environmental problem might be the air pollution (particulate matters, PM). Particulate matter refers to air pollution matters of which the diameter is less than 2.5 μm or less than 10 μm. The former is called PM 2.5 and the latter is called PM 10. In terms of the relation between China and South Korea, China is a source country and South Korea is a receptor country. However, China could be a receptor country in relations to Mongolia. This is due to the westerly prevailing in the region. Therefore, it is basically upstream-downstream problem.

There have been a lot of attempts for regional environmental cooperation in the Northeast Asia to date. China, Japan, and South Korea carried out a joint scientific research on long-range transboundary air pollution (LTP) from 2000 to 2019. At first, they measured air pollutants such as sulphur oxides (Sox) and nitrogen oxides (NOx) but, from 2013, PM 2.5 was included. In 2015, the Korea-China Joint Team for Air Quality Investigation was formed and began to analyze the causes of air pollution jointly. In June 2018, Korea-China Environmental Cooperation Center was established in Beijing. Most recently, the Memorandum of Understanding on Clean Sky Project was signed during the regular meeting of Korea-China Environmental Minister Meeting held in November 2019.

In spite of these efforts, however, substantive level of cooperation has not been made, and therefore, the outcome of cooperation is very limited. As was mentioned above, in the process of cooperation to address transboundary environmental problems, the most critical step is to conduct joint scientific research and investigation, share information, and accept the results of joint investigation. None of the above cases of cooperation has reached at this step. In the case of the LTP, it was not actually a joint research and investigation. Each of the three parties implemented its own research and investigation with its own methods and technique of modeling. They had never coordinated each other about these methods or even shared any information on them during the whole process of investigation. In November 2019, the joint committee announced the results of investigation but the results were actually average of the three values resulted from three different investigations. No surprisingly, the governments and people in both China and South Korea did not accept

the results. Similarly, the Korean research specialists in the Korea-China Environmental Cooperation Center in Beijing are carrying out their own investigation without any actual cooperation with Chinese research specialists.

In this paper, we focus on the case of Sino-South Korean transboundary air pollution problem and argue that the fundamental reason for cooperation deficit between the two countries might be the low level of trust and ideological hostility among the government and people in the two countries. To analyze the role of trust in effective transboundary environmental cooperation, we emphasize the role of idea in international environmental cooperation. Idea is one of the three key words, together with interest and institutions, by which international relations scholars explain international cooperation. We argue that cooperation deficit is not caused by the considerations of national interest nor the absence of institutions. It is mostly caused by the negative national image and antagonistic feelings on the partner country, which is a matter beyond the environmental problem. We especially emphasize the role of media, particularly in South Korea, that produces these negative images and feelings on China. This is important because it is usually the case that people in receptor countries have a negative image on the source countries due to the transboundary problem, and this image can be rapidly developed into hate feelings and antagonism.

In the next section, we introduce existing literature on the role of ideational factors, discuss the importance of scientific consensus in international environmental cooperation, and provide a theoretical framework for analysis. The third section explains how China and South Korea have addressed their own air pollution problem respectively and illustrates the results. The fourth section analyzes how media in South Korea (down-

stream country) produces negative and antagonistic feelings on China (upstream country) by conducting media frame effect investigation with 6 major South Korean newspapers. The fifth section provides conclusions and implications.

II. Theoretical Discussions

Scholars of international environmental politics have used three key words of international relations (IR) to explain international environmental cooperation. They are interest, institutions, and idea. First, those who focus on interest assert that states make decisions on international environmental cooperation based on the calculation of their national interest. When states participate in international environmental negotiations, they expect benefits resulting from cooperation and at the same time they are concerned about the cost that they have to pay for cooperation. Sprinz and Vaahtoranta (1994) point out that, in international environmental politics, ecological vulnerability and abatement cost are the two most important factors by which states calculate their interests. Based on these two factors, they classified four types of states in international environmental negotiations. They are pushers, draggers, intermediaries, and bystanders. According to their empirical analysis of the two cases, international environmental cooperation is usually made when there exist pushers who are ecologically vulnerable by the given problem but abatement cost that they have to pay is relatively small. On the contrary, cooperation is often delayed by draggers whose ecological vulnerability is relatively low but abatement cost is high. The interest-based explanations

give a parsimonious account for states' behavior in international environmental cooperation and became a foundation for further research progress in this field.

Second, institutions are a set of formal and informal rules, norms, and decision making processes deployed when states make decisions for cooperation. Specifically, scholars use a term 'regime' to include formal international treaties and various informal mechanisms for cooperation. There are cases in international environmental politics that institutions reduce transaction costs and provide solutions to address free rider problem, and therefore, overcome collective action dilemma and promote cooperation. Specifically, existing literature has shown that institutions are effective in making states cooperate if they have effective mechanisms for monitoring and punishment. By these mechanisms, states can verify their regime compliance, increase transparency, and improve regime effectiveness. One of the representative examples of effective environmental regimes is the International Convention for the Prevention of Pollution from Ships. This treaty was made to address the problem of intentional oil spill by oil tankers in their tanker washing process. The treaty was successful because, unlike previous approaches that would limit the location and quantity of oil release, it made tankers to mandatorily install crude oil washing devise or segregated ballast system by which tankers did not have to release oil anymore. These methods were costly but states complied because once tankers installed the devise, they did not have to concern about monitoring issue. In other words, the regime does not have to monitor every tanker whether they comply with the rules or not. Regime design was made to increase transparency and therefore increase regime effectiveness (Mitchell et al, 1999).

Third, ideational factors such as ideologies, norms, and culture are as important as interest and institutions. In some case, they play a critical role in international environmental cooperation. A certain level of environmental awareness in a society is necessary for the state to promote international environmental cooperation. What is important is, however, that environmental awareness is often heavily influenced by scientific information, culture and value system, and dominant norm of the society. Lack of scientific knowledge or cultural diversity sometimes disturbs cooperation. One of the most prominent scholarly works focusing on ideational factors might be the role of epistemic community in international environmental cooperation. Epistemic community is a network of knowledge-based experts who share a common body of knowledge, a common interpretative framework, and values from which they identify a shared set of cause-and-effect relationships of a problem and convert them into policy relevant conclusions. The scholarly works show that new idea, data, and scientific evidence often change people's mind and attitude towards a certain environmental issue and therefore enable cooperation. The case of Mediterranean Action Plan, a regime created for the abatement of sea pollution problem in the Mediterranean Sea, illustrates that a group of experts from different countries cooperated each other, acting as a transnational coalition, and redirect their governments to pursue a new common objective. In this way, they led the international cooperation and eventually contributed to solve the given problem (Haas, 1992).

In this paper, we focus on ideational factors in order to explain the low level of environmental cooperation on PM issues between China and South Korea. First, basically it is not the case where states (China and

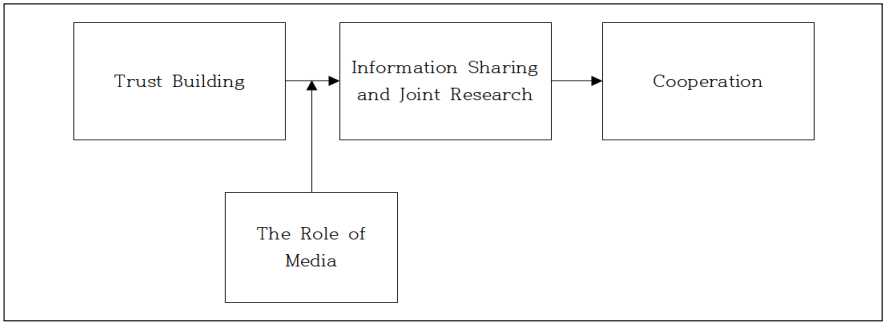
South Korea) make decisions to cooperate based on their calculations of ecological vulnerability and abatement cost. In fact, domestically, both countries have been taking costly measures to reduce PM 2.5 and PM 10 because of the increasing seriousness of the PM problem and its health effects. On the contrary, the key barrier to international cooperation is the lack of a common understanding of the extent that Chinese PM affects South Korea, based on common scientific investigation and information sharing. Similarly, regime design might not be a critical factor in this case because, first of all, regime has not been even created, and second, since this is an upstream-downstream problem, establishing effective monitoring and punishment mechanisms is a less urgent matter than estimating the approximate amount of PM 2.5 and PM 10 migrant from China to South Korea and jointly recognizing the result. Therefore, the most urgent task to promote cooperation is to have a common institutional ground in which they can share information and conduct joint scientific research and try to understand each other's situation. As was mentioned in the above section, all the attempts to date, including the LTP, have not been successful in providing a common institutional (or emotional) base for cooperation.

One of the critical reasons for these failures might be the lack of trust between the two countries. A minimum level of trust is the most fundamental base from which they can envision and initiate cooperation. In the case of CLRTAP, the former Soviet Union's willingness to improve its relations to Western European countries in the détente period became a momentum for building trust between the East and West. Trust was also a basis for the ASEAN Agreement on Transboundary Haze Pollution. The agreement was possible because, in spite of the conflictual relations

due to the haze problem, the ASEAN member countries have maintained a certain level of mutual trust for a long period of time. The case of ASEAN Agreement is also important in terms of the relations between idea and institutions. The norm of non-interference played a critical role in creating the agreement showing that idea matters at least in the formation of a regime although it can have a negative impact on the regime effectiveness (Muhammad, 2022).

A minimum level of trust can help mitigate antagonistic feelings especially in the receptor countries towards the source countries and promote information sharing and joint scientific investigations. It is also important because, even if source and receptor countries agree on the results of joint investigation, the only possible solution might be (1) to keep reducing PM 2.5 and PM 10 domestically in each side (2) recognize and encourage each other's efforts (3) cooperate each other, if possible, such as providing technology, financial support, and exchange of specialists. This is especially true if the relation between source and receptor countries is asymmetric in terms of state capacity and/or economic interests (Lee and Paik, 2020).

Figure 1. A Framework for Analysis



Then, what factors influence the level of trust between countries? In this paper, we focus on the role of domestic media in both sides. In both China and South Korea, media is virtually the only available source by which people get information on how severe the air pollution is and how seriously and effectively the government controls it in the opponent country, assuming that average people do not easily check academic journal articles and books. If media delivers incorrect and biased information on the opponent country's pollution problem and therefore incite hatred and fear, people will have a negative image on the opponent country and the transboundary air pollution issue will magnify conflictual situation between the two countries. There are previous works illustrating that media often intentionally uses a "blame frame" by which it inflates the peril of disaster and designates a target as a scapegoat and pass the buck to it without reporting the context of disaster situation (Rhee and Kim, 2018). Media in the downstream (receptor) countries often tends to deliver convoluted information on the negative environmental impact of source countries and intentionally omit the efforts of source countries to address the problem. This will result in excessive hate feelings on source countries and undermine trust between the two parties. Since people in both sides can access on the public opinions each other by the increased availability of social media, negative public opinions in receptor countries are promptly escalated to the same negative public opinions in the source countries. This will make them very difficult to even take the first step towards cooperation. Therefore, trust building and mutual understanding is the baseline and very critical condition for cooperation. The frame for analysis is illustrated in Figure 1. The media is an intervening variable affecting the magnitude of causality between trust and information sharing/joint research. In other

words, media can play a positive role in promoting low level cooperation between upstream and downstream countries (information sharing and joint research) based on mutual trust, which in turn, can develop into higher level cooperation.

There have been some previous works in international environmental politics emphasizing the role of domestic factors in promoting international environmental cooperation (Marchiori et al., 2017; Schulze, 2014; Sussman, 2004). However, among various domestic political, economic, and social conditions, the role of media, especially focusing on the framing effect, has been relatively a void of academic attention. There are some research articles showing how domestic media reports foreign affairs related to climate change (Berglez and Lidskog, 2019) but they have not focused on how these reports influence on international environmental cooperation. Also, there are some articles explaining the lack of cooperation between China and South Korea in the transboundary air pollution issue (Lee and Paik, 2020). However, existing literature on the case of China-South Korea PM 2.5 and PM 10 conflict focusing on the role of media is limited (Lee and Jeong, 2019; Lim, 2019). In the field of media study, although there are some works explaining the frame effect in the case of PM 2.5 and PM 10 between China and South Korea (Kim et al., 2015; Kim and Kim, 2018; Kwak and Han, 2017), they do not discuss the role of frame effect in promoting or delaying cooperation between the two countries.

Ⅲ. Domestic Measures to Address PM 2.5 and PM 10 in China and South Korea

PM 2.5 and PM 10 are the fine particles produced by burning fossil fuels. Specifically, they are generated by factories, power plants, vehicle combustion, heating, and so on but they are also formed in the atmosphere through chemical reactions of various gases (secondary particles). They can travel into and deposit on the surface of the deeper parts of the lung because the particle size is tiny. The problem is that they usually contain dust, mold spores, metals, and other types of pollution. Therefore, they are more harmful to human body than similar air pollution sources. In general, they are produced more in the winter season due to increased energy demand for heating, and produced more from coal than petroleum and natural gas.

In China, rapid industrialization and urbanization in the 1990s and 2000s inevitably caused serious problems of industrial pollution. Especially, the urban air quality had deteriorated and became a threat to citizen health and also to sustainable development of cities. The government had announced repeatedly that it would strongly crack down on polluting industries and take serious legal measures to control urban air pollution. However, its response had been occasional and spurious until the pollution level reached to unbearable levels in the early 2010s. In 2010, US Embassy Beijing announced via Twitter that its rooftop air pollution censor detected ‘crazy bad’ levels of PM 2.5 and PM 10, 20 times higher than the guideline issued by the World Health Organization (WHO).[1] In

2013, the air quality index (AQI) in Beijing reached 993, an extremely dangerous level. On the same day, AQI in New York City was 19. In the same year, the Ministry of Environmental Protection announced that only 3 of China's 74 cities met the Chinese national standard for 'fine air quality.' All three were the cities in remote areas such as Lhasa in Tibet, Haikou in Hainan, and Zhoushan in Zhejiang (Saikawa, 2014).

As China's urban air pollution had become an international issue and received much criticism especially from international organizations and developed countries, the Chinese government began to respond the problem seriously and systematically. The central government declared a war against air pollution and set up the Air Pollution Prevention and Control Action Plan as a comprehensive and long term policy framework, which is continued to work to date. Coal-burning stoves and boilers for cooking and heating systems were supposed to be replaced by natural gas boiler systems especially in some of the most polluting areas such as Shanxi province, which was called 'coal-to-gas campaign'. Some coal burning power plants and old factories that produce air pollution heavily were forced to shut down, and special emission limit was applied to specifically 6 heavily polluting industries such as iron and steel, cement, and petro-chemicals.

These radical measures were proven to be effective in the short period of time in a limited number of provinces and areas (Liu, 2020). However, the central government organized inspection teams and dispatched them to provinces from 2016 in order to further strengthen their policies to tackle urban air pollution. The inspection teams visited large and medium

1) *The Guardian*. 2010, November 19.

sized cities, reviewed local records of policy implementations, heard directly from residents about their complaints, punished local officials as well as leaders of powerful state-owned companies whenever necessary. These central environmental inspections were unprecedented in the history of China's policies to fight industrial pollution in terms of the seriousness and magnitude. The first round inspection was carried out from 2016 to 2017 targeting 30 major cities including the 4 Directly-Administered Municipalities and some most heavily polluted cities such as Taiyuan and Baoding. After the inspection was over, the local leaders were supposed to turn in their plans to implement the requirements they were given by the inspection teams. From 2018, the central government initiated the second round inspections and finished them in the end of 2021. The repeated inspections sent a strong signal to local leaders that the central government would put more emphasis on curbing air pollution than economic development. Therefore, local leaders began to take this message seriously (Shin and Kang, 2021).

As a result of these measures, air quality in almost all the large and medium sized cities in China has been improved. The Chinese government began to measure PM 2.5 and PM 10 systematically since 2014 covering all the large and medium sized major cities.[2] The average annual concentrations of PM 2.5 and PM 10 from 2014 to 2019 have decreased in almost all Chinese cities. In some cities where air pollution was extremely bad, the concentration dropped dramatically, such as the four Directly-Administered Municipalities and some cities in Hebei and Shanxi provinces. For example, Beijing, Tianjin, and cities in Hebei provinces

2) PM 10 data is available from 2011 to 2013 but limited to some major 30 cities.

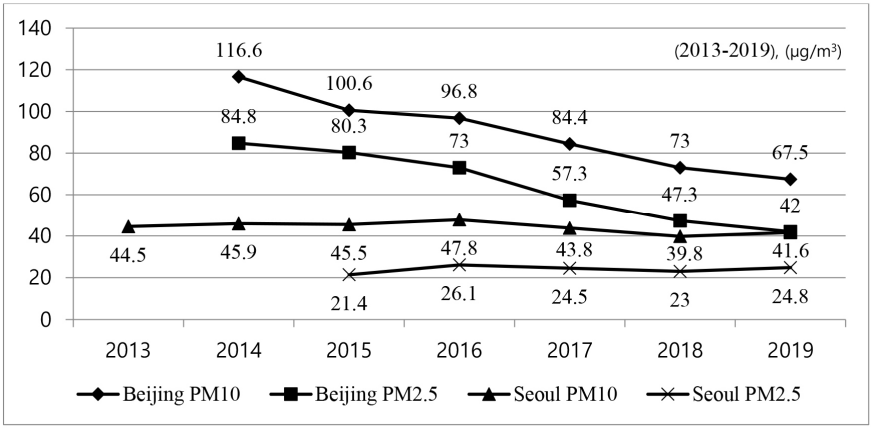
recorded 40～45 percent reduction of both PM 2.5 and PM 10 during the same period. When analyzed PM reduction in each province, the reduction was consistent in all the large and small cities within a province, rejecting the hypothesis described in some South Korean media that the Chinese government forced power plants and polluting firms to move into surrounding small cities in order to improve air quality in the major large cities in a province.[3)]

The concentration of PM 2.5 and PM 20 in South Korea is lower than China but still lagging behind the United States and Western European countries. As of November 2021, coal takes 34.6% of total energy generation in South Korea (Korea Electric Power Corporation, 2021). Moreover, transboundary air pollution from China moves towards the Korean peninsula due to the westerly and increases the concentration of PM 2.5 and PM 10 in the Korean peninsula. The Korean government began to take measures to address the PM problem from around mid-2000s, and the representative policy instrument to date has been the Comprehensive Plan to reduce PM 2.5 and PM 10 released in 2017. The Plan included specific domestic measures such as temporary shut-down of coal burning power plants, permanent shut-down of old (more than 30 years) coal burning power plants, and mandatory installation of emission reduction equipment of all coal-burning power plants. The Plan was effective in reducing PM 2.5 and PM 10 in the areas where coal-burning power plants were concentrated. The government kept implementing more

3) Data for PM 2.5 and PM 10 is available at https://www.aqistudy.cn/historydata/. It is also available at the homepage of Chinese Ministry of Ecology and Environment. Shin and Kang (2021) shows the reduction trend more detail based on their research on overtime trend of PM 2.5 an PM 10 in 170 Chinese cities from 2014 to 2019.

specific measures in 2018 and, in 2019, the Special Act on Particulate Matter Reduction and Management was enacted and the National Climate and Environmental Council was established. The Special Act provided a comprehensive legal ground to use various policy measures, and the Council became a platform in which citizens as well as specialists could participate and come up with solutions to reduce PM and suggest them to the government.

Figure 2. Average Annual Concentrations of PM 2.5 and PM 10 in Beijing and Seoul

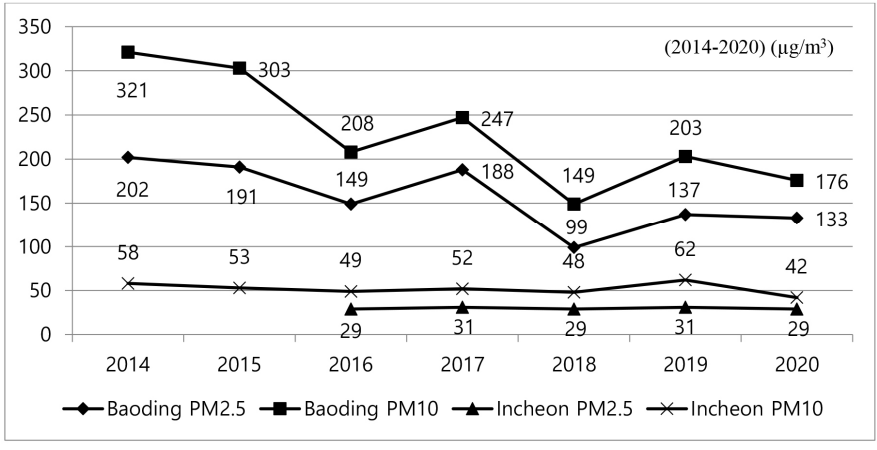


Sources: https://www.aqistudy.cn/historydata/ (Beijing), https://www.airkorea.or.kr/web (Seoul)

Figure 2 shows average annual concentrations of PM 2.5 and PM 10 in Seoul and Beijing from 2013 to 2019. Beijing, just like any other cities in China, shows consistently downward trend and the pollution was significantly reduced. This proves that the government measures including the central inspections have been effective in controlling air pollution in local cities. However, the concentrations are still much higher than the

standards of the European Union, United States, South Korea, and WHO.[4] On the contrary, concentrations in Seoul have not been changed radically because they are already low to a certain extent and a more fundamental measure should be taken to further the reduction. In other words, South Korea should attempt for a comprehensive energy transition not only to reduce PM but also to accomplish the national target of carbon neutrality. Although we show only Seoul and Beijing in this paper, almost all other cities in the two countries show exactly the same pattern.

Figure 3. Average Concentrations of PM 2.5 and PM 10 in January, Baoding and Incheon



Sources: https://www.aqistudy.cn/historydata/ (Beijing), https://www.airkorea.or.kr/web (Seoul)

4) The standards of average annual concentration of PM 2.5 are 25 (EU), 15 (US and South Korea), 10 (WHO). The unit is μg/m^3. China's standard is 35.

Figure 3 shows average concentrations of PM 2.5 and PM 10 in Baoding (a city in the Hebei province, China) and Incheon (a city in Korea) only in January from 2014 to 2020. The results show very similar pattern to Figure 2 meaning that the results are same in the winter period when concentration of PM is in general higher than rest of the seasons. This is also true in other cities in both countries, rejecting the hypothesis raised by some Korean media that migrant PM from China is more serious in the winter period than in the rest of the seasons. In sum, the two figures show that it might not make sense to argue at least that a majority amount of PM in South Korea is from China. In both Seoul and Incheon, the concentrations seem not to be heavily affected by the Chinese emissions, although the four cities show approximately similar trend of downward and upward overtime.

Ⅳ. Analysis of the South Korean media on the PM issue

In order to analyze how South Korean media frames the PM issue, we selected 6 newspapers and analyzed the contents.[5] We searched articles in the 6 newspapers by using the key word of fine dust during the period from January 1, 2014 to December 31, 2020. After ruling out articles irrelevant to this research such as commercials, weather reports, and some health related articles, we finally selected and analyzed 1,947 articles. Figure 4 shows that the number of articles had increased steadily

5) They are Kookmin (KM), Donga (DA), Joongang (JA), Hangyorae (HGR), Chosun (CS), and Gyunghyang (GH).

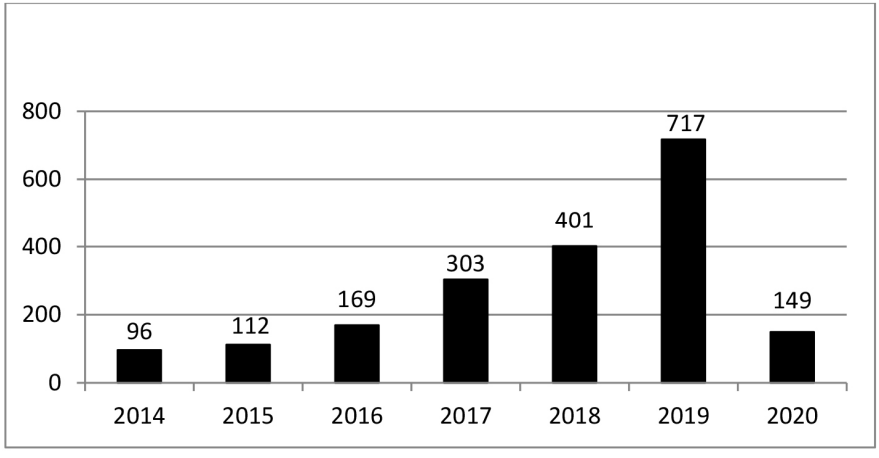
since 2014 and particularly soared to 717 in 2019. This rapid increase in 2019 is consistent in all the 6 newspapers. Since there had been no significant increase/decrease in the concentration in South Korea during 2018 and 2019, this might tell us that PM became a political issue particularly around these two years, and media used this issue to support or criticize the incumbent government. For example, JA published total 203 articles on the issue of PM in 2019. Among them, articles describing political arguments and contentions surrounding the issue raised by politicians were only 5. The rest of the articles were the opinions (mostly political and international) on the issue provided by the media itself. This means that media is not simply following up and reporting the politicization of the PM issue by politicians, but it engages itself very actively to politicize this issue. Figure 4 also shows that the number of articles published in the period of former president Park (from a conservative party) is roughly one third of the number of articles published in the period of current president Moon (from a progressive party).[6] This means that politicization of the PM issue by politicians and media has been far more actively promoted in the president Moon period.

As is shown in Table 1, we classified the articles by four categories according to their key perspective on the issue that the article emphasizes, i.e., how the media frames the PM issue. They are (1) China's Responsibility (China should be primarily responsible for the PM problem in South Korea) (2) Domestic or Joint Responsibility (South Korea should be primarily responsible for the problem, or at least joint responsibility)

6) The current president Moon was inaugurated in May 2017. In this paper, we counted the number of article from January 1, 2014 to December 31, 2016 (which was 377), and from January 1, 2017 to December 31, 2019 (which was 1,431).

(3) Criticism on the Government (The South Korean government should be blamed for not dealing with this problem effectively) (4) Support to the Government (The South Korean government has been doing very well to deal with the problem). (1) and (2) are whether media criticizes China or not, and (3) and (4) are whether it criticizes or supports the government, by using the issue of PM.[7)]

Figure 4. Number of Articles Searched, by Year



According to Table 1, the articles using the China responsibility frame is consistently more than the domestic/joint responsibility frame in every year, accounting for 65% of (1) and (2) combined (611 out of 929 articles directly mentioning the primary responsible country). According to Table 2, articles using the China responsibility frame are overwhelmingly

7) Of course, there are some overlapped articles belonging to more than one category. In this case, we located them to the categories on which they put more emphasis.

more than domestic/joint responsibility frame articles in the case of conservative media such as CS and DA. In CS, for example, 91 percent of the articles describe PM as a problem that China should be primarily responsible. They attach the expression of "from China" to PM so that readers might feel that the absolute amount of PM in South Korea is from China.

Table 1 also shows that the number of articles criticizing the government (495) and supporting the government (523) are roughly same. However, the ratio varies according to the ideological bias of the media. In the case of conservative media, for example, in the case of CS, the number of articles criticizing the government is 125 whereas the number of articles supporting the government is 62. On the contrary, in the case of progressive media such as GH, the number of articles criticizing the government is 89 whereas the number of articles supporting the government is 232. If we focus on the year 2019, the contrast between the two newspapers is more obvious: in the case of CS, criticism is 58 and support is 20 whereas in the case of GH, criticism is 7 and support is 78. These are illustrated in Table 3 and 4.

In addition to the clear ideological divide between conservative and progressive newspapers, a more detailed content analysis of these two newspapers shows that media uses slightly different frames to emphasize their own arguments. For example, CS has insisted consistently China's responsibility but the frame has been different in the former president Park period and the current president Moon period. In 2014 and 2015, CS uses the frame of China as an aggressor and South Korea and the Korean government as a victim. However, this frame has changed into a new frame from around 2017 emphasizing that South Korean government's

submissive posture towards China has been the real cause of the problem. In other words, it turns the blame from China to the current government for its pro-China policies. The two most frequently used words by CS to criticize the government were submission and incompetence. It argued that the Moon government was not only submissive to China but also incompetent to respond to this problem systematically. This frame change is identified quantitatively by comparing the number of articles of 'China Responsibility' and 'Criticism on the Government' in each year, shown in Table 3.

Table 1. The Four Categories

Year	China Responsibility	Domestic or Joint Responsibility	Criticism on the Government	Support to the Government	Total
2014	66	10	7	13	96
2015	71	14	17	10	112
2016	34	27	73	35	169
2017	95	40	80	88	303
2018	88	77	114	122	401
2019	202	126	186	203	717
2020	55	24	18	52	149
Total	611(31.4%)	318(16.3%)	495(25.4%)	523(26.9%)	1,947(100%)

Table 2. Percentage (%) of China Responsibility Articles by Media

Media	China Responsibility (%)
KM	62
DA	75
JA	68
HGR	50
CS	91
GH	34

Table 3. Articles on PM in CS

Year	China Responsibility	Domestic/Joint Responsibility	Criticism on the Government	Supporting the Government	Total
2014	14	0	1	5	20
2015	6	0	4	3	13
2016	5	2	9	6	22
2017	13	2	17	9	41
2018	13	1	27	13	54
2019	42	1	58	20	121
2020	3	3	9	6	21
Total	96	9	125	62	
%	91.4%(96/105)	8.6%(9/105)	67%(125/187)	33%(62/187)	

GH also clearly shows its ideological bias in the articles describing PM. Overtime, it has emphasized more on domestic or joint responsibility than on China's responsibility, and supported and encouraged the government rather than criticized the government. The key argument is that PM problem should be approached by a bigger framework of China-South Korea relations in the long term perspective and that policy priority should be given to resume diplomatic relations between the two countries, which virtually fell apart since the THAAD crisis in 2015. Moreover, since PM is also a domestic problem in South Korea, the central and local governments should take serious measures to reduce the domestic sources of PM emissions. GH has argued actively that the current government has been relatively successful in this process. In other words, for the most part, it highlights the capability of the government to cope with PM problem in both domestic and international dimensions. For example, it emphasizes that the current government's efforts to visit China and resume the tie between the two countries, and policy outcomes

especially for environmental cooperation such as the establishment of the Korea-China Environmental Cooperation center in Beijing and the National Climate and Environmental Council.

Table 4. Articles on PM in GH

Year	China Responsibility	Domestic/Joint Responsibility	Criticism on the Government	Supporting the Government	Total
2014	6	0	5	4	15
2015	6	3	6	2	17
2016	1	1	26	11	39
2017	7	6	24	45	82
2018	4	11	16	68	99
2019	5	33	7	78	123
2020	0	3	5	24	32
Total	29	57	89	232	
%	33.7%(29/86)	66.3%(57/86)	27.8%(89/321)	72.2%(232/321)	

This contrast between CS and GH is found in other newspapers meaning that media report on PM is strongly driven by its ideological preference in South Korea. It seems that the primary goal of media in reporting the PM problem might not to urge the government to find solutions but to criticize or support the government. This raises some critical problems as follows. First, media does not report (or intentionally omits) how the neighboring country has taken policy measures to cope with the problem and how successful its efforts have been to date. This is true in the case of both conservative and progressive newspapers. Therefore, people, in South Korea for example, are not able to understand if the Chinese government is strictly implementing policies or not. Second, biased and

convoluted information on the transboundary air pollution issue in South Korea, provided mainly by the Korean media, magnifies hate feelings towards China, weakens the foundation of trust, and therefore, obstructs international cooperation. Moreover, this is easily escalated into unnecessary emotional clash and conflicts between the two countries due to the internet debates via the social media (Lim, 2019).

One of the possible solutions to the politicization of PM issue and ideological divide in South Korean media might be that atmospheric scientists, China specialists, and scholars of international environmental cooperation provide information and explanations by which people can understand the nature of the problem, other similar cases of transboundary environmental pollution, and China's efforts to address it. In fact, less than 5 % of the total 1,947 articles that we investigated in this paper include the opinions and analyses of specialists. Although some articles include simple quotations and short comments from specialists, articles introducing full explanations of specialists are rare. This is true in both conservative and progressive media sources.

V. Conclusions

The PM issue between China and South Korea is a typical upstream-downstream style transboundary air pollution problem meaning that, by nature, cooperation is hard to achieve and possible only in some specific political, economic, and international conditions in which source countries accept scientific findings on the cause-and-effect of transboundary pollution

and lead cooperative efforts to solve the problem. This is what happened in the case of CLRTAP, which is a very exceptional case of successful cooperation. This case illustrates that the joint scientific research and investigation is a very critical first step towards cooperation, and in order for states to agree on this joint scientific research and investigation, a certain level of trust between the participating states is a necessary condition.

In this article, we investigated the role of media (especially in the downstream country, South Korea) in promoting (or limiting) cooperation between the two countries based on the hypothesis that media might function as an intervening variable that controls the magnitude of causality between trust and low level environmental cooperation (such as information sharing and joint research). We found that South Korean media report on PM has been strongly driven by its ideological preference meaning that the primary goal of media in reporting the PM problem seemed not to urge the government to find solutions but to criticize or support the government. This means that media in South Korea does not report (or intentionally omits) how China has taken policy measures to cope with the problem and how successful its efforts have been to date. This is true in the case of both conservative and progressive newspapers. People in South Korea are not able to understand if the Chinese government is strictly implementing policies or not. Similarly, biased and convoluted information on the transboundary air pollution issue in South Korea, provided mainly by the Korean media, magnifies hate feelings towards China, weakens the foundation of trust, and therefore, obstructs international cooperation.

The China-South Korea case shows that media, especially in a receptor

country, should play a role in mitigating antagonistic feelings and building trust between the two countries. This is far from an assertion that Korean media should be excessively in favor of Chinese policy performance and exaggerate its performance. What Korean media should focus on is to show what China has done to date exactly and what it has to do more. In addition, it should include more academic and professional articles and provide detailed and contextual knowledge and analysis on the problem. These efforts by the media in the receptor country will form a foundation for trust and cooperation, and it seems that this is the only way that the two countries can approach this issue.

Although this paper analyzes newspaper articles in South Korea and shows how it frames the issue in a way to magnify hate feelings and antagonism toward China, a further systematic research is necessary by which we can illustrate the causal connection between media frame effect and lack of trust in South Korea. A survey in South Korea asking media's bias or an experimental research analyzing the effect of media on South Korean people's attitude toward China should be supplemented. Moreover, investigating how Chinese media has framed this issue might add another dimension on this research and provide a new framework for analysis in which media framing is not just a unidirectional but reciprocal process.

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