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Policy Measures for Mitigating Fine Particle Pollution in Korea and Suggestions for Expediting International Dialogue in East Asia

Changsub Shim*

Abstract

The majority of the measurements sites over Republic of Korea place $PM_{2.5}$ concentrations above the national air quality standard of 25 microgram/m^3/year, posing great concerns for the national environment and public health. This particulate matter (PM) pollution is often associated with transboundary transport of air pollutants throughout East Asian countries. This paper reviews and discusses the Korean government's policies for mitigating PM pollution, and in particular, recent policies to control $PM_{2.5}$, including a system introduced by the Korean Ministry of Environment (KMOE). In addition, I analyze the system and performance of cooperative programs for improving East Asian air quality, considering current approaches by the Acid Deposition Monitoring Network in East Asia (EANET), the Joint Research Project on Long-range Transboundary Air Pollutants in North-East Asia (LTP), the North-East Asian Subregional Programme for Environmental Cooperation (NEASPEC), and Tripartite Environment Minister Meeting (TEMM) as the basis for a comparative study, focusing on international coordination, communication, scientific activities, and institutional structure. Based on this analysis, I have generated some recommendations for improving international dialogue on air quality over East Asia.

Keywords: Air pollution policy, East Asia, International cooperation, Korea, Particulate matter

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1. Introduction

Concentrations of air pollutants in Asia are higher than those are in Europe and North America, and levels are expected to worsen over time (Akimoto 2003). East Asian emissions of NOx, the major precursor of ozone and particulate matter (PM), accounted for 25% of global emissions in 2005, exceeding the emission levels of most European countries and the United States (HTAP 2010). Additionally, China's emissions of CO_2, a major greenhouse gas, exceeded those from the United States of America (US) after 2007. East Asia has emerged as the world's largest greenhouse gas and air pollutants emitter (CDIAC 2009). Since the 1990s, the US and Europe have succeeded in steadily reducing emissions of ozone precursors, including NOx, and emissions amounts of ozone precursors. On the other hand, NOx emissions in East Asia have skyrocketed since 1990, resulting in a doubling of emission amounts during this period (Streets et al. 2003; Richter et al. 2005). As more air pollutants are emitted, ozone concentrations in East Asia have correspondingly increased. Created substantially by secondary production, $PM_{2.5}$ levels have reached a critical level, with levels frequently exceeding environmental standards.

As air pollutants travel across borders, this has become a global issue. International cooperation is essential for understanding the mechanisms of air pollutants and the associated linkages between emissions and ambient air quality impacts. In this study, the Korean government’s policies for mitigating PM pollution are reviewed. Specifically, I investigate a recent policy to control particulate matter (PM), including a system put in place by the Korean Ministry of the Environment (KMOE) for warning and forecasting PM pollution, along with efforts to obtain accurate $PM_{2.5}$ measurements. Additionally, resolving the problem of long-range transboundary transport of pollutants requires international cooperation between neighboring countries. Thus, I also tried to analyze the system and performance of major cooperative programs for East Asian air quality, focusing on international coordination and

communication, scientific activities, and institutional structure. I briefly review the Acid Deposition Monitoring Network in East Asia (EANET), the Joint Research Project on Long-range Transboundary Air Pollutants in North-East Asia (LTP), North-East Asian Subregional Programme for Environmental Cooperation (NEASPEC), and the Tripartite Environment Minister Meeting (TEMM). Following an analysis of those programs, this paper concludes with some recommendations designed to improve cooperation regarding air quality issues in East Asia.

2. Korean Policy Measures Regarding PM

2.1 Background and accomplishments

Environmental health concerns have recently intensified due to high levels of PM. Concentrations of $PM_{2.5}$ in major Korean cities, including Seoul, Incheon, and Daejeon, were measured in 2011 and 2012, and the results demonstrated that the concentration of fine particulate matter in many urban centers exceeded the Korean annual average air quality standard (25 μg/m3) and the Korean daily average air quality standard (50 μg/m3). Most cities reported an annual average of 25~30 μg/m3, and their daily average was higher than this number for more than 30 days (KMOE 2013)—a situation that has generally continued (KESP 2016).

Compared with PM_{10}, $PM_{2.5}$ is more hazardous to health; thus, it is urgent issue to establish appropriate management measures. As a large part of PM pollution (30~50%) comes from abroad, from countries such as China, it is important that stakeholders encourage countries to cooperate on PM control and develop an effective response system for PM forecasts and warnings (KMOE 2013).

From 2009 to 2013, the KMOE laid the foundations for this action based on the Atmospheric Environment Conservation Act (Section 2, Article 7) in order to develop a forecast system. To this end, it developed the air quality forecasting model.

2.2 Current pollution levels in Korea

The annual average concentrations of PM_{10} in Seoul have decreased from 76 μg/m3 in 2002 to 41 μg/m3 in 2012, but even after this improvement, this level is still twice as high as other OECD countries, including European countries and Japan. $PM_{2.5}$ levels showed a nationally decreasing trend from 2008 to 2013. However, in most regions, these levels still exceeded environmental standards established by KMOE. Table 1 shows the annual mean concentration of PM_{10} and $PM_{2.5}$ in Seoul (at Yongsan Station, where it has represented air quality for a large part of central Seoul for many years). While PM_{10} has steadily decreased, $PM_{2.5}$ has shown mixed signals since 2011. In the same context, severe pollution events with $PM_{2.5}$ after 2013 have drawn serious social attention in Korean society. Official $PM_{2.5}$ data from KMOE has been only available since 2015 because national policy measures for PM pollution were first prepared in 2014 (KMOE 2016a), a clear limitation for studies on $PM_{2.5}$ in terms of trends and regional characteristics.

Table 1: Yearly concentrations of PM_{10} an $PM_{2.5}$ in Seoul (Yongsan area), Republic of Korea

(unit: μ g/m3)

YEAR	PM_{10}	$PM_{2.5}$
2004	62.1±34.4	33.5±17.5
2005	63.5±34.6	25.2±14.4
2006	57.5±74.6	25.2±19.5
2007	63.2±47.4	32.0±20.3
2008	54.9±34.7	27.1±16.1
2009	56.2±36.1	27.4±15.9
2010	50.0±30.6	23.7±14.4
2011	48.9±34.7	25.4±14.9
2012	40.1±21.2	21.9±11.8
2013	43.8±23.5	25.2±21.6

Source: Ahmed et al. (2015)

The contributions of long-range transboundary transport of PM to domestic PM pollution vary depending on individual study results, but estimates suggest that such contributions are approximately 30~50% of the total concentration of $PM_{2.5}$ (KMOE 2013). Specifically, when Westerly and North-Westerly winds are dominant, the international contribution to domestic PM_{10} concentrations increases by an average of 44.5% (KMOE 2013).

2.3 Action plans by sector

2.3.1 PM forecasts and warnings

KMOE began implementing a preliminary PM forecasting system in Seoul metropolitan areas in August 2013 and has provided official forecasts since February, 2014 (KMOE 2016a). The forecasts consist of four levels based on research on health effects (KMOE 2013).

Currently, PM concentrations are forecast over six forecasting regions including Seoul metropolitan areas four times per day (at 5 a.m., 11 a.m., 5 p.m., and 11 p.m.)(KMOE 2013).

Additionally, a warning system has been implemented so that immediate notification can be carried out for local governments when real-time PM concentrations have increased to hazardous levels. This system recommends actions to lessen the impact of high concentration levels, including limiting vehicle use and adjusting business hours (Enforcement of Atmospheric Environment Conservation, Article 2). This system is currently being implemented in seven cities and provinces, including Seoul, Gyeonggi Province, and Daejeon, and is also currently recommended to other local governments.

2.3.2 Pollution reduction measuring sector

(1) Current status and issues

The total amount of PM_{10} emissions from Korea in 2012 was about 120,000 tons, with 65% of PM_{10} emissions coming from manufacturing (plants), and 25% from transportation (KMOE 2016c). The total amount of $PM_{2.5}$ emissions from Korea in 2012 was about 76,000 tons and 52% of $PM_{2.5}$ emissions came from manufacturers, 33% from transportation, and 5% from the energy sector (KMOE 2016c).

When these emission patterns were examined, several limitations in Korean PM management were found. First, there were inadequate reduction measures for construction equipment or vehicles in the case of road and non-road mobile pollution sources, as these are responsible for the highest contribution to PM concentrations during server PM pollution events (KMOE 2016c). Additionally, efforts to disseminate eco-friendly cars (which can reduce pollutant emissions) and implement related management measures proved to be insufficient (KMOE 2013).

Second, although regulations regarding the total emissions of nitrogen oxide and sulfur oxide have been imposed for large emission sources (mostly power plants and manufacturers), the effectiveness of total emission management policies has weakened due to excessive emissions allowances. The lack of science-based management practices, which are necessary for better understanding of PM emission characteristics, was also identified as a problem (KMOE 2013).

Finally, in the case of household pollution sources, effective measures for home heaters and measures for particles from paved roads and workplaces were also insufficient (KMOE 2013). As a result, the government is in the process of promoting several improvement plans.

(2) Improvements and plans by the Korean Ministry of Environment (MOE)

To reduce road and non-road mobile pollution sources, efforts to disseminate zero-emission vehicles (ZEV), such as electric vehicles, will be expanded until 2024. In 2020, the mandatory purchase rate of eco-friendly cars for administrative and public agencies will be increased from the current portion of 30% to 50% (KMOE 2013). Moreover, emission standards and the corresponding management of production cars will be reinforced. The government will phase in the EURO 6 standard for diesel cars, the Super Ultra Low Emission Vehicle (SULEV) standard for gasoline cars, Tier-4 for construction and agricultural equipment, and Tier-3 for vehicles (KMOE 2013).

With reference to emission reduction measures for in-use vehicle and construction equipment, emission reduction equipment (e.g., DPF (Diesel Particulate Filter) and Diesel Oxidation Catalyst (DOC)) needs to be installed in decrepit diesel cars, construction equipment, and vessels. Support measures include remodeling cars to install eco-friendly engines and scrapping old cars, and both measures have been enforced (KMOE 2013; 2016c).

Lastly, management regarding transport demand will be strengthened. The operation of commuter and school buses will be revitalized, and the car sharing system will be expanded; meanwhile, the government established the goal of reducing car mileage by up to 30% by invigorating the management of corporate transport demand and public bicycle programs (KMOE 2013).

Installation of a Tele-Monitoring System (TMS) and a fuel flow meter is required for large emission facilities; by gradually decreasing the allowable emission standard allocation of pollutants for large-quantity disposing businesses, emissions of NO_x and SO_x have been reduced to 51% and 28%, respectively, since the 1990s (KMOE 2013). The use of eco-friendly fuel by the business sector is also expected to increase (KMOE 2013).

2.3.3 Measurement network and PM inventories

(1) Current status and issues

The Korean $PM_{2.5}$ measurement network currently includes 128 automatic measurement networks and 36 manual measurement networks throughout the country (KMOE 2013). However, regulations for management of national $PM_{2.5}$ pollution only became effective in 2014, making it difficult to determine regional pollution characteristics for enhancing air quality due to a lack of measurement data over a short observation period.

The quality of measurement and data analysis is also in need of improvement. The automatic measurement network of local governments is less reliable due to the use of older equipment and insufficient quality control (quality assurance (QA)/quality control (QC)). Moreover, there is a shortage of measurement and analysis experts available to each local government. Although monitoring and modeling for quantifying secondary PM formation is essential due to the characteristics of $PM_{2.5}$, the modeling methodology needs improvement, as the quality of the modeling input data is outdated (KMOE 2013).

The methods for measuring long-range transport air pollution are also insufficient, even though such practices are critical. There are air pollution monitoring stations on Baengnyeong Island (northwestern island of Korea), Jeju Island (southern island), and in various metropolitan areas, but further expansion is necessary.

(2) Improvement plans

The official automatic measurement guidelines for quality control of the automatic measuring instruments were established and distributed, followed by the approval of the system and instruments for measuring $PM_{2.5}$ (KMOE 2013). To strengthen both analysis and modeling, measurement error is being minimized and the quality control of input data is being reinforced by regularly educating local government staff. Meanwhile, guidelines for air quality modeling are being prepared (KMOE 2013).

Furthermore, to strengthen the observation system for long-range transport of air pollution, additional joint monitoring networks were established in the regions where pollution has high impacts. International joint research on the air quality of Northeast Asia (e.g., the aircraft-measured international campaign) is being developed. For instance, the Korean MOE started cooperating with NASA in the United States on the aircraft campaign to monitor comprehensive air pollutants. This research will be conducted over the Korean Yellow Sea and the Seoul metropolitan area until 2017, which will enable an understanding of air pollutant emissions and its transformations over East Asia (NIER 2015).

The government will also launch geostationary satellites in 2018 to monitor air pollution in Asia, which will establish a real-time air quality monitoring/forecasting system. As a result, upcoming air quality forecasts and analysis models based on Korean pollution characteristics are expected (Lee et al. 2009).

2.3.4 Reinforcement of cooperation among relevant Ministries and the expansion of air quality information

In addition to the data on the Air Korea homepage,[1] operated by the Korea Environment Corporation (KECO), there is nationwide real-time air pollution information with some limited real-time data. However, the cooperative system among government departments (classified by jurisdiction, such as schools, daycare centers, and hospitals) remains inadequate. Moreover, customized public relations and support measures targeted at vulnerable social groups (e.g., children, senior citizens, the infirm, etc.) also remain insufficient (KMOE 2013).

To improve this situation, the Korea Environment Corporation revised the Air Korea homepage and added a text message service: they will provide texting services when the PM forecast level rises above the 'bad' level and make available real-time information for each residential district through the smart phone service 'Air quality of our neighborhood' (KMOE 2013).

For vulnerable social groups, namely preschoolers, elementary school students, respiratory and cardiopulmonary patients, and senior citizens, forecasts and warnings are provided through the Ministry of Health and Welfare, the Ministry of Education, and local governments. By developing health impact indices based on air quality, forecasts and warnings of high concentrations of PM pollution can be provided. Furthermore, dust masks are disseminated to low-income groups with the cooperation of the Ministry of Security and Public Administration, the Ministry of Health and Welfare, and local governments (KMOE 2013).

Additionally, $PM_{2.5}$ concentrations around elementary schools will soon be measured with mobile measurement vehicles, and the Metropolitan Air Quality Management Office plans to educate citizens about PM information and the appropriate code of conduct by organizing atmospheric measurement experience classes at elementary schools. The target groups for these

[1] http://www.airkorea.or.kr/index

educational sessions will then be expanded to senior citizens, housewives, and expectant mothers (KMOE 2013).

Despite the above efforts of the Korean government and the strengthening of Chinese regulations to reduce air pollutant emissions, policies for the enhancement of air quality regarding PM_{10}/$PM_{2.5}$ in Korea remain unconvincing. A recent study by Lee (2016b) found that PM concentrations in Korea have increased further since 2012. These increasing PM levels have been likely attributed to meteorological conditions—the reduced average surface wind speed preventing the ventilation of air pollutants (Lee 2016b). However, the inefficient management of old diesel vehicles as well as the rapidly increasing number of diesel cars might also be contributing to current high levels of PM pollution in Korea (Lee and Cho 2009). Greater fossil fuel use (i.e., coal) based on increased energy demands in Korea has the potential to further aggravate PM pollution (Shim and Hong 2016). Thus, comprehensive analysis to identifying the origin of current PM pollution must be required to reinforce effective regulatory actions.

Recently, KMOE has increased the budget to reinforce air quality forecasting/warning systems and systemic nationwide PM2.5 measurements and reports (KMOE 2016a). It has published a "Manual for Vulnerable People to Respond to high PM Pollution" (KMOE 2016b). Increased efforts to construct the National Air Pollutant Emissions Services (NAPES)[2] and disseminate emissions inventories to the public are good examples of activities to verify and evaluate domestic air pollutants emissions, which can be used to support policymakers.

3. Promoting International Cooperation for Air Quality in East Asia

3.1 Background

As mentioned above, it is necessary to strengthen cooperation among countries to reduce PM. Korea, China, and Japan are expanding cooperative initiatives in each

[2] http://airemiss.nier.go.kr/mbshome/mbs/airemiss/index.do

sector to improve their air quality. Even though this article is primarily focused on PM pollution, it is realistic to discuss international efforts for mitigating general air pollution over East Asia since international cooperation in East Asia has not progressed as much as it has within domestic policies, or in other regions such as European Union (Kim 2007, 2014). Thus, this study collected relevant data through exchanges between international cooperation experts from Korea, China, and Japan. I reviewed the status of international cooperation and identified the limitations of joint research and cooperation programs for air quality management in Asia. My recommendations for improving the policy dialogue and expanding relevant research cooperation will be discussed in the final sections of this paper.

3.2 The current major cooperation frameworks on air pollution in East Asia

3.2.1 EANET

The Acid Deposition Monitoring Network in East Asia (EANET) is a monitoring network founded to promote international cooperation and facilitate research on acid deposition in East Asia. Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Mongolia, Myanmar, Philippines, Republic of Korea, Russia, Thailand, and Vietnam currently participate in EANET (EANET 2016). This network aims to ascertain the status of acid deposition, provide materials at the regional level to prevent the effects of acid deposition, and build a cooperative system among participating countries (Chu 2005).

The major programs of EANET focus on the following: (1) developing guidelines and a manual for monitoring acid deposition; (2) planning and implementing monitoring systems; (3) collecting, interpreting, evaluating, and providing monitoring data through networking; (4) providing a guaranteed standard and fully enforcing this standard through management activities to build a quality monitoring database; (5) preparing and publishing regular reports on the status

of acid deposition in East Asia; and (6) developing and operating programs for research and education on the theme of acid deposition (Chu 2005).

According to Chang (2013), as a leader of EANET, Japan designated 2005 as the first year of the regional agreement and carried out systematic preparations. Japan proposed joint responsibilities for sharing operating costs and insisted that member countries enter into a regional cooperation agreement. Since then, the office and the network center in Japan have been partially globalized. The agreement was executed in 2010 and published in 2012. EANET hosted the 14th inter-governmental meeting in Myanmar in November 2012. At this meeting, each country submitted plans for financial contributions to the office and the network center and discussed the implementation of measures for enforcement (EANET 2012).

As the causes and status of acid deposition have not been identified, the countries participating in EANET have not yet developed a shared understanding of this specific phenomenon. Additionally, levels of agreement and institutionalization are low due to the fact that the network is based on voluntary participation (Chu 2005). It is also proving to be a challenge to expand the scope of cooperative activities except the research issues related to acid deposition (Elder 2013). However, international participation in terms of the funding and staff has been expanded, and collaborative discussions with other international/global organizations have continued (EANET 2016). In particular, EANET has actively expanded its research target into activities such as identifying the effects of air pollutants on agriculture and regional ecosystems (EANET 2014).

3.2.2 NEASPEC

The North East Asian Sub-regional Programme of Environmental Cooperation (NEASPEC) is the inter-governmental cooperative body that develops plans for environmental cooperation in Northeast Asia, operates cooperative projects, and manages general affairs related to the preservation of the environment. NEASPEC's members include Korea, North Korea, China,

Japan, Mongolia, Russia, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), the Asian Development Bank (ADB), the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), and the World Bank (Chu 2005).

NEASPEC is supported by ADB and has operated programs that deal with environmental monitoring, data collection and analysis, reduction of pollution caused by coal power plants, and preservation of nature. It also operates the North East Asian Center for Environmental Data and Training (NEACEDT), which is in charge of education and training regarding pollution monitoring, collection and analysis of environmental pollution data from each country, and sharing collected and analyzed data (Chu 2005).

NEASPEC held the NEASPEC Expert Meeting on Transboundary Air Pollution of Northeast Asia in Russia in July 2012. During this meeting, the inclusion of Russia in the transboundary air pollution modeling areas was proposed. A mechanism for facilitating international cooperation to reinforce systems in small-scale areas and for expanding the geographic coverage of the systems was also proposed during the meeting. With regard to the above proposal, options related to the development of cooperation for small-scale areas were reviewed in terms of both mid- and long-term perspectives. Additionally, the goal of cooperation between the Convention on Long-Range Transboundary Air Pollution (CLRTAP) and Russia was reviewed in detail, and updates, including adoption of the revised Gothenburg Protocol (UNESCAP 2012a), were made.

In December 2012, UNESCAP's 17th high-level talk was held in China, and new initiatives to develop technical and policy systems for the evaluation and mitigation of transboundary air pollution were proposed by the government of Russia. Additionally, issues related to the prevention and control of dust and sand storms were addressed during the talk (UNESCAP 2012b). It was expected that by 2013, data sharing, including real-time monitoring, would expand via the promotion of the Northeast Asia long-range transboundary air pollution

project, a part of NEASPEC, and via requests for national emissions data and real-time monitoring data from China.

NEASPEC has produced positive results, including the collection of contributions from each country, to key funds, and the building of a consensus on the need for a comprehensive environmental cooperative body in Northeast Asia. However, due to the lack of agreement among stakeholders and governments, it has failed to establish an environment-related cooperative body in Northeast Asia, which is critical (Chu 2005; Kim 2014). This has limited the scope and the responsibilities of its cooperative activities (Elder 2013). Current severe air pollution in North-East Asia has led member countries to focus on multiple aspects of air pollution and seek interdisciplinary collaborations (NEASPEC 2016).

3.2.3 TEMM

The Tripartite Environment Minister Meeting (TEMM), which is the highest level inter-governmental meeting on environmental cooperation in Northeast Asia, aims to respond to environmental issues of Northeast Asia, including yellow dust and acid rain, and to improve the awareness of the environmental communities in three key countries in Northeast Asia: Korea, China, and Japan (Chu 2005).

Major cooperative programs include the ecosystem recovery program for the western part of China, a program to improve the quality of lake water, a roundtable for the environmental industry, and joint educational programs on the environment for the three countries. In terms of recent activities, the 15th TEMM was held in Japan in May 2013.[3] The health risks of air pollutants, including fine particles and photochemical ozone, were discussed in relation to air pollution. EANET expected that the reinforced monitoring of acid materials and related chemicals would contribute to improving the management of air quality and agreed to enforce

[3] So far, TEMM has been held 18 times, the latest of which was held in Japan in April 2016 (TEMM 2016).

cooperation. Additionally, an agreement to establish a Tripartite Policy Dialogue on Air Pollution (TPDAP) was enacted to facilitate information exchanges about related policies, monitoring technology, prevention and control technology, research, competency building, and international cooperation (TEMM 2013). The first TPDAP was held in Beijing in 2014, leading to the second TPDAP, which was held in Seoul in March 2015, followed by the third TPDAP held in Tokyo in February 2016. At the most recent meeting, the three countries exchanged opinions about PM, ozone, volatile organic compounds (VOCs), which are major pollutants, and non-road mobile pollution sources. Based on this meeting, the "VOCs Management Policy and Prevention Technique Seminar of Korea, China, and Japan" was held in Beijing in June and October 2015. The TPDAP has continued and is planning collaborative research on air quality, including constructing an air pollution emissions inventory, taking measurements, and modeling air quality.

With regard to climate change, the reduction of air pollutants, including fine particles and photochemical ozone, would be mutually beneficial for minimizing short-term climate change and for responding to the issue of air pollution. An awareness of the significance of climate change adaptation was shared at these meetings, and the efforts of each country to develop an adaptation plan were highlighted (TEMM 2013).

Each country involved in the organization of TEMM has launched small-scale projects that are quite collaborative and feasible. These countries are also playing critical roles in building awareness about the environment in Northeast Asia among the departments and officials in charge of environmental policies in these three countries. Although there has been previous criticism that participating countries have not made appropriate investments (Chu 2005) and that, with the exception of the yellow dust issue, the focus has been fairly limited (i.e., to air pollution) (Elder 2013), dialogue based on the TEMM framework has been reinvigorated. The three countries are aware of the current severe air pollution and consider the mitigation of air pollutants to be a high priority among the environmental issues facing East Asia and

dialogues and related projects has been developed and actively continued. The latest TEMM discussed and exchanged the regional policies in the context of two important UN frameworks of "the 2030 Agenda for Sustainable Development" and "the Paris Agreement" and made progress on the discussion regarding nine priority areas for environmental cooperation, including air quality improvement (TEMM 2016).

3.2.4 LTP

Korea, China, and Japan are participants in efforts related to long-range transboundary air pollutants in Northeast Asia (LTP), a joint research project regarding the transboundary transport of air pollutants in Northeast Asia with the following objectives (Chang 2012):

- provide and discuss the previous year's research results in the form of national reports submitted by each country;
- identify areas of uncertainty and gaps in knowledge that require additional research;
- develop a foundation for LTP research on the transboundary transport of air pollutants in Northeast Asia; and
- provide policy-makers with scientific information to prevent and control adverse impacts on the environment of Northeast Asia.

The research status of LTP is as follows. Following the International Workshop on Transboundary Air Pollutants of Northeast Asia, held in September 1995, meetings between public officials and expert groups were arranged in 1996 and 1997. The first sub-working group meeting was held, and the LTP project was launched in 1999. Phase 1 LTP activities were carried out from 2002 to 2004, resulting in the construction of the platform of international cooperation on monitoring, modeling, and emission listing. Phase 2 LTP activities were carried out from 2005 to 2007, LTP monitoring data were analyzed, and the LTP emissions inventory and model

assessments regarding the transboundary transport of sulfur were developed during this period. Phase 3 activities were performed from 2008 to 2012. Efforts were continuously made to monitor data analysis and emission inventory development, and the models of each country were improved through comparisons (Chang 2012). The latest phase, Phase 4 (2013 – 2017) has focused on making guidelines for air quality modeling in order to understand source – receptor relations in terms of transboundary air pollution (KMOE 2016d).

In 2014, Korea, China, and Japan also initiated an investigation into the joint effects of PM and the tripartite by promoting joint research about PM and expanding the LTP project to the Institute of Environmental Research of Korea, China, and Japan (KMOE 2013).

LTP has conducted research on the transboundary transport of air pollutants in Northeast Asia through the research organizations of each country. As the studies have been conducted at the level of individual countries, a shared view on the research results has not yet been developed. LTP is a joint research program based on voluntary agreements among experts from research organizations in each country—a situation that presents a challenge to efforts at developing legally binding systems or reaching detailed agreements. Additionally, the financing and budget execution structure is not sufficiently powerful to achieve systematic cooperation among the three countries. The monitoring and modeling methods used by the researchers of each country vary at LTP, and a standardized research method has not been developed. Efforts should be made to develop a monitoring and modeling method accepted by all stakeholders to facilitate the effective operation of this program (Chu 2005).

As the LTP program is run primarily by experts, the research results are not fully reflected in the policy-making process. Additionally, as diverse transboundary pollution issues have recently emerged, a comprehensive framework for cooperation is required. As more air pollution programs in Northeast Asia have arisen, concerns about potential overlap have also emerged. In turn, the LTP program needs to be improved to keep up with these challenges (Chang 2013). Although LTP is not a legally-binding program, the latest LTP in 2016 agreed on

further modeling studies using air pollution scenarios based on each countries' policies (Phase 5) and also agreed on future research to measure the chemical compounds of $PM_{2.5}$ in order to understand the physiochemical transformation of PM pollution over North-East Asia (KMOE 2016d).

3.3 Suggestions for improving international cooperation regarding air quality control in East Asia

3.3.1 Issues related to international cooperation regarding air quality management in Northeast Asia

A. Lack of scientific data for comprehensive air pollution research

Many international programs address the issue of air pollution in East Asia, including EANET, led by Japan; LTP, led by Korea; NEASPEC, operated by six countries; the ASEAN Haze Agreement; and the Central Environmental Convention. As programs have been established in diverse areas according to diverse interests, it is a challenge to select common agendas and build solid networks. As the matters of interest vary, it is also difficult for diverse countries to reach a consensus on the scientific causes and effects of air pollution (Kim 2007). This situation renders the achievement of scientific agreements and the development of policies on matters of common interest almost impossible. That East Asia has less scientific and financial resources than the EU or the US to determine the causes of air pollution creates an even greater challenge to efforts to reach policy agreements. The number of researchers and research achievements in the domain of air management has been increasing in East Asia, especially in China, which is a good sign. This is likely tied to the Chinese government's policy of prioritizing air pollution control. However, the use of international cooperation to achieve results related to air quality management in East Asia requires initial discussions about the major priorities (e.g., the relationship between emission sources and locations affected by long-range transboundary transport, calculation of the social costs and emissions of air pollutants, etc.) related to air pollution in East Asia. This should be followed by the development of a general agreement regarding the scientific basis of

such pollution and the selection of common research themes. Furthermore, there is no mechanism through which countries or stakeholders in East Asia can gather and promptly reach a policy agreement after the initial agreement on the scientific basis is reached. The three countries of TEMM (Korea, China, and Japan) agreed to enforce cooperation related to air pollution in May 2013. Although a high-level agreement for enforcement of international cooperation has been made, there are few mechanisms that enable working-level officers to closely communicate, and make further decisions. We should actively utilize existing programs or build a new working group platform at the governmental level.

B. Issues of overlapping cooperative bodies and the absence of permanent organizations

As mentioned above, there are a number of cooperative programs for air quality in Asia; this situation leads to issues such as program overlap and differences in priorities between countries. Due to the above issues, the stakeholders cannot even identify specific causes of pollution, which is critical for reaching a policy agreement. To address this issue, the "Joint Forum on the Atmospheric Environment in Asia and the Pacific" was established by Japan in 2006. Five existing programs have joined the Forum for an exchange of interests and the integrated development of programs. However, the biennial forum is still serving as a venue for relatively simple exchanges of interests, and the effects of the forum are questionable. In other words, such programs in Asia are only minimally effective. LTP, led by Korea, focuses on transboundary air pollution in East Asia, but the current condition in Asia, which is home to a mix of international programs, limits the development of a platform for a comprehensive discussion among China’s neighboring countries. As the issue of transboundary pollution affects not only Korea, China, and Japan, the results of LTP programs should be extended internationally. However, unlike the European Convention on Long-Range Transboundary Air Pollution (CLRTAP) of The European

Monitoring and Evaluation Programme (EMEP), LTP programs are not legally binding, and the organization is not permanent (Chang 2013).

Furthermore, there is no stable funding source, and the participation of stakeholders is limited to the scope of the central government. There is also no consensually accepted purpose, principle, or system for strategic planning or systematic environmental cooperation in East Asia, which limits the activities and growth of programs (Tian et al. 2009). When a specific country sponsors a program, the government's position or international conditions may affect its financial support. In Korea, the budget for international cooperation in the area of environmental policy is completely dependent on the decisions of the public officials in charge, and the subjective judgment of public officials, who can be reassigned at any time. This may determine government support for international cooperation, a factor that can affect the reliability of the program over the long term.

3.3.2 Measures to facilitate international cooperation for air quality management in East Asia

A. Consistent efforts to enhance, integrate, and permanently operate an international cooperative body

The ability of international cooperation to achieve positive results by successfully managing air quality in East Asia requires that international cooperative programs not be overlapped or discordant, as seen in the cases of Europe and the US. Accordingly, it seems desirable to establish an integrated international cooperative body with the shared aim of air quality management in East Asia. Countries and stakeholders must develop a shared vision, agree on basic principles, and make international cooperation efforts within a broader framework. There is no need to end existing programs: these can be included within a newly established, integrated mechanism according to the appropriateness of its sub-categories. In other words, individual mechanisms could be integrated into a comprehensive overarching one. This type of cooperative

framework should be developed with firm commitments from participating governments, detailed discussions, and the bottom-up participation of diverse stakeholders and experts. The Ministers at TEMM18 recognized the need for further and intense cooperation of current programs such as EANET and LTP (TEMM 2016), which should provide one step toward the future productive integration of existing activities.

B. Networking with international organizations and the participation of diverse stakeholders

The establishment of a framework for enhanced international cooperation should be accompanied by the development of a system for more active communication and management to maintain and further develop the framework. Additionally, because the program should be comprehensive and involve multiple stakeholders, it is critical to develop a mechanism for reinforced communication and management in East Asia.

If it is not easy to develop operational competency, tight networking with international organizations may be an alternative option. For example, partnerships with UNEP or UNESCAP can provide opportunities to coordinate the cooperative body, globally promote the results of cooperation, communicate with more experts, and increase interest and support. Multi-dimensional communication with international organizations may be the foundation for the development of a cooperative body in East Asia devoted to air quality management. The recent effort to establish the Asia Pacific Clean Air Partnership (APCAP) in cooperation with UNEP regional office for Asia and the Pacific would be a good example (UNEP 2015).

We should also expect financial support through reinforced partnerships with international organizations covering areas other than East Asia. Securing funding sources will be critical for the successful operation of this type of environmental cooperation mechanism. Contributions from the private sector and financing organizations are potential options in addition to the government to reinforce financing. Potential candidate financing organizations

include the World Bank, ADB, the Global Environment Facility (GEF), and business foundations. By broadening the funding sources, the limitations and weaknesses of depending too much on financing from specific countries can be reduced.

We should also expand the participation of stakeholders. Governments are leading actors in environmental cooperation, but the participation of businesses, private organizations, and academia is critical for reflecting the demands of local communities in terms of policy-making and effective policy design. The “Youth Forum and Tripartite Roundtable on Environmental Business” during TEMM18 (TEMM 2016) provides a good example of how stakeholder participation can be expanded.

C. Need to scientifically identify the causes and diverse influence of air pollution in East Asia

When the vision and principles of action of the cooperative body are agreed upon, the primary issues related to air quality management in East Asia should be identified, and a consistent program involving expert groups should be created to collect the scientific data necessary for air quality management. Additionally, efforts should be made to minimize conflicts between nations and stakeholders over scientific themes. This can be achieved through an agreement of renowned scientists with regard to higher-level scientific concepts. For example, Japan recently proposed the Asian Science Panel in Air Quality (ASPAQ) (Suzuki 2013), a gathering of scientists representing each region that is charged with contributing to the initiation of policy talks and the scientific determination of the bases of air pollution. The proposal has been implemented as the “Science Panel under APCAP” (UNEP 2015). Furthermore, it is important to establish a forum, like the Intergovernmental Panel on Climate Change (IPCC), where scientific, technical, and economic information can be reviewed and to achieve a consensus between scientists and policy-makers. By doing so, we can produce common scientific

consensus reports from an expanded group of experts that can, in turn, affect policy-makers in each country, which has been also proposed by Kim (2007).

It is also urgent that we define effective research themes. Issues in East Asia include developing the technology to reduce acid rain or pollutant emissions, as the emissions of air pollutants are being diversified and intensified as development proceeds, and ascertaining the effects of the above. This means that the complex effects of diverse air pollutants must be considered. The effects of secondary pollutants caused by the emission of diverse air pollutants (e.g., ozone, secondary aerosols, $PM_{2.5}$, etc.) and of diverse air pollutants on the environment and human health in East Asia (which is densely populated), as well the consequences of interactions between pollutants and climate change, are critical issues in East Asia that should be addressed in discussions of climate and the environment.

If a platform for discussions among scientists from various countries is established with the above themes, we will be able to reach scientific agreements through the accumulation of quality research results. Additionally, we can integrate existing programs according to theme. For example, led by Korea, the LTP has focused on modeling research related to long-distance movement; thus, it can play a leading role in research on the relationship between emission source and affected location. Such research activities do not need to be carried out exclusively in Asia. Indeed, the joint hosting of seminars with leading scientists from the US and Europe to promote issues in the international community would aid in reaching an agreement on the scientific facts.

D. Use of a system for sharing related information and research results

It is critical that research results and related information are shared to maintain the participation of countries and stakeholders. When scientific research is performed, the results should be shared with participating countries through such a knowledge sharing system. When

comprehensive information (scientific, economic, social, and legal) about the causes and effects of environmental issues is distributed, the awareness of stakeholders will increase, and a broader scope of participants will be involved in decision-making. Developing a new knowledge sharing system would be ideal, but it is not essential. We can also use existing information systems from international organizations, including UNEP, EANET, and LTP. The establishment of additional capacity-building programs and the hosting of policy meetings achieved through these systems can encourage additional positive collaborative effects.

E. Recommendations for improving intergovernmental policy dialogue in East Asia

I recommend that the following steps be taken to develop international cooperation with regard to air quality management in Northeast Asia. First, comprehensive and high-level cooperation, including cooperation among national leaders, should be pursued, and related groups should be integrated and receive status as permanent organizations. A consensus on the vision and the principles of these efforts should be reached, and this consensus should be based on a shared awareness of air and environmental issues and a mutual understanding among participating countries. In other words, participating countries need to understand the adverse effects of air pollutants and be committed to the idea that cooperation on this matter will be mutually beneficial. Given the above premise, we must also reach a consensus on the broader multilateral environmental cooperation framework to be used among national leaders and various stakeholders.

Second, to operate consistent and effective international cooperative programs, it is critical to induce the participation of various stakeholders. This is necessary for the successful operation and stable maintenance of international cooperative bodies, and experts from existing international organizations should participate through partnerships. Additionally, partnerships

with the World Bank, ADB, or Green Climate Fund (GCF) can facilitate the development of stable funding sources.

Third, the causes of air pollution in East Asia and the related effects should be scientifically identified, and a consensus on these issues should be reached. This is related to the reinforcement of the research competencies of East Asia. Currently, research budgets for air pollution are being expanded in Korea, China, and Japan, and the three countries can lead efforts to develop a consensus on the mechanisms of air pollution. By sharing information about this scientific basis and producing general research results, they will be able to drive policy agreements.

Fourth, reinforcing the competencies of diverse stakeholders and experts, including scientists and policy-makers, is a prerequisite for the development of cooperation in East Asia. To this end, a joint and comprehensive platform for knowledge sharing is a pressing priority, as it will enable related scientific and policy information to be shared and awareness to be improved. In this way, programs for competency reinforcement and academic seminars can be developed, and the effectiveness of cooperative bodies devoted to the management of air pollution can be improved.

Finally, the high-level, integrated and comprehensive air management cooperative body of East Asia needs to begin by reaching a political consensus on the broader framework of environmental cooperation. Mid- to long-term efforts and national determination are both required for understanding the complex relationships among air pollutants within the climate system (in terms of air quality and health impacts) and for building a consensus.

In addition to building a broad framework for cooperation on environmental issues in East Asia, basic research on air pollution is essential. In particular, we should pursue diverse joint studies on secondary air pollutants, such as $PM_{2.5}$ and ozone. Additionally, research on hazardous air pollutants (HAPs) is urgently needed.

Research on various toxic materials, with a main focus on China, is an important area of study in terms of the impact on the air environment and future health effects. Finally, an early warning system for the East Asian region should be established by connecting the monitoring networks of East Asia. With this system, severe air pollution events can be identified and warnings can be given in advance, helping to reduce the damage caused by transboundary air pollution. Studies and programs with the above themes are critical for progress related to sustainable development in East Asia in the 21st century. The direction of mid- to long-term strategies and research should be defined at the organizational level so that studies and programs can produce fruitful results.

4. Conclusions

Northeast Asia is currently the largest air pollutant and greenhouse gas emitter and is thus causing significant risks to the environment and to human health. Air pollution management is one of the areas in which international cooperation is critical, due to the long-range transboundary transport of air pollutants.

To respond to the severe air pollution in Korea, the Korean MOE implemented an air quality forecasting system and started air pollution forecasting services in 2014 (KMOE 2016a). The Korean MOE has spent large portions of its budget to improve air quality forecasting, including launching stationary satellite measurement instrument for East Asia. Constructing a national database inventory has also been useful in the development of policy measures related to local air pollution. Based on this information, the development of sector-specific mitigation policies that are derived from local scientific analysis will continue and contribute to overall domestic air pollution control.

Recently, the severe PM pollution over Korea resulted in widespread social attention, with the responsibility of diesel-driven vehicles and domestic coal fired plants for the current air

pollution publically discussed in the mass media. This public attention led the Korean government to strengthen the measures against PM pollution in 2016, suspending the construction of new coal power plants and expediting its plan for terminating old diesel vehicles (Lee 2016a; KMOE 2016c).

Korea has continuously participated in international cooperative initiatives, including LTP, for air pollution management and has declared a domestic goal of achieving reductions in greenhouse gas emissions. However, it has not yet effectively achieved this goal. Successful international cooperation requires a stronger and comprehensive coordination driven by high-level agreements and the participation of national leaders, policy makers, and scientists, and various stakeholders. This should be pursued in a consistent and cooperative manner.

References

Ahmed, E., K-H. Kim, Z.-H. Shon, and S.-K Song. 2015. "Long-term Trend of Airborne Particulate Matter in Seoul, Korea from 2004 to 2013." *Atmospheric Environment* 101: 125-33.

Akimoto, H. 2003. "Global Air Quality and Pollution." *Science*, 302 (5651): 1716-19.

CDIAC. 2009. "Top 20 Emitting Countries by Total Fossil-Fuel CO2 Emissions for 2009." http://cdiac.ornl.gov/trends/emis/tre_tp20.html.

Chang, L-S. 2012"LTP Project Assessment and Future Activity." Presentation at Better Air Quality 2012, December 7. Hong Kong.

Chang, L-S. 2013. "Dong-Asia Daegi Oyeom Jergamul Uyhan Kukjae Initiative" [International Initiatives for Mitigating Air Pollution in East Asia]. Presentation at Korea Environment Institute, October 30. Seoul, Korea.

Chu, J. 2005. "Dongbuk-A Hwankyung Hyupryuk Chaekye Hyoyulwha Bangahn Yunku" [Measures for Improving Efficiency of International Cooperation for Environment over Northeast Asia]. Report of Korea Environment Institute.

EANET. 2012. "Report of the Session" (14th EANET/IG). The Fourteenth Session of the Intergovernmental Meeting on the Acid Deposition Monitoring Network in East Asia 26-27 November 2012." Yangon, Myanmar. http://www.eanet.asia/event/ig/ig14.pdf.

———. 2014. "Strategy Paper for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances." http://www.eanet.asia/product/strategy/sp_sv_2.pdf.

———. 2016. "Report of the Session" (18th EANET/IG). The Eighteenth Session of the Intergovernmental Meeting on the Acid Deposition Monitoring Network in East Asia, 22-23 November. Bangkok, Thailand. http://www.eanet.asia/event/ig/ig18.pdf.

Elder, M. 2013. "Strengthening International Cooperation on Air Pollution in Asia." Presentation at the Korea Environmental Institute, November 8. Seoul, Korea.

HTAP. 2010. "Hemispheric Transport of Air Pollution 2010." Air Pollution Studies No. 17. New York and Geneva: UN Task Force on Hemispheric Transport of Air Pollution.

Kim, I. 2007. "Environmental Cooperation of Northeast Asia: Transboundary Air Pollution." *International Relations of the Asia-Pacific* 7, 439–62. doi:10.1093/irap/lcm008.

———. 2014. "Messages from a Middle Power: Participation by the Republic of Korea in Regional Environmental Cooperation on Transboundary Air Pollution Issues." *International Environmental Agreements* 14: 147–62. doi:10.1007/s10784-013-9214-5.

Korea Ministry of Environment (KMOE). 2013. "Misae Munji Jonghap Daecheck" [Comprehensive Measures Against Fine Particles]. December 10. Sejong: KMOE.

———. 2016a. "Misae Munji Oyum Hyunwhang-gua Daecheck" [Lists of Important Policy Measures for Mitigating Air Pollution (since 2014)]. June 7. Sejong: KMOE.

———. 2016b. "Go-nongdo Misae Munji Daeung Manual" [Manual for Vulnerable People to Respond Against High PM Pollution]. December 1, Sejong: KMOE.

———. 2016c. "Misae Munji, Dodaeche Muel Ka?"[What is the Nature of Particulate Matter?]. April 1, Sejong: KMOE.

———. 2016d. "Dongbuk-A Janggeory Idong Daeki Oyummulgil Gongdong Yunku Hwakdae, Kangwha" [Strengthening Collaborative Research on Transboundary Air Pollutants in North-East Asia]. Press Release, November 18. Sejong: KMOE.

Korea Environmental Statistics Portal (KESP). 2016. "Cho Misae Munji Nongdo Tongkye" [$PM_{2.5}$ air quality statistics in Korea]

http://stat.me.go.kr/nesis/mesp2/webStatistics/stat_main.jsp?tblID=DT_106N_03_0200129&inq_gubun=1.

Lee, S., Y. Hong, C. Song, M. Lee, S. Ryoo, and J. Kim, et al. 2009. “Geostationary Environment Monitoring Spectrometer (GEMS) Onboard MP-GEOSAT (Multi-Purpose Geostationary Satellite) over Asia-Pacific Region.” American Geophysical Union (AGU) Fall Meeting. San Francisco, CA.

Lee, J. and Y. Cho. 2009. “Demand Forecasting of Diesel Passenger Car Considering Consumer Preference and 218 Government Regulation in South Korea.” *Transportation Research Part A: Policy and Practice* 43: 420–29.

Lee, D. 2016a. “Minister of Environment Will Suspend the New Construction of the Posco Coal Power Plant.” *Money Today*, October 31. http://www.mt.co.kr/view/mtview.php?type=1&no=2016092714241867118&outlink=1.

Lee, S. 2016b. “Choeguen Misae Munji Nongdo Hyunwhange Daehan Dakakjuck Bunseok” [Analysis for recent PM concentrations in Korea]. *KEI Focus*, 4, 3(15), Sejoing: Korea Environment Institute.

NEASPEC. 2016. “Concept note of Expert Consultation Meeting on NEASPEC Transboundary Air Pollution Project. North-East Asian Subregional Programme for Environmental Cooperation. http://www.neaspec.org/sites/default/files/Concet%20Note.pdf.

———. 2012. “National Inventory of Atmospheric Emissions in 2011.” North-East Asian Subregional Programme for Environmental Cooperation.

National Institute of Environmental Research (NIER). 2015. “An International Cooperation Air Quality Field Study in Korea.” https://cleanair.nier.go.kr/index.do.

Richter, A., J. P. Burrows, H. Nü, C. Granier and U. Niemeier. 2005. “Increase in Tropospheric Nitrogen Dioxide over China Observed from Space.” *Nature* 437: 129-32. doi:10.1038/nature04092.

Shim, C. and J. Hong. 2016. “Impact of a National Plan for Future Electricity Supply on Ambient Air Quality in South Korea.” *Energy Policy* 88C: 278-88. doi:10.1016/j.enpol.2015.10.1033.

Streets, D. G., G. R. Carmichael, S. D. Fernandes, Q. Fu, D. He, and Z. Klimont, et al. 2003. "An Inventory of Gaseous and Primary Aerosol Emissions in Asia in the Year 2000." *Journal of Geophysical Research* 108 (D21): 8809.

Suzuki, K. 2013. "Mitigating Air Pollution and Climate Change in Asia: Toward an Integrated Approach." Parallel Lunch Session at the International Forum for Sustainable Asia and the Pacific, moderated by Mark Elder, July 23. Yokohama, Japan.

TEMM. 2013. “The 15th Tripartite Environment Minister Meeting Among Japan, Korea and China.” http://www.temm.org/sub03/11.jsp?commid=TEMM15.

———. 2016. “Joint Communiqué.” The 18th Tripartite Environment Ministers Meeting Among Japan, Korea and China. http://www.temm.org/sub03/11.jsp?commid=TEMM18.

Tian, C., S. Hongbo, E. Ota, H. Mori, and J. Chu. 2009. “Tripartite Joint Research on Environmental Management in Northeast Asia.” Policy Research Center for Environment and Economy, Ministry of Environmental Protection (PRCEE), Institute for Global Environmental Strategies (IGES), and Korea Environmental Institute (KEI).

UNEP. 2015. “Asia Pacific Clean Air Partnership.” (APCAP). http://web.unep.org/regions/roap/events/apcap.

UNESCAP. 2012a. “Report of the Meeting.” NEASPEC Expert Consultation Meeting on Transboundary Air Pollution in North-East Asia, July, 9-10. St. Petersburg, Russian Federation.

http://www.neaspec.org/article/expert-consultation-meeting-transboundary-air-pollution-north-east-asia.

———. 2012b. “Report of the Seventeenth Senior Officials Meeting of the North-East Asian Subregional Programme for Environmental Cooperation. December, 20-21. Chengdu, China. http://www.unescap.org/events/17th-senior-officials-meeting-north-east-asian-subregional-programme-environmental.

Abstract (in Japanese)

要約

韓国の領土の大部分で大気質基準（25μg/ m3 /年）以上の微粒子濃度が観測されており、これは韓国の国家環境と公衆衛生の 2 つの分野での深刻な懸念となっている。特に、大気汚染特定物質である PM の国境を越える移動は東アジア諸国をまたぐ国際的な課題となっている。本稿では、微粒子汚染を軽減する韓国政府の方針の検討について論じている。特に、PM2.5 を管理するために近年開発された韓国環境省（KMOE）の PM 管理システムについて検証を行った。また、東アジアの大気質に関する協力プログラムである東アジア酸性雨モニタリングネットワーク（EANET）、日中韓大気汚染物質長距離越境移動共同研究プロジェクト(LTP)、北東アジア環境協力プログラム(NEASPEC)、日中韓３か国 環境大臣会合（TEMM）について、国際的な調整、コミュニケーション、科学的活動、制度的構造に焦点を当てた比較を行った。これらの分析に基づいて、本稿において、東アジアの大気質に関する国際対話を改善するための複数のアイデアを提言した。

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