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STILL DIRTY AFTER ALL THESE YEARS: POLITICAL LEADERSHIP, KNOWLEDGE, AND SOCIALIZATION AND REGIONAL ENVIRONMENTAL COOPERATION IN NORTHEAST ASIA

A Dissertation Presented

by

INKYOUNG KIM

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2014

Political Science

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POLITICAL LEADERSHIP, KNOWLEDGE, AND SOCIALIZATION AND REGIONAL ENVIRONMENTAL COOPERATION IN NORTHEAST ASIA

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INKYOUNG KIM

Approved as to style and content by:

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Peter M. Haas, Chair

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DEDICATION

To my parents and restless supporters, Hojun, Owon, and Juwon

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I would like to thank everyone who has supported this project both intellectually and emotionally. From the ardent dissertation committee members who have made writing this dissertation a perpetual motion, to my interviewees who have shared their knowledge and experiences on regional environmental cooperation, I have so many people to express my deepest gratitude. First of all, I am indebted to Professor Peter Haas simply too much for providing incredibly helpful and timely comments. 60! This is the number of emails that we exchanged in just a week. After conducting many interviews in Northeast Asia during my fieldwork, I wanted to refine my research questions and hypotheses. We kept a trans-Atlantic conversation going for one week to satisfy my intellectual struggles and curiosity. I learned how to devote myself as a scholar and a teacher to help my own students. I am so grateful to have him as my advisor and mentor.

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ABSTRACT

STILL DIRTY AFTER ALL THESE YEARS:
POLITICAL LEADERSHIP, KNOWLEDGE, AND SOCIALIZATION AND
REGIONAL ENVIRONMENTAL COOPERATION IN NORTHEAST ASIA

MAY 2014

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This dissertation examines the microprocesses of regime creation in Northeast Asia regarding transboundary environmental problems. Despite the growing need for international environmental cooperation and policy coordination at the regional and global levels, Northeast Asia has not yet succeeded in reaching any binding regional agreement on any environmental issue, even though it has developed various environmental cooperative mechanisms regarding transboundary pollution. Rather than characterizing regional environmental cooperative mechanisms in Northeast Asia as "non-regime," this study unpacks the varying forms of collective action in terms of the speed of development of cooperative mechanisms and the substantive content of the development undertaken by states in the region. The causal relationships between specific forms of political leadership, knowledge, and socialization and the degrees and forms of regional collective action is explored regarding the transboundary air pollution issues of the region, including acid rain, dust and sandstorms, and various long-range transboundary air pollutants. In addition to comparing the participation of countries in

this region in broader Northeast Asian cooperative mechanisms, the study also analyzes the differences between European and East Asian experiences on this topic.

An analysis of the three cases indicates that all three independent variables are only partly associated with varying degrees of collective action as measured by formal features and concrete collective action in Northeast Asia. The study's comparison of the varying degrees of collective action in Northeast Asia and Europe and among the three studied Northeast Asian environmental cooperative mechanisms discovers two useful insights.

First, the analysis supports the hypothesis on social mechanisms among political leadership, shared knowledge, and socialization, which asserts that the stronger the political leadership and the greater the shared knowledge in the region, the more likely participants in regional cooperation are to engage in the learning process of socialization and thereby create the most formal and concrete collective action. The study finds that strong political leadership is not itself sufficient to lead member countries to engage in the learning process of socialization and that a lack of shared scientific knowledge is positively associated with the adaption process of socialization among participants in the cooperative activities of these three regional mechanisms.

Another insight is that the lack of shared knowledge and of the learning mode of socialization helps explain why all three regional cooperative mechanisms have failed to advance to become the legally binding regional environmental regimes rather than the comparatively higher degrees of collective action in terms of formalization and concreteness among regional entities within the UNEP's second category of regional action. This study argues that knowledge and socialization barriers are key determinants of the development of regulatory regional environmental regimes. Without shared scientific knowledge and engagement in the learning process of socialization, even given strong political leadership by a participating country, it is not likely for a region to develop a legally binding regional environmental regime. Therefore, this study concludes that to make the transformation from the least formal and concrete collective action to the most formal and concrete depends on creating shared knowledge and the learning process of socialization.

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LIST OF ABBREVIATIONS

ACAP	Asia Center for Air Pollution Research
ASEAN	Association of Southeast Asian Nations
CARICOM	Caribbean Community
CCC	Chemical Coordinating Centre
CEE	Central and Eastern Europe
China	People's Republic of China
CLRTAP	Convention on Long-Range Transboundary Air Pollution
DPRK	Democratic People's Republic of Korea
EANET	East Asia Acid Deposition Monitoring Network
EEA-32	15 pre-2004 member states + 10 member states joined in 2004 + 4 European Free Trade Association members + Romania, Bulgaria and Turkey
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe
EPB	Environmental Protection Bureau in China
EU	European Union
EU-27: 27	Member states of EU
FAO	Food and Agriculture Organization
FGD	Flue-gas desulfurization
FYP	Five-Year Social and Economic Development Plans in China
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
IG	Intergovernmental Meeting of EANET

KMA	Korea Meteorological Administration
LTP	Joint Research on Long-range Transboundary Air Pollutants in Northeast Asia
Med Plan	Mediterranean Action Plan
MOEJ	Ministry of Environment in Japan
MOEK	Ministry of Environment in the Republic of Korea
MSC-E	Meteorological Synthesizing Centre-East
MSC-W	Meteorological Synthesizing Centre-West
NAFTA	North American Free Trade Agreement
NEASPEC	North-East Asia Sub-regional Program for Environmental Cooperation
NECD	National Emission Ceilings Directive
NIER	National Institute of Environmental Research
NILU	Norwegian Institute for Air Research
NOx	Nitrogen oxides
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
ROK	Republic of Korea
SADC	Southern African Development Community
SEPA	State Environmental Protection Administration in China
SO_2	Sulfur dioxide
TOR	Terms of Reference
UNCCD	United Nations Convention to Combat Desertification
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme

UNESC	United Nations Economic and Social Council

CHAPTER 1

INTRODUCTION: LEADERSHIP, KNOWLEDGE, AND SOCIALIZATION

Research Questions

There has been a growing consensus on the need for international environmental cooperation and policy coordination at the regional and global levels. Global warming, ozone depletion, and tropical deforestation are typically acknowledged as global environmental problems requiring global cooperation, while acid rain, haze, and regional water pollution are typically viewed as regional issues. In response to these problems, more than a thousand multilateral environmental agreements have been made between 1950 and 2010.[1] Northeast Asia, however, has not yet succeeded in reaching any binding regional agreement even though it has developed various environmental cooperative mechanisms regarding transboundary pollution, as shown in Table 1.1. It is also notable that none of the countries of this region have accepted a binding dispute resolution mechanism in the numerous bilateral agreements they have made (Henry, Kim, & Lee, 2012).

Table 1.1
Participation of Northeast Asian Countries in Environmental Cooperative Programs

Issue areas	Acronyms	Full name	Starting Year	Region/ Sub-region	Level of actors

[1] This number includes conventions, treaties, agreements, accords, or their non-English equivalents and protocols and amendments to such instruments and excludes "soft law" such as action plans, agreed measures, codes of conduct, declarations, resolutions, and similar policies (Mitchell, 2002-2011).

Regional Cooperation[a]	APEC	Asia-Pacific Economic Cooperation	1989	Asia-Pacific	State
	ASEAN+3	ASEAN Plus Three	1997	East Asia	state, IO
	ASEAN+6	ASEAN Plus Six	2005	Asia-Pacific	State
	EAS	East Asia Summit	2005	East Asia	State
	Tripartite Summit	Trilateral Summit	2008	Northeast Asia	State
Comprehensive	AECEN	Asian Environmental Compliance and Enforcement Network	2005	Asia	State
	Project ABC	Project Atomospheric Brown Cloud	2002	Asia and Pacific	State
	ECO-Asia	Environmental Congress for Asia and Pacific	1991	Asia and Pacific	State
	NEAR	The Association of Northeast Asia Regional Governments	1996	Northeast Asia	Local govern-ments
	-	Joint Meeting of the Intergovernmental Networks on Regional Air Pollution in Asia and the Pacific	2009	Asia and Pacific	IOs
	NEAC	Northeast Asian Conference on Environmental Cooperation	1992	Northeast Asia	State

	NEASPEC	Northeast Asian Sub-regional Program of Environmental Cooperation	1993	Northeast Asia	State
	TEMM	Tripartite Environment Ministers Meeting	1999	Northeast Asia	State
	APN	Asia-Pacific Network for Global Change Research	1995	Asia-Pacific	State
	TPM	Tripartite Presidents Meeting	2004	Northeast Asia	national research institutes
	ENVIRO-ASIA	Eco-Peace Network in Northeast Asia	2001	Northeast Asia	NGOs
Air Pollution[b]	EANET	Acid Deposition Monitoring Network in East Asia	1998	East Asia	State
	TDGM	Tripartite Director General Meetings for yellow sand/Dust sand storm among China, Japan and ROK	2007	Northeast Asia	State
	LTP Project	Joint Research Project on Long-Range Trans-Boundary Air Pollutants in Northeast Asia	1995	Northeast Asia	State
	NEAFF	Northeast Asian Forest Forum	1998	Northeast Asia	NGOs
	TEEN	Tripartite Environmental Education Network	-	Northeast Asia	NGOs

Water Pollution	NOWPAP	Northwest Pacific Action Plan	1994	Northeast Asia	State
Biodiversity	EABRN	East Asian Biosphere Reserve Network	1995	Northeast Asia	state, IO
	Crane Network	Northeast Asian Site Network Center	1997	Northeast Asia	State
	APMWCS	Asia-Pacific Migratory Waterbird Conservation Strategy	2002	Northeast Asia	State
	NAPEP	Northeast Asian and North Pacific Environmental Forum	1992	Asia and Pacific	NGOs

[a] These five cooperative mechanisms were not explicitly developed for environmental cooperation and have been more focused on general cooperation, particularly economic cooperation, although they have set up side meetings for environmental issues. For example, APEC has held meetings of ministers responsible for the environment. Some meetings tend to be sporadic rather than consistent. For example, the meeting of environmental ministers at APEC in 2012 was held 15 years after the previous meeting in 1997.

[b] There are two other international cooperative mechanisms that deal with air pollution in Asia or East Asia: Environmental Monitoring of Persistent Organic Pollutants (POPs) in East Asian Countries and Clean Air Initiative for Asian Cities (CAI-Asia). However, China has not participated in the POPs monitoring project since 2005, and the ROK has not participated in CAI-Asia at the governmental level.

Previous research studies addressing this issue have strived to identify the factors that determine the emergence, persistence, and dissipation of international regimes regarding the environment (Hasenclever et al., 1997; Krasner, 1983; Young, 1989; Young and Osherenko, 1993). For the successful development of such regimes, scholars have suggested the following contributing factors: efficient leadership (Chung, 1999; Haas 2000); scientific consensus (Chung, 1999; Haas, 2000; Kim, 2007; Nam, 2002); the influence of public concern and NGOs (Haas, 2000; Komori, 2010); previous institutional experience regarding regional cooperation (Nam, 2008; Valencia, 2008); and coordinating mechanisms among various overlapping initiatives (Komori, 2010). Northeast Asia has been characterized as a region where the development of environmental regimes has been slow. Most researchers have concluded that environmental regime-building in this region has remained elusive, or remains at most in an embryonic stage, because the main factors that promote regime creation have not yet sufficiently developed to trigger real international cooperation.

This dissertation project focuses on the variations among different regional environmental cooperative mechanisms in Northeast Asia. This does not mean that it disregards the regional characteristics of Northeast Asia in explaining regional environmental cooperation, as some factors may be more closely related to regional characteristics than to characteristics of the issues themselves. However, the focus of this project is on the variations among issue areas in Northeast Asian environmental cooperation despite general regional characteristics so as to avoid deterministic explanations.

This examination of cooperative mechanisms developed to address environmental issues related to air quality is motivated by several driving questions with relevance to the field of international relations and policy making that it hopes to answer. If countries aim to reduce transboundary air pollution through international cooperation, why have various cooperative mechanisms developed different forms and degrees of collective action within a region? What determines the forms and degrees of collective action? Why do countries participate more actively in certain cooperative mechanisms than in others?

What driving forces are contributing factors for regional cooperation to produce behavioral changes among participating countries?

Thus, rather than stating that the cooperative efforts of Northeast Asia have been failures by defining them as nonregime cooperation,[2] I ask why collective actions through various cooperative mechanisms have developed at variant speeds and degrees even though regional characteristics are specific and significant enough to explain regional environmental cooperation. In doing so, instead of asking what factors are missing in the region that could contribute to developing successful environmental regimes, this study analyzes the causal relationships between the degrees and forms of regional collective action and the existence of political leadership, shared knowledge, and socialization.

Background of Research and Purpose

The comparison of annual anthropogenic sulfur dioxide (SO_2) in 2000 from ten continental regions in Figure 1.1 shows that East Asia, encompassing Far East Russia, Mongolia, China, the Republic of Korea (hereafter ROK), and Japan, records the highest emissions.[3] It is astonishing to see that the small number of Northeast Asian countries recorded the highest emissions of SO_2 in the world.

---

[2] Nonregime cooperation is defined as "transnational policy arenas characterized by the absence of multilateral agreements for policy coordination among states" (Dimitrov et al., 2007, p. 231).

[3] Liu and Mauzerall (2007) define the ten continental regions as follows: North America (NA), South America (SA), Europe (EU), the former Soviet Union (FSU, excluding part of Russia in the European domain), Africa (AF), the Indian subcontinent (IN), East Asia (EA), Southeast Asia (SE), Australia (AU), and the middle East (ME).

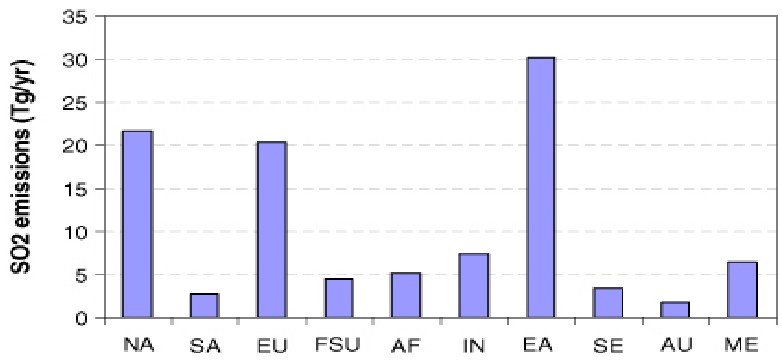

Figure 1.1. Annual anthropogenic SO_2 emissions in 2000. Adapted from J. Liu & D. L. Mauzerall, D. L., 2007, "Potential Influence of Inter-continental Transport of Sulfate Aerosols on Air Quality," *Environmental Research Letters,* 2: 045029, p. 3.

Despite its ecological interdependence due to geographical proximity, which is considered a primary condition for multilateral environmental cooperation (Soroos, 1997, pp. 266-267), Northeast Asian countries have shown relatively slow progress toward creating cooperative environmental regimes. Throughout their history, China, Japan, and the ROK have been the most interactive parties and thus those most recognized as having influenced one another through various channels. It is therefore puzzling that the Northeast Asian countries seem to be less active in solving common environmental problems than countries of other regions such as Europe and even other subregions of Asia.

Since the first wave of regionalism began in Western Europe in the 1950s, regionalism has undergone many ups and downs (Kim, 2004). After fizzling out in the 1960s and 1970s, a second wave of regionalism came in the late 1980s and 1990s, initiated by the Single European Act of 1986.[4] Finally, the so-called new regionalism has

[4] Mansfield and Solingen identifies four waves of regionalism: the first wave during the second half of the 19th century as "largely a European phenomenon" which "was associated with the emergence of a liberal international trading system"; the second wave after World War I as "more economically discriminatory" phenomenon; the third wave between the 1960s and the early 1970s; and the fourth wave during the 1990s (2010, pp. 147-148).

blossomed due to the extensive discontents of globalization, such as the Asian financial crisis of 1997-1998, the collapse of the 1999 World Trade Organization talks in Seattle, and the push of European Union toward more rigorous integration through the launching of a common currency in 1999. In fact, regionalism is seen as an emerging notion against a backdrop of rapid globalization that contains the triumph of democracy, open financial movements, and the comprehensive battle against terror (Rozman, 2004). Under these circumstances, looking at a region to better understand international interactions seems inevitable.

Social science scholars, including those in international relations, have recently paid extensive attention to regions. This attention derives from the growing number of formal institutional arrangements such as the European Union (EU), the North American Free Trade Agreement (NAFTA), the Gulf Cooperation Council (GCC), the Central American Common Market, the Caribbean Community (CARICOM), and the Southern Common Market (Mercosur) (Pempel, 2005) as well as the less formalized efforts of the Association of Southeast Asian Nations (ASEAN) and Southern African Development Community (SADC) (Breslin & Higgott, 2000). It has been argued that a focus on regions can help us better understand changes in and processes of world orders because regions are "social constructions created through politics" rather than natural, or "determined by geography" (Katzenstein, 2000, pp. 353-354).

Northeast Asia is under construction as a region. The two competing views among scholars regarding Northeast Asian regionalism are what Rozman called "liberal openings and realist suspicions" (2004, p. 12). The liberal political economists argue that economic integration based on soaring intraregional trade will soon lead to regionalism, whereas realists doubt that regionalism will form because of insecurity in Northeast Asia. Some scholars have focused on the lack of integration within the region based on the political actions of governments (Frankel & Kahler, 1993; Mansfield & Milner, 1997). Others have highlighted increased “cohesiveness” or “interconnectedness” in the region based on nongovernmental actions such as popular culture (Cohen, 2002) and the development of “open regionalism” in “more peaceful East Asia” than in “more conflict-prone Middle East” (Solingen, 2007, pp. 774-775). Thus, there appear to be both positive and negative prospects for regionalism in Northeast Asia, and this study is intended to shed light on how the core participant countries have responded to common environmental issues under these circumstances.

Examination of this topic is complicated by the fact that there is little consensus on the boundaries of this region. Scholars have included different sets of countries depending on the topic of their research (Mack & Ravenhill, 1995). For example, Hong Kong and Taiwan are typically included as main actors in economic discourses on Northeast Asia, while Russia is generally excluded from the region in cultural studies due to a lack of racial and cultural commonalities (Nam, 2002). As most studies regarding Northeast Asia name China, Japan, and the ROK as the core states (Kim, 2004; Rozman, 2004) of the region, this study also focuses primarily on the interactions of these three countries.

As shown in Figure 1.2, this dissertation defines Northeast Asia as containing six countries: the Russian Federation, Mongolia, China, Democratic People’s Republic of Korea (hereafter DPRK), the ROK, and Japan.[5]

[5] For further discussion of this region, see Inkyoung Kim, 2007.

Figure 1.2. Map of Northeast Asia. Adapted from NEASPEC. http://www.neaspec.org/envir-impera.asp.

Northeast Asia as a region is also quite diverse. It includes not only substantially different political systems but also various levels of economic development: an economic superpower, Japan; the rapidly developing ROK and east coast areas of China; and the poor and largely unindustrialized DPRK, rural China, Russian Far East, and Mongolia. Given these different levels of economic development, international cooperation within Northeast Asia can serve as a model to the whole world.

The Asian and Pacific region is worthy of study because it is "home to 60 percent of the global population, accounts for over 40 percent of the global economy" (UNEP, 2011). There are several subregions in the Asian Pacific: Southeast Asia, Northeast Asia, South Asia, Central Asia, and Pacific Islands.[6] Among them, Southeast Asia has developed the most environmental cooperation through numerous legal instruments and policy statements. This successful institutionalization is attributable to their extensive

[6] The classifications of subregions in Asia Pacific may vary across studies and organizations.

cooperative experiences through the Association of Southeast Asian Nations (ASEAN) since the 1960s (Nam, 2008). The ASEAN Ministerial Meeting on the Environment was established in 1981 as one of 30 ASEAN Sectoral Ministerial Bodies. As shown in Table 1.2, ASEAN has reached agreements on 16 environmental issues. For example, the implementation of the Agreement on Transboundary Haze Pollution signed in 2002 by 10 ASEAN member countries (ASEAN, 2010) was accomplished smoothly by designating the ASEAN Secretariat as its secretariat.[7] This arrangement is quite different from some cooperative mechanisms of Northeast Asia that have struggled with problems such as duplication and delays in designating secretariats, as discussed in the following chapters.

Table 1.2
Agreements and Declarations of Southeast Asia

- ASEAN Declaration on the 13th session of the Conference of the Parties to the UNFCCC and the 3rd session of the CMP to the Kyoto Protocol (2007)
- Singapore Declaration on Climate Change, Energy, and the Environment (2007)
- ASEAN Declaration on Environmental Sustainability (2007)
- Cebu Resolution on Sustainable Development (2006)
- Agreement on the Establishment of ASEAN Centre for Biodiversity (2005)
- ASEAN Declaration on Heritage Parks (2003)
- Yangon Resolution on Sustainable Development (2002)
- ASEAN Agreement on Transboundary Haze Pollution (2002)
- Jakarta Declaration on Environment and Development (18 September 1997)
- Bandar Seri Begawan Resolution on Environment and Development (1994)
- Singapore Resolution on Environment and Development (1992)
- The Kuala Lumpur Accord on Environment and Development (1990)
- Jakarta Resolution on Sustainable Development (1987)
- Agreement on the Conservation of Nature and Natural Resources (1985)
- Bangkok Declaration on the ASEAN Environment (1984)

[7] Haze pollution is defined as “smoke resulting from land and/or forest fire which causes deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems and material property and impair or interfere with amenities and other legitimate uses of the environment.” (ASEAN, 2010).

- ASEAN Declaration on Heritage Parks and Reserves (1984)

Note: Adapted from ASEAN, http://environment.asean.org/index.php?page=agreements.

Of course, ASEAN also has faced a few challenges, such as weak enforcement due to the “ASEAN Way” based on non-intervention, lack of ratification, and limited national capacity (Nam, 2008). In fact, Indonesia, the key polluter, has not ratified the Haze Pollution Agreement yet, unlike nine other member countries, namely, Brunei Darussalam, Cambodia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam. The House of Representatives of Indonesia rejected ratification in 2008, stating that the agreement threatened Indonesia’s state sovereignty and that it feared other countries interfering in their domestic issues (*Jakarta Globe*, January 23, 2011).

Despite these difficulties in implementation, ASEAN’s institutional experience with transboundary air pollution is way ahead of Northeast Asia’s environmental cooperation because of its more highly developed administrative structures. Considering that Northeast Asia includes countries with more advanced economic capacity than those in Southeast Asia, a lack of national capacity is not a sufficient explanation for the limited institutionalization of environmental cooperation. In 2009, the total GDP of China, Japan, and the ROK formed more than one sixth of the world’s total GDP, more than the U.S. GDP of US$10 trillion: US$4.985 trillion in China, US$5.069 trillion in Japan, and US$832.512 billion in the ROK (World Bank, 2011). Despite its rapid economic development, this region has not yet developed international regimes to deal with transboundary environmental problems even though it has endeavored to build regional cooperation since the early 1990s. Bilateral environmental cooperation flourished in the 1990s: between the ROK and China (1993), the ROK and Japan (1993), the ROK and Russia (1994), and China and Japan (1994). However, these bilateral agreements have been stalled and ineffective due to geopolitical characteristics, leadership issues, domestic circumstances, and other such issues (Ye, 2011).

It is commonly understood among policy makers and experts in Northeast Asia that successful European experiences in dealing with transboundary pollution are less likely to be transplanted to this region due to “substantially different political and economic systems” and “various levels of economic development” (Kim, 2007). In addition, little scientific consensus (Chung, 1999; Nam, 2002) and political antipathies shaped by historical memories (Yoshimatsu, 2010) have been obstacles to regional governance.

It is easy to assume that these unique characteristics of Northeast Asia may have prevented the region from building regional institutions. However, it is puzzling to see how the European countries managed to create the 1979 Long Range Transboundary Air Pollution despite the distrust between the West and East during the Cold War (Farrell and Keating, 2006), how the Mediterranean countries were able to reach agreements on the Med Plan despite economic gaps and political dissimilarities (Haas, 1990), and how ASEAN countries have reached the ASEAN Agreement on Transboundary Haze Pollution despite even greater cultural diversity. According to previous studies of regional environmental governance, this difference can be explained by leadership (Chung, 1999, 2010; Haas, 2000), former experiences with regional institutionalization (Nam, 2008), and weak organizations and the limited influence of public concerns and NGOs (Haas, 2000). To make this study useful for policymakers in the region, however, more attention needs to be paid to the specific elements within each of these factors needed for this region to successfully expand its existing cooperation. General explanations have flourished, and what is now needed are specific lessons that this region can apply to its own surroundings. Thus, this study attempts to shed light on the microprocesses of each factor in regime creation within current regional cooperation efforts.

Why Study Transboundary Air Pollution?

Social scientists, policy makers, and concerned citizens should care about transboundary air pollution in Asia simply because the emissions of Asian countries are so extensive and cross national borders. The size of the region's total economy and the resulting emissions has grown at a dramatic speed. For example, the ROK has faced air pollution problems that started in the late 1960s due to the nation's development of heavy industries and reached their peak in the 1970s and 1980s. However, the increasing use of low-sulfur oil and liquefied natural gas has brought a significant decrease in emissions. Various domestic measures were taken in the 1980s, including the 1981 Standard for Sulfur Content, the 1985 Prohibition of Solid Fuel Use, and the 1988 Clean Fuel Use Duty (Chang et al., 2008). As a result, emissions of SO_2 in Seoul have continuously declined (Chang et al, 2008). The emission reductions for nitrogen oxides (NOx) are not as significant as for sulfur, but it is notable that emissions have been kept at a certain level, 125 thousand tons, since the sharp reduction between 1989 and 1990 (Chang et al., 2008). For particulate matter (PM), Seoul has met the standard of an atmospheric environment of $50\mu g/m^3$ as of November 2010, for the first time since the countermeasures for improvement of metropolitan atmospheric environments were implemented in 2005, recording a 17% improvement.[8]

The most recent 2012 Environmental Performance Index indicates the successful management of pollution of the ROK to some extent.[9] The ROK is ranked 43rd out of 132 countries classified as "strong performers"[10] which is quite different from 2002, when the ROK was ranked 135th among 146 countries and its air quality 120th among 122 countries, evaluated on the performance of urban SO_2, NO_2, and Total Suspended Particles (TSP) concentrations (World Economic Forum, 2002).[11] This poor record resulted from "rapid urbanization and the exponential growth of the vehicle fleet in the Seoul Metropolitan Area[12]" (Kim, 2010, p. 3). However, the dramatic improvement is shown clearly by its ranking of 13th out of 132 countries of Pilot Trend EPI, which represents "the change in their environmental performance over the last decade" and "who is improving and who is declining over time" (Yale Center for Environmental Law and Policy et al., 2012, p. 4).

In the case of Japan, since modernization in the middle of the 19th century, it has achieved rapid economic growth through industrialization and urbanization. In 1955-64,

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[8] This data was provided by a Korean governmental official of Ministry of Environment in an interview.

[9] "The 2012 EPI rankings are comprised of both a snapshot of performance based on the latest available data (the 2012 EPI) and a trend rank based on performance over the last decade" (http://epi.yale.edu/epi2012/rankings).

[10] Japan is ranked 23rd in the group of strong performers, and China 116th in weak performers. EPI classifies countries into five groups; strongest performers, strong performers, modest performers, weaker performers, and weakest performers.

[11] TSP is the particle diameters approximately less than 50-100 microns (μm) which is different from PM10, inhalable particles less than 10 microns in diameter which penetrates through the nose, and PM2.5, "fine fraction" less than 2.5 microns in diameter which penetrates to the lungs.

[12] From 1990 to 2000, the population of the Seoul metropolitan area, covering 12% of the nation's entire area, increased by 20% to almost 22 million, accounting for 46% of all South Koreans. More impressively, the number of vehicles in the Seoul metropolitan area increased by 211%, from 1.8 million in 1990 to 5.6 million, in 2000 (Ministry of Environment, Republic of Korea, 2004).

the economic development of Japan was supported by tripled energy consumption, which resulted in various air pollution problems that were at their peak in the 1960s. However, Japan's technological innovation, institutional development, and collaboration between government and industry led to the significant decrease of sulfur dioxide emissions, by nearly 40% between 1974 and 1987 (UNEP, 2001, p. 32).

Northeast Asia has been not an exception to the growing global ecological interdependence, which is known as one of systemic process changes that have contributed to emerging restrictions on air pollution. In ecological science the term "ecological interdependence" refers to the fact that the loss or weakening of an ecosystem service, such as the soil's retaining ground moisture, can harm many species that rely on the ecosystem. In environmental politics, however, the term "ecological interdependence" is typically used to refer to common environmental problems shared by several countries. But as Nam has observed, "Geographical proximity and climate contiguity may seem to constitute what shapes a region into a single ecological community, but that is not necessarily the case. Rather, deterioration of regional common pool resources drives the region to become a destined ecological community" (2002, p. 169).

Thus the efforts made by the ROK and Japan in the region have been diluted by China, which has followed the same pattern of development taken by most developed nations, including the United Kingdom, United States, and Japan: "pollute first, control later." Under this model, countries consider environmental protection only after they achieve a certain degree of economic development (Wang, 2006-2007). China has developed its economy at a dramatic speed since the advent of Deng Xiaoping's "reform and opening" in the late 1970s. Between 1979 and 2011, China recorded a 9.6% average annual GDP growth rate. Its urban population increased by 4.2% annually between 1990 and 2003, even though the total population growth rate remained under 1%, and urban dwellers accounted for 40.53% of the total population in China (OECD, 2006). The total population in China comprises 20% of the global population, although China possesses only 6.8% of global arable land. See Figure 1.3 for the remarkable decrease in arable land in China between 1996 and 2002.

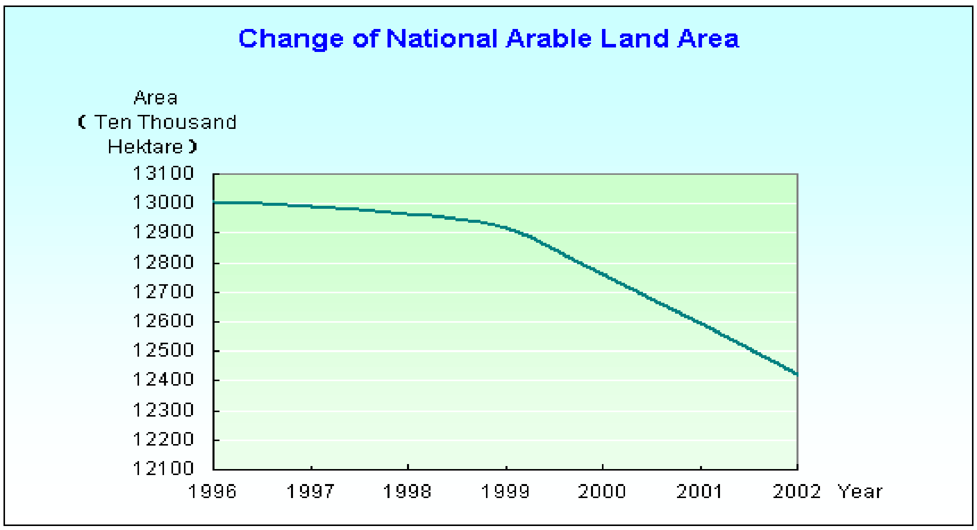

Figure 1.3. Change in arable land area in China between 1996 and 2002. Adapted from Environmental Information Center, SEPA. (2004). Analysis Report on the State of the Environment in China. http://english.mep.gov.cn/SOE/analysis/index.htm#wastegas1.

Moreover, China's "desire for self-sufficiency has exerted large pressures on the ecosystem" (OECD, 2006, p. 12). This economic development has led to several key problems in China: contamination of fresh water resources; air pollution by particulate matter and other pollutants; soil erosion and desertification ("desert now covers 25% of China's territory") due to degradation and destruction of forests; and the loss of cultivated land due to unsustainable agricultural practices and expansion of urban and industrial areas; and biodiversity loss (OECD, 2006, p. 11).

A 1999 study by the World Bank estimated that “air and water pollution damage, especially the dangers that fine airborne particulates pose to human health, have been estimated to be at least USD 54 billion a year--nearly 8% of China’s GDP” (OECD, 2006, p. 11). Another report by the Chinese Academy of Environmental Planning for the State Environmental Protection Administration (SEPA) in 2006 states the cost of air pollution at CNY 219.8 billion (OECD, 2006, 12). In fact, the amount of emitted industrial waste gas has shown a gradual increase, as seen in Figure 1.4, even though the rate of increase has slowed to some extent since 1997.

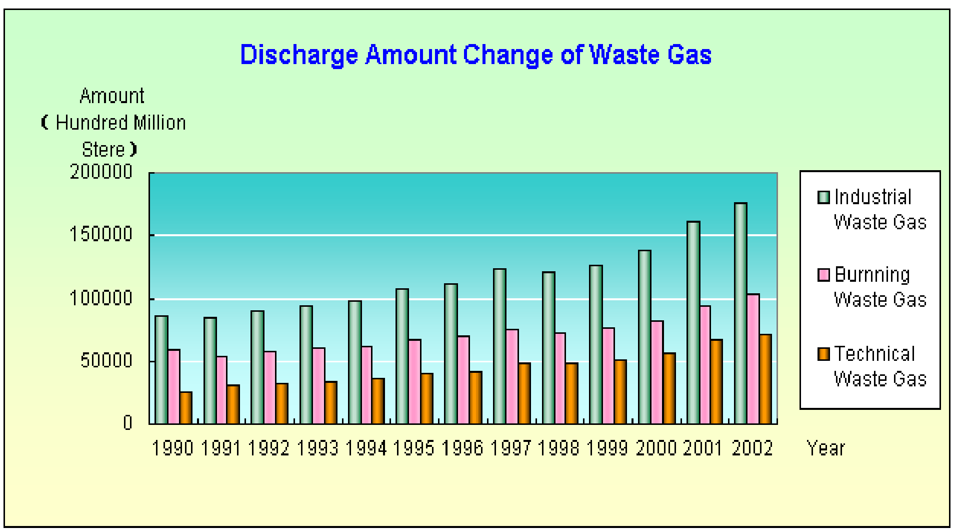

Figure 1.4. Change in amount of discharge of waste gas in China, 1990–2002. Adapted from Environmental Information Center, SEPA. (2004). Analysis Report on the State of the Environment in China. http://english.mep.gov.cn/SOE/analysis/index.htm#wastegas1.

Chinese efforts to deal with these environmental problems can be seen in (a) its institutional framework for environmental regulation, (b) environmental legislation, and

(c) Five-Year Environment Plans in line with Five-Year Social and Economic Development Plans (FYPs).[13] It should be noted that the national-level institutional framework for environmental regulation has been improved. The China's first top-level environmental body was the Environmental Protection Bureau (EPB), set up in 1974 with a staff of 20 as a unit under the State Council. Since then, the status of the EPB has improved gradually. After subsequent reorganizations of the governmental system, SEPA was set up as a ministry at the end of March 1998, upgraded from the National Environmental Protection Agency and promoted from a sub-ministry to a ministry. SEPA was placed directly under the State Council as one of its ministries, and at the time "its head reports directly to the Vice Premier in charge of environmental protection, has the status of Minister and participates in State Council meetings when environmental matters are discussed" (OECD, 2006, p. 15). SEPA had around 2,200 employees including administrative staff in Beijing and in various SEPA-affiliated national offices and centers. Although this number was a great increase over EPB's staff of 20 in 1974, it remained quite small relative to the size and population of China and "still considered a relatively weak agency," as suggested by its not having a permanent seat in the State Council (Wang, 2006-2007, p. 199).

In 2008, the Ministry of Environmental Protection (MEP) was established to replace SEPA. The Ministry of Environmental Protection is the current national-level administrative body that prepares and implements national policies, legislation and regulations; formulates environmental quality criteria and pollutant discharge/emission standards at the national level; organizes environmental quality monitoring; and initiates

[13] FYPs have been the basis for coordinating Chinese public policy priorities, developed by the Chinese government and approved by the Chinese Communist Party and the National People's Congress.

enforcement activities together with local environmental authorities. However, its autonomy seems limited due to the large number of ministries and agencies of the State Council that have to manage separately a range of environment-related issues.

> The National Development and Reform Commission (NDRC) plays a key role as the body responsible for developing and implementing FYPs. In this capacity, NDRC integrates environmental issues into the overall planning system in China and into sector-specific policies (e.g., on energy). The key ministries engaged in the implementation of environmental policies include:
>
> - Ministry of Water Management: watershed management, soil erosion, groundwater quality;
> - Ministry of Land and Resources: land use planning, mineral and marine resource management, land rehabilitation;
> - Ministry of Agriculture: management of agricultural chemicals, aquatic natural reserves, agro-biodiversity and grasslands;
> - Ministry of Forestry: forest management and protection and nature conservation;
> - Ministry of Health: monitoring the quality of drinking water and the incidences of related diseases;
> - Ministry of Construction: environmental infrastructure, including water supply and wastewater treatment plants and solid waste management;
> - Ministry of Communications: shares responsibility with SEPA on vehicle emissions control;
> - Ministry of Supervision: takes part in environmental enforcement campaigns carried out by SEPA.
> - Other government agencies concerned with environmental policy include:
> - State Forest Administration: forest conservation, afforestation, biodiversity and wildlife management;
> - State Oceanic Administration: management of coastal and marine waters, including marine biodiversity conservation; and
> - China Meteorology Administration: regional air quality management, climate change issues. (OECD, 2006, pp.15-16)

Along with the national-level institutional framework for environmental regulation, the sub-national-level framework has improved. Around 2,000 Environmental Protection Bureaus (EPBs) employ some 60,000 people “at the provincial, prefecture/municipal, district/counties, and township administration levels” to oversee environmental impact assessment (EIA), to monitor pollution releases from industries, to assess fees for pollution discharges, to initiate legal action against violations by firms, and to raise public awareness (OECD, 2006, p. 17). These sub-national level EPBs are subordinate to provincial and local governments both institutionally and financially, even though they receive guidance from SEPA. The EPBs' dependency on these more local governments has led its low ranking in the government hierarchy, as economic development has been favored over environmental considerations by local governments (OECD, 2006, p. 18). To overcome the low profile of environmental protection, in 2007, the State Council adopted a policy that stipulates that performance in energy saving and emissions reduction are two of the deciding factors for promotion of leaders and heads of local government. Thus, poor performance on either of these two factors will prevent governmental officials from being promoted even if the economic performance of the region is good (Koyanagi, 2008; Miyajiri, 2009).

Environmental Cooperation in Northeast Asia

In the mid-1990s China began to embrace multilateralism, moving away from a preference for bilateralism, because of its status as a "primary mover of regional economic and security cooperation in East Asia" (Zhao, 2011, p. 53). In May of 2012, China released a white paper titled *China-Japan-ROK Cooperation (1999-2012)* to review "the history of trilateral friendly exchanges, showcase the achievements of trilateral practical cooperation and envision the broad prospects of tripartite relations" (Ministry of Foreign Affairs, China, 2012).[14] As it shows, the three key countries of

[14] China's motive for this white paper was as the coordinator for 2012 trilateral cooperation, hosting the Fifth Trilateral Summit Meeting. In addition, the year 2012 "marks the 40th

Northeast Asia have developed significant cooperation on a variety of issue areas, including political and security affairs, trade and finance, sustainable development, and social and cultural exchanges. Based on Hidetaka Yoshimatsu's compilation of trilateral cooperative mechanisms on various issue areas (2010, p. 232), Table 1.3 demonstrates that environmental cooperation has a longer history in Northeast Asia.

Table 1.3
Summits and Ministerial Meetings Among China, Japan, and ROK

Policy Field	**Start Date**	**Major Features**
Summit	1999	The meeting was not held in 2005 due to political tensions. The meeting, independent of ASEAN + 3, has been held annually since 2008.
Environment	1999	Framed as Tripartite Environmental Ministers Meeting (TEMM, and issued a joint communiqué.
Finance	2000	Held just before the annual ASEAN + 3 Finance Ministers meeting.
Economy and trade	2002	Organized on the sidelines of the ASEAN + 3 meeting. The meeting was not held in 2005.
Information technology (IT)	2002	The formation of director-general meetings in various sub-fields.
Logistics	2006	The publication of a concrete action plan.
Tourism	2006	The issuing of a joint declaration.

anniversary of normalization of diplomatic relations between China and Japan, the China-Japan Year of Friendly Exchanges, the 20th anniversary of the establishment of diplomatic relations between China and the ROK, and the Year of China-ROK Friendly Exchanges" (Ministry of Foreign Affairs of China, 2012).

Health	2007	The issuing of the joint action plan on pandemic influenza in 2008.
Science and technology (S&T)	2007	The establishment of 'China-Japan-Korea Trilateral S&T Cooperation' at governmental and institutional levels.
Foreign Affairs	2008	The Three-Party Committee was held before 2007.

Note: Adapted from Yoshimatsu, 2010, p. 232.

As noted earlier, cooperation among Northeast Asian countries regarding environmental issues has not brought concrete regulations through the creation of environment regimes yet. Unlike many studies that ask why Northeast Asia has not built any legally binding international regime despite considerable effort to institutionalize cooperation since the early 1990s (for example, Kim, 2007; Lee, 1999; Ohta, 2008), this dissertation intends to explain the variation in the extent of environmental cooperation around different issue areas, and asks what factors can explain the variations among issue areas even under the same power relations, economic relations, and cultural surroundings. Rather than characterizing regional environmental cooperative mechanisms in Northeast Asia as "non-regime," the study unpacks varying forms of collective action undertaken by states in the region regarding transboundary air pollution in terms of the substantive content of their cooperation. In doing so, this study examines the causal relationships between degrees and forms of regional collective action and political leadership, knowledge, and socialization.

Case Selection

China, Japan, and the ROK have participated in more than 20 environmental cooperative programs since the mid-1980s as shown in Table 1.1. Some programs include Asia-wide cooperation, and others are exclusive to Northeast Asian countries. For this study, three cases were selected according to the four following criteria: issue-specific, involving a problem with transnational effect related to air pollution, currently operating, and participated in by the core three countries of Northeast Asia (China, Japan, and the ROK). The three cases that met these criteria are the EANET (Acid Deposition Monitoring Network in East Asia), developed to monitor acid deposition among 13 East Asian countries; the Tripartite Director General Meetings (TDGM), developed to address yellow sand and dust sandstorms among China, Japan, and the ROK under the Tripartite Environment Ministerial Meetings (TEMM); and the LTP (Joint Research on Long-range Transboundary Air Pollutants in Northeast Asia), developed to cooperate on issues of air pollution among the same three countries. Selecting cooperative mechanisms among the same countries and in the same issue area (transboundary air pollution) is intended to control for other possible independent variables.

Two other cooperative mechanisms met the first three criteria but not the last criteria of participation of the three core countries and thus were not included. These are the Environmental Monitoring of Persistent Organic Pollutants (POPs) in East Asian Countries, and the Clean Air Initiative for Asian Cities (CAI-Asia). In December 2002, 10 East Asian countries (Cambodia, China, Indonesia, Japan, the ROK, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) established the Workshop on Environmental Monitoring of POPs in order to identify the levels of POPs remaining in East Asia as required by the Stockholm Convention on Persistent Organic Pollutants. The

Convention was ratified or accepted by most Asian Countries, including China, Japan, and the ROK (UN Treaty Collection, 2013). Although China participated in workshops in its early years—2002, 2003, and 2005—it has not attended any meetings of the organization, such as expert working group meetings and policy group meetings, since 2006 (Ministry of Environment in Japan, 2013).

The second of these rejected mechanisms, the Clean Air Initiative for Asian Cities (CAI-Asia), was established in 2001 by the Asian Development Bank, World Bank, and USAID to "promote better air quality and livable cities by translating knowledge to policies and actions that reduce air pollution and greenhouse gas emissions from transport, energy and other sectors" (CAI-Asia, 2013a, 1). CAI-Asia has various partnership members, including 45 cities, 33 government agencies, 112 nongovernmental and academic organizations, 17 international development agencies and foundations, and 36 members from the private sector (CAI-Asia, 2013b). Both the Ministry of the Environment in Japan and the Ministry of Environmental Protection in China have been participating governmental agencies, but no governmental agency from the ROK has been involved in CAI-Asia. Only a few Korean academic institutes have participated in CAI-Asia, such as Seoul National University, International Environmental Analysis and Education Center, and Korea Advanced Institute of Science and Technology.

Dependent Variables

The dependent variables of this study are the forms and degree of collective action in regime-building processes. Collective action is typically categorized into three categories: legally binding, structured and science-focused, and less structured cooperative mechanisms. The United Nations Environment Programme (UNEP) classifies regional environmental action and initiatives into three different categories: (a) “regional entities with established infrastructure and a policy focus”; (b) “regional entities with permanent structure and a science focus”; (c) “other initiatives” that “have no permanent structures, but provide viable policy making fora for regional cooperation” (UNEP, 2011, 36-37). Most regional cooperative mechanisms regarding transboundary air pollution in East Asia fall into UNEP’s second category, including the three cases that this dissertation examines

The first and highest level is “regional entities with established infrastructure and a policy focus,” which includes “detailed regional legal instruments and infrastructure” (UNEP, 2011, p. 36). Among these, the UNEP recognizes the Convention on Long-Range Transboundary Air Pollution (CLRTAP) as “the most established example” of these entities as it “mandates legally-binding national emission ceilings for different pollutants” (ibid.).

The UNEP’s second category of regional action is regional entities with permanent structures and a science focus. These have permanent structures such as a secretariat but have not reached any legally binding agreements and are focused largely on developing a regional scientific base by promoting or undertaking regional monitoring and modeling projects. The UNEP includes in this category the Acid Deposition Monitoring Network in East Asia (EANET) and the Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia.

Its third category includes regional initiatives that “provide viable policy making for regional cooperation” without permanent structures or legally binding measures

(UNEP, 2011, p. 37). The UNEP includes several regional initiatives in this category: ministerial declarations of Sub-Saharan African governments, such as the Lusaka Agreement for southern Africa, the Nairobi Agreement for eastern Africa, and the Abidjan Agreement for west and central Africa, which "lay out common policy, set regional priorities and offer a framework for future cooperation"; the intergovernmental Network on Air Pollution in Latin America and the Caribbean, which "was created and given a mandate from the Regional Forum of Environment Ministers of Latin America and the Caribbean to develop a regional work plan"; and the Joint Forum on Atmospheric Environment Issues in Asia and the Pacific, which draws together several institutions and intergovernmental initiatives (UNEP, 2011, 37).

None of the Northeast Asian environmental cooperative mechanisms have created regional legal instruments and infrastructures with legally binding national emission ceilings for transboundary air pollutants. Instead, they have all built permanent structures with a scientific focus to promote and undertake regional joint monitoring and modeling projects. This study compares the experiences of these Northeast Asian cooperative efforts to those of Europe in terms of their political leadership, knowledge, and socialization processes to explain the reasons for these differences.

At the same time, there are differences in the degree of collective action among these three cases even though they all fall into UNEP's second category. To compare different forms and degrees of collective action in Northeast Asia, this dissertation classifies the forms and extents of collective action according to three characteristics: their formalization, concreteness, and legalization. Given that none of these Northeast Asian cooperative mechanisms have reached legally binding agreements, the formalization and concreteness of their collective action are classified in more detail to compare the cooperative mechanisms in Northeast Asia.

The dissertation investigates the UNEP's second category in more detail. To determine the formal forms of collective action, it examines not only whether a regional cooperative mechanism has permanent structures such as a secretariat but also whether those permanent structures are working in practice. For this, this study analyzes the division of labor of each entity within a regional cooperative mechanism, such as its secretariat, governing body, and scientific advisory body, as well as formal financial structures shared by member countries. To illustrate the concrete degrees of collective action, the study examines the existence of agreed-upon shared formats and guidelines for joint monitoring and modeling activities. Based on these criteria, the three cooperative mechanisms under study demonstrate different forms and degrees of collective action dealing with different transboundary air pollution issues.

Of the three cases, the EANET has developed the most formal and concrete form and degree of collective action. It has a structured, concrete, and specific organizational scheme with a clear division of labor among four key entities: a secretariat, intergovernmental meetings as a governing body, a scientific advisory committee as its source of knowledge, and the network center to control monitoring activities. Moreover, the EANET has established formal standards for the financial structures of the EAENT, even though they are still on a voluntary basis. In addition to these formal characteristics, the EAENT has established the highest degree of collective action through developing common and concrete monitoring guidelines and quality assurance and quality control measures to confirm the comparable quality of monitoring data among its 13 member countries.

In contrast, the TDGM has a formal form of collective action that contains a clear division of labor among its organizational entities, but it has inspired a lesser extent of collective action due to lack of concrete and agreed-upon methods for DSS monitoring. The steering committee that serves as a governing body has determined two working group activities: Working Group I for "joint research on a regional network for DSS monitoring and early warning system" and Working Group II for the prevention and control of DSS. These TDGM objectives were also clarified in a joint announcement of the 2007 TDGM. However, the participants of the TDGM have not created commonly shared monitoring methods and indicators for DSS, as the three governments' agencies, mostly national meteorological agencies, have used their own methods and indicators for DSS monitoring.

The LTP has developed neither a formal nor concrete form of collective action despite engaging in cooperative efforts for two decades. Little clarification of financial structures and the division of labor between its organizational entities have reduced its formalization as a regional cooperative mechanism. Moreover, the three participating countries have all used different monitoring and modeling methods, which has made it difficult to compare their research results in a useful way. Table 1.4 summarizes the variations among these three cases. The following sections discuss what analytical approaches this dissertation uses and adopts can explain these variations among three East Asian cooperative mechanisms.

Table 1.4
Variation Among Dependent Variables

	Since	**Initiator**	**Formal**	**Concrete**	**Legal**
EANET	1993	Japan	Yes	Yes	No
DSS	2007	ROK	Yes	No	No
LTP	1995	ROK	No	No	No

Note: The “formal” degree of collective action is measured through examining the permanent structures of cooperative mechanisms, such as a secretariat, and the division of labor of their entities, such as the secretariat, governing body, and scientific advisory body, as well as formal financial structures shared by member countries. The “concrete” degree of collective action is measured through examining the existence of agreed-upon shared formats and guidelines for joint monitoring and modeling activities. The “legal” form of collective action is measured through examining the existence of legally binding agreement among participating countries.

Analytical Frameworks, Independent Variables, and Hypotheses

The starting premise of this study is that international cooperation is a form of social interaction and, furthermore, that each factor that determines the form of cooperation itself can evolve along with the social interaction. Mainstream international relations theories accept that social interaction can change state behavior (Johnston, 2008). For structural realists, the social interaction of states tends to occur among countries through balancing against rising power in order to maximize security under anarchy (Mearsheimer, 1995; Waltz, 1979). Neoliberal institutionalism at the international level (Axelrod, 1984; Keohane, 1984; Keohane & Martin, 1995; Keohane & Nye, 1977; Oye, 1986; Powell 1991; Snidal, 1991) and rationalist institutionalism at the domestic level (Milner, 1998) regard social interaction inside institutions as a key driver of actors’ behavior through altering cost-benefit analyses based on fixed preferences. For them, strategic interactions within political institutions and among domestic constituents can explain how diverse domestic preferences are aggregated into collective choices.

In contrast, constructivists do not treat preferences as inherent in states or within the international system and as generated from states' material conditions and functional needs. Rather, they claim that social interaction in international relations can change actors' interests through such social structural elements as shared beliefs, norms, institutions, identities, and discourse (Wendt, 1994). In particular, constructivists suggest that "there is a causal link between the presence of particular normative structures embodied in institutions and the incorporation of these norms in behavior by the actor/agent at the unit level" (Johnston, 2008, p. xx). Following the constructivist view, this study assumes that interactions among countries within international institutions can change their interests and strategies. Thus, the focus of this research is the interactions among participating countries through the processes of the studied regional cooperative mechanisms.

In contrast to the constructivist view, neorealist and neoliberal scholars share an unproblematized assumption of pre-specified state preferences of states as actors. For them, what states want in the foreign policy arena and international interactions is the result of the relevant actors' actions to maximize their material capabilities. Unlike these theories, constructivists pay more attention to how national interests get defined and have evolved and treat national interests endogenously rather than exogenously. For them, an understanding of national interests is molded by social structural elements, such as shared beliefs, norms, institutions, identities, and discourse. This study also dismisses what Haas and Stevens called the "standard rationalist account that major problems create the incentives for their resolution, and thus modern bureaucracies . . . either develop effective responses almost automatically or are so powerfully constrained by the strategic interests of powerful member states or participants" (2011, pp. 127-128). Instead, this study highlights the social interactions between states of the region and assumes that interactions among countries within international institutions can change their interests and strategies throughout the processes of the regional cooperation.

To analyze these international interactions, this study examines the independent variables of leadership, scientific knowledge, and socialization. As discussed below, political leadership and knowledge serve as structural girders, and socialization is associated with the process.

Independent Variable 1: Political Leadership

The first independent variable of this study is leadership, which Underdal has defined as "an asymmetrical relationship of positive influence in which one actor directs the behavior of other actors toward a certain goal, based on a collective pursuit of common good or joint purpose" (Underdal, 1994, pp.178-179). Positive influence excludes veto collective action, and thus "being the first to defect from a joint undertaking would not qualify as leadership" (Underdal, 1994, p. 179). Unilateral behavior without shared interests and beliefs also would not qualify as leadership due to the lack of collective pursuit of a common good. Similar to the leadership of religious leaders who inspire followers and business leaders who lead explosive performance in industrial transformations, political leadership in the international cooperation arena can be defined as ability to inspire or lead member countries to reach agreements on proposed policy arrangements (Underdal, 1994).

Previous scholars have asserted that the emergence of leadership is a necessary condition for success in efforts to gain agreements at the international level (Young, 1991). Once these regimes develop their structure and dynamics, leadership may not be important anymore because the systematic arrangements of regimes can run the institutions. Until regimes can proceed autonomously, however, “when a regime is clearly in a process of evolution, when the principles underlying the regime are still in a process of being articulated, when the division of responsibilities between countries is still a critical negotiating point, there is a clear role for leadership” (Grubb & Gupta, 2000b, p. 17). This study presumes that political leadership is a product of international interactions rather than granted based on the status of countries’ relative material capability. Realists presume that leadership can only come from the most powerful country in the region, which in this case would be China. Instead, this study presumes that various modes of leadership are contributing factors. When countries organize international cooperative mechanisms, considerable expenses need to be borne to complete their objectives; complicated communication must take place to hold international meetings; and intellectual systems (ideas) need to be generated to guide the direction of their cooperation. To meet these requirements, it has been asserted that the emergence of leadership is a contributing factor for successful generation of agreement at the international level.

As shown in Table 1.5, the modes of leadership have been differently categorized by various authors (Grubb & Gupta, 2000b; Malnes, 1995; Underdal, 1994; Young, 1991).[15] Notable is the clear correspondence between these various typologies. Despite differences in vocabulary and scope, these scholars’ definitions of leadership all fall into

[15] In addition, Haas classifies leadership in the following ways for the Mediterranean Action Plan, based on “regional economic, scientific, and diplomatic resources” (Haas, 1990, 167).

three similar main categories. This study adopts the terms *structural, instrumental*, and *directional* for these three modes, each of which is discussed in more detail below.

Table 1.5
Typologies of Leadership Modes

Mode of exercising leadership	Authors and Terms for Modes			
	Young (1989)	Underdal (1994)	Malnes (1995)	Gupta &Grubb (2000)
use political and economic power to provide incentives	structural	coercive	carrots and sticks	structural
craft structures and apply diplomatic skills	entrepreneurial	instrumental	problem-solving	instrumental
use ideas and example of own domestic implementation to influence others' perception	intellectual	unilateral	directional	directional

Structural Leadership

The first category of leadership typologies is what this study is calling structural leadership. Structural leadership comes from the ability to wield economic and political power that stems from that state's material resources and is used to affect "the incentives of others to accept one's own terms or at least make a concession" (Underdal, 1994, p. 186). Structural leadership "is exercised through the commitment of financial, technical and scientific resources necessary for environmental assessment and policy-making with the intent of shaping agendas and policy outcomes" (Selin, 2012, p. 216).

It is hard to say that any single country holds regional hegemonic power in Northeast Asia. There is considerable competition for power between China and Japan and a solid awareness of the ROK as a middle power, leaving the power of other countries such as Mongolia and North Korea far behind within this region. Grubb and Gupta argue that pure hegemony, considered the extreme of structural leadership, is not relevant to global environmental issues because a single country – even the United States or the European Union – "could not impose a global solution that would last; nor would they be willing to bear the full and long-term costs of providing enough carrots to bring the rest of the world along" (2000, p. 19). Adler and Barnett posit that power, as one of structural girders for the development of a security community, is "an important factor in the development of a security community by virtue of a core state's ability to nudge and occasionally coerce others to maintain a collective stance" (Adler & Barnett, 1998, p. 39). They argue that the "existence of core states or a coalition of states will be necessary for providing leadership, side payments, and perhaps protection to the other members of the group" (p. 52). This approach has been appropriated by power theorists who stress the role of a hegemon that possesses preponderant material resources in the regime formation processes.

This study, however, asserts that the simple existence of power in a region would not necessarily lead to effective cooperation on transboundary environmental issues. No matter what country might have the ability to coerce others to create and maintain a collective action,[16] actually exerting political leadership is a different story. This is

[16] This approach to power is based on the famous Dahl's definition of power, which is the ability of A to get B to do what B otherwise would not do (1957, pp. 202-03). However, Barnett and Duvall (2005) generated a fourfold taxonomy of power based on two dimensions: "the kinds of social relations through which power works, and the specificity of the social relations through

particularly the case in Northeast Asia, where no one major country would be regarded as a regional hegemon or dominant power.

Accordingly, this dissertation assumes that any state in the region could exercise any form of leadership if it is willing to, which is a significantly different approach from most leadership literature, particularly regarding structural leadership. As many previous studies have already proven, active participation of a hegemonic power is not a necessary condition for success in dealing with international environmental problems (Young, 2011), and different forms of leadership have been wielded in global environmental politics.

The corresponding typologies of structural leadership mentioned above tend to focus on the role played by states with the ability to exert economic and political power driven by their material resources to shoulder most of the considerable costs of cooperation under an assumption that only great powers can succeed in exerting structural leadership. This corresponds to the realists' assertion that leadership can come only from the most powerful country in the region.

This dissertation pays special attention to the material contributions that member countries make to regional environmental cooperation as a proxy variable, as we cannot see political leadership directly but can see spending. This study treats spending as evidence of structural leadership by assuming that states wanting to exercise or actually exercising structural leadership will be spending more in that effort. It also argues,

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which power's effects are produced" (12). They argued that "compulsory power exists in the direct control by one actor over the conditions of existence and/or the actions of another. Institutional power exists in actors' indirect control over the conditions of action of socially distant others. Structural power operates as the constitutive relations of a direct and specific, hence, mutually constituting, kind. And, productive power works through diffuse constitutive relations to produce the situated subjectivities of actors" (p. 12).

however, that the states of the region decide whether to exercise structural leadership on their own, based on their national goals on particular issue areas. As mentioned above, this study contends that these national goals or interests are not predetermined but changeable throughout international interaction. Thus the study does not regard structural leadership as predetermined by a state's material capabilities. As noted, structural leadership may be exercised by powerful countries, but may also be exercised by willing countries regardless of their material capabilities. Bill Gates, for instance, is one of the largest donors in the world, but there are a large number of willing donors who have limited income but are eager to share with others. Thus, structural leadership measured by dominant material contributions to regional environmental cooperation is, for the purposes of this study, a matter of choice of the states in the region rather than a gift or burden determined by the international setting. In this sense, China or Japan would not be the only countries who can wield structural leadership in the Northeast Asian context. This study argues that any country in the region can try to exercise structural leadership if it is willing, based on its national goals for specific issue areas and international interactions among member countries.

Instrumental Leadership

The second form of leadership examined by this study is what it terms instrumental leadership, which refers to "negotiating skills to frame issues in ways that foster integrative bargaining and to put together deals that would otherwise elude participants endeavoring to form international regimes through institutional bargaining" (Young, 1991, p. 293). Actors exercising instrumental leadership can "function as (1) agenda setters shaping the form in which issues are presented for consideration at the international level, (2) popularizers drawing attention to the importance of the issues at stake, (3) inventors devising innovative policy options to overcome bargaining impediments, and (4) brokers making deals and lining up support for salient options" (Young, 1991, p. 294).

In Europe, the Nordic countries exerted considerable instrumental leadership through active participation in various bodies of the Convention on Long-Range Transboundary Air Pollution (CLRTAP). Several Norwegian and Swedish participants presided over the meetings of the executive body and the working group on strategies as well as leading the CLRTAP secretariat in the 1980s. Along with the Nordic countries, Germany also exerted instrumental leadership after the "catalytic change in German air policies" (Wettestad, 2011, p. 51). This instrumental leadership exerted by these European countries for CLRTAP, played an important role for strengthening and developing the environmental regime further.

In the case of the Mediterranean Action Plan (Med Plan), UNEP took over instrumental leadership from the Food and Agriculture Organization (FAO) (Haas, 1990) and from the chairman, Stjepan Keckes (Haas, 1990) in mid 1970s. Even though the FAO continued to be involved in organizing meetings on monitoring and principles, it "lost the leadership and coordination of Mediterranean pollution control to UNEP":

> In August 1974 UNEP informed the FAP that UNEP, after receiving a formal proposal from Spain, had decided to convene a meeting of government representatives in December 1974 or January 1975 to discuss the preparation of a framework convention, based on the FAO consultations. (Haas, 1990, p. 91)

UNEP exerted its instrumental leadership through mobilizing scientific support for the exercise and elaborating the FAO's early efforts for monitoring. UNEP cosponsored the International Workshop on Marine Pollution in the Mediterranean with other agencies in September 1974, and the Workshop "served to set the agenda for all subsequent pollution discussions" (Haas, 1990, p. 91). Through this process, UNEP was able to create "agreement on an extremely comprehensive list of sources and channels of pollution" (Haas, 1990, p. 91).

In the case of the three Northeast Asian cooperative mechanisms on transboundary air pollution issues examined in this study, Japan and the ROK have exercised instrumental leadership to a limited degree particularly within the cooperative mechanisms that they initiated. In addition, the scientific focus rather than policy innovation of the cooperative mechanisms has limited the development of instrumental leadership in Northeast Asia.

Directional Leadership

The third form of leadership is what this study is terming directional leadership, the ability to produce "intellectual capital or generative systems of thought that shape the perspectives of those who participate in institutional bargaining" (Young, 1991, p. 298). This directional or intellectual leadership "relies on the power of ideas, norms, and knowledge to shape the way other participants involved in regime formation perceive issues and conceptualize policy alternatives," and thus intellectual leaders "often seek the adoption of particular policies by trying to secure broad assimilation and acceptance of new ideas, norms, and knowledge" (Selin, 2012, p. 216). Examples of ideas that have played a significant role in building international regimes are the "embedded liberalism" that provided coherent support of free trade and establishment of a new system of adjustable exchange rates (Ruggie, 1982) and the "tragedy of the commons" (Hardin,

1968) that showed the dilemma of common property resources. This form of leadership is generally considered one that middle powers and even small and weaker countries a can also exert (Kanie, 2005). The active role played by the Scandinavian countries in building CLRTAP in Europe is a case that demonstrates this form of leadership.

In addition to the intellectual influence of knowledge, another aspect of directional leadership is the ability to persuade other countries. Social persuasion is “the possibility of states leading by a combination of internal and external initiatives that seek to influence the perception of other countries as to what is desirable and what is possible” through demonstrating successful domestic policy (Grubb & Gupta, 2000b, p. 20). States can serve as a good example for other countries to follow in two ways. The first way is through advocacy “groups of environmentalists who claim that by unilaterally imposing on one’s own society strict standards of pollution control a government may help strengthen public demands in other countries for equally strict measures,” and the second is through a government who “can strengthen demand within its own society for international regulations” “by imposing or threatening to impose unilateral environmental protection measures” (Underdal, 1994, p. 185). Kanie anticipates that the EU can exert this form of leadership on the post-2012 international climate-change regime-building process through demonstrating the successful implementation of the EU Emissions Trade Scheme (Kanie, 2005).

This study examines these three modes of leadership as practiced by national (rather than individual) leadership under the assumption that states operates as aggregate political entities. Despite having different political systems, the three core countries of Northeast Asia—China, Japan, and the ROK—share “a strong orientation of developmentalism" (Yoshimatsu, 2010, p. 231).[17] Democratic Japan and South Korea with their capitalist economies and state-party-dominant China with its socialist market economy all allow their governments to exert "strong influences on the market in order to attain steady economic development" (Yoshimatsu, 2010, p. 231).

This study does not discuss the role of environmental NGOs for the development of regional environmental cooperation as transboundary pollution has not attracted much public attention in Northeast Asia. It is true, however, the quantity of environmental NGOs in the three countries has grown significantly. In particular, increased democratization in the ROK has led to the rapid growth of the environmental movement there since the late 1980s (Schreurs, 2002, p. 61). The issues that the Korean environmental NGOs pay attention to have also diversified, from political and economic concerns with compensation from the government through the mid-1990s to ecological concerns with neighboring environments after the mid-1990s (Cho, 2010). In a regional scale, chemical management and e-waste management systems have been developed with strong support from NGOs in Northeast Asia (Yoshimatsu, 2010). However, transboundary air pollution issues still have not captured much public attention in these countries. According to Komori, for example, the "environmental NGOs and the public in South Korea have focused more on domestic environmental problems than regional and global issues" (2010, p. 11). Some researchers have acknowledged the role played by the public and NGOs regarding the problems of dust and sandstorms (Ohta, 2008), but their effect remains less impressive than it might due to their tendency to organize sporadic events without long-term strategies.

[17] The developmental state is "characterised by the strong state with autonomous power to achieve economic development through direct intervention in the market" (Yoshimatsu, 2010, p. 231).

Given the strong influence of states and limited influence of NGOs, this study focuses on the national leadership played by each country rather than leadership exerted by individuals or groups who participate in cooperative environmental mechanisms. Other studies that have examined national leadership in this way include that of Kanie (2005) on the successful leadership of the middle-power countries of Australia and Canada in the Cairns Group at the Uruguay Round negotiations of the GATT and of Sprinz and Vaahtoranta (1994) on the leadership of Canada, Australia, Switzerland, and the Nordic countries of Denmark, Finland, Norway, and Sweden in the negotiations regarding stratospheric ozone depletion.

Considering the importance of political leadership played by particular states in the region, this study analyzes the exercise of three forms of leadership on three different cooperative mechanisms on transboundary air pollution in Northeast Asia. This study hypothesizes that the strong political leadership exerted by a particular country or countries, the more formal and concrete we can expect collective action to be. Stronger political leadership by any country in the region can increase the likelihood of development of more formal and concrete collective action.

Thus, these analytical frameworks and previous research lead to the first hypothesis of this study:

Hypothesis 1: The stronger the leadership, whether structural, instrumental, or directional, by a participating country (not necessarily a hegemon or the regionally dominant state actor) or a group of countries in a form of regional environmental cooperation, the more formal and the more concrete will be the collective action developed in the region.

Independent Variable 2: Knowledge

Regarding the role of ideas in political action and cooperation, international relations theory has been divided into two varying approaches, which various scholars have given different names: “cognitive” versus “constructivist” (Bieler, 2001; Yee, 1996); “weak” versus “strong” cognitivism (Hasenclever et al., 2000, 10-12); or “top-down” versus “bottom-up” approaches (Knopf, 1998). According to Bieler, the main focus of cognitive approaches is the causal effects on policy exerted by ideas, or in other words, “the transmission of ideas into policy,” while constructivism emphasizes the constitutive role played by “intersubjective meanings” in constructing part of the social totality (2001, p. 94), although this distinction is somewhat elusive because cognitive and constructivist approaches often seem to be incorporated into each other. Adler also recognized that constructivism should be complemented by a cognitive approach, such as a “cognitive evolution” theory, to explain why certain ideas succeed in being accepted more generally than others (1997).

The contrast between “weak” versus “strong” cognitivism seems a clearer categorization. According to Hasenclever, Mayer, and Rittberger, both strands of cognitivist thought agree that actors’ preferences should not be treated as exogenous “givens,” as realists and neoliberals simply assume (Hasenclever, Mayer, & Rittberger, 2000). Nonetheless, they also argue that there is a significant difference between the weak and strong strands of cognitivism. Strong cognitivists are concerned with intellectual knowledge, like their weak counterparts, but they stress the underpinnings of social knowledge such as norms and identity rather than the causal beliefs that are the focus of weak cognitivists (Hasenclever, Mayer, & Rittberger, 2000). In this sense, strong cognitivism can be viewed as a “bottom-up” approach, while weak cognitivism can be seen as a “top-down” analysis. Weak cognitivism tends to be state-centric, as scientific knowledge groups create new interpretations of state interests and try to convince state leaders why cooperation is more desirable through the leverage of knowledge.

Weak cognitivists stress the role of causal beliefs. They argue that decision-makers face high levels of uncertainty in many issue areas and the necessity of complex learning. In particular, a high degree of uncertainty about causal relationships leads decision-makers to seek reliable issue-specific knowledge, and in turn those who supply it can exert a significant political influence. Numerous works have explored the interplay between science and politics and the conditions under which policy processes are influenced by information (Dimitrov, 2006).

Among others, the epistemic community approach examines this mechanism of knowledge and policy-making (Haas, 1989, 1992, 2004). Haas has defined epistemic community as “a network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area” (1992, p. 3). He asserted that a community that shares consummatory values or principled beliefs, causal beliefs or professional judgments, common notions of validity, and common policy enterprises can contribute to formulating state preferences. In Haas’s view, contemporary politics and international relations are highly interdependent and global, which make them highly complex. In turn, this complexity increases uncertainty about goals and preferences and limits substantive rationality. Accordingly, “embedded and institutionalized beliefs about the nature of collective response” rather than rationally formulated state preferences play a more important role in national/international politics and policy choices (Haas, 2004, p. 11579). Therefore, growing demands for information and specific knowledge to frame policy debates make it possible for an epistemic community to play an eminent role as "a principal channel through which consensual knowledge about causal connections is applied to policy formation and policy coordination" (Haas, 2004, p. 11579).

In the example of the Med Plan, few countries were aware of the degree of their coastal pollution at the beginning. Only a few LDCs, such as Egypt and Lebanon, possessed domestic monitoring capabilities. Given this lack of knowledge regarding pollution, countries were reluctant to take a positive position toward regional cooperation. As Haas pointed out, the Algerian case demonstrates the importance of national knowledge, which also has significant implications for Northeast Asian efforts

> Algeria was so opposed to controlling industrial pollution that a United Nations Development Programme (UNDP) consultant's demonstration of the extensive pollution of Algerian harbors was denied by the government. It was only after Algerian marine scientists with access to the government could produce similar evidence were its implications accepted, and Algeria came to support the Med Plan. (Haas, 1990, p. 84)

Engaging in cooperative action to deal with transboundary air pollution also requires "much scientific knowledge on the definition of the problems, the identification of dangerous substances, the monitoring of possible damages, the understanding of causal mechanisms, and the analysis of policy responses and their impact on ecosystems" (Siebenhüner, 2011, p. 93). As Adler has asserted, "the political influence of transnational epistemic communities . . . is most likely to rest on the transfer from the international to the domestic scene of the ideas that national scientists and experts raise at their transnational meeting" (2005, p. 150). For him, national experts and through them national governments are the decisive “customers” of such knowledge from domestic and international political perspectives, even though both national and international epistemic communities may contribute to the evolution of international cooperation under conditions of technical uncertainty and complexity.

Considering the potential roles played by the epistemic communities who share scientific knowledge and policy options, this study analyzes the status of knowledge and policy suggestions on specific transboundary air pollution issues in Northeast Asia to see whether this region has been able to create epistemic communities for particular issues. As most regional environmental cooperative mechanisms in Northeast Asia have focused on data gathering through joint monitoring and research, few policy options have yet been suggested by scientists, and in turn this study anticipates few epistemic communities. Thus this research emphasizes the development of scientific knowledge on particular issues rather than the development of epistemic communities themselves. As a result, this study posits the following hypothesis:

Hypothesis 2: The greater the commonly shared knowledge among participating countries in regional environmental cooperation efforts, the more formal and the more concrete will be the collective action found in the region.

Independent Variable 3: Socialization

The third independent variable of this study is socialization, defined for the purposes of this dissertation as “the internalization of the values, roles, and understandings held by a group that constitutes the society of which the actor becomes a member” (Johnston, 2008, p. 22), a process that in this context occurs through participation in regional cooperative mechanisms. According to Johnston, there is “general agreement across the social sciences that socialization is a process by which social interaction leads novices to endorse ‘expected ways of thinking, feeling, and acting’” (Johnston, 2008, p. 20) and to therefore engage in cooperative efforts.

Many political scientists have adopted a narrow notion of socialization based on neoliberal institutionalism that holds that nations develop strong international institutions when they perceive that the payoff or benefits of doing so will outweigh the costs (Keohane & Axelrod, 1993). Thus, for instance, Schimmelfennig views international socialization as “a process of rational action in a normatively institutionalized international environment”:

> Rational state behaviour is constrained by value-based norms of legitimate statehood and proper conduct. Selfish political actors conform to these norms in order to reap the benefits of international legitimacy, but as instrumental actors they also calculate whether these benefits are worth the costs of conformity and how they can be reaped efficiently. (2000, p. 109)

The problem with adopting this view for investigating the development of international environmental cooperation is that there are few mechanisms through which the scientists and policy makers within a given country can discuss and assess the complex costs and benefits of their government’s involvement in such efforts.

This study, in contrast, adopts a broader notion of socialization that holds that institutional processes and mechanisms also play a role in the adoption of common values, roles, and understandings that lead states to become more accountable and transparent to others. According to this view, socialization occurs through a set of learning processes and international institutions that together have the effect of constraining participating states from engaging in free riding because they become more densely interdependent with one another (Ikenbury & Kupchan, 1990). In other words, socialization is a whole process of interaction among states beyond one particular issue area, which shows that if states are more economically interdependent and they know one government is depending on another government, then they are more likely to cooperate in other areas as well. This is a much thicker notion of socialization.

This thicker conception of socialization was adopted as more appropriate for this study in large part because of two particular characteristics of Northeast Asia. First, the three countries examined in this study have developed a significant economic interdependence, as shown by the intraregional trade among them, which accounts for more than 50% of their total trade. This number is high in comparison to the ratio of intraregional to total trade in ASEAN and South Asian countries, which is 20-25% and 5%, respectively (Nam, 2008). Second, in contrast to the narrower understanding of socialization, the countries in the region, particularly Japan, would seem to have had comparatively little to gain scientifically from the cooperative efforts of the studied mechanisms, as they had already accumulated adequate funding for their scientists and considerable scientific knowledge of their own.

To better understand how socialization processes may shape the forms and extent of regional environmental cooperation, this study examines two different processes of the internalization of norms that operate within these regional cooperative mechanisms: adaption and learning. According to Haas (1990), *adaptation* refers to the acceptance and adoption of preexisting, external norms and behaviors, while *learning* is a more transformative process, which Levy described as “a change of beliefs (or the degree of confidence in one's beliefs) or the development of new beliefs, skills, or procedures as a result of the observation and interpretation of experience” (1994, p. 283). Describing this difference metaphorically, Johnston observed that while “adaptation refers to tactical shifts in cooperation, say, by a player with prisoners’ dilemma preferences, as the exogenously imposed relative costs of defection increase,” learning can be viewed as “a change in the basic preferences of the player, a shift away from one type of preferences through intensive socialization processes” (Johnston, 2008, p. xxiv).[18] Within this framework, adaptation can lead actors to change their behavior in response to new events without questioning their own preexisting values or understanding of basic causal mechanisms. Learning, in contrast, yields “behavior changes as actors question original implicit theories underlying programs and examine their original values” (Haas, 1990, p. 3). In other words, through the adaptation process, the broad goals of countries do not change even though their means do as a result of their social interaction with other participants at meetings among them. In contrast, through the learning process, international actors can change their behaviors through new thinking that reflects “a process more fundamental than adaptation” (Johnston, 1996, p. 29).

To determine which of these two processes of socialization the participating countries have engaged in, this study qualitatively assesses the participation patterns of member countries in international meetings of the studied cooperative mechanisms in terms of two criteria. First, for each of the three studied cooperative mechanisms, the case studies investigate whether the participation of countries in the region has been prompted by indirect, rather than intrinsic, concerns about particular transboundary air pollution issues. Countries are considered as having engaged in the adaptation process of

[18] Valencia, using the terms “tactical learning” and “complex learning” to explain these processes, argued that the former, “in which behavior toward cooperation changes,” needs to be replaced by the latter, “in which values and beliefs about reaching goals through cooperation change,” if Northeast Asia is to build cooperative security (2008, p. 158).

socialization if indirect political concerns have led them to participate in regional environmental cooperation on such issues; they are considered as having engaged in the learning process of socialization if they have found intrinsic motivations for their regional cooperation.

Second, each of the following case studies analyzes the participation patterns of delegates to international meetings of that particular cooperative mechanism as a proxy for socialization. This study assumes that social interaction among delegates attending international meetings can enhance their understanding of the objectives and issues of the meetings, which they can then share with colleagues and policy makers in their home country and which can in turn lead to continued international cooperation. Given that the learning process of socialization typically requires extended exposure to the expected norms, values, and practices, the case studies assume that delegates are more likely to have engaged in the adaptation process of socialization if they have had the opportunity to attend international meetings for only a short period or in a sporadic manner, and to have engaged in the learning process of socialization if they have been able to attend international meetings for an extended period in a consistent manner.

Based on the above assumptions regarding socialization processes as they relate to political action and cooperation, this study poses a third and final hypothesis, as follows:

> *Hypothesis 3: If participating countries in regional environmental cooperation efforts adopt learning rather than adaptation as a process of socialization, they are more likely to create formal and concrete collective action through regional cooperation.*

Interaction Among Variables

Socialization is a process that is a consequence of the interplay between sets of independent variables, and thus socialization processes can be viewed as the intervening variables or "social mechanisms" (Hedström & Swedberg, 1998) that link the independent variables to my dependent variable of the forms and degrees of collective action. Mechanism-based explanations like this one search for systematic relationships between variables or events and aim to "specify the social 'cogs and wheels' . . . that have brought the relationship into existence" (ibid., p. 7), unlike black-box explanations that search for mere systemic covariation under the assumption that "the link between input and output, or between *explanans* and *explanandum,"* is "devoid of structure, or, at least, whatever structure there may be is considered to be of no inherent interest" (ibid., p. 9). In short, they assume that a mechanism (M) can provide a plausible account of how input (I) and output (O) are linked to one another:

$$I \rightarrow \boxed{M} \rightarrow O$$

This study calls for attention to the causes and consequences of collective action rather than mere associations between variables, as "it is actors and not variables who do the acting" (ibid., p. 24). Table 1.6 demonstrates the hypothesized social mechanism between the other variables of leadership and knowledge in which the stronger the political leadership and the greater the shared knowledge in the region, the more likely participants in regional cooperation are to engage in the learning process of socialization and thereby create the most formal and concrete collective action.

Table 1.6
Social Mechanisms Among Variables

	Knowledge	No Knowledge
Leadership	a) Learning b) Most formal and concrete collective action	a) Learning/adaptation b) Less formal and less concrete collective action
No Leadership	a) Learning/adaptation b) Less formal and less concrete collective action	a) Adaptation b) Least formal and concrete collective action

As the arrow in Table 1.6 illustrates, to make the transformation from the least formal and concrete collective action to the most formal and concrete depends on creating the independent variables that are present in the uppermost left-hand box. This study examines whether this transformation can occur if participating countries of the region develop both or either strong political leadership and shared scientific knowledge among participating countries. In doing so, it also examines two additional questions: whether political leadership and shared scientific knowledge are necessary or sufficient factors for the engagement in the learning process of socialization of participating countries in the first place, and whether the learning process of socialization can lead the region to achieve more formal and concrete collective action.

Research Methods

To test these three hypotheses, this research study employs content analysis and semi-structured interviews. Reports on meetings of the target cooperative mechanisms are the main source of information for the content analysis. Most of this information was available on the organizations' websites; where those groups have not created their own websites, I examined reports from the sponsoring or umbrella organizations that deal with the issues addressed by the cooperative mechanisms. All of the reports on meetings, proceedings, and other information are indicated in the reference.

For semi-structured interviews, more than 40 interviews were conducted with governmental officials from ministries of environmental and foreign affairs and experts from national research institutes and universities in China, Japan, and Korea. For the full list of interviewees, see Appendix I. Delegates to the international meetings from Southeast Asia, such as Indonesia and Malaysia, were also interviewed, as were a few participants from Europe to examine the transfer of knowledge and experiences from Europe to East Asia.

To identify key participants in the policy-making meetings, I used snowball sampling or a chain referral sample. The crucial feature of this sampling strategy is the direct or indirect linkage through which each person or unit is connected with another, which allows for the verification of the respondents' accounts through third parties. This triangulation increases the validity of the interviews with relevant decision makers that would otherwise be unavailable. The semi-structured interviews used open-ended questions because this approach let the interview subjects provide detail, depth, and an insider's perspective and to organize their answers within their own frameworks. In structured interviewing in which investigators define the question and problem and looks for answers within the bounds set by their presuppositions, the cognitive processes of the respondents could not be teased out as successfully.

At the same time, this technique can also decrease the likelihood of achieving good triangulation, as snowball sampling can be a source of biased inference. It is risky to sample only self-selected parts of the government apparatus if a researcher speaks only with officials who recommend one another, which could result in missing out on dissident perspectives within that government apparatus. To avoid this selection bias, I tried to diversify the verification process beyond snowball sampling by interviewing several authors of peer-reviewed journal articles to cross-check the validity of information gained from the interviews and by choosing some interviewees among participants of international meetings who were not referred by others. These efforts can widen our understanding of the scope of internal competition regarding policies.

Overview of the Dissertation

Before presenting the substantial case studies of the selected cooperative mechanisms, chapter 2 is a background chapter that shows a big picture of Northeast Asian environmental cooperation. It introduces two comprehensive and three issue-specific environmental cooperative mechanisms in Northeast Asia that have been designed to tackle transboundary air pollution. For comprehensive cooperative mechanisms, it focuses on the participation by the ROK as a middle-power state in the North-East Asia Sub-regional Program for Environmental Cooperation (NEASPEC) and the Tripartite Environment Ministers Meeting among the ROK, China, and Japan (TEMM); for issue-specific cooperative mechanisms, it examines EANET, TDGM, and LTP. This chapter finds the role played by the ROK promising in that it creates some positive competition between member countries, but it also points out challenges that

Northeast Asian countries have to deal with in order to create solid regional environmental cooperation.

The following three chapters examine the three cooperative mechanisms examined for this study. Chapter 3 discusses the development of Acid Deposition Monitoring Network in East Asia (EANET). Even though EANET has developed into the most formal and concrete form and degree of collective action among the various regional environmental cooperative mechanisms in which Northeast Asian countries have participated, this chapter argues that EANET is largely a failure in terms of generating broader cooperation and producing useful measurement data that could lead to the creation of a regional environmental regime. It concludes that political leadership is the only variable positively associated with this highly formal and concrete collective action as Japan's much greater financial contributions to the EANET budget have enabled EANET to enhance capacity building and the quality of monitoring data in a practical sense. However, the lack of shared and new scientific knowledge regarding acid deposition among the participating countries of EANET and the adaptation process of socialization that they have taken fail to show that EANET's highly formal and concrete form and degree of collective action are attributable to shared scientific knowledge and the learning process of socialization.

Chapter 4 discusses regional environmental cooperation through the Tripartite Director General Meeting (TDGM) on Dust and Sandstorms (DSS). This chapter argues that TDGM has become a formal cooperative mechanism, yet it has neither developed specific obligations that participating countries are required to fulfill for the joint research program nor largely proven a success in generating broader cooperation and useful measurement data for the region. This study concludes that political leadership is the only variable positively associated with highly formalized collective action. The lack of shared scientific knowledge about DSS among the participating countries of TDGM and the adaptation rather than learning process of socialization in which they engage cannot explain why TDGM has succeeded in creating the first governmental-level, multilateral cooperative mechanism that focuses exclusively on DSS issues in Northeast Asia in a relatively short period of time, from 2007 to the present.

Chapter 5 discusses Joint Research on Long-range Transboundary Air Pollutants in Northeast Asia (LTP). Despite the active involvement of working-level governmental officials from the ministries of environmental affairs of China, Japan, and the ROK, the LTP project has achieved little formal form and little concrete collective action. This study argues that this can be attributed to a lack of political leadership, particularly instrumental and directional leadership; little development of shared scientific knowledge; and little development of adaptation as a socialization process among delegates to the LTP meetings, particularly among governmental officials.

Chapter 6 compares the current state of regional environmental cooperation regarding transboundary air pollution, particularly on emission reductions, in two regions, Northeast Asia and Europe. This chapter argues that Europe has succeeded in reducing air pollution through developing better air quality management with regional regulatory regimes, whereas Northeast Asia has encountered increasing air pollution due to the rapid growth of energy consumption in China. A comparative analysis between cooperative efforts in Northeast Asia and Europe demonstrates that the Northeast Asian cooperative efforts through EANET, TDGM, and LTP have failed to generate broader cooperation and produce useful measurement data that could lead to the creation of a regional environmental regime with a solid infrastructure and a policy focus such as that which European cooperative efforts have achieved through CLRTAP. This chapter also finds that shared scientific knowledge and the learning process of socialization are key determinants of the success or failure of regional environmental cooperation. The small amount of conclusive scientific knowledge shared by member countries and the adoption of the adaptation process of socialization among participating countries may explain why all three of Northeast Asia's regional cooperative mechanisms on transboundary air pollution issues have been unable to advance beyond the UNEP's second category of regional action, regional entities with permanent structures but a scientific rather than a policy focus.

CHAPTER 2

MESSAGES FROM A MIDDLE POWER: PARTICIPATION BY THE REPUBLIC OF KOREA IN REGIONAL ENVIRONMENTAL COOPERATION ON TRANSBOUNDARY AIR POLLUTION ISSUES[19]

Introduction

Since regime studies began in the 1980s, a few scholars have used negative cases of policy creation in order to understand the obstacles to regime creation. Nonregime is defined as "transnational policy arenas characterized by the absence of multilateral agreements for policy coordination among states" (Dimitrov et al., 2007, p. 231). These so-called "nonregime" studies regard the absence of policy coordination in certain issue areas as a result of a collective decision, and try to respond to why institutions for collective action do not come into being (Dimitrov, 2006).

In order to understand why Northeast Asian countries have not created any agreements on transboundary air pollution issues, less-developed cases of collective action must be examined to understand why there have not been agreements on transboundary air pollution issues, despite various regional efforts for around two decades. Successful cases of European experiences with transboundary pollution are not applicable to Northeast Asia due to its diverse political systems, different levels of economic development, and mutual distrust drawn from historical memories. However,

[19] This chapter was published in *International Environmental Agreements: Politics, Law and Economics* in 2014, entitled "Messages from a Middle Power: Participation by the Republic of Korea in Regional Environmental Cooperation on Transboundary Air Pollution Issues" (14(2): 147-162). This paper is based on a draft presented the International Experts Workshop on International Framework and Co-benefits Approach to Promote Air Pollution Control in East Asia, January 17-18, 2011, Hayama, Japan. This research was supported in part by the Global Environment Research Fund of the Ministry of Environment, Japan (S-7-3) and the Institute of Global Environmental Strategies (IGES). The author would like to thank Dr. Mark Elder and Mr. Xiaofeng Zhou at the IGES as well as three anonymous reviewers for useful comments and discussion.

even if Northeast Asia has not succeeded in creating any regulatory regime yet, this region has created various cooperative mechanisms in order to deal with transboundary pollution issues since the early 1990s. It would be too simplistic to state that their efforts have been failures through juxtaposition of regime vs. nonregime. Rather than stating that Northeast Asia has not built any regime to manage environmental challenges driven by transboundary issues, we need to understand how countries have participated in a variety of channels of regional cooperation in varying degrees in different issue areas.

In doing so, this study will focus on the participation by the ROK as a middle power of the region in regional cooperative mechanisms particularly regarding transboundary air pollution issues. The study examines the extent to which the ROK as a middle power has contributed to regional cooperation, illustrating the ROK's diplomatic ability and limitations on regional environmental cooperation. During the Cold War period, Canada and other smaller Western states "defined themselves as middle powers through their staunch support of international institutions, their ability to mediate, and their limited relative power" (Collins, 2012). David R. Mares does not provide a clear definition of middle powers when presenting "a model of the international behavior of a middle power located in a regional hegemony" (Mares, 1988, p. 453). He treats lesser powers vis-à-vis greater powers as middle powers, such as Brazil and Mexico in Latin America.

In the post-Cold War era, the definition of middle powers has been discussed more diversely. Melissa Rudderham (2008) describes middle powers as states that are "politically and economically significant," leaving the meaning of "significant" wide open. Cooper, Higgott and Nossal (1993) assert that states have to act as middle powers in order to identify themselves as middle powers in specific attributes such as economic issues, environmental issues and human rights, taking passive actions on issues like security. As Collins points out, however, middle powers are neither “a homogenous group of states” nor do they act in the same way. Thus, these definitions are challenging to apply. Due to these difficulties, some studies make the simple assumption that material variables determine whether states are middle powers or not. For example, Sohn simply states:

> Based on material variables such as gross domestic product, population and military capability, it [the ROK] is, indeed, a middle power. In 2010, South Korea’s GDP ranked 15th in the world, while its military budget ranked 12th. Its population, meanwhile, is about 50 million. (Sohn, 2012)

Despite the simplicity of Sohn’s definition, the ROK’s categorization as a middle power is useful because of the ROK’s power relative to other regional countries such as China and Japan, which are considered as greater powers distinguishing from middle powers. For these reasons, this article follows Sohn’s identification of the ROK as a middle power.

Northeast Asia

Geographic proximity, shared perceptions of the region, and intensity of interactions have been the three common conditions for defining regions (Katzenstein, 1997; Nam, 2002). However, there is no consensus on the boundaries of the Northeast Asia region. Based on the conditions of geography and ecological interdependence, this study defines Northeast Asia as six countries: People’s Republic of China (China), Democratic People’s Republic of Korea (DPRK), Japan, Mongolia, the ROK, and the

Russian Federation (primarily the Far East). Seen from the composition of countries, Northeast Asia as a region has great diversity in terms of political and economic development.

This region has not developed any legally binding international regime yet to deal with transboundary environmental problems, even though it has endeavored for regional cooperation since the early 1990s. Some might argue that this lack of formalization is the salient characteristic of the region. In fact, East Asia has been summarized in two points: underinstitutionalization and disjointedness, compared to ones of other regions such as Europe and North America (Lee, 2012). For underinstitutionalization, realists focus on historical mistrust or power rivalry as the legacy of the Cold War, and argue that the "hub-and-spoke" bilateral security system organized by the United States has led the region to have little necessity of formal institutionalization of East Asian regionalism despite increasing economic interdependence (Acharya, 1991; Aggarwal & Koo, 2007; Hemmer & Katzenstein, 2002).

For disjointedness of East Asian regionalism, it is argued that East Asian institutions are lacking of systematic linkages (Pempel, 2010), even though East Asian countries have searched for many regional institutions for various regional issues on security, economy and environment. Instead of sticking with overarching institutional arrangements, East Asian institutions have evolved in decentralized, overlapping and sometimes contradictory regionalism. Some scholars name this feature "thin gruel (Friedberg, 1993)" or "informal regionalism" (Katzenstein, 1997). All has led Asia's characteristics of "marginal adjustments, insistence on state sovereignty and a preference for bilateralism" (Katzenstein, 2005, p. 103).

These characteristics of Northeast Asia might have prevented this region from building regional institutions. Interestingly enough, these blocking factors for regional security are quite similar to ones that explain the lack of environmental cooperation in Northeast Asia. It is commonly understood among policy makers and experts in Northeast Asia that successful European experiences in dealing with transboundary pollution are less likely to be transplanted to this region due to “substantially different political and economic systems” and “various levels of economic development” (I. Kim, 2007). In addition, there is little scientific consensus (Chung, 1999; Nam 2002, p. 168) and due to historical memories, political antipathy (Yoshimatsu, 2010) has been an obstacle to regional governance.

Particularly, this paper pays considerable attention to the disjointed regional efforts as Pempel pointed out. It is argued that “characteristics of complexity, disconnection, and lack of an organization hub” have been key features of regional environmental cooperation in dealing with Northeast Asia yellow sand, implying “a lack of a coordinating mechanism to eliminate project overlap” (Jho & Lee 2009, p. 69). In addition, a more “holistic approach” is necessary for “subregional/regional framework in East/North-East Asia” to cover “all components of transboundary air pollution management” (NESPEC, 2012a, p. 3).

Under these fragmented circumstances, it is crucial to shed light on each cooperative mechanism. Thus, this article divides the cooperative mechanisms into two groups to discuss transboundary air pollution issues: comprehensive and issue specific ones. Even though comprehensive cooperative mechanisms have included some issues, the issue-specific mechanisms still bear stand-alone features to represent participation of member countries. The Northeast Asian environmental cooperation would be more so due to the lack of interlinkages between various mechanisms.

The ROK's Environment and Its Performance

The ROK faced air pollution problems which started in the late 1960s due to the national development of heavy industries and reached their peak in the 1970s and 1980s. However, the increasing use of low-sulfur oil and liquefied natural gas has brought significant decrease of emissions. Emission reductions of sulfur dioxide (SO_2) in Seoul have been achieved continuously (Chang et al., 2008). For nitrogen oxides (NO_X), the emission reductions are not significant as much as sulfur, but it is notable that emissions have been controlled at a certain level, 125 thousand tons, since the sharp reduction between 1989 and 1990.

To improve air quality, the ROK took various domestic measures in the 1980s, including the 1981 Standard for Sulfur Content, 1985 Prohibition of Solid Fuel Use, and the 1988 Clean Fuel Use Duty (Chang et al., 2008). The ROK has also participated in various multilateral cooperative mechanisms on transboundary air pollution since the early 1990s. Global environmental efforts and regional cooperation of Europe and North America have awakened the ROK's concerns on transboundary pollution. Since Principle 21 of the 1972 Declaration of the United Nations Conference on the Human Environment clarified the right and responsibility of states regarding transboundary pollution, Europe and North America have developed successful frameworks, protocols or provisions to tackle acid rain in their respective regions since 1979. Paragraph 9.26 of Agenda 21 of the 1992 United Nations Conference on Environment and Development explicitly pointed that European experiences should be shared with other regions.

Northeast Asia has tried to implement its learning from these international experiences regarding transboundary pollution issues. In particular, the ROK has strongly committed to regional environmental cooperation in Northeast due to its environmental and geographic conditions that situate Korea as “a principal victim of transferred air pollution from China, while its emissions also affect the region’s ecosystem to some degree” (Yoon, 2006, p. 85). In contrast to the ROK, Japan has been active in developing “broader regional cooperation” circumscribing East Asia or Asia-Pacific. Japan has focused on the East Asia Acid Deposition Monitoring Network (EANET), which covers both Northeast and Southeast Asia, and the Environment Congress for Asia and the Pacific (ECO-Asia). It is revealing to see that the ROK has paid little attention to the Eco-Asia and Regional Environmental Sustainable Transport (EST) Forum in Asia established by the Ministry of Environment in Japan (MOEJ)[20].

Since the Basic Environment Plan was enacted in 1994, Japan has manifested its leadership role as a key resource provider for regional environmental cooperation. However, the Japanese “leadership raises suspicions in the region, due to its history of military invasions of neighboring countries; and Japan itself seems reluctant to step out in front” (Yoon, 2006, p. 84). In addition, Japan is “cautious and passive when it comes to government-level multilateral cooperation” in Northeast Asia as it regards the multilateral framework as redundant “form of development aid” which Japan has already been “active in utilizing unofficial channels of cooperation through the Green Aid Plan” (Jho & Lee,

[20] Interview with Gyu Il Kim, Deputy Director of Climate and Air Quality Policy Division at the Ministry of Environment in the ROK on December 23, 2010.

2009, p. 66). In fact, Japan has provided China with various lower-interest loans for environmental projects through the Official Development Assistance. As such, bilateral cooperation has been a major channel for Japan to deal with its "concern with and enthusiasm for the acid rain issue" (Lai et al., 2001, p. 1848).

These Japanese preferences for bilateral cooperation have coincided with China's pursuit on "bilateral cooperation with Japan and Korea, which might enable it to have more leverage in negotiations" and China's opposition to "binding agreements that would supersede the sovereign control of environmental policy-making" (Yoon, 2006, p. 85). As a result, unlike Japan and China, the ROK as a middle power has promoted environmental cooperation in Northeast Asia with a "strong incentive to pursue binding environmental cooperation that would impose some constraints on its two powerful neighbors' unilateral interpretation of international agreement" (Yoon, 2006, p. 84).

Comprehensive Intergovernmental Cooperation Mechanisms

The ROK has participated in numerous multilateral environmental cooperation mechanisms since the early 1990s. It can be argued that the following two mechanisms[21] have directly related to transboundary air pollution in Northeast Asia: the North-East Asia Sub-regional Program for Environmental Cooperation (NEASPEC) since 1993 and the Tripartite Environment Ministers Meeting among the ROK, China, and Japan (TEMM) since 1999[22].

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[21] There is one more multilateral mechanism, the NEAC (Northeast Asian Conference on Environmental Cooperation), which the ROK has participated since 1992. However, the activities of NEAC have been discontinued since 2009 and it is not currently working.

[22] The Northwest Pacific Action Plan (NOWPAP), within the Regional Seas Programme of the United Nations Environment Programme, also deals with air pollution issues to some extent in

The NEASPEC

This mechanism includes six member countries: China, DPRK[23], Japan, Mongolia, the ROK and the Russian Federation. At the 1996 Third Meeting of Senior Officials (SOM3), the NEASPEC adopted the "Framework for the North-East Sub-Regional Program for Environmental Cooperation," recognized as "a unique and remarkable event and a significant milestone in the subregion as the six countries of North-East Asian subregion for the first time came to a consensus and adopted an agreement on subregional environmental cooperation" (NEASPEC 1996, p. 1). Currently, the NEASPEC is implementing projects in the three areas: i) Mitigation of transboundary air pollution from coal-fired power plants; ii) Cooperation mechanisms for nature conservation in transboundary areas; iii) Implementing the regional master plan for the prevention and control of dust and sandstorms. Transboundary air pollution, particularly SO_2 emissions from coal-fired power plants, has been considered in a greater degree in the subregion. For Mitigation of Transboundary Air Pollution from Coal-Fired Power Plants, the NEASPEC has undertaken the first and second phase (1993-2008) technical assistance projects funded by Asian Development Bank (ADB).

The current third phase of the Mitigation Program is trying to achieve integrated strategies for mitigating air pollution and greenhouse gases, standardization and regulation of technology related to the management of SO_2, demonstration projects and knowledge transfer and dissemination. While the Mitigation program overwhelmingly

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relation to marine deposition. However, this study does not include the NOWPAP due to its extensive focus on marine environment. For the NOWPAP's development, see Chung 2010.

[23] The DPRK participated in only five out of 13 meetings of senior officials between 1993 and 2008. The years attended were 1994 (SOM2), 1996 (SOM3), 1998 (SOM4), 2000 (SOM 7), and 2007 (SOM12), which none of them were held in the ROK.

relies on international institutions, two other programs (Prevention and Control of Dust and sandstorms from Source Areas in China and Mongolia; and Cooperation Mechanisms for Nature Conservation in Transboundary Areas) have been conducted through the NEASPEC Core Fund. The NEASPEC has added most recently marine environment for its expenditure (NEASPEC, 2012e) to the Nature Conservation and Dust and sandstorms. The NEASPEC has tried to diversify its focus, reducing its previous concerns on transboundary air pollution.

The annual revenue from the Core Fund consists of three sources: balance carried forward from the previous reporting period, contribution from member countries and interest income in previous years. As seen in Table 2.1, the Core Fund has been composed of mainly Korean (the ROK) contribution, and in a less degree, Japanese (in previous years) and Chinese (in recent years) contributions.

Table 2.1
Contributions to the Core Fund of the NEASPEC (Unit: US$)

	ROK	Japan	China	Russia	Mongolia
2001	100,000	100,000	0	0	0
2002	100,000	0	0	0	0
2003	0	72,000	50,000	0	0
2004	100,000	57,600	0	0	0
2005	0	0	49,970	0	0
2006	100,000	0	49,985	0	0
2007	100,000	0	49,985	0	0
2008	100,000	0	49,985	0	0
2009	0	0	49,985	0*	0
2010	0**	0	50,000	0*	
2011	100,000	0	50,000	0*	0
Total	**700,000**	**229,600**	**399,910**	**0**	**0**

* The Government of the Russian Federation has contributed $75,000 to the Secretariat since 2009 to directly support a project on nature conservation.
** The ROK did not contribute to the Core Fund in 2010 as it was supposed to contribute to the Secretariat of US$100,000-120,000 from the Korea Environmental

Industry and Technology Institute and Suwon city for two joint activities: the Meeting of Asia-Korea Carbon Footprint Partnership Program in 2011 and the North-East Asian Forum on Eco-efficiency for Low Carbon, Green Cities in 2011 (NEASPEC, 2011).

Note: Adapted from SOM Reports.

Japan has provided financial and technical support for establishing a regional network on environmental monitoring, data collection, comparability and analysis, implemented by the Japanese agencies such as the Ministry of Environment and the Japan Environmental Technology Association (JETA) (NEASPEC, 2004; 2011). However, it is interesting to note Japan's limited financial contribution to the NEASPEC compared to other cooperative mechanisms, particularly the EANET, which Japan took the initiative as this paper will examine in more detail later. Japan's reduction in contribution has been interpreted by the Koreans as a sign of Japan's lack of willingness to improve the NEASPEC as a legitimate regional comprehensive or far-reaching cooperative tool. Under these circumstances, it is argued that the NEASPEC member countries have not succeeded in showing "any great leadership in turning the sub-region into a hotbed for environmental solutions and cooperation" (Chung, 2008, p. 161). Particularly, during the most recent years the Korean initiative has not been impressive as "China has been the only member State that sustains the annual contribution to the Core Fund" (NEASPEC, 2011, p. 3).

Since the member states agreed to establish the Core Fund at the Sixth Meeting of Senior Officials on Environmental Cooperation in North-East Asia in 2000, there were two difficulties: establishing Trust Fund and creating a permanent secretariat. As of November 2012, the NEASPEC has not succeeded in creating its Trust Fund. Instead, the ADB and the Russian Federation have provided project-based funding (NEASPEC, 2010). However, the concern on building a permanent secretariat has been solved to some extent. The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) had acted as an interim secretariat for the NEASPEC until mid-2011. The secretariat was relocated from the UNESCAP Headquarters in Bangkok, Thailand, to its Subregional Office for East and North-East Asia (SRO-ENEA) in Incheon, the ROK, during 2009-2010. The 67th UNESCAP Commission Session in 2011 decided to "discontinue the interim nature of the NEASPEC Secretariat" and endorsed "the SRO-ENEA to function as the secretariat" (NEASPEC, 2011). The Korean government interprets this as other member countries have given the ROK the leadership for the NEASPEC.[24] It could be a correct interpretation in the sense that the ROK and Japan finally agreed on this issue, unlike in the past when they competed to build the Secretariat of the NOWPAP and ended up creating two offices in Japan and the ROK. The ROK has succeeded in establishing organizational foundations to exert its influence on regional environmental cooperation as a middle power.

Tripartite Environment Ministers Meeting among the ROK, China, and Japan (TEMM)

This multilateral cooperative mechanism was initiated by the ROK at the 6th Session of the United Nations Commission on Sustainable Development in May 1998. Since then, it has been recognized as the highest-level environmental meeting in Northeast Asia. The Ministers of the three countries have reaffirmed the needs of promoting the existing activities under other mechanisms such as the EANET and joint research on Long-range Transboundary Air Pollutants in Northeast Asia (LTP) through

[24] Interview with Jang Min Chu, a senior researcher at the Korea Environment Institute (KEI) on December 29, 2010.

the TEMM. It also created new cooperative programs in 2009. The future 10 priority areas for cooperation during the period of 2009-2014 have been selected and implemented. Even though taking a lead on certain issue areas does not necessarily mean that the lead country would have specific interests in it, it can show at least higher degrees of concerns on certain issues among others.[25] In fact, the ROK has distinct interests in dust sandstorms, and this will be elaborated in the later section on DSS as an issue-specific mechanism. Japan prioritizes pollution management and has actively called for more Korean governmental cooperation on marine litter or floating wastes on the coasts of Japan from the ROK[26].

The TEMM has wider array of participating actors. For example, the Tripartite Environmental Education Network (TEEN) program has built networks on environmental education among research institutes, experts and NGOs of three countries. The TEEN program has established a cornerstone for environmental education, which combines both theories and practices. It is also notable that the TEMM is the highest-level meeting in Northeast Asia. In fact, China, as the largest stakeholder country, pays the most attention to the TEMM as an intergovernmental cooperative mechanism in the region[27].

However, the TEMM still has shown various limits in tackling transboundary air pollution issues. First, even for information sharing activities, guidelines and formats have not been agreed upon. This has led member countries to take only voluntary and

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[25]Interview with Sang-Joon Lee, Deputy Director of International Cooperation Office in International Affairs Division at Ministry of Environment of Korea on December 23, 2010.
[26] Interview with Sangwoo Park, Third Secretary of Climate Change Team in Energy and Climate Change Division at Ministry of Foreign Affairs and Trade of the ROK on December 29, 2010. And Ministers also agreed to pay more attention to “marine litter” on the Tenth TEMM in 2008 (TEMM 2008).
[27] Interview with Haibin Zhang, Professor at School of International Studies in Peking University on January 18, 2011.

spontaneous actions. Since the working group was established in 2004, based on the agreement of the Sixth TEMM, they have worked to improve this problem and create new programs. However, the TEMM still does not have any agreements on specific responsibilities and action plans (Chu, 2005).

In terms of financing, the TEMM has established only a weak structure. The ROK has provided the largest contributions and Japan has kept passive attitudes on resource provision related to TEMM programs. China has provided resources only for holding TEMM meetings without additional spending on cooperative activities (Chu, 2005). Although the ROK has endeavored for establishing and promoting TEMM's activities within its limited financial capability, the ROK has exerted limited leadership due to the competitive relationships with Japan regarding selections of cooperative programs.

Issue-specific Cooperative Mechanisms

The ROK has participated in the following three issue-specific cooperative mechanisms related to transboundary air pollution. They not only deal with different issues of transboundary air pollution, but they also have different focuses on activities. The EANET tackles acidification in the region, and its main objectives are collecting monitoring data through the compilation, evaluation and storage of data at the Network Center. The LTP deals with more diverse air pollutants including PM and ozone, and its main focus is to establish sound scientific explanation on source-receptor relationships through modeling. The Tripartite Director General Meeting (TDGM) on Dust and Sandstorms among Japan, China and the ROK aims to develop specific activities for both control and prevention of dust and sandstorms and deforestation.

Acid Deposition Monitoring Network in East Asia (EANET)

The ROK has been participating in the EANET since the very beginning including four expert meetings between 1993 and 1997, and preparatory phase between 1998 and 2000. The three monitoring sites in the ROK for the EANET have reported monitoring data on many air pollutants including SO_2, O_3 and PM10 (EANET, 2010a). For these activities, the EANET has established a sound format for countries to provide comparable data. At the Second Session of the Intergovernmental Meeting in 2000, member countries approved the technical documents of the EANET, including technical guidelines, manuals and data reporting procedures and formats. This provides specific guidelines for monitoring, such as monitoring sites and interval, monitoring parameters indicating first and second priority, and meteorological measurement. The creation of a specific monitoring format for compatible data can be evaluated as strong advancement of the regional environmental cooperation. It is also notable that the development of Quality Assurance/Quality Control manual of the EANET activities has also enhanced data compatibility among member countries.

The ROK has recognized EANET's high status as an international program in the region compared with other programs regarding transboundary air pollution. The EANET has been equipped with the most advanced organizational setting in the region. Unlike the TEMM, the EANET has developed specific statements on obligations of member countries. Despite these achievements, EANET has faced two problems. First, Japan's unilateral leadership has caused the EANET to be regarded as a one-country-led program rather than an international program in which other participating countries contribute on an equal basis. The other problem of the EANET is its limited scope of activities and specific air pollutants. As a result of the specific objections of China, the scope of activities has been limited to monitoring of acid deposition without moving toward modeling. Monitoring itself must be a meaningful activity for future discussions on enhancing transboundary air pollution. However, only monitoring acid deposition is limited in its scope and could prevent the creation of complex solutions to acid deposition. In addition to the limited scope of activities, the limited scope of air pollutants is another problem for the EANET. Since the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-Level Ozone, adopted in the framework of the UN/ECE Convention on Long-Range Transboundary Air Pollution in 1999 and amended in 2012, interconnectedness of various air pollutants has been discussed extensively. Under these circumstances, the EANET's focus on monitoring and acidification is incomplete and outdated.

The ROK signed the "Instrument for Strengthening the Acid Deposition Monitoring Network in East Asia" at the Twelfth Intergovernmental Meeting (IG12) in 2010. It was argued that concerns of the ROK and China on the Japanese dominant leadership have reduced the status and scope of activities of the EANET (Chu, 2005). However, through signing of the Instrument, the ROK acknowledges Japan's leadership on the EANET[28]. This is meaningful for further development of the EANET as the ROK is one of the major contributors to the Secretariat of the EANET.

The EANET's financing capability is regarded as the highest among other regional cooperative mechanisms. The EANET has put in a lot of effort to ensure organizational principles for financial arrangement. After three sessions of the Working

[28] Interviews with Jang Min Chu and LimSeok Chang at the National Institute of Environmental Research (NIER) of the ROK on December 29, 2010.

Group on Further Financial Arrangement for the EANET in 2002 and 2003, the Fifth Intergovernmental Meeting adopted the Decision on the Further Financial Arrangement for the EANET (EANET 2003). This decision mentions participating countries' responsibilities to make financial contributions to the Secretariat and the Network Center budgets on a voluntary basis but using the latest UN assessment scale-based burden sharing as the first step. The Japanese government has played a vital role for this development of the EANET. At the Eighth Intergovernmental Meeting in 2006, it was agreed that a flat rate amount for a three consecutive year period (2008-2010) would be applied for the voluntary financial contribution to the Secretariat budget from the participating countries. In addition, the "Revised Procedures and Guidelines for Voluntary Financial Contribution to EANET" was approved at the Ninth Intergovernmental Meeting in 2007.

Japan's contribution (US$382,262) comprised more than 90% of total expenditures of the Secretariat (US$423,033) in 2009. Japan's contribution to the Network Center Core Budget (US$422,967) comprised more than 99% of the total contribution from participating countries in 2009. In addition, more than 94% of total expenditure of the Network Center in 2009 has been supported by the Japanese government through various channels, including contribution to the core budget, additional budget for technical support and training, and contracts for its Ministry of Environment and National Institute for Agro-Environmental Studies[29].

Despite Japan's status as the dominant resource provider, Korean researchers and governmental officials have raised a "transparency issue" of the Network Center of the

[29] The author calculated these figures, based on information provided at the IG 12 of the EANET in 2010. These percentages far exceed the UN scale of assessment during the 2007-2009 period (16.6%). For these scales, see EANET 2009.

EANET. For this reason, the ROK has not yet transferred any contributions to the Network Center Core Budget while it has contributed around US$18,000 to the Secretariat annually in recent years. The ROK has asserted that it is necessary to reorganize the Network Center of the EANET into a more international, rather than Japanese, organization for the ROK to be motivated to contribute to the Network Center core budget.[30] Even though this transparency issue has been raised quite a few times during various meetings including the IG 12, no party has pushed the issue in detail and this has led to many misunderstandings and unresolved disputes between members[31]. A Japanese delegate to the EANET points out that the language barriers are quite serious in the international meetings of the region. Communicating in English must be a significant problem as delegates speak all different native languages. The ROK has requested more diversified participation in the Network Center which means hiring more international researchers rather than relying on mainly Japanese researchers. Member countries need to pay attention to how to reduce these disputes driven by miscommunication and often language barriers.

Joint Research on Long-range Transboundary Air Pollutants in Northeast Asia (LTP)

The LTP was initiated by the ROK in 1995 through the first Northeast Asian Workshop on Long-range Transboundary Pollutants among China, Japan, and the ROK. The three countries agreed to launch a working group, composed of both governmental officials and experts, and to establish an interim secretariat at the National Institute of

[30] Interviews with Korean delegates, Professor Seog-Yeon Cho at Inha University in the ROK, and LimSeok Chang at the NIER in the ROK at various EANET meetings.
[31] Interview with Dr. Ken Yamashita, Head of Planning and Training Department at the Asia Center for Air Pollution Research (ACAP) in Japan on February 8, 2011.

Environmental Research (NIER) of the ROK. Since the first Expert Meeting in 1996 when participating countries agreed to perform a joint research on both monitoring and modeling of the LTP, the Expert Meetings have been held annually mostly in the ROK but sometimes in China or Japan. The Terms of Reference for Joint Research on Long-range Transboundary Air Pollutants in Northeast Asia was adopted at the first Sub-Working Group Meeting in 1999 (Secretariat of Working Group for LTP Project, 2010).

The LTP has achieved meaningful development in that it persuaded China to participate in the monitoring and modeling activities despite its passive attitudes toward transboundary air pollution (Chu, 2005). Even if main actors of the LTP activities are environmental research institutes[32] of three countries, the LTP has reached a higher status as an international cooperative program beyond research due to active involvement of the countries' respective ministries of environment. The participation of governmental officials in the annual meetings as well as experts in the field has contributed to increasing its status as an official international cooperation in the region[33] (Chu, 2005). The funding of the LTP relies heavily on the ROK's contribution, between 2000 and mid the 2000s around US$600,000 and between 2007 and the present US$1,000,000[34]. This shows that the ROK has taken the greatest initiative for the LTP.

[32] The NIER of the ROK, the National Institute for Environmental Studies (NIES) of Japan, and the Chinese Research Academy of Environmental Studies (CRAES) of China.
[33] It is worth noting that China and Japan seem to have different perceptions on the LTP's status. The Chinese delegates to IG12 of EANET in 2010 seemed to understand that the LTP is only one of many research activities that China has participated in. (Interviews with two Chinese delegates, Jun Zhou from Policy Research Center for Environment and Economy and Shuyan Xie from the China National Environmental Monitoring Center. Japan has rarely mentioned the LTP as one of various cooperative mechanisms that the region is working currently in its projects. (For example, see UNEP Regional Resource Center for Asia and the Pacific 2009)
[34] Interview with LimSeok Chang at the NIER of the ROK, on December 23, 2010.

It is notable that countries have been less resistant to the proposal of extending the scope of air pollutants. The LTP has undergone three phases: the 1st phase between 1999 and 2004; the 2nd phase between 2005 and 2007; and the 3rd phase between 2008 and 2012. The first phase mainly focused on monitoring on the ground and aviation to understand air quality in Northeast Asia. The second phase started modeling to figure out source-receptor relationships regarding SO_2, and the third phase is examining source-receptor relationships regarding NO, Ozone, PM focusing on their human health effects.

This expansion of scope of air pollutants might have been possible as the LTP is more research-oriented without showing intensions on regime creation.[35] It is different from the EANET in which member countries have been reluctant in expanding and broadening scope of activities. It could be also because China does not seem to regard the ROK as its competitor[36]. This could be true to some extent in that both China and the ROK have been categorized as developing countries unlike Japan[37]. China seems to apply the principle of the “common but differentiated” responsibilities to the regional cooperation like the climate change discussions[38]. However, China’s stance could become a potential obstacle for future development of the LTP toward the EANET’s direction. The EANET has wider array of member countries as well as more systemized and clearer principles than the LTP.

The LTP has a stronger possibility for the inclusion of wider array of air pollutants than the EANET as mentioned above. In addition, both cooperative mechanisms deal with monitoring which can create duplication of work. This does not

[35] Interview with Gyu Il Kim.
[36] Ibid.
[37] Interview with Haibin Zhang.
[38] Ibid.

mean, however, that they share the same objectives or activities. The EANET focuses on measuring pollution to establish a regional framework compatible to Europe's with a long-term purpose, while the LTP is aiming to establish common understanding on modeling in the nearer future (I. Kim, 2007). However, it seems unavoidable to have some overlapping activities on monitoring. In fact, a Japanese researcher at the Network Center of the EANET has collaborated in monitoring for a LTP project by sharing data from the EANET[39].

Due to this duplication of activities, the ROK proposed to combine the EANET and the LTP for an ideal mechanism through reasonable division of labor in 2009. However, the Korean proposal was rejected by both China and Japan. Northeast Asia needs to consider any possibility and benefits of combining these two mechanisms to enhance regional cooperation. As shown by the proposal, the ROK as a middle power can become a good mediator for China and Japan for further environmental cooperation on regional air pollution issues.

Dust and Sandstorms (DSS)

While DSS has been regarded as a natural phenomenon of wind carrying dust from the Yellow River basin and deserts, the rapid increases of frequency and intensity highlight the anthropogenic causes for DSS (MOEJ, 2008). Human factors in the formation of strong sandstorm weather include population growth, the rapid development of urbanization and irrational land-use such as excessive cultivation, deforestation, grazing and the abuse of water resources (Longjun, 2001). Due to these anthropogenic

[39] Interview with Dr. Tsuyoshi Ohizumi, Head of Atmospheric Research Department at the Asia Center for Air Pollution Research (ACAP) on February 8, 2011.

causes, the number of storms in two source countries, China and Mongolia, has increased significantly (Wilkening, 2006; Natsagdorja et al., 2003).

Various impacts by DSS have also been observed in the ROK. The frequency and intensity of PM in Seoul have increased significantly. A study mentions that around US$3-5 billion of financial damages are incurred per year due to “respiratory & mucous membrane diseases, retarded growth of crops, difficulties in outdoor activities” (J. Kim, 2007). In addition, some industries have claimed damages on precision machines and electronics which require very clean conditions, and food processing industries have also complained of contamination by DSS.

To tackle these problems, the ROK has taken various domestic measures. In order to build infrastructure for prevention of damages from DSS, a legal framework of the “Comprehensive Measures for Prevention of DSS Damage” was introduced, and the “Framework Plan for National Safety Management” deals with DSS response system at the level of disaster management. These measures aim to strengthen standards for DSS early warning, to improve DSS forecast through expanding monitoring stations, to share observation information with source countries for early warning, to strengthen monitoring and research on DSS, and to promote measures for certain areas. The serious impacts of DSS in the ROK have led its government to place the issue in the forefront of environmental concerns.

In addition to various domestic measures, the ROK created numerous bilateral cooperative mechanisms. The bilateral cooperation has mainly focused on forestation on desert areas in source countries, China and Mongolia. In fact, the ROK has supported several plantation projects in China to plant trees for erosion control. Despite the impressive development of bilateral cooperation, various bilateral initiatives tended to be limited to some specific fields and national boundary areas even though DSS is a transboundary environmental problem at a regional scale (ADB, 2005).

The ROK has also participated in several multilateral programs. The United Nations Convention to Combat Desertification (UNCCD) was enacted in 1994 to stop the anthropogenic deforestation and desertification caused by excessive development through providing developing countries with financial and technical assistance. China, Japan and the ROK all signed and ratified the Convention in the 1990s. Since the adoption of this convention, various multilateral programs have evolved. A preliminary investigation of the Global Environment Facility (GEF) launched an ADB/GEF joint project on Prevention and Control of Dust and Sandstorms in North-East Asia from January 2003 to March 2005 (NEASPEC, 2009; MOEJ, 2008). This project is evaluated as "meaningful in that it provided the basic framework for building the first regional cooperation scheme with the aim of countering yellow sand in Northeast Asia" (Jho & Lee, 2009, p. 51).

Along with this project, the three countries agreed to create the Tripartite Director General Meeting (TDGM) on Dust and Sandstorms at the Eighth TEMM in 2006. At the first meeting of the TDGM on March 2007 in the ROK, three countries started to discuss the Terms of Reference (TOR) of the Steering Committee for Joint Research on DSS. At the second meeting of the TDGM in September 2007, the TDGM adopted the TOR for Joint Research. The high political will of the Korean government for DSS is revealed in the ROK's efforts to create the TOR of the Steering Committee for Joint Research on DSS.

The ROK recognizes three important meanings of the creation of the Joint Research on DSS (MOEK, 2007c). First, even though the Joint Research is a research-oriented cooperative body, it is the first governmental level multilateral cooperative mechanism in Northeast Asia which was agreed at the TEMM and the TDGM. Thus, this body can garner high levels of political commitments from each government. Second, the Joint Research can be a channel for important policy dialogue for governments and experts. Third, the Joint Research is expected to play a role of an incubator that helps the region boost multilateral cooperation for DSS monitoring and network for early warning and forecasting. Past bilateral channels and new multilateral mechanisms have revealed several challenges such as “the lack of an irrigation system, quick-shifting sands, destroying newly planted trees and shrubs, and limited local interests” (NEASPEC, 2009). New cooperative mechanisms must take into consideration these difficulties that past projects have experienced.

Conclusions

The ROK has shown strong interests in developing an overarching regional mechanism through playing a role of an initiator at various multilateral mechanisms such as the NEASPEC, the TEMM, the LTP and the TDGM. Despite its initiatives in all of these mechanisms, the ROK argues that regional cooperative mechanisms require more even contributions and participation by member countries, rather than mainly being led by one country. In this sense, the ROK has proposed to combine the EANET and the LTP for an ideal mechanism through reasonable division of labor. It is worth noting that the activities of the ROK as a middle power show its intention to create an institutional atmosphere for shared ownership without dominance by one country. However, the proposal was not accepted by China and Japan. This shows that the Korean initiatives have not been strong enough to construct a new direction of regional environmental cooperation. The ROK needs to better strategize how to meet this challenge throughout regime creation processes to become a successful middle power.

Northeast Asia has a far way to go in terms of institutionalization of a regional environmental regime. Despite this lack of formal regime creation, this region has developed a variety of cooperative mechanisms. Even though they are fragmented without creative interlinkages between them, they are still under construction. The ROK's initiatives in the various cooperative mechanisms might have become an example to other participating countries, and have led to a growing participation in financial contributions from China and Russia in the NEASPEC. In this sense, the role of the ROK as a middle power is promising.

The other side of the coin, however, tells us that no single country has grasped strong leadership in any of the cooperative mechanisms and the unnecessary competition, particularly between Japan and the ROK, might have interrupted institutional development of environmental cooperation in Northeast Asia. It could be too early to tell because the regime creation processes are still in the nascent stage despite two decades of cooperation. The ROK will continue to contribute to developing current regional environmental cooperation as a middle power, until a country in the region takes firm leadership, probably China, once it is ready to pay more attention to regional environmental issues.

CHAPTER 3

ACID DEPOSITION MONITORING NETWORK IN EAST ASIA (EANET)

Introduction

EANET is an intergovernmental regional network in which 13 East Asian countries currently participate to address acid deposition problems in the region (Figure 3.1). After holding four meetings of experts between 1993 and 1997, 10 countries, including China, Indonesia, Japan, Malaysia, Mongolia, Philippines, ROK, Russia, Thailand, and Vietnam, joined the EANET at the First Session of the Intergovernmental Meeting on the Acid Deposition Monitoring Network in East Asia in 1998 in Yokohama, Japan. Cambodia, Lao PDR, and Myanmar also became members of EANET in 2001, 2002, and 2005, respectively.

Despite considerable progress of monitoring activities through EANET which has developed into a highly formal and concrete cooperative mechanism, this chapter argues that EANET is largely a failure in terms of generating broader cooperation and producing useful measurement data that could lead to the creation of a regional environmental regime. This chapter finds that its existence appears to be driven by Japanese diffuse interests in promoting soft power and applying foreign aid to cement more diffuse political relations in the region; there are few broader effects or benefits. There are also few opportunities for the learning mode of socialization because of the too frequent turnover of bureaucrats and diplomats, and the very small numbers of scientists who are trained under the program.

Figure 3.1. Member countries of EANET as of 2013. Adapted from EANET http://www.eanet.asia/eanet/org.html

As of December 2012, participating countries had established 54 monitoring sites for wet deposition and 47 sites for dry deposition (Jiro, 2012) (Figure 3.2). The 13 participating countries conduct ecological surveys at 20 soil survey sites, 18 forest/vegetation survey sites, and 18 inland aquatic environment sites, such as lakes and rivers.

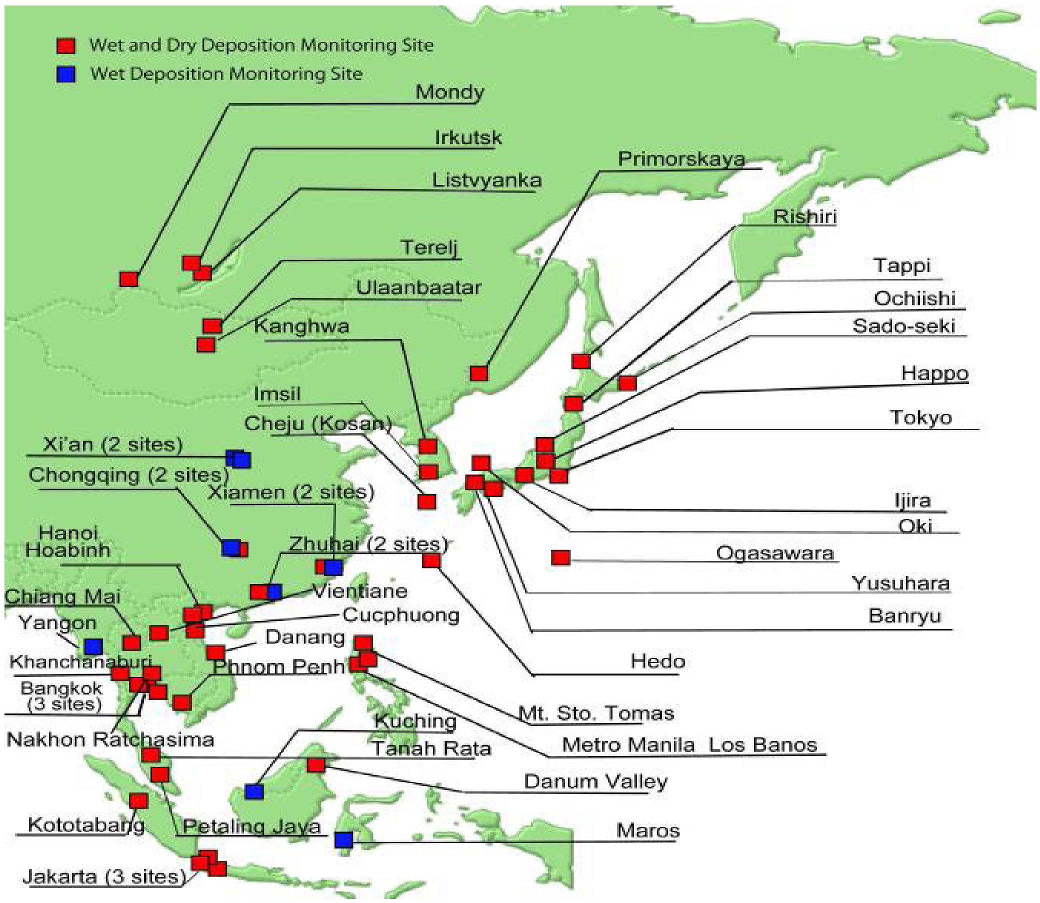

Figure 3.2. Locations of EANET monitoring sites by area type. Adapted from "Review of Exisitng and Required Capacities for Addressing Adverse Environmental Impact of Transboundary Air Pollution in North-East Asia," by Sato Jiro, 2012, p. 15. http://www.neaspec.org/documents/tap_jul_2012/Session1-Japan.pdf.

Table 3.1
Numbers of Monitoring Sites of Member Countries

	Wet Deposition	Dry Deposition	Total
Cambodia	1	1	2
China	8	3	11
Indonesia	5	4	9
Japan	12	12	24
Lao PDR	1	1	2
Malaysia	4	3	7
Myanmar	1	1	2
Mongolia	2	2	4
Philippines	3	3	6
Republic of Korea	3	3	6
Russia	4	4	8
Thailand	6	6	12

Viet Nam	4	4	8
Total	54	47	101

Note: Adapted from "Review of Existing and Required Capacities for Addressing Adverse Environmental Impact of Transboundary Air Pollution in North-East Asia," by Sato Jiro, 2012, p. 15. http://www.neaspec.org/documents/tap_jul_2012/Session1-Japan.pdf.

EANET has developed into one of the most successful cooperative mechanisms in terms of "formal" modes and "concrete" degrees of collective action in East Asia.[40] Its high level of formalization can be seen in its clear organizational scheme and the financial structures. Participating countries have succeeded in structuring clear indications of the purpose and division of labor among their secretariat, intergovernmental meetings, scientific advisory committee, and network center. The EANET's financial structure has been constructed through formal measures agreed to by member countries. In addition to these formal characteristics, the EAENT has established the most concrete forms of collective action by developing a common set of formats and guiding principles for monitoring for EANET activities as well as common monitoring guidelines and quality assurance (QA) and quality control (QC) measures to confirm the comparable quality of the monitoring data among its 13 member countries. The monitoring itself has been improved by implementing quality assurance and quality control activities through their Inter-laboratory Comparison Projects. Capacity building in participating countries has been significantly enhanced through various EANET activities, such as individual training and the network center's technical missions.

As discussed later in the chapter, a qualitative analysis of the data indicates that EANET has developed into a highly formal cooperative mechanism in which high-level governmental officials attend meetings and sign non-legally binding agreements on

[40] For specific explanation about measurement of formal and concrete characteristics of regional cooperative mechanisms, see Table 1.5 in chapter 1.

proposals even though it is a science-focused cooperative effort that does not attempt to reach any legal agreements, it. Of the three variables included in this study's hypotheses—political leadership, knowledge, and socialization—the only variable positively associated with this highly formal and concrete form and degree of collective action is political leadership. Strong structural leadership by the Japanese has enabled participating countries in the region to structure their cooperation, particularly during the early phase of EANET development. Japan's biggest financial contribution to the EANET budget has made EANET the most financially abundant regional cooperative mechanism in East Asia and has created the most practical benefits and capacity building through its monitoring activities. Japan's leadership, particularly its structural leadership based on its material capabilities, has succeeded in driving more highly formal and concrete forms and degrees of collective action.

Yet Japan's dominant contributions also have become an obstacle to moving EANET to the UNEP's first category of regional cooperation, which, as mentioned in chapter 1, is legally binding cooperation. Regional efforts over the past 2 decades have not led to the creation of any regulatory regional environmental regime to address acid deposition in East Asia. EANET still falls into the UNEP's second category of regional environmental action, a regional entity with a permanent structure and science focus without the solid legal infrastructure and a policy focus of the characteristics of the first category.

The relatively small amount of scientific knowledge about acid deposition shared among the participating countries of EANET and the adaptation rather than learning process of socialization in which they engage do not seem sufficient to explain why

EANET has achieved the most highly formal and concrete form and degree of collective action among regional environmental cooperative mechanisms. Nonetheless, an examination of those two variables of scientific knowledge and socialization reveals the social mechanisms among political leadership, shared scientific knowledge, and socialization and explains why EANET remains in the UNEP's second category without advancing to the highest category of legally binding cooperative mechanisms. First, the examination of the hypothesized social mechanism—i.e., that the stronger the political leadership and the greater the shared knowledge in the region, the more likely participants in regional cooperation will be to engage the learning process of socialization and thereby create the most formal and concrete collective action—shows that strong political leadership alone did not lead participating countries to engage in the learning process of socialization, and the lack of shared scientific knowledge can be attributed to the adaptation rather than learning process of socialization by participants in the EANET activities. Second, the lack of scientific knowledge and the adaptation process of socialization among the participating countries of EANET can address why EANET has been stuck in the UNEP's second category over the course of 2 decades of cooperative efforts regarding transboundary acidification issues despite producing the most formal and concrete mode of collective action in the region.

The lack of shared knowledge among regional scientists about the compelling impacts of acid deposition has not motivated the countries participating in EANET to develop a more regulatory regional regime. Political calculations among countries in the region about whether to participate in EANET activities and East Asian bureaucratic rotation systems, which make public officers hold the same position for only a limited time to prevent corruption and increase creativity, have led countries in the region to engage in the adaptation process of socialization, and thereby they have not been motivated enough to pursue a regional environmental regime creation.

To better understand how EANET has achieved of the most successful collective action of the three cases but failed to generate a legal infrastructure on acid deposition in the region, this chapter investigates how the existing level of cooperation through EANET has resulted from political leadership and scientific knowledge and whether the adaptation or learning as socialization processes constrained or boosted its regional collective action. As socialization is a process that is a consequence of the interplay between sets of independent variables, this chapter calls for attention to the social mechanism between the two variables of political leadership and scientific knowledge. The following sections explain how the acid rain issue has become an environmental concern in East Asia, and how the region has responded to its concern through developing the EANET mechanism.

Acid Rain

Acid rain refers to rain below an acidity of pH 5.6. It affects most constituents of the ecosystem, such as lakes, valleys, mountains, forests, plants, and animals. The damage it produces is widespread and diverse. Sulfur dioxide (SO_2) and nitrogen oxides (NOx) that are emitted from the combustion of fossil fuels are known to be major causes of acid rain. Acid rain was first recognized as an environmental problem in 19^{th} century Europe. In his pioneer 1872 article, "Air and Rain: The Beginnings of a Chemical Climatology," English chemist Robert Angus Smith coined the term *acid rain* to describe the acidic precipitation in Manchester, England. About 90 years later, Svante Odén, a soil scientist working at Sweden’s Agricultural College near Uppsala, synthesized diverse strands of research to conclude that the acidity of precipitation and surface water was increasing in many areas and causing detrimental impacts on fish, forests, and materials (Odén, 1968). Following Odén’s hypotheses, various research and monitoring programs were initiated after the 1972 United Nations Conference on the Human Environment in Stockholm, Sweden. According to Clark and colleagues, the Organization for Economic Cooperation and Development’s Cooperative Technical Program to Measure Long-Range Transport of Air Pollutants, initiated in 1972,“provided international legitimation for Odén’s ideas in 1977” (2000, p. 51). Indeed, the Canadian Network for Sampling Precipitation (CANSAP) was established in 1976, the United States National Atmospheric Deposition Program (NADP) in 1978 was organized by the State Agricultural Experiment Stations (SAES), and later funded by the National Acid Precipitation Assessment Program (NAPAP) to measure the effects of atmospheric deposition on the environment.

These various programs and studies have found that widespread loss of fish populations, especially in Scandinavia but also in the United States, Canada, and the United Kingdom, has resulted from surface-water acidification. In addition, severe forest dieback has been noticed in the vicinity of emission sources over the centuries, particularly that caused by direct SO_2 damage. Central Europe observed widespread forest declines in the 1980s even though it was far from emission sources.

Table 3.2
Acidity and Its Effects

Acidity (pH)	Effects

6.0 or lower	Freshwater shrimp cannot survive.
5.5	Bottom-dwelling bacterial decomposers begin to die, causing non-decomposed leaf litter and other organic debris to lie on the bottom and depriving plankton of food supply.
4.5 or lower	All fish and most frogs and insects die. Acid rain also damages buildings and historical monuments; leads to the release of harmful chemicals, such as aluminum, from rocks and soils into drinking water sources; and corrodes lead and copper piping.

Note: Adapted from "Acid Rain in China and Japan: A Game-theoretic Analysis," by Y. Nagase and E. C. D. Silva, 2007, *Regional Science and Urban Economics* 37, pp. 100-101.

Acid Rain in Northeast Asia

Acid rain has been a serious and growing problem in Northeast Asia. In China, acid rain emerged as an important environmental problem in the late 1970s and grew worse throughout many years of record economic growth due to increased energy demand, greater coal combustion, and larger emissions of pollutants. As smokestack heights are usually very high in China, its emissions contribute more to regional than to local acid rain.

Acid rain in China is caused mostly by emissions of sulfur dioxide by power plants, industrial boilers, ore smelters, and oil refineries. Power plant boilers are known as the single largest contributor, followed by industrial boilers and residential stoves and boilers. Moreover, power plants contribute to pollutant emissions that are transported long distances and accordingly to regional acid precipitation, while industrial and residential sources contribute mainly to local acid precipitation (Sinton, 1991).

Between 1980 and 2004, China's aggregate energy consumption grew enormously. Even though shares of other energy sources such as hydropower, nuclear power, and natural gas have grown, coal remains the dominant source of energy in China. In fact, the proportion of coal in China's energy mix increased from 51% in 1980 to 62%

in 1996, as its economy made a particularly quick expansion (Aden & Sinton, 2006). Due to its pattern of energy consumption, the acid rain in China is still evident, and serious acidification is most dominant in Southeastern China, where the economy is growing fast. Figure 3.3 shows pH values in 2007 in China.

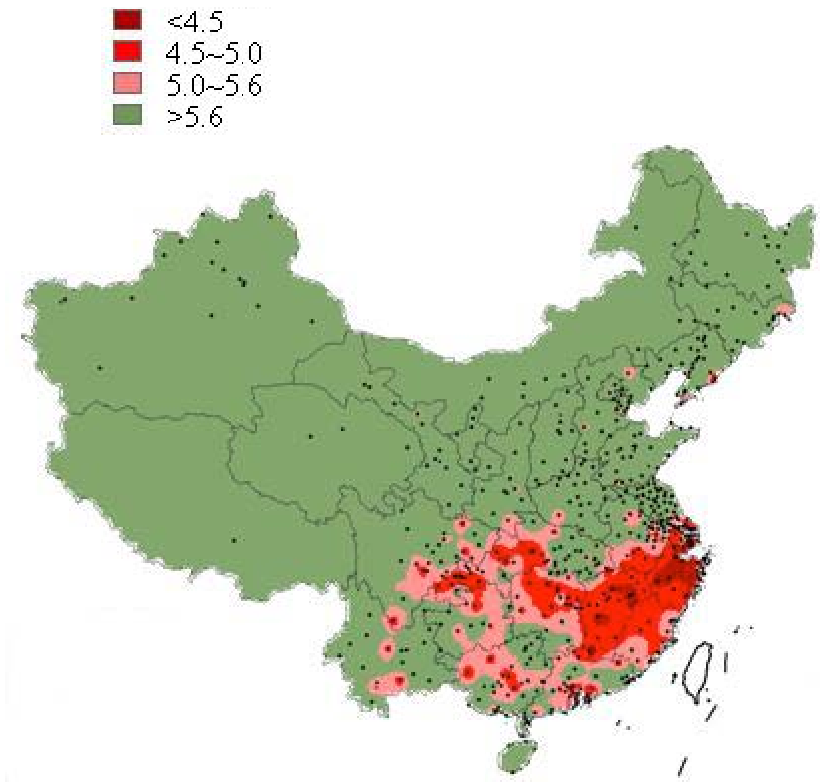

Figure 3.3. 2007 regional distribution of acid rain in China. Adapted from "Report of China's Environmental Conditions," by Ministry of Environmental Protection of China, 2007, http://jcs.mep.gov.cn/hjzl/zkgb/2007zkgb/200811/t20081117_131297.htm

Development of EANET

Along with this serious and growing problem regarding acid rain in East Asia due to the rapid increase of China's energy consumption, international discussions on acid rain alarmed East Asia. Agenda 21, adopted at the United Nations Conference on Environment and Development (UNCED) in 1992, declared that "the experiences of the programs on transboundary air pollution in Europe and North America needed to be shared with other regions of the world" (EANET, 2010d, p. 15). In addition, the World Bank estimated in 1995 that 1990 levels of sulfur dioxide emissions in East Asia would nearly triple by 2020 if energy and environment policies remain unchanged (EANET, 2011a). These two findings led the region to recognize the potential problem of adverse impacts of acid deposition in the region. Thus, Japan initiated regional discussions regarding the acid deposition issue. Dr. Naoko Matusmoto at the Institute for Global Environmental Strategies (IGES) in Japan stated that the fundamental basis for establishing the EANET was the Rio Conference and the resulting Agenda 21 (IGES, 2010). The development of EANET was led by bureaucrats from Japan's Environment Agency because acid rain was "considered to be an issue which Japan had the capability to take up and contribute to, and could have high visibility among East Asian countries" (IGES, 2010, p. 4).

Japan's initiative was set in motion in 1993 by holding the First Expert Meeting in Toyama, Japan (EANET, 1993). At this meeting, participants shared the view that atmospheric protection was a critical issue for sustainable development in East Asia and recognized that acid precipitation due to the expanding economies was being observed in East Asia. They shared a common fear that the adverse effects of acid precipitation would become a problem in certain areas in the future despite a lack of evidence of acid precipitation at the time. Accordingly, the participants acknowledged the necessity of a comprehensive approach to assessing the impact of acid precipitation and providing greater monitoring of acid precipitation. Thus, the participants agreed that regional cooperation would be essential to this end and to collaborative monitoring to understand the state of acid precipitation in East Asia through creating regional monitoring guidelines, as monitoring methods varied across countries. Finally, the participants shared the view that an Acid Precipitation Monitoring Network in East Asia needed to be established in the near future.

Since then, Japan's initiative developed in three phases: the early years between 1993 and 1997, the preparatory phase between 1998 and 2000, and the regular phase since 2001. Four Expert Meetings were held between 1993 and 1997 to discuss the state of acid deposition in the region, ecological effects, and potential steps toward regional cooperation regarding acidification. Through these meetings, participants agreed on the necessity of creating a comprehensive approach for assessing impacts and establishing a regional monitoring network with standardized monitoring methods and analytical techniques. The participants are composed of delegates from ministries of environment and national research centers.[41]

During the preparatory phase from 1998 to 2000, participating countries agreed on the *Joint Announcement on the Implementation of EANET* and the *Tentative Design of EANET*, resulting in the organizational structure of EANET shown in Figure 3.4. The Third Session of the Intergovernmental Meeting (IG3) in 2001 adopted the *Rules of Procedure for EANET*. Since the IG3, the Intergovernmental Meetings and Scientific Advisory Committee (SAC) meetings have been held annually. Four subsidiary bodies—

[41] Specific institutes involved in EANET activities are Ministry of Environment for Cambodia; The China National Environmental Monitoring Center & Ministry of Environmental Protection for China; Ministry of the Environment for Indonesia; Ministry of the Environment for Japan; Water Resources & Environment Administration for Lao P.D.R; Malaysian Meteorological Department (MMD) for Malaysia; Ministry of Nature and Environment for Mongolia; Ministry of Transport for Myanmar; Department of Environment and Natural Resources (DENR) for Philippines; Environmental Management Bureau(EMB) for Philippines; Ministry of Environment & The National Institute of Environmental Research (NIER) for ROK; Ministry of Natural Resources of the Russian Federation & Russian Academy of Sciences for Russia; Pollution Control Department(PCD) for Thailand; Ministry of Natural Resources and Environment (MONRE) for Viet Nam.

the Task Force on Monitoring for Dry Deposition, Task Force on Soil and Vegetation Monitoring, Task Force on monitoring instrumentation, and Task Force on Research Coordination—were established under the Scientific Advisory Committee (SAC). It was also decided that the senior technical managers (national QA/QC managers) from the participating countries should meet to discuss important technical issues related to the network and exchange information on their 2001 monitoring activities.

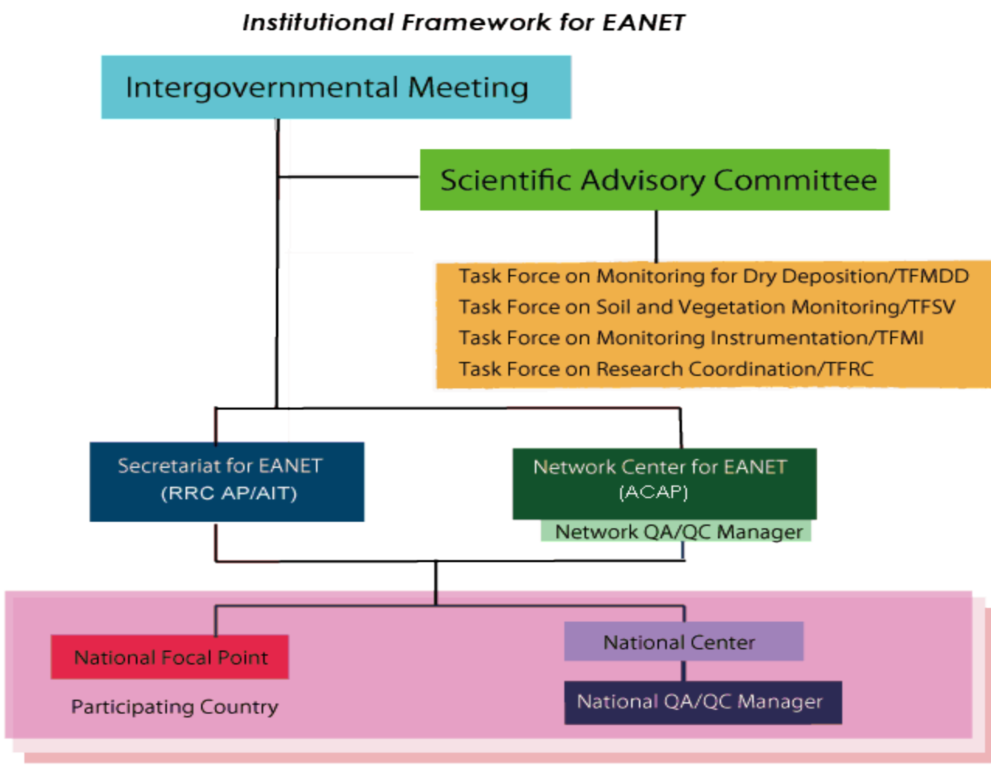

Figure 3.4. Organizational structure of EANET. Adapted from EANET, 2013b, http://www.eanet.asia/eanet/org.html

The Intergovernmental Meeting is the decision-making body of EANET, composed of the representatives of all the participating countries. Its tasks are as follow:

> 1) review and approval of the work program and budget of the Network; 2) review of implementation of the work program; 3) review and approval of periodic reports on the state of acid deposition in East Asia; 4) establishment of

> subsidiary bodies as necessary and appropriate; 5) review and approval of scientific, technical, administrative and financial matters for the management of the Network; 6) adoption of the rules of procedures for the Intergovernmental Meeting and subsidiary bodies, including the Scientific Advisory Committee; 7) provision of necessary instructions and guidance to the subsidiary bodies, the Secretariat and the Network Center, on their activities; and 8) decision on other matters related to the management of the Network and implementation of the work program. (EANET, 2000b, p. 2)

The Scientific Advisory Committee (SAC) is the advisory team that supports the Intergovernmental Meeting on scientific and technical issues of the EANET. It is composed of scientists and technical experts nominated by the participating countries, and establishes task forces when necessary. In fact, the members of the SAC include scientists at national research institutes and professors at universities (EANET, 2010e). Its tasks are to advise and assist the Intergovernmental Meeting with the following matters:

> 1) scientific and technical aspects of the monitoring strategies for the Network; 2) development and revision of the monitoring guidelines and technical manuals; 3) matters related to the selection of monitoring sites, QA/QC programs, data reporting procedures and formats; 4) matters related to collection, evaluation, assessment and analysis of monitoring data; 5) preparation of periodic reports on the state of acid deposition in East Asia, based on the data reports by the Network Center; 6) matters related to studies of other scientific issues; and 7) other scientific matters as requested by the Intergovernmental Meeting. (EANET, 2000b, p. 3)

The secretariat is in charge of communication among the participating countries. The United Nations Environment Program’s Regional Resource Center for Asia and the Pacific (UNEP RRC.AP) in Bangkok, Thailand was designated as the secretariat following the interim secretariat run by the Environment Agency of Japan in 2001. It consists of three employees: one coordinator, one program officer, and one administrative assistant. The employees tend to be Thais due to the location of the secretariat. It prepares for the meetings and conducts necessary administrative and financial management activities. The secretariat is designated by the Intergovernmental Meeting and facilitates cooperation among member countries in a transparent manner. Under the guidance of the Intergovernmental Meeting, the secretariat carries out the following tasks:

> 1) necessary administrative arrangements for the meetings of the Intergovernmental Meeting, the Scientific Advisory Committee, and other subsidiary bodies; 2) necessary administrative and financial arrangements for managing the Network; 3) communication and cooperation in administrative aspects as the focal point of the Network; and 4) other necessary tasks as requested by the Intergovernmental Meeting. (EANET, 2000b, p. 3)

The network center has conducted the most important activities for the EAENT because of its main objective of monitoring. The Acid Deposition and Oxidant Research Center (ADORC, renamed as Asia Center for Air Pollution Research [ACAP]) based in Niigata, Japan was designated as the network center for EANET. It compiles and evaluates the monitoring data and provides data upon request from the participating countries. It has helped participating countries enhance their quality assurance and quality control (QA/QC) activities, and has provided technical support and training for the participating countries. It has also worked on the promotion of public awareness on acid deposition issues. A list of its tasks includes:

> 1) central compilation, evaluation and storage of monitoring data and related information; 2) preparation of data reports on acid deposition in East Asia; 3) dissemination of monitoring data and other relevant information; 4) provision of technical assistance to the participating countries in implementing the network activities; 5) implementation and coordination of QA/QC activities; 6) development and implementation of education/training programs for those engaged in the network activities; 7) implementation of research activities on acid deposition; 8) provision of scientific and technical support for the Intergovernmental Meeting, Scientific Advisory Committee and other subsidiary bodies; and 9) other tasks as requested by the Intergovernmental Meeting. (EANET, 2000b, p. 4)

Each of the participating countries organized its national focal points of the EANET, national centers, and national QA/QC managers. The national focal points of the 13 member countries are basically all governmental officials in ministries of environment and are responsible for communicating with the EANET secretariat and the network center regarding implementation of their network activities (EANET, 2010g). The national centers of participating countries collect national monitoring data and submit them to the larger network center. They deal with technical matters regarding the network activities and with promoting national QA/QC activities. The national centers consist mostly of national research institutes, such as the China National Environmental Monitoring Centre (CNEMC) in China, the Asia Center for Air Pollution Research (ACAP) in Japan, and the National Institute of Environmental Research (NIER) in the ROK (EANET, 2010a). National QA/QC managers, mostly from the national centers of the EANET, work to promote national QA/QC activities in cooperation and coordination with the national centers (EANET, 2010c).

EANET's Achievements and Limitations

Since 2001,[42] the EANET's objectives are (a) to "create a common understanding of the state of acid deposition problems in East Asia"; (b) to "provide useful inputs for decision-making at local, national regional levels aimed at preventing or reducing adverse

[42] To test the feasibility of creating EANET, the objectives of the preparatory phase of EANET between 1998 and 2000 were more specific than those of the regular phase of EANET since 2011. They included (a) "to examine the feasibility of the designed Network activities and relevant guidelines and technical manuals"; (b) "to provide time for participating countries to further develop national monitoring systems for the Network; and (c) "to formulate policy recommendations for the further development of the Network" (EANET, 2013a). During this period, participating countries developed the technical manuals and guidelines for monitoring of wet deposition, soil, and vegetation and inland aquatic environments, and finally adopted them at the Second Interim Scientific Advisory Group Meeting of EANET in 2000.

impacts on the environment caused by acid deposition"; and (c) to "contribute to cooperation on the issues related to acid deposition among the participating countries" (EANET, 2011a). The *Tentative Design of EANET* outlined the activities required to achieve several objectives such as collection of the monitoring data and information, the implementation of the QA/QC programs, and publication of periodic reports on the state of acid deposition in the region.[43]

EANET has accomplished several achievements. First of all, the number of monitoring sites in the network has increased from 42 at the start of the regular EANET monitoring activities in 2001 to 54 in 2010, which has improved the quantity of data. As shown above in Table 3.1, Japan has established nearly a quarter of total monitoring sites of EANET (24 out of total 101 sites) as of December 2012. Thailand has established the second largest number of monitoring sites, 12. China has 11; Indonesia 9; Russia and Vietnam 8 each; Malaysia 7; Philippines and ROK 6 each; Mongolia 4; and Cambodia, Lao PDR, and Myanmar 2 each.

In addition to increasing the number of monitoring sites, EANET has enhanced concrete procedures for monitoring through developing clear monitoring guidelines (EANET, 2000e), technical manuals (EANET, 2000d), and QA/QC programs (EANET, 2000c). Particularly, QA/QC plays an important role in acid deposition monitoring by ensuring the collection of meaningful data and enhancing the quality of datasets "at the national levels and in the Inter-laboratory Comparison Project schemes" (EANET, 2011d, p. 9). Thus, EANET has developed several documents on QA/QC programs intended to

> support the provision of reliable data with comparability among participating countries and with information from other monitoring networks outside the East Asian region, such as EMEP (the Co-operative Programme for Monitoring and

[43] For specific objectives, see EAENT, 2000a, pp. 1-2.

Evaluation of the Long-range Transmissions of Air Pollutants in Europe) and WMO (the World Meteorological Organization) (EANET, 2011d, p. 1).

EAENT's QA/QC programs have supported work at the national level in participating countries through providing appropriate documentation on QA/QC procedures and regulation of individual monitoring entities. The QA/QC program aims to "obtain reliable data that can be comparable among the countries of the East Asian region, as well as with other networks by ensuring data accuracy, precision, representativeness and completeness in acid deposition monitoring" (EANET, 2000e, p. 1).

In particular, the annual "Inter-laboratory Comparison Projects" implemented by the network center of EANET, contributed to improving "reliability of analytical data through assessment of suitable analytical methods and techniques" (EANET, 2013b, p. 1). The projects have been expanded to a wider range of fields including dry deposition, soil, and inland aquatic environments.

For example, the EANET network center distributes artificial rainwater samples for testing to participating laboratories in the13 member countries to compare the analytical precision and accuracy of the measurement of wet deposition.[44] The participating laboratories have to dilute the artificial samples 100 times with deionized water and analyze the diluted samples for 10 parameters: pH, EC, SO_4^{2-}, NO_3^-, Cl^-, Na^+, K^+, Ca^{2+}, Mg^{2+}, and NH_4^+ (EANET, 2013b, p. 6). The laboratories are required to apply the analytical methods and data-checking procedures specified in the *Technical Manual for Wet Deposition in East Asia* and the *QA/QC Program for Wet Deposition Monitoring in East Asia* and to submit their results to the EANET network center. The results of this wet deposition comparison in Figure 3.5 indicate the percentage of data that satisfied the

[44] For specific information on participating laboratories in member countries, see Table 1.1, Participating Laboratories in EANET, 2013b, p. 3.

data quality objectives (DQOs) and flags those that did not. The flags indicate the degree of deviation from the DQOs: Flag E stands for deviations between 15% and 30% and Flag X for deviations over 30%. Figure 3.5 shows that the quality of measurement data has improved over time as the blue bars, which indicate the qualifying percentage of data, appear to be increasing.

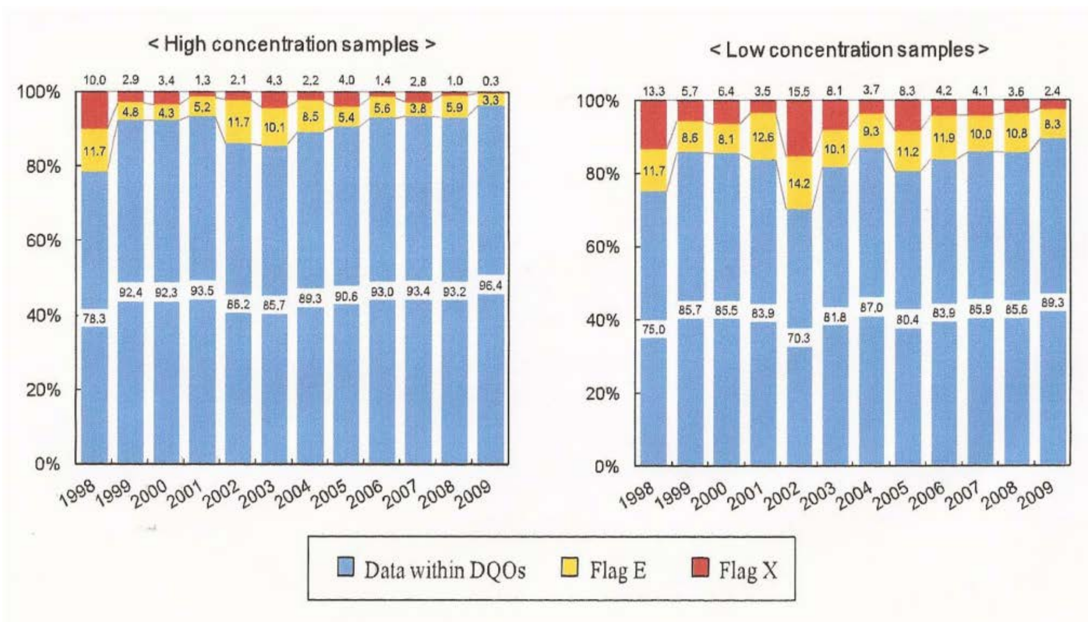

Figure 3.5. Results of the inter-laboratory comparison project on wet deposition for 1998-2009. Adapted from *The Second Periodic Report on the State of Acid Deposition in East Asia: Part III: Executive Summary*, by EANET, 2011e http://www.eanet.asia/product/PRSAD/2_PRSAD/2_ex.pdf. p. 5

In addition to improvements in the quantity and quality of data, capacity building in the participating countries of EANET has improved. According to EANET, the "technical capabilities and skills of the participating countries in acid deposition monitoring and assessment were significantly enhanced" through EANET's training of individuals and the network center technical missions taken to assist all the participating countries in "monitoring performance, laboratory operations, data management, and other procedures" (EANET, 2011b, p. 10). Various activities such as scientific workshops and individual training courses at EANET's network center and Japanese agencies helped to enhance the skills and knowledge of personnel in national monitoring centers. China, Cambodia, Indonesia, Lao PDR, and Vietnam have consistently received individual training. Russia participated in the individual training program three times for a total of 13 years. The ROK has never participated in any of training opportunities because of the preexisting capabilities of its own personnel. The individual training program has been held at ADORC, now ACAP, annually to teach monitoring and data management skills (Table 3.3). It is striking to see the remarkably small numbers of people trained each year.

Table 3.3
Individual Training Programs at ADORC

Year	Number of Participants	Countries	Training Provided
1998	2	Thailand, Russia	Filter-pack monitoring
1999	10	China (9), Indonesia	Training on EANET activities
2000	4	Philippines, Russia, Thailand (2)	Training on EANET wet and dry deposition monitoring, data management
2001	6	Indonesia (3), Malaysia, Philippines, Vietnam	Wet and dry deposition, soil and vegetation, inland aquatic environment monitoring, and data management
2002	6	China (2), Indonesia, Mongolia, Philippines, Thailand	Wet and dry deposition, soil and vegetation, inland aquatic environment monitoring, and data management
2003	6	Cambodia, China, Lao PDR, Malaysia, Philippines	Wet and dry deposition, soil and vegetation, inland aquatic environment monitoring and data management
2004	5	Cambodia, China, Lao PDR, Malaysia, Philippines	same as above

2005	6	Cambodia, China, Indonesia, Lao PDR, Thailand, Vietnam	same as above
2006	2	Cambodia, Lao PDR	same as above
2007	5	Cambodia, China, Indonesia, Lao PDR, Malaysia	same as above
2008	5	Cambodia, China, Lao PDR, Myanmar, Vietnam	same as above
2009	6	Indonesia, Malaysia (2), Mongolia, Russia, Thailand	same as above
2010	3	China, Indonesia, Vietnam	same as above

Note: Adapted from *Proceedings: The Ninth Session of the Working Group on Future Development of EANET*, by EAENT, 2010g, p. 73.

According to EANET, not only its network center but also Japan's International Cooperation Agency (JICA) "has delivered the training program through conducting the JICA Third Country Training Program in Thailand and the JICA Training Course on EANET in Japan to provide training on acid deposition and air quality management" (EANET, 2011b, p. 10). All of the member countries except Russia and the ROK have sent at least one researcher to the JICA Third-Country Training Course every year (Table 3.4). Cambodia, Mongolia, Myanmar, Thailand, and Vietnam have sent the largest number of researchers between 2004 and 2009.

Table 3.4
Participants in JICA Third-Country Training Course on Acid Deposition Monitoring and Assessment in Thailand (NC collaboration with JICA and PCD, Thailand)

	2004	2005	2006	2007	2008	2009	Total
Cambodia	2	3	2	2	3	2	14
China	2	2	2	1	1	0	8
Indonesia	0	1	3	3	0	0	7
Lao PDR	2	2	2	0	3	2	11

Malaysia	0	2	1	1	0	2	6
Mongolia	2	2	3	1	2	2	12
Myanmar	0	2	2	3	2	3	12
Philippines	0	1	1	0	2	2	6
ROK	0	0	0	0	0	0	0
Russia	0	0	0	0	0	0	0
Thailand	6	4	6	6	6	8	36
Vietnam	4	3	2	2	3	0	14

Note: Adapted from *Proceedings: The Ninth Session of the Working Group on Future Development of EANET*, by EANET, 2010c, p. 75.

These training programs have enhanced the monitoring skills of member countries of EANET. One of the Chinese delegates has stated that the training implemented by the network center has let Chinese trainees learn monitoring techniques that are believed to have improved other monitoring sites in China as well.[45]

The technical manuals and guidelines for monitoring of wet deposition, soil, and vegetation and inland aquatic environment were developed during the preparatory phase between 1998 and 2000. Each country provides the EANET network center with data and related information obtained from the monitoring activities conducted at the EANET sites in their respective countries following the technical manuals and guidelines for monitoring by the end of June of each calendar year. Then, the network center prepares and presents an annual draft data report containing the monitoring data submitted by the participating countries at the meeting of the Scientific Advisory Committee (SAC). After it is reviewed by the SAC, which is composed of experts from the participating countries, the draft data report is finalized. Since 2000, data reports have been published annually without interruption.

[45] Interview with a Chinese delegate at the Twelfth Session of the Intergovernmental Meeting on the Acid Deposition Monitoring Network in East Asia 23-24 November 2010, Niigata, Japan.

The Fifth Session of the Intergovernmental Meeting (IG5) held in 2003 decided to establish a Working Group on Future Development of EANET (WGFD) to review the performance of the secretariat and network center and develop guidelines for their administrative and financial management. A high-level segment held with the Seventh Session of the Intergovernmental Meeting (IG7) in 2005 launched the *Report for Policy Makers: Goals, Achievements and Way Forward.* IG7 also adopted Decision 1/IG7 (Niigata Decision), which endorsed the necessity of an appropriate instrument and legal status for a sound basis for financial contributions to EANET. The Eighth Session of the Intergovernmental Meeting (IG8), held in 2006, adopted a 5-year medium-term plan (MTP), renamed *Strategy on EANET* Development (2006-2010), which was then followed by another for 2011-2015.

EANET characterized the most recent agreement on and the operation of the *Instrument for Strengthening the Acid Deposition Monitoring Network in East Asia* at the 12th Intergovernmental Meeting (IG12) in 2010 as “another important historical milestone of the EANET cooperation” (EANET, 2012b, p. 1). Seven participating countries – Cambodia, Japan, Mongolia, Myanmar, Philippines, the ROK, and Thailand – signed the instrument, waiting for responses from the other countries at the IG12 in 2010. In 2011, Indonesia announced that it “is not able to sign the Instrument due to consideration on legal aspects. The willingness was expressed to continue joining the activities of EANET” (EANET, 2011c, p. 5). Lao PDR informed the IG that its Ministry of Foreign Affairs approved the instrument and it would contact the secretariat soon, and Malaysia informed the organization that it was “already at the final stage of internal consultation to sign the Instrument. The clarification was requested to the Session if there will be any legal obligations as the effect on signing the Instrument after the operational date" (ibid., 6). In Russia, the instrument has been undergoing internal processes among ministries such as Ministry of Foreign Affairs and Ministry of Finance to seek approval for a financial contribution (EANET, 2011c). Christer Holtsberg, Senior Technical Advisor at RRC.AP, Asian Institute of Technology, "encouraged the two remaining countries to expedite the internal process for the signing of the Instrument as soon as possible" in his opening remarks at the 11th Session of the Working Group on Future Development of the EANET in 2012 (EANET, 2012b, p. 1).

The high-level segment meetings have enhanced the authority of the agreements. The fact that very senior officials, including the Minister of the Environment of Japan, the Parliamentary Vice-Minister for Foreign Affairs of Japan, the Vice-Minister of the Ministry of Nature, Environment, and Tourism of Mongolia, and the Director General at the Climate and Air Quality Policy Department of the Ministry of Environment of ROK, attended IG12 in 2010 to sign the instrument has made it a strongly official and formal statement. This official involvement has made EANET a formal form of collective action regarding acid deposition in East Asia.

Based on these developments, it can be asserted that the monitoring activities have been managed properly to the standards of providing clear monitoring guidelines, technical manuals, and quality assurance/quality control (QA/QC) programs. These forms of EANET activity go much beyond simple discussion. The devotion of the network center to the EANET monitoring activities is well represented by its various publications, including strategy papers, technical manuals, and scientific and technical reports. In terms of organizational structure, the clear division of labor among the secretariat, the network center, and SAC support the EANET's strong presence in the region.

Despite this development of formal and concrete collective action, EANET has not advanced to a legally binding agreement since countries in the region started discussions in 1993 regarding acid deposition in East Asia. A comparison of the *2000 Tentative Design* and the *2010 Instrument* shows the slow development of EANET. The *Instrument* is almost identical to the *Joint Announcement on Implementation and the Tentative Design of 2000*, essentially just adding several phrases and labeling each section in the text. Two perhaps significant differences between the two are more clarification of financial contributions and an expansion of the scope of monitoring air pollutants, as discussed next.

As to the first of these, the *Tentative Design* indicates financial arrangements of EANET very briefly:

> The administrative and operational costs of national monitoring within each country will be borne by each country. The administrative and operational costs of the Network will be financed by voluntary contributions by the participating countries, while efforts should be made to mobilize existing funding sources and seek new ones. (EANET, 2000e, p. 4)

However, Item 14 of the *2010 Instrument* indicates more specific financial arrangements than the *Tentative Design.*[46] But, this more specific indication of the financial structure in the later document is not that different from the earlier one in that all financial contributions are still on a voluntary basis.

The key change between the 2000 and 2010 documents might be the latter's indication of a potential expansion of EANET in the future. Along with the objectives of

[46] For detailed arrangements, see EANET, 2010a, p. 22

EANET, the new document adds a statement that the "scope of this Instrument may be extended, as decided by the IG" (EANET, 2010d, p. 17). Other than this acknowledgement of potential expansion of EANET's research scope, the 2010 document is very similar to the texts agreed to 10 years earlier, and remains not legally binding.

As noted, a few countries declined to sign the instrument due to internal processes that might be required for their signature. It is notable, however, that Japan and the other countries that signed the instrument in 2010 were not concerned about following national processes to obtain approvals for their signature, not because their national delegates had full authority to sign it, but because it is a non-legally binding agreement.

Regarding the EANET's future direction, according to one of Japanese delegates to the IG 12 of 2010,[47] the Japanese Ministry of Foreign Affairs (MOFA) and Ministry of Environment seemed to have agreed that Japan wanted a legally binding agreement. But in 2008, the MOFA reviewed the document and concluded that Japan needed to keep EANET not legally binding because making it legally binding might require a more equal contribution among member countries rather than the then-current heavy reliance on the Japanese financial contribution, which supplied more than 90% of the annual budgets of both the secretariat and the network center.[48] The Japanese MOFA was concerned that

[47] Informal discussion with a Japanese delegate at the Twelfth Session of the Intergovernmental Meeting on the Acid Deposition Monitoring Network in East Asia, November 23-24, 2010, in Niigata, Japan.
[48] Japan made financial contributions of US$ 367,402 in 2008 and US$ 382,262 in 2009 for the secretariat and US$ 422,967 to the network center core budget in 2009 (EANET, 2010b). Most of the network center's additional budget is also contributed by the Japanese government, including its Ministry of Environment, National Institute for Agro-Environmental Studies of Japan, and Niigata city and prefecture, and Japanese companies such as Nissan Science Foundation and Mitsui & Co., Ltd. (EANET, 2010c).

the existing system of EANET might not work if Japan reduced its contribution and few of the other countries were willing to increase their financial contribution to EANET.

This internal decision by the Japanese government led to the proposed non-legally binding instrument, which seven countries signed without much difficulty or reluctance. As mentioned above, the instrument specifies no mandatory financial contribution or regulations for the reduction of pollution because the objectives of the EANET are only to set up a common monitoring system and to formulate policy recommendations for the further development of the network based on their monitoring results without considering specific emission standards.

Thus, Japan's significant financial contributions have made the EANET's financing capability "the highest among other regional cooperative mechanisms" (Kim, 2013, 12). The other side of the coin, however, is that Japan's enormous contribution has prevented EANET from moving on the next step of creating a legally binding regional agreement. The reasons for both these achievements and limits of EANET are discussed in the following sections.

Political Leadership

This section tests Hypothesis 1, which predicts that the stronger the political leadership—whether structural, instrumental, or directional—that a participating country in the region exerts, the more formal and the more concrete the collective action in the region will be. It examines whether stronger political leadership taken by any country in the region increases the likelihood of developing more formal and concrete collective action.

Since EANET's beginning, Japan has exerted firm structural leadership through its dominant financial contributions, but only limited directional leadership despite its advanced research and limited instrumental leadership. Before discussing Japan's structural leadership, we need to understand the limit of Chinese leadership. In terms of environmental cooperation, as discussed in chapter 1, China, despite its growing political and economic strength in the global order and its enormous emissions that contribute to regional air pollution, has emphasized its status as a developing country without showing any leadership in acid deposition issues.

Although China has taken various domestic measures to tackle air pollution and acid rain in particular, it has shown little interest in regional environmental cooperation. China's environmental policy is essentially decided in accordance with its National Economic and Social Development Plan on a 5-year basis. In the sixth 5-year-plan period between 1979 and 1985 during the reformation of the country's political and economic systems, widespread acidic pollution was observed and the issue of acid rain emerged in China based on nationwide surveys on precipitation chemistry (Lai, Kawashima, Shindo, & Ohga, 2001).

In the seventh 5-year-plan period between 1986 and 1990 during a period of economic stabilization, the acid rain issue was adopted as one of China's national key projects. Systemic studies suggested that the level of acidity was going to worsen and that Southern China was the most seriously hit area. Accordingly, China adopted the Air Pollution Control Act in September 1987, but the act excluded many sulfur emission facilities, such as power stations, from those requiring control. During the eighth 5-year plan period between 1991 and 1995, when China was experiencing a booming economy and its government advocated the concept of sustainable development, Chinese officials strengthened the acid rain projects in the National Plan and began to release data relating to acid rain to make information about pollution openly available in response to growing public concerns. During the ninth 5-year-plan period between 1995 and 2000, the plan for economic development included environmental protection:

> The Air Pollution Control Act 1987 was amended, and articles dealing with sulfur and acid rain pollution were revised in 1995. The new act prescribes provisions relating to the acid deposition control zone and the sulfur dioxide control zone. It has been a remarkable step in China's policy toward acid rain control. In 1996, sulfur dioxide was listed as one of the pollutants requiring control under the System for Controlling the Total Amount of Major Pollutants. (Lai et al., 2001, p. 1846)

Despite China's considerable concern about domestic air pollution, particularly the acid rain issue, it has shown little interest in regional environmental cooperation. China has cited its insufficient financial capacity and more pressing domestic issues, such as wide economic gaps among regions and various problems in public health,[49] to explain its low level of activity on environmental questions. However, it seems evident that the Chinese disinterest in EANET is related to its strategic recognitions of what the network might find because of its status of a source country. China's position was similar to those of the United Kingdom and Poland who refused to sign the 1985 Sulfur Protocol (*Protocol on the Reduction of Sulfur Emissions or Their Transboundary Fluxes)* which mandated uniform reductions of 30% in sulfur dioxide emissions from 1980 levels by 1993 because these two countries "burned large amounts of dirty coal, and were upwind from the very sensitive ecosystems in Scandinavia" (Levy, 1993, p. 94). According to

[49] Interview with a Chinese professor at Peking University in April 2011.

Komori, China, as a net contributor to regional air pollution, “had initially denied any responsibility for its role in causing transboundary acid rain” (Komori, 2010, p. 17).

Since the China-Japan Environmental Cooperation Agreement was signed in March 1994, bilateral environmental activities in the area of air pollution have been heavily promoted by Japan. The environmental projects addressed by the two countries have been supported by the Japan’s Official Development Assistance (ODA) programs[50]. Japan has provided China with special lower-interest loans for environmental projects since 1995, which it has assessed as “effective in helping to control China’s acid rain” (Lai et al., 2001, p. 1848). Accordingly, bilateral cooperation between China and Japan has been largely one-way, in which Japan has been a resource provider and China a resource beneficiary. In fact, the bilateral projects have been “a reflection of Japan’s concern with and enthusiasm for the acid rain issue” rather than a reflection of China’s (Lai et al., 2001, p. 1848).

Structural Leadership in EANET

Structural leadership is measured by contributions to the financing of the regional cooperative mechanisms, treating spending as evidence of structural leadership. The lack of interest in leading regional environmental cooperation on the part of China means that Japan has been the only country exerting leadership in the acid deposition issue. As noted earlier, Japan has been the key resource provider for the EANET monitoring activities. To support the monitoring activities of EANET, its network center has provided basic measuring equipment for most member countries except the ROK, which was able to make its own monitoring samples and other tools (Table 3.5). One of the Chinese delegates to IG12 in 2010 stated that EANET’s capacity building was one of the most

[50] The Japanese ODA programs for China began in 1979.

important outputs of EANET.[51] In fact, the provision of this monitoring equipment to member countries enhanced their monitoring capabilities in a practical manner.

Table 3.5
Equipment Provided to Participating Countries for Monitoring Activities

Year	Country Assisted	Equipment Provided
1998	Mongolia	IC, Wet-Only Sampler, Filter Pack Sampler Kit
	Russia	Wet-Only Sampler
1999	China	Wet-Only Sampler, Filter Pack Sampler Kit
	Philippines	Wet-Only Sampler, Refrigerator
	Vietnam	Wet-Only Sampler, Filter Pack Sampler Kit
2000	Indonesia	Wet-Only Sampler
	Malaysia	Filter Pack Sampler Kit
	Vietnam	Filter Pack Sampler Kit, Flow Meter
2001	-	-
2002	Cambodia	Wet-Only Sampler, Power Stabilizer
	Lao PDR	Wet-Only Sampler, Power Stabilizer
	Mongolia	Pure Water Generator Boiler
	Vietnam	Flow Meter
2003	Cambodia	pH and EC Meter
	Lao PDR	pH and EC Meter
	Mongolia	Digital Pipette, Flow Meter
	Philippines	Filter Pack Sampler Kit, Computer, Digital Camera
	Russia	AAS (used)
2004	Philippines	Filter Pack Sampler Kit, Refrigerator
	Vietnam	Filter Pack pump
2005	Lao PDR	Refrigerator
	Vietnam	Refrigerator
2006	Cambodia	IC (purchased using Secretariat's savings)
	China	Filter Pack Sampler Kit
	Lao PDR	IC (purchased using Secretariat's savings)
	Myanmar	Wet-Only Sampler, pH and EC Meter
	Philippines	Rain Sensor
2007	Cambodia	Filter Pack Sampler Kit
	Lao PDR	Filter Pack Sampler Kit
2008	Cambodia	Refrigerator of Wet-Only Sampler

[51] Interview with a Chinese delegate in November, 2010 in Niigata, Japan.

	Philippines	Refrigerator of Wet-Only Sampler
2009	Myanmar Lao PDR Vietnam	IC (donated by JICA) IC Suppressor Filter Pack Pump
2010	China Indonesia Myanmar	Filter Pack Kit Filter Pack Kits (2) Refrigerator for Wet-Only Sampler

Note: Adapted from *Proceedings: The Ninth Session of the Working Group on Future Development of EANET*, by EANET, 2010c, p. 69.

As mentioned above, based on the *Tentative Design*, the EANET member countries have borne the administrative and operation costs of national EANET monitoring activities. The *Report of the Second Session of the Working Group on Further Financial Arrangements for EANET* in 2003 reported the annual expenses for national monitoring, as seen in Table 3.6.

Table 3.6
Annual Expenses for National Monitoring (US$)

Cambodia	N/A	Mongolia	11,000
China	135,000	Philippines	24,000
Indonesia	22,000	ROK	125,000
Japan	874,000	Russia	37,000
Lao PDR	N/A	Thailand	69,000
Malaysia	248,000	Vietnam	16,000

Note: Adapted from *Report of the Session: The Second Session of the Working Group on Further Financial Arrangement for EANET*, by EANET, 2003, http://www.eanet.asia/event/wgf/wgf02.pdf. p. 3

Unlike self-borne expenses for national monitoring, Japan has consistently contributed the bulk of the financing of the secretariat and the network center. Because of Japan's considerable financial support, EANET has established the most financially abundant regional cooperative mechanism in East Asia. At the same time, continuous efforts have been made to diversify financial resources other than the contributions of Japan. *Decision on the Further Financial Arrangement for EANET* was adopted in 2003 at the Fifth Intergovernmental Meeting (IG5) to urge member countries to contribute to the financing of the secretariat and network center. EANET considers the latest UN guidelines for burden sharing based on assessment scales as the first step in this direction. (The UN assessment scales are set by the UN General Assembly for all UN member states based on GNP, population, and geographic criteria.) At the annual Intergovernmental Meetings, the secretariat and the network center announced the expected contributions of each of the member countries using something like the UN assessment formula to calculate the money share. For example, Japan took part in 16.624% UN scale of assessment in 2007-2009, and reflecting its sharing on the global scale, 71.314% scale of EANET burden sharing on the regional scale. Based on this calculation, it was estimated that Japan might make an EANET contribution of US$337,571 in 2010 (Table 3.7) (EANET, 2009a, p. 236).

Table 3.7
Estimated Participating Countries' 2010 Contributions to Secretariat Budget, Based on Latest UN Assessment Scale

	UN scale of assessment, 2007-2009 (%)	Scale of EANET burden sharing (%)	Estimated contribution (US$) in 2010
Cambodia	0.001	0.004	19
China	2.667	11.441	54,157
Indonesia	0.161	0.691	3,271
Japan	16.624	71.314	337,571
Lao PDR	0.001	0.004	19
Malaysia	0.19	0.815	3,858
Mongolia	0.001	0.004	19
Myanmar	0.005	0.021	99
Philippines	0.078	0.335	1,586
ROK	2.173	9.322	44,127
Russia	1.2	5.148	24.368
Thailand	0.186	0.798	3,777

Viet Nam	0.024	0.103	488
Total	23.311	100	473,359

Note: Adapted from *Proceedings of the Eleventh Session of the Intergovernmental Meeting on Acid Deposition Monitoring Network in East Asia* by EANET, 2009a, p. 236.

EANET financial reports have shown that few countries have met these estimated contributions, however, which may be because they are made on a voluntary basis without any specific enforcement measures. *Revised Procedures and Guidelines for Voluntary Financial Contribution to EANET* was adopted at the Ninth Intergovernmental Meeting (IG9) in 2007 to determine the minimum amount of US$50 for the voluntary financial contributions by participating countries, and Cambodia, Mongolia, and Lao PDR have paid US$50 annually in recent years. China and the ROK have annually contributed around US$15,000 and US$18,000, respectively, for the financing of the secretariat since 2002 and 2006. However, compared to the total actual annual expenses (between US$330,000 and US$500,000) of the secretariat (Table 3.8), these contributions seem minor, and as a result, the shortfall in the budget has been covered by Japanese contributions.

Table 3.8
Summary of Income and Expenses of the Secretariat in US$ 2004-2009

Details	Income	Expenses (Regular + Savings)
Savings from 2002 and 2003 budget	469,931	
Income for 2004 budget	290,284	
Total expenses for 2004 budget		329,814
Income for 2005 budget	346,831	
Total expenses for 2005 budget		337,720
Income for2006 budget	254,302	
Total expenses for 2006 budget		413,101
Income for 2007 budget	343,988	
Total expenses for 2007 budget		367,407

Income for 2008 budget	408,503[52]	
Total expenses for 2008 budget		497,920
Income for 2009 budget	423,083[53]	
Total expenses for 2009 budget		423,033
Total	2,532,382	2,350,995

Note: Adapted from "The Review of Performance of the Secretariat (2008-2009)," by EANET, 2010f.

Based on the latest UN assessment scale, contribution estimates (in U.S. dollars) were China, $73,942; Japan, $290,526; ROK, $52,403; Russia, $37,146; and the other countries, less than $6,000 (EANET, 2010f). Yet the actual contributions of member countries for the financing of the secretariat have fallen far short of that except Japan's. In 2009, Cambodia contributed $50; China $15,000; Japan $382,262; Lao PDR $50; Malaysia $3,835; Mongolia $50; the ROK $18,029; and Thailand $3,777. In 2008, Cambodia contributed $50; China $15,000; Japan $367,402; Malaysia $3,836; Mongolia $50; ROK $18,388; and Thailand $3,777. Japan's contributions for the financing of the secretariat ($382,262) comprised more than 90% of the total expenditures of the secretariat in 2009.

Japan's dominant contributions to the EANET budget are even more significant for the financing of the core budget of the network center, accounting for more than 99% of the total contributions of participating countries toward this budget in 2009. Furthermore, the network center has been supported by the Japanese government, which has provided extrabudgetary contributions for technical support and training and contracts for research through its Ministry of Environment. The 99% contribution of Japan resulted partly from the lack of participation of other member countries,

[52] In USD, Cambodia contributed 50; China 15,000; Japan 367,402; Malaysia 3,836; Mongolia 50; Korea 18,388; and Thailand 3,777.
[53] In USD, Cambodia contributed 50; China 15,000; Japan 382,262; Lao PDR 50; Malaysia 3,835; Mongolia 50; Korea 18,029; and Thailand 3,777.

particularly China and the ROK, in the financing of the network center. For example, Korean delegates to EANET have expressed their reservations about contributing to this financing because of some transparency issues, and therefore the ROK has not made any contribution to the core budget of the network center, whereas it has made around $18,000 in annual contributions to the secretariat in recent years.

One of key arguments of the Korean delegates regarding the controversial transparency of EANET is that the annual budget for the network is too high considering the size of the EANET, with just 13 participating countries. The annual core budget of the network center, US$400,000-500,000, is almost same as the budget of the Chemical Coordinating Centre (CCC) of the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP), which is in charge of measurements, including data monitoring, data storage, and quality control and assurance, for more than 40 member countries (UNESC, 2012, p. 13). Moreover, the additional budget for the EANET network center (US$803,000 in 2009) is considerably higher than the Norwegian Institute for Air Research (NILU)'s voluntary extrabudgetary contributions for the CCC of EMEP (US$326,438 in 2008). In the view of Korean delegates, EANET's relatively high budget might have resulted from its more expensive personnel costs in comparison to those of the secretariat. As stated during discussions at the IG8 on problems with hiring a coordinator in the secretariat in 2006, staff members in the secretariat have earned a "low salary for this position compared to similar positions in the UN system" (EANET, 2006b, p. 2).[54]

[54] Interviews with Ken Yamashita, a Japanese researcher at Asia Center for Air Pollution Research (ACAP) on February 8, 2011, and with Korean participants in various EANET meetings.

This cost issue has been raised since the early years of development (see, for instance, EANET, 2002, p. 5), and is still controversial in 2013. Against the Korean assertions about the higher personnel costs in the network center, a Japanese participant argues that there actually is not much difference in the personnel costs between the network center and the secretariat. According to the organization's financial reports, the EANET secretariat spent $135,518 for three employees, including the coordinator, the program officer, and an administrative staff member, while the network center spent $577,794 for 12 employees. On this account, the Korean delegates argue that the staff of the network center is not responsible solely for EANET monitoring activities but also conduct domestic measurements and other research activities, costs which should not be borne by other participating countries. A Japanese participant explained that the network center had tracked the amount of labor allotted to EANET activities by employees for a year and has included only a percentage of the salary of staff members in the annual EANET budget and expenditures. However, the Korean delegates have not been persuaded by the Japanese argument about the division of labor within the Network Center because of the potential difficulties of distinguishing between the labor for national research and for international research.

Therefore, even though Japan's dominant role in the financial support of EANET has given it the highest financial capability among various regional cooperative mechanisms, it has also become an obstacle to other nations' justifying the use of their national resources to financially contribute to EANET's operations. The key point of Korean delegates on the transparency issue has been that the EANET's network center is not an international organization but a Japan-led program for which the Japanese government discretionally sets and executes the annual budget.

As mentioned above, this problematic Japanese dominance was recognized by the Japanese government when it decided to maintain EANET as a voluntary, not binding, mechanism. EANET recently discussed whether to convert its current voluntary mechanism to a legally binding one, but ironically Japan opposed the idea in favor of maintaining the current EANET system. One Japanese scholar attributes this to bureaucratic inertia,[55] saying that the Japanese government wishes to keep EANET's existing system even though it recognizes that doing so might not work for further development of EANET. Under the current voluntary circumstances, it is doubtful the dominance of Japanese financial contributions is likely to change in the near future.

Directional Leadership in EANET

Directional leadership refers to developing substantive solutions based on knowledge and changing perceptions of risks. Japan also seems to have expected to exert directional leadership and instrumental leadership from the beginning of EANET activities. Neither of these two modes of leadership, however, has been successfully practiced by Japan because of other member states' objections to Japanese leadership. Regarding directional leadership, Japan anticipated leading the technical arrangements of EANET in the early years (1993-1997) based on its high technology. As described below, the development of the *Guidelines for Monitoring Acid Deposition in the East Asia Region* demonstrates how Japanese directional leadership has been both asserted and denied throughout the development of EANET.

[55] Interview with Professor Atsushi Ishii at Tohoku University, Japan on October 17, 2010.

At the early years of EANET, Japan exerted its directional leadership without objections from other countries. At the First Expert Meeting in 1993, the participating countries welcomed the leadership exerted by the Environment Agency of Japan, as they believed that Japan "could play a coordinating role toward the establishment of a monitoring network and host this kind of expert meeting for the next two years" (EANET, 1993). This meeting recognized that a regional acid precipitation monitoring network was needed, as "adverse effects of acid precipitation would become a critical problem in certain areas in the future although evidence of the effects of acid precipitation on ecosystems has yet to be determined" given the significant expansion of the economies in the region (ibid.). Thus, draft guidelines had been prepared by the Environment Agency of Japan and adopted at the Second Expert Meeting in March 1995 in Tokyo, Japan without many difficulties.

"Data Reporting Procedures and Formats for Acid Deposition Monitoring in East Asia"[56] was agreed to in the Second Interim Scientific Advisory Group Meeting in 2000 without difficulties. It included concrete formats for reporting monitoring results and guidelines for monitoring, such as monitoring sites and intervals, monitoring parameters indicating first and second priorities, and meteorological measurement.[57] This creation of a concrete monitoring format for compatible data can be considered a strong advancement in environmental cooperation in the region.

Since April 1998, when EANET's activities were accelerated by the First Intergovernmental Meeting in March 1998, the participating countries grew more

[56]Available at http://www.eanet.cc/product/datarep_form.pdf

[57] EANET has collected monitoring data on SO2, NO2, O3, CO, PM10 for ambient air quality; pH, EC, Cation including NH4+, NA+, Ca2+, Mg2+ and Anion for wet deposition; and PM2.5 mass and composition in PM2.5 for dry deposition (EANET, 2010f).

concerned about the guidelines and technical leadership provided by Japan. While the adoption of "Data Reporting Procedures and Formats for Acid Deposition Monitoring in East Asia" was not controversial, adoption of other technical documents, including QA/QC and technical manuals, raised significant concerns among other participating countries. If EANET were to be established as an international program, only monitoring devices that were appropriate to the technical documents should be used in EANET activities.[58] Several Japanese monitoring device companies had dispatched employees to the network center anticipating the adoption of their devices for EANET monitoring activities because the network center purchased equipment from Japanese companies and provided them for the member countries for free in the earlier stage of EANET.

However, there were two problems that the official adoption of the Japanese devices because they were very different from the international standards or the often-used global techniques that the United States and Europe had invented. First, the East Asian countries, particularly the ROK, which had already equipped itself with monitoring devices (mostly made in the United States), would have to change their existing devices to the Japanese devices. Second, the monitoring data could not be compared and accepted globally because of the different standards. Accordingly, the Interim Scientific Group made considerable modifications to the guidelines that were proposed by the Environment Agency of Japan and submitted by the network center. In fact, the meeting report of the Interim Scientific Advisory Group in Jakarta in March 2000 stated that "[a]fter intensive review and discussions, ISAG [Interim Scientific Advisory Group] adopted the monitoring guidelines, technical manuals and other technical documents

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[58] Email discussions with a Korean delegate on March 17 and 19, 2012.

(EANET/ISAG 2/4/1-8) with the modifications presented in Annex II" (EANET, 2000c, p. 4).

Under these circumstances, the Japanese device companies could not dominate the sale of monitoring equipments and lost their desire to play a role as stakeholders in EANET. There is an interesting parallelism here to the Med Plan except the subjects of opposition to the leadership of a particular country, Japan in the case of EANET and France in the case of the Med Plan (Haas, 1990). In the Med Plan, France tried to exercise directional leadership, which is similar to that of Japan – providing money, soft power, and seeing an opportunity for selling French technology, yet it failed because UNEP interceded and created a network of scientists that were able to socialize other governments and thus the efforts that France initially helped support evolved in ways far different from what France anticipated and wanted. In the case of EANET, participating countries rather than an international organization opposed to the directional leadership that Japan tried to exert, through opposing to the idea of adopting Japanese technology.

Thus, directional leadership by the Japanese has been reduced since 1998, but without leading to an increase in directional leadership by other participating countries. During the regular phase since 2001, no other countries have demonstrated a strong interest in exerting leadership in developing EANET. In fact, few participating countries actually contribute to writing the manuals due to their own limited labor resources, which has let Japan maintain its practical leadership in preparing technical guidance and QA/QC. Nonetheless, Japanese directional leadership has been subtle and unstable to some extent, due to technical reasons such as those mentioned above.

Instrumental Leadership in EANET

Instrumental leadership is demonstrated by negotiating skills to frame issues and to put together deals through institutional bargaining. Like its directional leadership, the instrumental or entrepreneurial leadership played by Japan also has not been impressive, but no alternative country has shown an interest in taking firm instrumental leadership over EANET, either. Instrumental leadership can be defined as exercising the "negotiating skills to frame issues in ways that foster integrative bargaining and to put together deals that would otherwise elude participants endeavoring to form international regimes through institutional bargaining" (Young, 1991, p. 293). In the case of EANET, which has not created any regulatory mechanisms, countries which provide instrumental leadership could function mainly as agenda setters and popularizers, drawing more attention to the issues, rather than as inventors or brokers of policy options.

Japan's limited instrumental leadership is well represented by the issue of extending EANET's scope in terms of substances and activities. At the Second Expert Meeting in 1995, the participating countries agreed to use the term "acid deposition," rather than "acid precipitation," to accommodate all aspects of acid rain issues in the future development of the network. Thus, in the early years of the EANET, countries understood that acid rain might be too narrow a concept for regional cooperation in the future and adopted the more inclusive term, acid deposition. During the preparatory phase, the potential extension of EANET therefore had been anticipated. At the Second Interim Scientific Advisory Group in March 2000, in Jakarta, Indonesia, scientists endorsed a statement regarding the eventual necessity of modeling, mentioning that "[c]ontribution by anthropogenic and natural emission sources cannot be distinguished through the network monitoring activities. It will be done at the next step through modeling" (EANET, 2000c, p. 2).

China has stressed the step-by-step process since the beginning of the regular phase. The ideal steps in such a progression would be to move from monitoring to inventory work to modeling and then to the mitigation of impact damage. This incremental approach advocated by China has consistently blocked Japan's ambition to expand the scope of EANET and thereby exert its instrumental leadership. Comments of a key Japanese delegate who has participated in the EANET meetings since March 1998 reflect the Japanese view which is different from China's. He mentioned that EANET is not focusing on acid deposition only and that participating countries need to think big and integrate air pollutants and climate issues.[59] He asserted that the hemispheric transport of air pollution (HTAP) could serve as a good precedent study regarding intercontinental transport of ozone, aerosols, mercury, and persistent organic pollutants.

In fact, the *Report of the Long-Term National Acid Deposition Monitoring in Japan (JFY 2003-2007)* produced by Japan's Ministry of Environment in 2009 clearly points out the necessity of extending the scope of EANET's actions to include more diverse air pollutants and modeling:

> Aiming to extend the action scope of EANET from the conventional acid deposition monitoring to the management of the atmosphere environment in East Asia, it is necessary to establish the international cooperative relationship and promote regional collaboration to prevent air pollution. . . . It is needed that the transboundary air pollution monitoring including not only acid deposition but also ozone and aerosol should be conducted. (MOEJ, 2009, pp. 6-7)

[59] Interview on April 23, 2010.

However, Japan's ambitions toward instrumental leadership have not been exerted due to Chinese objections to the expansion of the scope of air pollution substances and of EANET activities to modeling. The Chinese objection was not the only reason for Japan's failure to exert instrumental leadership. As the regular phase evolved, Japanese delegates started to realize the necessity of enhancing the ownership of other countries in the organization through various meetings. In fact, Japanese delegates have consciously tried to let delegates from other countries talk more rather than guiding the meetings to increase other countries' sense of ownership in EANET.[60]

In short, as EANET has evolved from its early years through its preparatory and regular phases, various forms of Japanese leadership have been exerted and also challenged. Above all, the structural leadership of the Japanese brought the acid deposition issue to the attention of the region. The establishment of the cooperative mechanism during the earlier phases is attributable to Japanese structural leadership. Despite criticisms by other member countries regarding Japan's dominant contributions and seeming lack of transparence about the expenditures of the network center, Japan seems to be the only country which has been willing to exercise structural leadership up to now. Japan's strong willingness will need to continue to be a driving force if EANET is to remain the most formal and concrete collective action among various regional cooperative mechanisms. In addition to Japanese structural leadership, Japanese directional leadership succeeded in igniting the regional discussions on acid deposition in the first phase, it was reduced at the second preparatory phase due to potential problems regarding Japanese-led technical guidance. During the final regular phase, Japan has

[60] Informal discussions with a Japanese delegate to the Twelfth Intergovernmental Meeting in November 2010, Niigata, Japan.

relaxed its instrumental leadership through its own initiative in order to better share ownership with other member countries. Some member countries, particularly China, have objected to the Japanese instrumental leadership regarding the issue of extension of EANET. Such challenges to Japanese directional and instrumental leadership have made Japan more cautious in exerting its political leadership. However, no other member country has stepped up to the plate with meaningful financial support for this issue. This has created a considerable gap in the leadership of EANET, which is one of obstacles that EANET must overcome if it is to proceed to the next stage of regime creation so as to produce visible outcomes in both institutional and environmental terms.

Knowledge

This section tests Hypothesis 2, which asserts that a region will develop more formal and more concrete forms of collective action if participating countries in its environmental cooperation efforts develop greater commonly shared knowledge. As mentioned in chapter 1, this research emphasizes the development of scientific knowledge rather than the development of epistemic communities because of the characteristics of regional environmental cooperative mechanisms in Northeast Asia, principally its focus on science without the development of policy options by scientists.

Japan had developed research on acid deposition between 1868 and 1920 that was conducted by foreign professors in Japan, but no syntheses of the environmental phenomena were made due to "sporadic, uncoordinated, and minimal" ideas from the West (Wilkening, 2004, p. 86). In the 1930s and 1940s, limnological research focusing on the chemical analysis of lake water with comprehensive field research was conducted in Japan, but none of researchers at that time succeeded in making “a link between acidic inputs from the atmosphere and changes in lake chemistry” (Wilkening, 2004, p. 101).

The field of air pollution research began in the late 1950s in Japan. The Air Pollution Society of Japan was established in 1959, and the number of articles on air pollution significantly increased in the mid-1960s. The journals of the Air Pollution Research group and the National Air Pollution Monitoring Network (NAPMN) were founded in 1965 and spurred further research. Scientists found tree decline in the Kanto Plane surrounding Tokyo in the 1970s, and the Environment Agency of Japan started a survey on wet air pollution in the Kanto region in 1975. Wilkening argues that before the 1970s, however, “Japan lay completely outside the mainstream of this international activity on acid rain” (Wilkening, 2004, p. 144).[61]

One of the reasons for the late development of research regarding acid deposition in Japan is that Japanese scientists could not get funding without the establishment of law about environmental problems.[62] Wilkening argues that the environmental “law was the first in Japan to establish general principals and objectives for overall environmental policy and to provide a legal mechanism for their implementation” (Wilkening, 2004, p. 127). As a key Japanese scientist, Dr. Hajime Akimoto, stated, “In Japan, without law, no research fund is provided. It is contrasting that no law is created without research in the U.S. In Japan, science has little power. Laws are made ahead of science. This is quite state-centric.”[63] As these statements indicate, it is hard for Japanese scientists to get

[61] The international literature regarding acid rain in China appeared in the 1980s, which was much later in than Japan (Larssen et al., 2006).
[62]Interview with Director General of the Network Center of EANET on February 8, 2011.
[63] Interview with Dr. Akimoto, Director General of Asia Center for Air Pollution Research (ACAP), on Feb. 8, 2011.

money from even a general research fund or from their government, including the Ministry of Environment, because research funds in Japan are available only when legal measures are developed.

Even though research capacity has spread to local research institutes, it is an undeniable fact that the "national-level researchers remained the scientific leaders" (Wilkening, 2004, p. 148). The national-level researchers are more reliant on governmental funding to research a phenomenon, and the Japanese government is reluctant to provide funding before certain laws are established. Thus, the development of measures to control sulphur dioxide emissions in Japan, as outlined in Table 3.9, can be a key to understanding why Japanese researchers started to recognize acid deposition only in the early 1970s.

Table 3.9
Measures to Control Sulphur Dioxide Emissions in Japan

YEAR	Description
1962	Establishment of the Law Concerning the Regulation of Smoke and Soot Emissions and Other Measures
1968	Establishment of the Air Pollution Control Law
1969	Establishment of the Environmental Quality Standards concerning SOx
1970	Partial revision of the Air Pollution Control Law (introduction of the K-value regulation for each designated area)
1973	Revision of the Environmental Quality Standards on sulfur dioxide
1974	Partial revision of the Air Pollution Control Law (introduction of Total Mass Emission Control)
1976	Partial revision of the Air Pollution Control Law (revision of the emission standards)

Note: The information presented in this table was provided by a Japanese delegate to EANET in an interview on February 8, 2011.

As Table 3.9 shows, the first Japanese law passed to control air pollution was enacted in the 1960s. With the legal infrastructure in place, Japan started to pay attention to the possible causes of acid rain in the mid-1980s (Wilkening, 2004, p. 140). In 1983, Japan started its National Acid Deposition Survey with 14 national monitoring stations through the Acid Deposition Prevention Committee, established by the Environment Agency of Japan. The committee consisted of experts in air pollution, soil/vegetation, and inland water, and it has extended the number of monitoring sites and conducted research on acid deposition to clarify the actual condition and influence of acid deposition in Japan. The monitoring results between 1983 and 2002 were summed up in the "General Report about Acid Deposition Research" in 2004, which noted that acid depositions in Japan were not observed to be as high as those in Europe and the United States (Ministry of Environment of Japan, 2009).

The results of Japan's domestic research were identical to the reports of the Expert Meetings of EANET in the organization's early years. At the First Expert Meeting of EANET in 1993, participants agreed that acid deposition would cause adverse effects and become a critical problem in some areas in the future, considering the expanding economies in the region, even though evidence of its effects had not yet been determined (EANET, 1993). Monitoring results over the following 2 decades have also shown only low impact of acid deposition in East Asia.

The key outcomes of EANET research activities have also been published in two periodic reports on the state of acid deposition in East Asia, in 2006 and 2011. EANET concludes that acid deposition is still common in East Asia, but has not yet had a significant impact on ecological systems in the region. The first *Periodic Report on the State of Acid Deposition EANET* in 2006, based on its monitoring activities between 2000 and 2004, stated that no clear adverse ecological impacts had been found. For impacts on soil, the report points out that little evidence of acid deposition causing changes in soils had been observed because it had been only a few years since EANET began soil monitoring. For impacts on vegetation, the report asserted that there had been no report of data that clearly blamed acid deposition for the deterioration of tree conditions, even though trees in Russia showed some symptoms of decline.[64] Although it had been alleged that high ozone concentrations may be harmful to plants, the report acknowledged that this issue could not be verified through EANET activities because they had not conducted specific observations on ozone effects. Regarding lakes and rivers, the report mentioned that no clear trend in acidic values was observed in the aquatic environments in the region. Finally, the report concluded its findings on the impacts of acid deposition as follows:

> Some EANET data revealed high values of sulfate and nitrate loadings from the atmosphere, as well as low pH precipitation. The effects on vegetation and aquatic life are still inconclusive, however, so more coordinated studies are needed. Based on previous studies conducted in different areas, the ecological impacts of acid deposition, especially on forest tree species and aquatic organisms, could not be determined or were not observed with the short observation period. (EANET, 2006a, p. 25)

In 2011, the most recent periodic report of the EANET also stated that:

> EANET's monitoring work has demonstrated that acid rain remains prevalent across East Asia. The annual average pH of rainwater is lower than 5.0 (the threshold for acid rain) at 60% of monitoring sites, and values of less than 4.6 have been recorded in several locations. Sulphuric acid (H2SO4) remains the primary contributor to acid rain across the region . . . [and] contribution of nitric acid (HNO3) to acid rain is almost equal to that of sulphuric acid. Despite continued acidification in the region, the impact of acid deposition on eco-system functions still appears limited. No decline in tree growth or in the number of

[64] Despite forest decline in some areas of China due to the direct effects of SO2, effects on forests are much less certain in China because "few reports are made about widespread damage in more remote areas," and "scientists have stated that soil acidification is likely to have negative effects on forest growth in China" in the future (Larssen, 2006, p. 422).

> species in understory vegetation has been observed during monitoring, and overall forest functions and structures apparently remain sound. (EANET, 2011d, p. ii)

Whereas some sites in Malaysia, China (Chongqing), Indonesia, the ROK, and Japan had recorded 5-year (2005-2009) average rainwater pH values lower than 4.6, other sites in China (Xi'an) and Mongolia (Ulaanbaatar) had recorded average rainwater pH values higher than 6.0 due to "increased contribution of alkaline species such as ammonia (NH3) from agriculture and calcium carbonate in soil dust, respectively" (EANET, 2011d, iv).

Despite no evidence of significant damage from acid deposition at that time, the report pointed out that "the influence of acid deposition could become obvious in the future if we continue to have acid depositions as it is, because the influence of acid depositions to soil/vegetation and land water is considered to appear after long term period" (Ministry of Environment Japan, 2009, p. 9). Along this line of thought, EANET acknowledged acid deposition as one of several future problems, and it regarded monitoring as a way of preparing for those problems. As it noted, "Considering the significance of possible future problems regarding acid deposition, it becomes increasingly important to obtain accurate and precise data on acid deposition" (EANET, 2000a, p. 1).

Probably due to this inconclusive state of acid deposition in East Asia, EANET has not provided precise analysis of acid deposition in this region and only vindicated the need for "further amplification." According to the *Second Periodic Report*,

> Although the EANET has accumulated ten-year record at most, the length of period does not suffice for temporal trend analysis because the wet deposition has a number of factors most of which are quite variable with time, the existing time trend could be concealed unlike gas and aerosol species. This would stress the significance of a long-term high-quality monitoring is indispensable to detect some symptoms at all for elimination and mitigation of potential impacts. . . The data trend generated over the years of monitoring in the ecological stations across

> the EANET participating countries suggests possible acidification or nitrogen saturation in several sites. There is, however, a need to isolate other existing environmental conditions that may have contributed to such an observation. . . The pH of water in five inland aquatic systems significantly decreased from 2000 to 2009. The accumulated data for the last years suggested the possible acidification or nitrogen saturation of the inland ecosystems in several EANET sites. But just like in the cases of the forest soil and vegetation, some other factors that can bring about nitrogen saturation in inland waters need further amplification. (EANET, 2011a, pp. 2-3)

Given that one of the objectives of EANET is to "create a common understanding of the status of acid deposition problems in East Asia" (EANET, 2010b), it is uncertain whether this weak scientific conclusion can help EANET achieve that objective in the near future. As Dimitrov argues, a key factor in international policymaking is knowledge about transboundary consequences of an environmental problem rather than just the extent and causes of the problem. Considering that the position of the Federal Republic of Germany "dramatically changed after the release of its first comprehensive forest survey in 1982" (Sprinz and Vaahtoranta, 1994, p. 98), it seems that East Asia will need greater evidence of the environmental impact and consequences of acid deposition in East Asia to justify regional environmental cooperation.

East Asian countries seem little motivated to exert their political leadership given this "lack of an urgent ecological imperative" (Komori, 2010, p. 18). When the Japanese government, particularly the Environment Agency of Japan, decided to pay more attention to the regional implications of European experiences after Agenda 21 of the 1992 Declaration of the United Nations Conference on Environment and Development, it asked Japanese scientists to identify the most appropriate issue on which Japan could initiate regional environmental cooperation. The accumulation of scientific knowledge in

Japan in the 1970s and 1980s had given Japan the confidence to proceed to regional environmental regime creation.

It is argued by a Japanese scientist that the Japanese government was informed by its scientists that acidification was not a serious threat to this region due to the naturalization and diversity of its forests, which are quite different from Europe's. The former are more diverse than the latter, as Europe's forests are dominated by very similar kinds of trees that are very sensitive to acidity.[65] Ironically, the Japanese government pushed the issue of acid deposition to be the regional agenda precisely because of these characteristics of acid deposition in East Asia, thinking it would be easier for East Asia to begin regional environmental cooperation by addressing a less sensitive and non-urgent issue. Indeed, Korean participants in the Intergovernmental Meetings asserted that if the acidification issue had generated intensive concerns regarding responsibility and regulations, other countries might have not agreed on Japan's initiative to create EANET in the first place.[66]

Therefore, since EANET was established, Japan's scientific knowledge has been neither challenged nor strengthened by EANET research activities. The state of knowledge has remained elusive, requiring further research. For around 2 decades, regional scholars have not discovered any commonly shared significant adverse consequences of acid deposition in East Asia, and Komori argues that "governments' commitment to the acid rain problem is primarily limited to the enhancement of scientific cooperation" due to "the lack of an urgent ecological imperative" (2010, p. 18).

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[65] Interview with Dr. Akimoto, Director General of Asia Center for Air Pollution Research (ACA) on February 8, 2011.
[66] This statement was frequently made by Korean interviewees.

Socialization

This section tests Hypothesis 3, which is that participating countries in regional environmental cooperation efforts are more likely to create formal and concrete collective action through regional cooperation if they adopt learning rather than adaptation as a process of socialization. Through the adaptation process of socialization, international actors can change their behaviors in response to new events, but they do so without fundamental changes in their beliefs about underlying values and causal mechanisms. In comparison, the learning process of socialization can produce more significant behavioral changes, as international actors can raise questions on fundamental and implicit theories and have a chance to examine their original values.

As mentioned in chapter 1, to determine which of these two processes of socialization the participating countries have engaged in, this chapter assesses the participation patterns of member countries in international meetings of EANET in terms of the two criteria. First, this section investigates whether the participation of countries in the region has been prompted by not intrinsic but indirect concerns about particular transboundary air pollution issues. It is considered that countries have engaged in the adaptation process of socialization if indirect political concerns have led them to participate in regional environmental cooperation on the acid rain issue; it is considered that countries have engaged in the learning process of socialization if they have found intrinsic motivations for their regional cooperation.

Second, this section also analyzes the participation patterns of delegates to international meetings as a proxy for socialization. Given that the learning process of socialization typically requires extended exposure to the expected norms, values, and practices, it is considered that delegates are more likely to have engaged in the adaptation process of socialization if they have had the opportunity to attend international meetings for only a short period or in a sporadic manner, and to have engaged in the learning process of socialization if they have been able to attend international meetings for an extended period in a consistent manner.

For the first criteria of the participation patterns, the following sections examine the external and internal contexts of East Asia to illustrate processes of socialization. Thus, it is helpful to examine the external environment of international negotiations in the early 1990s, such as Europeans' responses to transboundary pollution issues, in order to understand the socialization processes of Northeast Asian countries.

Japan, the initiator of EANET but a novice in regional environmental cooperation, took the adaptation process rather than learning process in the early years of EANET because of both its external and internal political environment rather than because of its intrinsic concerns over acid rain issues. Japan recognized regional environmental cooperation could be a means to improve its international status through leading regional cooperation. Other countries, particularly China and the ROK, also took the adaptation process, as they recognized joining the EANET as their chance to achieve other objectives than solely focusing on acid deposition issues in East Asia.

Principle 21 of the 1972 Declaration of the United Nations Conference on the Human Environment had awakened global concerns on transboundary pollution.[67] It stated that although each nation has "the sovereign right to exploit their own resources

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[67] In terms of international law, the 1941 Trail Smelter Arbitration between the United States and Canada is known as the starting point in the evolution of transnational environmental dispute resolution. For the historical development of international environmental law from classical dispute resolution based on the principle of territorial sovereignty to multi-state regulation based on conservation and prevention ethics, see Sand, 2007.

pursuant to their own environmental policies," it also has "the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."[68] As shown above, even though various domestic measures were taken to respond to air pollution problems, it was not until the 1990s that Japan, the initiator of EANET, began regional initiatives. The Agenda 21 of the 1992 Declaration of the United Nations Conference on Environment and Development explicitly stated that successful European experiences on tackling acid rain should be shared with other regions of the world.

Japan had confidence in the issue of acid deposition as a subject of regional environmental cooperation due to its scientific accumulation over several decades, as discussed in the knowledge section above. At the same time, the success of the Convention on Long-Range Transboundary Air Pollution (CLRTAP) in 1979 provided Japan with more confidence about the successful development of regional environmental cooperation on transboundary air pollution issues. These incidents show that Japan tried to adapt to the international surroundings that emphasized environmental concerns and regional cooperation to deal with transboundary environmental problems.

Yet given the historical context of East Asia, Japan's will and confidence seems to have yielded suspicion among other countries in the region as to Japan's political motivations for creating a regional network. These suspicious neighboring countries did not seem to initially welcome Japan's initiative for regional environmental cooperation, although both China and the ROK adapted themselves to the international surroundings

[68] Available at
http://www.unep.org/Documents.Multilingual/Default.asp?documentid=97&articleid=1503

for boosting regional cooperation and viewed joining the EANET as a means to achieve other ends of their own.

As mentioned above, even though China did not accept any responsibility for its contribution to causing transboundary acid rain in the region, it "acknowledged in1992 that its pollution might have contributed to the transboundary problem" (Komori, 2010, p. 17). It is argued by Korean delegates that China had changed its position because of Japan's investment in building the Sino-Japan Friendship Center for Environmental Protection in China, which was established in 1992.[69] Also, when China decided to participate in the network not as an observer party but as a full member of EANET in 1998, it seemed like a diplomatic gift at the 1998 summit meeting between China and Japan.

Korean participants claimed that the ROK also agreed to participate in EANET in exchange for Japan's agreement on the ROK's initiative for NEASPEC (North-East Asia Sub-regional Program for Environmental Cooperation). NEASPEC was the first comprehensive regional environmental cooperation in Northeast Asia among six member countries and which, unlike EANET is an issue-specific regional cooperative initiative, as discussed in chapter 2. The NEASPEC was created by the Korean government in 1992 to create a role for the ROK as an international and regional actor through initiating the regional environmental cooperation.

Thus, it can be argued that all three countries of Japan, China, and the ROK have taken the adaptation process of socialization because the creation of EANET was based

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[69] This might be regarded as a structural leadership of Japan through providing China with the economic incentives. However, unlike the hegemonic powers, Japan was not coercive because of both historical responsibilities for regional air pollution and its colonialization in East Asia. This is why Japanese leadership cannot be regarded as a structural leadership.

not primarily on an environmental concern of these countries, but rather by their particular political and practical concerns. Participation in EANET activities was a means for each to achieve other objectives than an end to the acid deposition issue itself. Japan's motive for initiating this regional environmental initiative was mostly the request of the international community to spread the successful European experience and the Japanese willingness to become a responsible international actor as befitting its economic superpower status. It is difficult to assert that other member countries, particularly China and the ROK, have changed their fundamental causal understanding of acid deposition. Rather, both China and the ROK have found their own political reasons to participate in EANET. No learning process of socialization has been observed in the participation of these three member countries.

Along with these external international negotiation circumstances in Europe and Northeast Asia, the participation patterns of delegates to the international meetings of EANET also show the adaptation processes of socialization. Bureaucratic rotation systems in East Asia have led countries to take the adaptation process rather than learning process. Bureaucratic systems in East Asia allow public officers to hold the same position for only a limited time in order to prevent corruption and increase creativity. The ROK usually rotates the positions of its public officials every year or at most every 1.5 years, and Japan uses a similar rotation with a little more flexibility in the duration of positions, but still at most every 2 years. China seems to allow public officials to stay a little longer than do the ROK and Japan.

Appendix II, which contains the list of delegates to the Intergovernmental Meetings of EANET between 2001 and 2010, shows these patterns of participation by delegates. Most member countries have changed their delegates to the Intergovernmental Meetings very frequently. One Japanese delegate to the EANET meetings pointed out one of the difficulties that EANET has been facing, noting that "a biggest problem for Japanese dialogue with Korea is that Korean bureaucracy is changing too frequently. Thus very frequently, counterparts have to suspend the on-going discussions and start from explanation on previous history/discussions to Korean newcomers."[70]

There are two groups of delegates to these meetings: (a) governmental officials, mostly from ministries of the environment and (b) scientists, mostly from national research centers and universities. The bureaucratic rotation system has been directly applied to governmental officials, and the officials of most member countries have changed at least every 2 or 3 years.

The ROK tends to send one or two governmental officials from the Ministry of Environment to the Intergovernmental Meetings, who change almost every year. Jae-Moon Yang, Deputy Director of the Air Quality Policy Division in the Ministry of Environment, attended three consecutive IG meetings between 2003 and 2005, the only Korean governmental official who remained in the group of Korea delegates for more than 2 years. Jae-Hyun Lee, Director of the Air Quality Policy Division in the Ministry of Environment, attended the IG6 in 2004 and came back to the IG12. As mentioned in the previous discussion of EANET's achievements, the high-level meetings have enhanced the formal form of collective action of EANET member countries. Director General Lee's participation also showed how seriously and formally the Korean government treated the EANET and the 2010 Instrument. However, the high-level officials

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[70] Interview with Professor Katsunori Suzuki on April 23, 2010. He was one of founding members of EANET while working at the Japanese Environmental Agency.

participated in the IG12 Intergovernmental Meeting just for a short period of time to read their scripts to represent their governments regarding the Instrument. It is hard to imagine that his second visit to the Intergovernmental Meetings might have led him to the learning process of socialization. Of course, during his rotation within the Ministry of Environment, he must have become familiar with various environmental concerns of the Korean government. At the same time, the 6-year gap and the difference in his role as an EANET delegate between his two visits undoubtedly affected his learning process regarding the changing EANET issues and objectives.

Many Japanese governmental officials from the Ministry of Environment and Ministry of Foreign Affairs have changed every year. Japan has sent three to five delegates in total to each Intergovernmental Meeting. Only a few officials attended more than two Intergovernmental meetings over 10 years. Reiko Sodeno, Deputy Director of the Global Environmental Issues Division of the Ministry of the Environment, attended three consecutive meetings between 2006 and 2008, and Toshihisa Kato, an official of the Global Environment Division of the Ministry of Foreign Affairs, attended four consecutive meetings between 2007 and 2010. One may wonder whether the 1-year difference in Japan’s pattern of rotation would make a difference in the amount of learning that took place.

China shows a pattern similar to Japan’s. China has tended to send two to five delegates in total to the Intergovernmental Meetings annually. Among them, governmental officials from the Ministry of Environmental Protection, the former State Environmental Protection Administration of China, have changed every year or two. Only one governmental official attended more than two Intergovernmental Meetings.

Fang Li, the Deputy Director of the Division of General Affairs in the Department of International Cooperation at the State Environmental Protection Administration of China, attended three consecutive IG meetings between 2003 and 2005. Other officials have attended at most two IG meetings.

Lao PDR, Russia, and Thailand are exceptions to this pattern of participation. Lao PDR has sent two governmental officials from the Science Technology and Environment Agency (STEA) between 2003 and 2006, and from the Water Resources and Environment Administration since 2007. One delegate, Sisouphanh Luangrath, has participated in a consistent manner, attending six of eight meetings. Russia has also tended to send the same delegates to the IG meetings. The Russian Federal Service for Hydrometeorology and Environmental Monitoring in the Ministry of Natural Resources and Environment has sent two officials to the IG meetings, and one delegate, Veronika Ginzburg, has participated in eight IG meetings over 10 years. Thailand has sent three or four governmental officials from the Pollution Control Department in Ministry of Natural Resources and Environment, and one delegate, Supat Wangwongwatana, participated in all the IG meetings between 2001 and 2010. This consistency is not common among the other 10 member countries.

In order to overcome difficulties that have originated from the bureaucratic rotation system, countries have adopted various organizational measures. For example, one of the Korean governmental officials stated that the transfer of duties has been systemized within the Ministry of Environment to create some consistency despite the annual change of positions.[71] All predecessors are required to hand over their job

[71] Interview with Gyu Il Kim, Deputy Director of the Climate and Air Quality Policy Division at the Ministry of Environment in the ROK on December 23, 2010.

description for the position, including the development and challenges that they have experienced. Yet this transfer process might also lead governmental officials to stick to their predecessors' learning and understanding of the cooperative mechanisms and not give successors much time to think critically on their own regarding the participation of their countries in the international meetings or to play different and more constructive roles for the international cooperative mechanisms. The job descriptions prepared by the predecessors for succeeding officials might become a set of instructions or directions for participation of new officials in the international meetings.

In general, it can be assumed that 1- or 2-year terms would be too short for the governmental officials to take the learning process of socialization through a critical assessment of their countries' participation in and contribution to the EANET activities. This can make the legacy of previous meetings, such as controversial points or competitiveness among member countries, continue rather than being solved due to the "instructions" passed by the predecessors. Participants might be so busy with adapting to the international settings and the national participation trends. As a result, few behavioral changes can be driven through the adaptation process of socialization.

The other group of delegates to the Intergovernmental Meetings has consisted of scientists. Unlike the frequent changes in national delegates from ministries of environment, scientist delegates have engaged in the Intergovernmental Meetings as well as SAC meetings in a more consistent manner. China has sent at least one scientist delegate to the Intergovernmental Meetings from national research centers such as the China National Environmental Monitoring Center (CNEMC) and Chinese Research Academy of Environmental Sciences (CRAES) since 2004. Wang Ruibin, Director of the

Department of Air Quality Monitoring in the CNEMC, attended four Intergovernmental Meetings over 10 years. Moreover, China has sent him to the SAC meetings eight times over 10 years along with relatively new researchers from CNEMC.

The ROK has sent one or two scientist delegates to Intergovernmental Meetings from universities and national research centers. A Korean scientist delegate, Seog-Yeon Cho, a professor at the Environmental and Civil Engineering Division of Inha University, has attended seven Intergovernmental Meetings over 10 years and ten consecutive SAC meetings. The other SAC participant from the ROK, Jin-Seok Han, Director of the Atmospheric Chemistry Division of the National Institute of Environmental Research (NIER), was also present at six SAC meetings between 2001 and 2010.

Japan has not sent any scientist delegates to the Intergovernmental Meetings, but has sent same three scientists to the SAC meetings for 10 years. Unlike other member countries that send governmental officials mostly from ministries of the environment, Japan has sent at least one official from the Ministry of Foreign Affairs every year rather than having scientists represent Japan at the IG meetings. In addition, Japan began to send specialists in international environmental negotiations. Norichika Kanie, Associate Professor at the Department of Decision Science and Technology of the Tokyo Institute of Technology, and Yukari Takamura, Professor of Law at Ryukoku University, have joined the group of Japanese delegates to the IG meetings since 2007. The greater participation of the MOFA in Japan and the professionals in international negotiations indicate that Japan has paid considerable attention to structuring EANET as an international institution rather than merely focusing on joint monitoring like other participating countries.

Japan has sent at least three scientists to the SAC meetings every year, and the three key scientists have participated in SAC meetings very consistently. Dr. Hajime Akimoto attended 8 SAC meetings, Tomoyuki Hakamata 7 SAC meetings, and Hiroshi Hara 10 consecutive SAC meetings. The changes in their affiliations have not affected their attendance, which shows that the Japanese government has a preference for relying on particular scientists rather than certain research institutes for the advisory mission for EANET.

The more consistent participation patterns of scientist delegates to the IG meetings and SAC meetings show that participating scientists have had enough time to engage in the learning processes of socialization than have governmental officials. Even though the governing body is the Intergovernmental Meeting and the national focal points[72] of EANET are officials from ministries of environment, these scientist delegates have played the role of key resource persons to consult with the governmental officials who newly join the EANET delegates. They thus have provided new delegates with their understanding of other countries' intentions on specific occasions as well as changes in and struggles of EANET activities. For example, the ROK started to change its attitude toward the EANET from being passive to being more active in 2009. According to one of the Korean delegates to the IG 12,

> It is a transition period for all three countries [China, Japan and the ROK]. China and the ROK have been opposing to the development of EANET. However, in 2009, the Korean attitude changed to be more prospective for EANET, and thus China started to take a wait-and-see attitude rather than opposition. In fact, the interests in transboundary pollution have been increased due to the limitations of domestic measures in improving environmental quality. Therefore, countries in the region seem to recognize that they need to develop more active international

[72] For the list of National Focal Points of EANET, see http://www.eanet.asia/eanet/nfp.html.

> cooperation rather than simply sharing technology and discussing compensation for the environmental degradation.[73]

However, it is unclear whether the communication among governmental official delegates and scientist delegates of member countries has been substantial. To some extent, it is true that both scientist delegates and political delegates from the same country within East Asia communicate with each other because the political delegates might acknowledge the professional expertise of scientist delegates based on their longer terms of service and the scientific focus of the cooperative mechanisms. However, the adaptation processes of the governmental official delegates, given their short terms of service in their relevant positions because of bureaucratic rotation systems, have been affected by the limited interaction with scientist delegates from other countries as well as with their national scientist delegates.

In addition to the limited communication between delegates from the same member countries, the communication and interaction with delegates from other countries might have been too limited to influence or be influenced by other delegates, particularly political delegates, from other countries. This lack of channels of communication between the two groups of international delegates has led to little learning process of socialization.

Conclusions

This chapter examined how political leadership, scientific knowledge, and socialization have affected extent of collective action regarding acid deposition. EANET

[73] Interview with Lim-Seok Chang on August 17, 2009 at the National Institute of Environmental Research in ROK.

has developed into the most formal and concrete collective action among the various regional environmental cooperative mechanisms in which Northeast Asian countries have participated. It concludes that political leadership is the only variable positively associated with this highly formal and concrete collective action. Japan's much greater financial contributions to the EANET budget have enabled EANET to enhance capacity building and the quality of monitoring data in a practical sense. Paradoxically, however, the dominant structural leadership of the Japanese government also has become an obstacle to EANET's movement toward legally binding agreements.

The lack of shared and new scientific knowledge regarding acid deposition among the participating countries of EANET and the adaptation process of socialization that they have taken fail to show that EANET's highly formal and concrete form and degree of collective action are attributable to shared scientific knowledge and the learning process of socialization. This chapter does not support the second hypothesis that the greater the commonly shared knowledge among participating countries in regional environmental cooperation efforts, the more formal and the more concrete will be the collective action found in the region. The adaptation process of socialization also does not seem to support the third hypothesis that participating countries in regional environmental cooperation efforts are more likely to create formal and concrete collective action through regional cooperation if they adopt learning rather than adaptation as a process of socialization.

However, the examination of these last two variables has not been in vain because it reveals the social mechanisms between these variables to some extent and helps explain why EANET has not advanced to become a legally binding cooperative mechanism. As socialization is a process that is a consequence of the interplay between sets of independent variables, this study intended to examine the hypothesized social mechanism between the other variables of political leadership and knowledge, which is that the stronger the political leadership and the greater the shared knowledge in the region, the more likely participants in regional cooperation are to engage in the learning process of socialization and thereby create the most formal and concrete modes of collective action.

First, the hypothesized social mechanism between political leadership and shared scientific knowledge is half-proven. Strong political leadership alone did not lead participating countries to engage in the learning process of socialization, and the lack of shared scientific knowledge can contribute to the adaptation process of socialization among participants in EANET activities.

Second, the lack of shared and new scientific knowledge can explain the other side of the coin that EANET has not proceeded to develop a legally binding regime despite its considerable efforts for 2 decades. During the 1970s and 1980s, Japanese scholars had accumulated enough knowledge concerning the extent and causes of acid deposition to lead the Environment Agency of Japan to choose acid deposition as the most appropriate issue in which Japan could initiate regional environmental cooperation. However, scholars have not discovered the significant adverse consequences of acid deposition that might motivate member countries to take firm policy initiatives. The lack of proven negative impacts of acid deposition has made member countries reluctant to push for institutional development into a more regulatory regime.

Regarding socialization, external pressures for developing regional environmental cooperation in East Asia and internal organizational characteristics have led the participating countries in EANET to take the adaptation process of socialization.

Responding to those external pressures, all three of the countries of China, Japan, and the ROK have found their own political reasons to create and participate in EANET activities rather than finding a clear need for solving adverse environmental impacts of acid deposition. Japan developed its willingness to initiate a regional cooperative mechanism in order to become a responsible international actor. China seemed to have achieved what might be considered side payments for participation in the EANET monitoring activities, and the ROK seemed to have gained Japanese participation in a ROK-initiated cooperative mechanism, NEASPEC, through pledging to participate in EANET.

Along with these political calculations, the East Asian countries also have been led to take the adaptation process of socialization by their bureaucratic rotation systems, which allow governmental officials to serve in a particular position within their organizations for only a limited number of years. As a result, governmental officials are too busy adapting themselves to the national participation patterns through understanding "instructions" passed by the predecessors to do much independent thinking or learning on their own. This adaptation process has been strengthened by a lack of communication between political delegates and science delegates from the same country and between delegates from other countries.

Yet the lack of new scientific knowledge and the adaptation rather than learning process of socialization among participating countries cannot explain why EANET has developed into the most formal and concrete collective action among regional environmental cooperative mechanisms. However, they can help explain why EANET has been stuck in the UNEP's second category over the course of 2 decades of cooperation efforts regarding transboundary acidification issues.

CHAPTER 4

TRIPARTITE DIRECTOR GENERAL MEETING (TDGM) ON DUST AND SANDSTORMS (DSS)

Picture 4.1. Koreans wear dust masks in Seoul on March 19, 2011 after the announcement of the national yellow dust advisory. Adapted from *Yonhap News Agency*. http://english.yonhapnews.co.kr/national/2011/03/20/52/0301000000AEN20110320000400315F.HTML.

Introduction

Seasonal Dust and Sandstorms (DSS) carry fine particulate matter, aerosols, ozone, and heavy metals through southeasterly wind and cause significantly negative consequences on human health (In & Park, 2003). To deal with DSS, China, Japan, and the ROK initiated joint research under the Tripartite Director General Meeting (TDGM) on Dust and Sandstorms at the Tripartite Environmental Ministers Meeting (TEMM) in 2007. Mongolia has participated in working group meetings since the 2009 ad hoc working group meeting in Shenyang, China.

The Korean government, as the initiator, points out three important reasons for the creation of this Joint Research on DSS (MOEK, 2007c). First, even though the joint research program is a research-oriented cooperative body, it is the first governmental-level, multilateral cooperative mechanism in Northeast Asia agreed upon at the ministerial (TEMM) and directors-general level (TDGM). Thus, this body can garner higher-level political commitments from each government. Second, the Joint Research program can be an important channel for policy dialog among governments and experts. Third, the Joint Research program is expected to play the role of an incubator that helps the region boost its multilateral cooperative mechanisms for DSS monitoring and construct a network for early warning and forecasting.

Despite the Korean government's positive contributions to creating formal regional cooperation on DSS through TDGM, a qualitative analysis of the data indicates that TDGM has been working as a formal cooperative mechanism through the involvement of ministries of environment of the three countries and agreement on the Terms of Reference (TOR) of the Steering Committee and the Working Groups for Joint Research on DSS, but it has neither developed concrete obligations that participating countries are required to fulfill nor reached any legally binding agreements. Thus, it is argued that TDGM has largely been a failure in terms of generating broader cooperation and useful measurement data for the region as TDGM has produced few research outcomes that would lead participating countries of the region to fashion any practical policies to deal with environmental degradation caused by DSS.

Of the three variables discussed in the hypotheses—political leadership, scientific knowledge, and socialization—the only variable positively associated with the highly formal collective action is political leadership. The moderate but dominant structural leadership by the Korean government has enabled participating countries in the region to structure their cooperation. The ROK's role as the only financial contributor to the TDGM has led China to participate in joint research through TDGM.

Yet, the lack of shared scientific knowledge about DSS among the participating countries of TDGM and the adaptation rather than learning process of socialization in which they engage explain why TDGM remains in the UNEP's second category of focusing on science without advancing to the highest category of legally binding cooperative mechanisms. Even though the Korean government expects the role of these regional efforts through TDGM to be an incubator for constructing a network for early warning and forecasting, as mentioned above, the organization's joint research for half a decade in Northeast Asia has produced few broader effects or benefits, such as bringing about specific policy outcomes.

In order to understand how TDGM has achieved the current extent of cooperation, this chapter investigates the roles played by political leadership, shared scientific knowledge, and the socialization processes. In the following sections, the background and development of regional cooperative mechanisms on DSS are examined. This is followed by a discussion of how the region has responded to its concerns about DSS through participation in TDGM activities.

Dust and Sandstorms (DSS)

DSS[74] occur when large quantities of dust and fine sand particles are blown away from the ground by strong winds. Dry, loose surfaces and strong, persistent winds are prerequisites for DSS. DSS arise when meteorological conditions and soil surface properties interact. Four types of climatic conditions are associated with DSS: cold waves, cyclone weather, atmospheric thermo-instability, and sharp changes in weather elements. The surface properties that are the most critical determinants of DSS are surface roughness length (highly related to land use and cover), soil texture, and moisture content (ADB, 2005, p. 64). According to ADB, "6.5 meters/second (m/s) is regarded as the threshold wind velocity to initiate a dust outbreak provided that the soil surface is dry" (ADB, 2005, p. 9). Dust storm strength is measured in terms of ground particle matter concentrations such as PM_{10} and dust height distributions from various remote sensors (Wang et al., 2011).

DSS are transboundary environmental problems that have been globally observed. The Total Ozone Mapping Spectrometer sensor on the Nimbus 7 satellite has identified the major dust source in the Northern Hemisphere as a broad "dust belt" extending from the west coast of North Africa through the Middle East, Central and South Asia, and into China (Wang et al., 2011, p. 6369). It is known that North Africa is a source of dust deposition in Southern Europe and that Saharan dust is transported westward over the Atlantic Ocean and becomes the main source of dust in the world (UN, 2001). India, Pakistan, Iran, and the Arabian Peninsula also contribute to global dust, as they bring about Arabian Sea dust deposition (UN, 2001).

[74] Other terminology sometimes used to refer to DSS includes "Sand and Dust storms (SDS)" (Wang, Steinb, Draxlerc, Rosad, & Zhanga, 2011) and "yellow sand" (Jho & Lee, 2009).

DSS in Northeast Asia are “a phenomenon of wind-borne soil and mineral particles raised thousands of meters into the air in the arid and semi-arid regions inland China, such as the Takla Makan and Gobi deserts and the Loess Plateau” (MOEJ, 2008, p. 2), which are in the “mid-latitude Desert Zone (N 40-45°E 90-120°)” (ADB, 2005, p. 9).

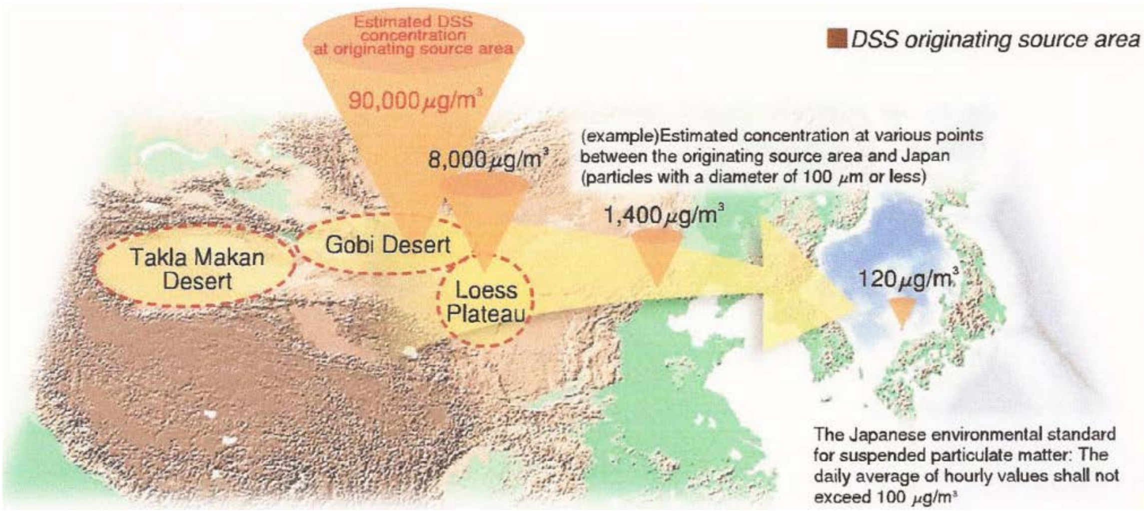

Figure 4.1. DSS originating source areas. Adapted from “Dust and Sandstorms,” by MOEJ, 2008, p. 2. http://www.env.go.jp/en/earth/dss/pamph/pdf/full.pdf

Picture 4.2. Dust storms attacking a village near the Gobi Desert. Adapted from “Governing Trans-boundary Pollution in Northeast Asia,” by Yoon, 2013, p. 13.

The ADB specifies that

> the geographic area covered includes part of continental Asia (PRC, the Korean peninsula, and Mongolia) and the neighboring islands of Japan…. However, the wind and weather patterns of the DSS force may originate in the Russian Federation to the north and west and from Kazakhstan to the west of the PRC and Mongolia. The DSS impact may be felt in Democratic People's Republic of Korea (DPRK) and in North America. (2005, p. 60)

Moreover, satellite imagery and model calculations have shown that the North Pacific Ocean and the North American continent are influenced by DSS that originate in Northeast Asia and are carried by prevailing westerlies (Wang et al., 2011, p. 6368). A recent study concluded that "32% of total emitted dust…is suspended in the atmosphere or subject to long-range transport" (Li, Han, & Jhang, 2011, p. 3954). [75] It shows that "while dry deposition dominates total deposition of dust near source regions" such as North and Central China and the middle and lower reaches of the Yangtze River, "wet deposition plays a more important role in the intermediate pathway of dust transport and the far downwind areas," including "northeast China, the Korean Peninsula, the west Pacific and Japan" (Li et al., 2011, p. 3962).

The number of dust storms in China (Table 4.1) and Mongolia (Figure 4.2), two source countries in Northeast Asia, illustrate the increasing frequency of DSS.

Table 4.1
Record of Strong Dust Storms in China, 1950-2001

Year(s)	Average occurrence of DSS a year
1950s	5
1960s	8
1970s	13
1980s	14
1990s	23
2000	12

[75] This study utilized a Regional Air Quality Model System (RAQMS) to "investigate the spatial and temporal distributions of PM10 concentration and soil dust aerosol over East Asia in March 2010" (Li et al., 2011, p. 3954).

2001	32

Note: Adapted from “Dragon Dust: Atmospheric Science and Cooperation on Desertification in the Asia and Pacific Region,” *Journal of East Asian Studies*, 6: 433-461, by Wilkening, 2006, p. 438.

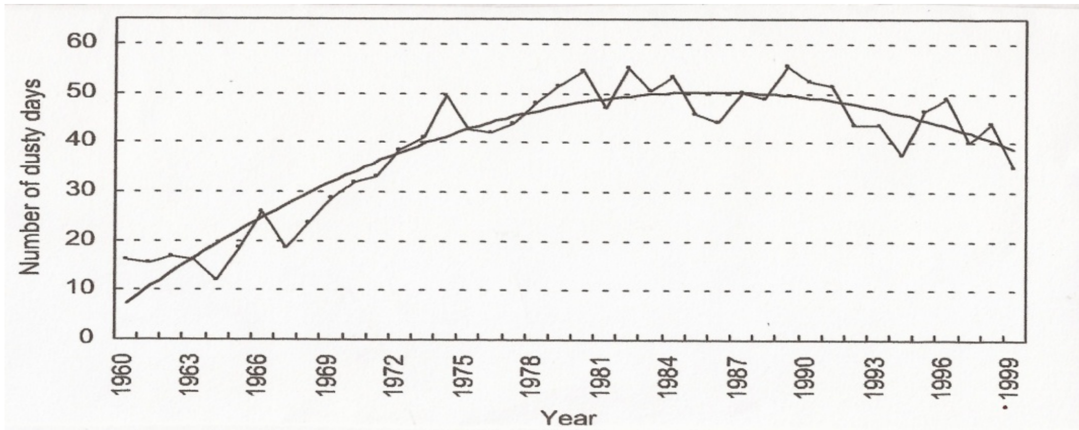

Figure 4.2. Number of dusty days in Mongolia. Adapted from “Analysis of Dust Storms Observed in Mongolia During 1937-1999,” *Atmospheric Environment* 37: 1401–1411, by Natsagdorja, Jugdera, & Chung, 2003, p. 1409.

The increasing frequency of DSS with their transboundary characteristics has resulted in severe damage in Northeast Asia, including a few intense events that affected Northeast Asia considerably. The following provides a vivid illustration of the damage of some of these events:

> The DSS on 5 May 1993 directly affected 1.1 million square kilometers in the PRC, which resulted in human casualties (i.e., 85 deaths and 246 injuries) and destruction of 4,412 houses, 120,000 livestock, and 373,000 hectares of crop land. The direct economic cost of this DSS within the PRC alone was more than CNY550 million (about US$66 million at 2002 exchange rate). The two most severe DSS events in decades took place in March and April 2002. They swept across Mongolia and hit 18 provinces in the PRC, the Korean peninsula, and a large area of Japan. . . . The DSS in early April 2002 was so severe that Mongolia had to close its international airport in Ulaanbaatar for three days. Also, the Republic of Korea had to close their primary schools and cancel more than 40 flights departing from Gimpo Airport in Seoul. Satellite images of DSS events . . . . have revealed that impacts of strong DSS are not limited to the region, but reached as far as North America across the Pacific Ocean. (ADB, 2005, p. 61)

The increasing frequency of DSS has also been observed in the ROK (Figure 4.3). Regarding effects of DSS, one study states that between US$ 3-5 billion of financial damage is incurred each year due to "respiratory & mucous membrane diseases, retarded growth of crops, difficulties in outdoor activities" caused by DSS in Korea (Kim, 2007). In addition, some Korean food processing industries and industries that use precision machines and electronics, both of which require clean conditions, have reported damages due to DSS contamination (Kim, 2007).[76]

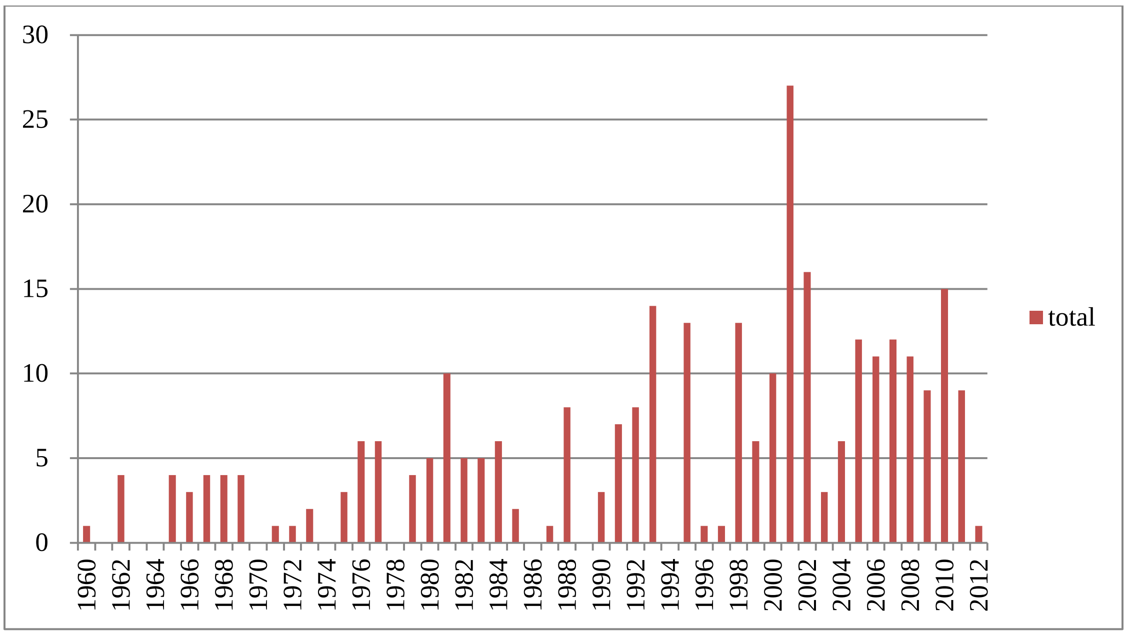

Figure 4.3. Number of dusty days in ROK. Adapted from Korea Meteorological Administration, 2013. http://www.kma.go.kr/weather/asiandust/observday.jsp.

The increasing frequency of DSS has been observed in Japan as well (Figure 4.4). The total number of days of DSS observation at 108 Japanese meteorological observation points "had rarely exceeded 300 days annually before the late 1980s in Japan," but it has often exceeded 300 days per year since 1988 and reached "an especially high number of

[76] In contrast, some studies argue that little evidence exists to prove that DSS causes damage to precision machinery and electronics.

recorded observations of approximately 700 to 1,200 days in three years from 2000 to 2002” (MOEJ, 2006, pp. 1-2). High concentrations of atmospheric aerosols have been reported from various sites, although, compared to the ROK and China, Japan has observed low dust levels.

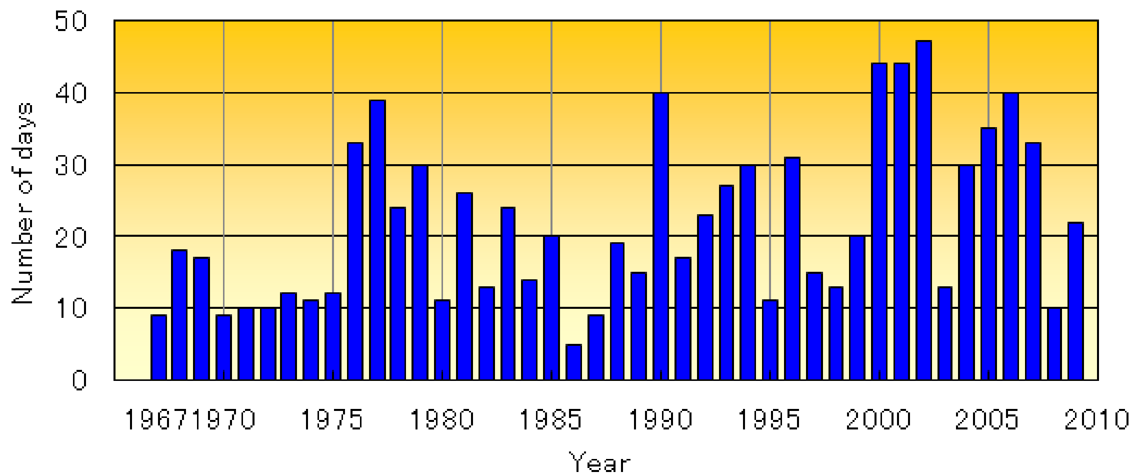

Figure 4.4. Number of dusty days in Japan. Numbers represent the days when any station in Japan observed DSS between 1967 and 2009, targeting the 67 stations that had been active for the whole period. Adapted from Japan Meteorological Administration, 2013. http://www.data.kishou.go.jp/obs-env/cdrom/report/html/4_2_1.html

Development of TDGM

The Korean government took the initiative for this joint research program under TDGM based on its continuous bilateral efforts to deal with DSS concerns since the early 1990s. At the summit meeting between China and the ROK in June 1994 in China, both governments first started to discuss DSS as one of the major topics on its agenda (MOEK, 2007a, p. 5). Following this meeting, ministers of science and technology agreed in November 1996 to carry out the joint study on DSS, and the actual joint study was launched in 1997. Since then, various bilateral cooperative programs have been developed between China and the ROK to establish joint measurements of DSS and a data sharing system.[77] China and Japan have also developed a variety of bilateral cooperative programs to deal with DSS. Japan has implemented various Official Development Assistance (ODA) projects to combat desertification. ODA projects include support for water resource conservation, reforestation and forest conservation, agricultural development, capacity building and education, and research on desertification (MOEJ, 2000).

Along with these bilateral efforts to combat DSS, international concerns about desertification started to lead the states in Northeast Asia to realize a need for creating regional cooperative mechanisms beyond bilateral cooperation in order to tackle DSS issues more efficiently. Since the United Nations Convention to Combat Desertification[78] (UNCCD) was enacted in 1994, Northeast Asian countries have diversified their bilateral cooperative efforts, but at the same time they have strengthened their multilateral cooperation, as discussed below.

Even though UNCCD was established in 1994 to stop the anthropogenic deforestation and desertification caused by excessive development through providing developing countries with financial and technical assistance, the international level discussions progressed from the early 1970s through the early 1990s. For example, under the auspices of the Economic Commission for Africa (ECA), the first All-African Seminar on the Human Environment was convened in 1971 and "made specific recommendations for steps to be taken to combat the spread of deserts in Africa" (UNCOD, 1978). Furthermore, the United Nations Conference on Desertification

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[77] For more information on bilateral cooperative programs between the ROK and China, and between the ROK and Mongolia, see Table 4.2.

[78] Desertification is defined as "the diminution or destruction of the biological potential of the land, and can lead ultimately to desert-like conditions" (UNCOD, 1978).

(UNCOD) adopted a Plan of Action to Combat Desertification (PACD) in 1977 for all regions of the world, not only Africa. The PACD presented “a set of recommendations for initiating and sustaining a co-operative effort on the scale required to combat desertification” (UNCOD, 1978).

Even so, in 1991 the United Nations Environment Programme (UNEP) concluded that the problem of land degradation had intensified despite several local examples of success. Thus, the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, named desertification as one of the greatest challenges to sustainable development. As a result, the UNCCD was established in 1994 at one of the Rio Conventions, along with the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD).

It seems that these international discussions have educated the Northeast Asian countries about the existence and extent of the problem. Since UNCED, Northeast Asian countries have developed numerous bilateral cooperative mechanisms to tackle transboundary DSS issues. This bilateral cooperation has mainly focused on forestation on desert areas in China and Mongolia, both of which have been identified as source countries. In fact, the ROK has supported several plantation projects to plant trees for erosion control in China. Moreover, the ROK and China have conducted various joint research projects. For example, they conducted joint research on methods for combating desertification in Ulbanbuhe and Kubuchi between 1996 and 2002. This research studied sand dune fixation based on sand-carrying volume, aerial seeding based on coverage and growth rate, and selection of drought resistant trees based on survival and growth rates. Another joint research project in Dengkou conducted between 2002 and 2005 examined tree selection and desertification control, focusing on soil amelioration and the selection of drought-resistant grass species. Joint research between the ROK and Mongolia has also studied sand dune fixation with straw and stone, vegetation establishment tests, and tree nurseries (J. Kim, 2007). Despite these impressive examples of the development of bilateral cooperation, bilateral initiatives have tended to be limited to some specific field and national boundary areas, even though DSS poses a transboundary environmental problem on a regional scale (ADB, 2005). In addition to bilateral cooperative programs, inspired by the international discussions on desertification at UNCCD, Northeast Asian countries have also created various multilateral research programs, including the joint project on Prevention and Control of Dust and Sandstorms in Northeast Asia (RETA 6068) between 2003 and 2005, and Joint Research conducted under the Tripartite Director General Meeting (TDGM) on Dust and Sandstorms at the Tripartite Environmental Ministers Meeting (TEMM) in 2007. Before discussing the development of TDGM, the following section considers international contributions made by international organizations to developing understanding DSS issues in the region between 2003 and 2005.

The RETA 6068 Project was collaboration between various international agencies and Northeast Asian countries that was designed to serve as a cornerstone for regional cooperation. The governments of China and Mongolia requested international assistance to tackle DSS in the early 2000s. In 2002, the Asian Development Bank (ADB) approved "the regional technical assistance for Prevention and Control of Dust and Sandstorms in Northeast Asia (RETA 6068, the Project) to support the establishment of a regional cooperation mechanism and framework to guide and coordinate the interventions to combat DSS concerns" (ADB, 2006, p. 1). Since ADB was coordinated, the UNCCD Secretariat, the United Nations Economic and Social Commission for Asia and Pacific (UNESCAP), and the United Nations Environment Programme (UNEP) have partnered to process and implement this cooperative project.

These three UN agencies drafted a project proposal seeking financial support from the Global Environment Facility (GEF) as a response to ADB's request for regional technical assistance that originated as a concept paper in May 2002. As a result, RETA was financed by the ADB between 2003 and 2005[79] on a grant basis, with US$500,000 funded by the Japanese government's Japan Special Fund and US$500,000 by the GEF. To implement this project, the four participating governments—China, Japan, the ROK, and Mongolia—made in-kind contributions in the form of human resources, such as counterpart staff, professional services, and national experts, and of office facilities (ADB, 2005; NEASPEC, 2009; MOEJ, 2008).

The RETA 6068 Project was conceptualized as an entity that would produce a master plan that could guide regional collaborative activities for both the prevention and control of DSS in Northeast Asia. This regional master plan consisted of two components. The first component was intended to establish "a regional network for monitoring, early warning, and forecasting of DSS" through "strengthening the monitoring capacity in the two DSS source countries" (ADB, 2005, p. 6). The second component was designed to implement three activities: "(i) the selection of sites for nine demonstration projects . . . , (ii) the identification of best practices for the demonstration projects for DSS prevention

[79] The Project was slated for completion by June 30, 2004; however, this date was extended to February 28, 2006 because of "(i) the postponement in project commencement due to the outbreak of SARS in 2003, and (ii) the requests for translation and publication of the Master Plan in the national language of all the four participating countries" (ADB, 2006, p. 4)

and control, and (iii) the development of an investment strategy including recommendations on sustainable financing mechanisms for the promotion and dissemination of best practices in addressing the causes of DSS" (ADB, 2005, p. 7).

In 2005, ADB published the findings of RETA in three volumes: *Regional Master Plan for the Prevention and Control of Dust and Sandstorms in Northeast Asia*; *Establishment of a Regional Monitoring and Early Warning Network for Dust and Sandstorms in Northeast Asia*; and *An Investment Strategy for the Prevention and Control of Dust and Sandstorms through Demonstration Projects*. The Master Plan has been "endorsed by the governments of participating countries through various official statements including the Communiqué of the Tripartite Environment Minister Meeting" (ADB, 2006, p. 2). According to Jho and Lee, this project has been "meaningful in that it provided the basic framework for building the first regional cooperation scheme with the aim of countering yellow sand in Northeast Asia" (2009, p. 51).

In addition to the RETA project, several international meetings proved to be catalysts for the creation of TDGM, as shown in Table 4.2.

Table 4.2
Timeline of TDGM Creation

Year	Meetings	Locations	Theme
December 2006	8th TEMM	China	Agreeing to create TDGM and Joint Research on DSS
January 2007	7th China-Japan-ROK Summit Meeting	Philippines	Recognizing DSS as a common issue in the region
March 2007	1st TDGM	ROK	Agreeing to create organizational structure for the Joint Research
September 2007	2nd TDGM	Japan	Agreeing on the Terms of Reference of the Steering Committee (SC)
December 2007	9th TEMM	Japan	Finalizing members of the SC
December 2008	1st SC Meeting	Japan	Agreeing on the Terms of

			Reference of the Working Groups and Joint Research Plan for 2008-2010

As shown in Table 4.2, China, Japan, and the ROK acknowledged the urgency of addressing the threat DSS posed to the region and agreed to strengthen countermeasures under TEMM at the Eighth Tripartite Environment Ministers Meeting (TEMM) held in Beijing, China in December 2006, and the Seventh Summit Meeting between China, Japan, and the ROK, held in the Philippines in January 2007 (MOEK, 2009a).

The Ministers recognized that dust and sandstorm in Northeast Asia was posing common concerns for countries in this region and agreed to work together to reduce the damage caused to possible human health and the environment in this region. They recognized the necessity of capacity building and monitoring data sharing in order to promote a monitoring network in Northeast Asia region. In this regard, they welcomed the efforts to develop the outputs of the ADB-GEF DSS regional technical assistance (RETA) project. Also, they concurred in holding a director general meeting before the next TEMM to discuss concrete measures including the establishment of a joint research group (TEMM, 2006). Based on these international discussions, the three governments agreed to create the first regional cooperative mechanism dealing with DSS, the Tripartite Director General Meeting (TDGM) on Dust and Sandstorms, at the Eighth TEMM in 2006. The objectives of TDGM were identified in a 2007 meeting report:

> Participants shared the view that DSS is one of the most critical environmental issues in Northeast Asia and that they must take urgent actions against DSS in a cooperative manner. They reconfirmed the importance of the regional monitoring and early warning network in Northeast Asia in order to mitigate environmental, economic and social impacts of DSS in the region, and that they would continue to cooperate in establishing the network by sharing information with each other. (TEMM, 2009e, p. 1)

TDGM's Achievements and Limitations

TDGM presents mixed characteristics of the formal mode of collective action due to its firm organizational structure but lack of financial arrangements, and it has demonstrated little concrete collective action related to the joint research on DSS. First of all, the TDGM established three organizational entities: Steering Committee, Working Group I, and Working Group II. Each entity has met annually (see Table 4.3). The Steering Committee was composed of governmental officials and experts from each country, while Working Groups I and II were composed of officials and experts from national research institutes, such as the Meteorological Administration and the Forest Service.

Table 4.3
Meetings of TDGM and Entities Associated with Joint Research

Year	TDGM	Steering Committee	Working Groups
2007	1st / ROK 2nd / Japan	-	-
2008	3rd / ROK	1st / Japan (January) 2nd / ROK (July)	1st / ROK
2009	4th / China	3rd	Ad hoc meeting / China (June) 2nd / Japan (September)
2010	5th / NA	4th	3rd / ROK
2011	6th / NA	5th	4th / China
2012	7th / China	6th	5th / Japan
2013	8th / Japan	7th / Japan (Feb)	6th / ROK

Note: Adapted from "Joint Communiqué of TEMM," by TEMM, 2010, p. 31; TEMM, 2013e, p. 3.

The objectives of each body of TDGM have been clarified in the *Joint Announcement* that was formally adopted by Directors General of China, Japan, and the ROK. Along with the *Joint Announcement*, the Terms of References of the Steering

Committee and the two Working Groups have clearly defined the division of labor among these three organizations within the TDGM Joint Research project.

The *Joint Announcement* adopted at the first TDGM meeting in March 2007 held in the ROK indicates that the three participating countries agreed on the organizational structure of the TDGM, as well as on the establishment of a Steering Committee and two Working Groups (Working Group I & Working Group II) that would perform joint research on DSS in Northeast Asia. According to the *Joint Announcement*, the "the Steering Committee will include determination of the two working group activities, coordination of relevant departments and agencies at national and regional levels, exchange of information, and exploring financial resources" (TEMM, 2009a, p. 2). The Steering Committee's responsibilities are clearly stated in its Terms of Reference, and include providing "general guidance for establishing and implementing the project plan of the Joint Research Group," determining "the direction of each working group's research plan and activities, and support them," and reporting "the result of joint research to the TDGM on DSS" among others (TEMM, 2009b, p. 1). The 2007 *Joint Announcement* contained the proposal that Working Group I (WG1) focus on DSS monitoring and early warning systems, while Working Group II (WG2) investigate methods for preventing and controlling DSS (MOEJ, 2007b).

Although this solid organization structure has made TDGM a formal mode of collective action regarding DSS, its unclear financial arrangements have not. Instead, the *Joint Announcement* emphasized the need for external financial assistance from international organizations rather than from participating countries. It stated that the Directors General of China, Japan, and the ROK recognized the importance of the immediate implementation of the proposed second phase of the ADB-GEF Project, including securing project funds, and asked "GEF to provide necessary financing for the regional monitoring and early warning network on DSS" (TEMM, 2009a, p. 2).

The Terms of References (TORs) also failed to specify the financial contributions required from each member country. The TOR of the Steering Committee meetings merely stated that all expenses for holding meetings "shall be covered by the Chair Country (TEMM Host Country) and the traveling expenses, including accommodations, shall be born by each country" (TEMM, 2009b, p. 2). The TOR of the Working Groups stated that expenses for holding meetings "shall be covered by the host country, and the traveling expenses shall be borne by each country" (TEMM, 2009c, p. 2). Nothing was mentioned regarding specific financial contributions from member countries.

Since the TORs were drafted, no country has taken the initiative to raise the issue of financial arrangements for joint research that would provide a core fund similar to EANET's. In particular, China has not shown a willingness to contribute to financing the joint research. On the contrary, it has requested financial support from the other participating countries from the beginning. For example, at the first meeting of the Steering Committee, China requested "positive consideration for financial support by Japan and Korea" for the "effective implementation of the joint research activities" when the participating countries agreed that "exchange of DSS related policy and existing research findings for the implementation of the Joint research would be started regardless of the status of financial arrangement, while exploring financial mobilization such as from international organization is also important" (TEMM, 2009d, pp. 1-2). Few efforts have been made to establish solid financial structures.

In addition to having the limited extent of formal mode of collective action, TDGM has demonstrated little concrete collective action related to the joint research on DSS. Even though participating countries have determined what information to share while conducting joint research projects, they have not developed specific guidelines for data collection. For joint research projects, action plans and timelines are roughly designed by the participating countries at the working group meetings without further discussion of the shared and specific research methods that will be used.

At the meetings of the two working groups, the participating countries have proposed joint research projects and introduced their pre-existing DSS-related research to one another at the annual meetings. For example, at the 2008 meetings of the WG1 and the WG2, participating countries agreed to launch joint research projects. The action plan of the WG1's project included four items: (a) determining the type of data that would be shared; (b) holding a joint conference; (c) conducting a joint field campaign; and (d) writing an annual report (MOEK, 2008). Regarding data sharing, the participating countries of WG1 agreed to share "meteorological conditions for DSS occurrence, PM physical properties & compositions, [s]atellite data, [m]odel results, and [l]idar data" (ibid., p. 22-23). Although they agreed to share "any necessary information," they failed to adopt common measurement methods (ibid., p. 23).

The participating countries have also discussed QA/QC activities for the joint research. Indeed, the Third Meeting of WG1 for the Joint Research on Dust and Sand Storms, "China and Korea reported on the joint QA/QC activities recently conducted by CMA and KMA" separately (TEMM, 2011, p. 2). In addition, the Japanese participants of the Fourth Meeting of the WG1 presented "the QA/QC activities for SPM monitoring and pointed out the technical problems in SPM monitoring" (TEMM, 2012).[80] Although the three participating countries attempted to establish commonly shared methods and indicators for DSS monitoring through these discussions at working group meetings, they have not been able to formalize common QA/QC criteria like those of EANET.

The participants of the working groups have acknowledged the importance of the lack of common monitoring methods that would enable countries to compare data, but they have not solved this problem. At the fifth meeting of WG1 for Joint Research in November 2012, a Japanese participant Hitoshi Yoshizaki pointed out that "information sharing based on a similar template would contribute to forming common understanding among participants" (TEMM, 2013d, p. 1).

Therefore, it can be argued that TDGM has developed a certain degree of formal collective action through agreement at the ministerial level, but a lesser degree of formal financial arrangements when compared with those of EANET. Additionally, TDGM has not established concrete forms of collective action, such as monitoring with common indicators and methods, as EANET has. The following sections explain why Northeast Asian countries have developed this limited degree of DSS-related regional cooperation through TDGM.

To summarize, TDGM presents mixed characteristics of the formal mode of collective action. It is notable that the objectives of each body of TDGM have been clarified in the *Joint Announcement* that was formally adopted by Directors General of China, Japan, and the ROK, and the division of labor among those organizational entities has been clearly defined in the Terms of References of the Steering Committee. However,

[80] SPM (Suspended Particulate Matter) are "finely divided solids or liquids that may be dispersed through the air from combustion processes, industrial activities or natural sources" (OECD, 1997).

the lack of financial arrangements for the TDGM activities has reduced the formal characteristic of collective action. In addition to the limited extent of formal collective action, TDGM has demonstrated little concrete collective action related to the joint research on DSS as shown in little development of specific guidelines for data collection of the joint research.

Political Leadership

This section tests Hypothesis 1, which predicts that the stronger the political leadership exercised by individual participating countries in regional environmental cooperation efforts, the more formalized and the more concrete the collective action in the region will be. This study aims to investigate whether stronger political leadership taken by any country in the region, regardless of its materialistic power, increases the likelihood of developing more formal and concrete collective action.

Structural Leadership in TDGM

As described in chapter 1, unlike most leadership literature that maintains that structural leadership comes from a state's ability to wield economic and political power commensurate with its material resources, this study assumes that any state can seek to exercise leadership if it is willing. The typologies of structural leadership previously mentioned assume that structural leadership is not grasped by willing countries but determined by the international community or powerful countries that shoulder most of the considerable costs of cooperation. However, this study argues that the states of the region can exert structural leadership based on their issue-specific national goals that are changeable through international interaction rather predetermined. Structural leadership thus may be exercised not only by powerful countries, but by any willing country, including those with few material resources. To investigate which countries exert structural leadership, this dissertation analyzes the material contributions that participating countries make to regional environmental cooperation as a proxy variable and regards spending as evidence of structural leadership given that states wanting to exercise or already exercising structural leadership would expend more financial resources than other countries to ensure successful regional cooperation.

As described above, no specific financial arrangements have been made since the establishment of joint research programs within TDGM. From its inception, participating countries have requested that international organizations continue financing various projects related to DSS. The most critical issue for the TDGM in 2007 seemed to be implementing the project for Establishing a Regional Monitoring and Early Warning Network for Dust and Sandstorms in Northeast Asia. In fact, in June 2007, the Directors General submitted a letter signed by the three ministers to GEF and ADB requesting immediate approval of the second phase of the ADB-GEF Project (MOEJ, 2007a). In addition, the 2007 *Joint Announcement* of TDGM stated that "three countries request GEF to provide necessary financing for the regional monitoring and early warning network on DSS" (MOEJ, 2007b, p. 2). The initial focus of TDGM seems to have been acquiring support for assistance from various international organizations and maintaining funding for previously begun international research projects.

Under these circumstances, the ROK has exerted moderate structural leadership through making more financial contributions than other participating countries since TDGM originated. Neither China nor Japan has exhibited any firm leadership on DSS issues. However, the ROK's moderate contribution has led the program to have insufficient funding because no country has been willing to step forward and pay the necessary money.

Thus, the TDGM has focused on securing financial support and research funds from international organizations. In TDGM's working group meetings for joint research, the participants have tended to present their plans for requesting international funding for research in the upcoming years (for example, see TEMM, 2013b). Regarding this financial dependency on external sources, a Korean delegate to the Seventh Steering Committee Meeting in 2013, professor Suh-Yong Chung, pointed out "the importance of self-sustainability of activities toward solving the issues" (TEMM, 2013b, p. 4). After Chung's presentation, participants discussed a potential problem: the previous "GEF/ADB project had not been continued with a follow up project, and therefore the matter should be discussed more carefully as a follow-up option after the completion of the current tripartite joint action plan" (ibid.).

As previously noted, the TOR of Steering Committee for Joint Research on DSS states that for expenditures and finances of joint research, the chair country (i.e., TEMM host country) must cover the costs of holding the Steering Committee Meeting and that each country bears the financial responsibility of covering its traveling expenses to international meetings. In a joint research project, "Analysis of Selected DSS Cases and Capability Building for Dust and Sandstorms Monitoring," WG1 stated that each country was responsible for its own research and development expenses for joint research projects between 2008 and 2010.

WG2 presented more specific information regarding budget sharing and the division of labor among three countries for its joint research projects conducted between 2008 and 2010 in its "Identifying Successful Factors and Developing an Advanced Model for Ecological Restoration of Area." WG2 agreed on a total budget in the first year of around US$75,000 (MOEK, 2008, p. 32). The ROK proposed contributing around US$55,000 toward the total budget, and China around US$20,000, although the ROK planned to provide China's share of US$20,000 and to cover its travel expenses to support China's participation in the joint research. In situations in which other countries have lacked the funding necessary for participation in the Joint Research of DSS, the ROK has been the only resource provider and has thus exercised structural leadership. It is arguable that the financial configuration established by WG2 shows Korea's structural leadership to the extent that the scale of its financial contributions far outweighs those of other countries.

Although Japan has born its own travel expenses unlike China contributed its share, exactly how much Japan expended to participate in this joint research remains unknown. It is likely that Japan would have utilized resources from its own existing research projects, including researchers from various research institutions that had conducted research on similar topics. Japan might not have allocated additional funds solely for this project.[81]

Japan has expressed a relative lack of interest in regional cooperation efforts partly because DSS has not been a significant environmental issue within its borders. There are several reasons for Japan's passive participation in the TDGM Joint Research,

[81] This opinion has been made based on interviews with researchers who are involved in the LTP initiated by the ROK, as discussed in the next chapter.

contrary to its dominant contributions to EANET as described in the previous chapter. Since 1994, when the Basic Environment Plan was enacted, Japan has maintained its leadership role as a key resource provider for regional environmental cooperation. In general, however, Japanese “leadership raises suspicions in the region, due to its history of military invasions of neighboring countries; and Japan itself seems reluctant to step out in front” (Yoon, 2006, p. 84). Moreover, Japan is “cautious and passive when it comes to government-level multilateral cooperation” in Northeast Asia because it regards the multilateral framework as a “form of development aid” that is redundant with its already being “active in utilizing unofficial channels of cooperation through the Green Aid Plan” (Jho & Lee, 2009, p. 66).

Japan’s political caution and sponsorship of its Green Aid Plan have encouraged reliance upon direct bilateral cooperation with countries in the region. In fact, the Japan-China Friendship Center, established by Japan’s Official Development Assistance (ODA) program, has undertaken cooperative programs since 1996 together with Japan’s National Institute for Environmental Studies (NIES) (MOEK, 2007c). For example, the Japan-China Friendship Center and Japan’s NIES conducted research into the evolution and transportation of DSS between 1996 and 2000, into the transport mechanisms of DSS that originated in Northern China, and into the environmental impact of dust aerosol between 2001 and 2003. In addition, funded by Japan’s Ministry of Education, Culture, Sports, Science, and Technology, Japan’s Meteorological Agency, and the Chinese Academy of Science, Japan launched the Aeolian Dust Experiment on Climate Impact project in 2000 and studied the climatic impact of aerosol radiative forcing.

In addition, compared to the ROK and China, Japan has hardly felt the impact of DSS. In fact, the Kyushu area (Nagasaki), which is close to China, has observed only low-level dust aerosol phenomena, whereas the Tokyo area (Tsukuba) observed only trace levels of dust aerosols in April 2002 (Table 4.4). In contrast, it was reported that dust concentration at the ground surface level in Beijing exceeded 1mg/m³ and that dust aerosol blown to Beijing was observed several hours later in ROK. The Kyushu area in Japan, however, recorded only 0.1-0.2mg/m³ during this time.[82]

Table 4.4
Occurrence of Low Level Dust in Nagasaki and Tokyo

	Nagasaki		Tokyo	
Year	No. of days DSS observed	Max concentration of SPM (mg/m³)	No. of days DSS observed	Max concentration of SPM (mg/m³)
2001	15	0.306	0	-
2002	20	0.705	0	-
2003	1	0.099	0	-
2004	11	0.152	0	-
2005	11	0.178	0	-
2006	6	0.296	1	0.13
2007	11	0.582	4	0.167
2008	6	0.446	0	-
2009	5	0.152	3	0.131
2010	11	0.898	4	0.898
2011	7	0.316	2	0.156

Note: Adapted from "Past Records of DSS in Japan," by Ministry of Environment of Japan, 2011. http://www.env.go.jp/air/dss/past/index.html. (In Japanese)

Likewise, China has expressed little interest in regional environmental cooperation, even though it is a source country and thus directly and seriously affected by DSS. This seeming apathy may be due to the fact that DSS has existed for thousands of

[82] For an overview of DSS observations in Japan, see http://www.env.go.jp/press/file_view.php?serial=5960&hou_id=5225

years and is thus not a new issue for China. China seems to regard DSS as a natural phenomenon rather than an environmental crisis, as is discussed below in the knowledge section. In addition, China has also pursued bilateral cooperation with Japan and the ROK because bilateral cooperation "might enable it to have more leverage in negotiations" (Yoon, 2006, p. 85). Japan's preference for bilateral cooperation with neighboring countries, particularly China, over multilateral cooperation has coincided with China's preference of bilateral cooperation over multilateral cooperation.[83]

Instrumental Leadership in TDGM

In addition to providing structural leadership, the ROK has exerted instrumental leadership around DSS-related issues. As explained in chapter 1, actors who exercise instrumental leadership function as agenda setters, who shape the forms that issues take; popularizers, who draw attention to the issues; policy inventors, who bring innovation to the table; and brokers, who make deals and line up support options through negotiations. As in the case of EANET, participants in the joint research program exercise instrumental leadership through becoming agenda setters and popularizers rather than policy brokers because EANET and TDGM have not established any regulatory policy measures. The Korean participation in various TDGM joint research meetings illustrates the ROK's instrumental leadership that is in some ways similar to Japan's display of instrumental leadership within EANET.

The Research Plan 2008-2010 highlights the ROK's role as an instrumental leader. Agreed to by WG2 in 2008, the plan indicated what information each participating

[83] Unlike China and Japan, the ROK has promoted environmental cooperation in Northeast Asia with a "strong incentive to pursue binding environmental cooperation that would impose some constraints on its two powerful neighbors' unilateral interpretation of international agreement" (Yoon, 2006, p. 84).

country was required to provide for joint research during its first year of TDGM membership. China was expected to (a) “provide relevant information on ecosystem restoration projects,” (b) “review restoration projects,” (c) “select the demonstration region (sites), and the field survey of the status,” and (d) “review vegetative restoration technology in practices” (MOEK, 2008, p. 31), and Japan was expected to (a) “provide the concerned project reports,” (b) “take part the joint field survey (provisional),” (c) “provide useful information and lesson learnt at the field through the activities of on-going Japanese projects,” and (d) “suggest the ideas on entire research process and data analysis” (ibid.). Whereas China and Japan were tasked with reviewing the existing research, the ROK played the role of program coordinator and focused on the development of common tools for future research. The ROK was required to (a) “make a check up list for field survey,” (b) “select study sites and perform joint field survey,” and (c) “develop a monitoring and assessment method for ecosystem restoration projects” (ibid).

The ROK’s instrumental leadership was further displayed through its involvement in choosing a joint research project. At the First WG1 Meeting in 2008, the participating countries agreed to adopt the suggestions put forth in “Identifying Successful Factors and Developing an Advanced Model for Ecological Restoration of Area” after accommodating all the concerns of other countries, particularly China. The ROK delegates to WG1 proposed that the three participating countries jointly monitor DSS in Baekdu Mountain, known in China as Changbai Mountain, situated on the border between the DPRK and China. China declined this proposal, maintaining that Baekdu Mountain was an inappropriate location for DSS monitoring because foreign research institutes were not allowed to bring monitoring equipment into China (MOEK, 2008). Japan also submitted plans for two research projects, but China and the ROK objected to both. For both projects, Japan proposed sharing only the monitoring data acquired through its own existing monitoring projects and equipment: the Aeolian Dust Experiment on Climate Impact project collaborated on by Japan's Meteorological Agency and the Chinese Academy of Science, and the NIES's LIDAR (Light Detection And Ranging).[84] China and the ROK rejected both of Japan's proposals because their own participation in the projects would have been difficult in using Japan's devices for monitoring. It is interesting to note that Japan demonstrated similar desire to adopt Japanese-made devises for the collection of monitoring data both in EANET and TDGM joint research projects.

Despite Korean efforts to structure research activities, the Joint Research of the TDGM remains under development without producing specific outputs. As mentioned above, the Working Groups of the Joint Research program started to discuss developing common methods of monitoring in 2010. Japan proposed to "discuss the QA/QC practices of each country regarding PM10 measurements" and, at the Third Meeting of Working Group I for Joint Research in 2010, participants approved Japan's proposal and "exchanged views on QA/QC practices regarding LIDAR and visibility measurements as a study item following PM10" (TEMM, 2011). As explained in the previous chapter about EANET, QA/QC activities are critical for gathering data from various countries that each use different methods and tools. This Japan's initiative for QA/QC activities might be an indicator of Japan's initial attempts to exert instrumental leadership based on

[84] LIDAR is "a remote sensing technology that can distinguish DSS particles which cannot be seen with the naked eye from other atmospheric pollutant particles" (MOEJ, 2013).

its extensive experiences within EANET. Its attempt to exert such leadership on the issue of DSS is quite recent.

In short, the ROK has played an important role in developing regional cooperation through exerting structural leadership involving financial contributions and instrumental leadership involving activities proposed for future development. However, the ROK's limited structural and instrumental leadership and Japan's newly-born instrumental leadership still have a long way to go if more specific rule-based cooperation is to develop.

Directional Leadership in TDGM

Directional leadership can be described as the ability to drive "intellectual capital or generative systems of thought that shape the perspectives of those who participate in institutional bargaining" (Young, 1991, p. 298) through the power of ideas, norms, and knowledge (Selin, 2012). Thus, social persuasion would play an important role in influencing and shaping the perceptions of other participants in demonstrations of successful domestic policy. All three countries have taken various domestic measures to build infrastructure in order to prevent, or at least lessen, damage from DSS. The ROK's establishing several legal frameworks for DSS early warning and forecast seems to best demonstrate such taking of domestic countermeasures.

The ROK introduced a legal framework in its "Comprehensive Measures for Prevention of DSS Damage" and "Framework Plan for National Safety Management" plans for dealing with DSS "at the level of disaster management." These measures aim to strengthen standards for DSS early warnings (Table 4.5) and improve DSS forecasting (Table 4.6).

Table 4.5
ROK's Standard Forecast Regarding the Intensity of DSS

Category	Predicted Density
Weak DSS	When the 1-hour average PM-10 density due to DSS is predicted to be less than 400 $\mu g/m^3$
Strong DSS	When the 1-hour average PM-10 density due to DSS is predicted to be about 400~800 $\mu g/m^3$
Exceptionally Strong DSS	When the 1-hour average PM-10 density due to DSS is predicted to be greater than 800 $\mu g/m^3$

Note: Adapted from "Current Status," by Ministry of Environment of Japan, 2012b. http://eng.me.go.kr/content.do?method=moveContent&menuCode=pol_cha_air_pol_dus_status.

Table 4.6
DSS Special Announcement Issuing Process and Behavior Guideline in ROK

Category	Issue Standard	Behavioral Guideline
DSS Information	1 hour average PM-10 density of over300 $\mu g/m^3$, Predicted continuation of over 2 hours	• Children, the elderly, and persons with respiratory disorders recommended to limit outdoor activity • Kindergarten and elementary school students recommended to limit outdoor activity (physical education classes, field trips, etc.) • General public (junior and high school students included) recommended to limit strenuous outdoor activity
DSS Warning	1 hour average PM-10 density of over400 $\mu g/m^3$, Predicted continuation of over 2 hours	• Children, the elderly, and persons with respiratory disorders recommended to cease outdoor activity • Kindergarten and elementary school students recommended to cease outdoor activity (PE, field trip, etc.) • General public (junior and high school students included) recommended to cease strenuous outdoor activity and limit other outdoor activity
DSS Alert	1 hour average PM-10 density of over800 $\mu g/m^3$, Predicted continuation of over 2 hours	• Children, the elderly, and persons with respiratory disorders recommended to remain indoors • Kindergarten and elementary schools suspend outdoor activity (PE, field trip, etc.), and student protection measures, such as early dismissal and school closure are recommended • General public (junior and high school students included) recommended to avoid outdoor

		activity and to remain indoors • Outdoor sports games recommended to be stopped and postponed

Note: Adapted from "Current Status," by Ministry of Environment of Japan, 2012b. http://eng.me.go.kr/content.do?method=moveContent&menuCode=pol_cha_air_pol_dus_status.

The ROK has also attempted to expand its number of monitoring stations and share observation information with source countries regarding early-warning development to strengthen DSS monitoring and research (J. Kim, 2007), possibly implying that DSS has affected Korea to such an extent that the Korean government has come to position DSS as a high-profile environmental concern. According to Masataka Nishikawa at the Laboratory of Intellectual Fundamentals for Environmental Studies, Environmental Analytical Chemistry Section, National Institute for Environmental Studies (NIES) in Japan, the ROK "is known as the only country to have set up standards on concentration of DSS for forecasting advisory and warning levels."[85]

The ROK's active stance reflects its instrumental leadership on DSS. In addition to demonstrating directional leadership through introducing policy measures for setting standards on DSS concentrations for forecasting advisories and warning levels, the ROK seems to have exercised directional leadership through its role in building organizational structures and creating research plans within the joint research program. For example, Korean experts[86] and governmental officials (MOEJ, 2007a) drafted and proposed the Terms of the Reference (TOR) of the Steering Committee and Working Groups for Joint Research on DSS.

[85] Interview with Dr. Masataka Nishikawa on March 8, 2011.

[86] Among others, Suh-Yong Chung, an associate professor of Law and International Relations in the Division of International Studies at Korea University, helped draft the TOR.

Knowledge

This section tests Hypothesis 2, which asserts that a region will develop more formal and more concrete collective action if participating countries in its environmental cooperation efforts develop greater commonly shared knowledge. This section argues that scientists in the region continue to have significant uncertainties regarding the causes and consequences of DSS because different countries embrace different monitoring standards. Furthermore, China, which has registered the largest number of experts on the UNCCD's Roster of Experts, has shared little of its monitoring information due to the bureaucratic rivalry among various institutes involved in DSS monitoring. Before discussing variances in the monitoring methods of the three participating countries, the following section examines the development of scientific knowledge about DSS in Northeast Asia, focusing on international research projects operating through UNCCD and ADB/GEF.

The accumulation of knowledge through the UNCCD activities has rarely led Northeast Asian countries to build commonly shared scientific knowledge in the region because the UNCCD has not provided enough scientific information about the causes and consequences of desertification. L.L. Stringer criticized for "its absence of scientific and institutional benchmarks and indicators for monitoring the international impact of the convention on the overall condition and extent of the world's drylands" (Stringer, 2008, p. 2067). For example, the Plan of Action to Combat Desertification[87] had not met expectations by the early 1990s, according to Bauer and Stringer, in that desertification

[87] Its Plan of Action to Combat Desertification (PACD) resulted from "political discussions following direct scientific input," and "provided the UNEP with a general mandate to organize and coordinate action with a view to eventually controlling desertification worldwide by the year 2000, as well as 28 specific recommendations on what needed to be done" (Bauer & Stringer, 2009, p. 250).

“had not been insufficiently prioritized within national development plans and legislation” (2009, p. 250).

Because the UNCCD’s “negotiators deliberately referred to ‘knowledge’ as a broader concept, not to privilege science but to allow space to be created to incorporate a wider range of cognitive resources” and “drew so heavily on chapter 12 of Agenda 21--‘Managing Fragile Ecosystems: Combating Desertification and Drought’--there was little room for maneuver over issues such as defining desertification” (Bauer & Stringer, 2009, p. 252). According to Bauer and Stringer, media and policy circles sidelined the scientific community throughout the negotiation process because they blamed it for the “world’s failure to solve the desertification problem after the earlier, more scientifically informed UNCOD” (2009, p. 253).[88] The role of scientific knowledge in the organization remains insignificant even today.

> To date, the UNCCD process has lacked an efficient operational mechanism to process and channel practical and scientific expertise for political decision makers. Ultimately, this results in minimal ideational interplay and inhibits cross-institutional learning. This is because the COP has failed to tap the information potentially available from the scientific community, which in turn has been unable to draw the attention of the Parties to the scientific aspects of the issues on their agenda. Accordingly, there have been calls for the provision of independent scientific policy advisory services from outside the immediate UNCCD process, referring to the role of the Inter-governmental Panel on Climate Change (IPCC) vis-à-vis the United Nations Framework Convention on Climate Change (UNFCCC) as a promising model. (Bauer & Stringer, 2009, p. 254)

Science had little influence on the development of shared knowledge about the causes of DSS in Northeast Asia. The project on the Regional Master Plan for the

[88] Bauer and Stringer argue that there are several reasons for this scapegoating: the lack of ability of science to “provide quick-fix solutions to urgent problems” or “simple solutions that can be easily transferred between biophysical and institutional contexts, thus presenting a problem of scale”; the tendency of scientific research to be “rarely definitive and final”; and the selective use or interpretation of scientific research for political purposes (2009, p. 253).

Prevention and Control of Dust and Sandstorms in Northeast Asia (2003-2005) also highlighted the lack of common understanding of DSS among countries. Even today, there is no agreed-upon definition, terminology, or perception of DSS phenomena and no common monitoring method or similar capacity for monitoring. The upstream countries in the source areas consider DSS a natural phenomenon that has existed for thousands of years, whereas the downstream countries see it as a problem of air quality.

Furthermore, the definition of DSS varies, depending on both monitoring method and threshold value. Moreover, needs and expectations are different not only among countries but also among agencies within individual countries (ADB, 2005). The ADB project urges Northeast Asian countries to build optimization and flexibility with step-by-step approaches to formulate a feasible program for a proper regional monitoring and early-warning network. Yet the master plan did not contribute to shared scientific knowledge about DSS.

This absence of shared scientific knowledge in Northeast Asia has resulted not only from the few contributions of these two international cooperative mechanisms, but also from bureaucratic rivalry in the monitoring of DSS, particularly in China. Common methods of monitoring DSS do not exist among countries in the region even though monitoring is the first step that each country must take toward an understanding of environmental issues. Once monitoring indicators are determined,[89] surface- and satellite-based observations will produce results that will be used for DSS source identification and impact assessment, including health and economic loss, for short-term forecasting

[89] Two kinds of indicators are used for DSS monitoring. The first is atmosphere indicators, which include meteorological parameters, wind, visibility, etc., and ambient atmosphere (TSP/PM10, vertical profile by LIDAR). The second is ground surface, which includes land use/cover change and soil attributes (ADB, 2005).

through data sharing in real time and forecasting models, and for long-term forecasting through tracing annual trends in DSS outbreaks. Early warnings on DSS, then, can be achieved based on the results of monitoring. Thus, it is ironic that although monitoring produces the information necessary for making early warnings possible, it is the activity that countries disagree about most.

The DSS monitoring situation in China is complicated. Even though many Chinese governmental agencies and institutions maintain monitoring stations that collect data for DSS forecasting and early warnings, there is little cooperation among these institutions, and access to the data required by modelers and forecasters is not always available. To varying extents, at least four institutions at the central government level have been directly involved in DSS monitoring, forecasting, and early warnings: the China Meteorological Administration (CMA), the Ministry of Environmental Protection (MEP, formerly SEPA), the State Forestry Administration (SFA), and the Chinese Academy of Sciences (CAS). Each has developed its own individual network, as “each institution strives to be self-sufficient in data gathering” (ADB, 2005, p. 69), which highlights a general lack of cooperation among these institutions.

Each of these Chinese institutions uses different databases for monitoring and allows different scopes of data availability. The CMA collaborated with the National Satellite Meteorological Center to use databases of GMS images, and with the US National Oceanic and Atmospheric Administration (NOAA) to use images for the DSS density map and visibility. MEP uses data from its own 43 monitoring sites for PM10, TSP, and Light Detection and Ranging (LIDAR). [90] The Ministry of Land and Resources

[90] LIDAR is radar that use laser light instead of radio waves. A remote sensor can measure a DSS passing above from the ground. “The laser light emitted from the ground is scattered by fine

uses databases based on Landsat TM integrated with ground surveys, land use maps, ecological environment maps, land degradation maps, vegetation maps, soil maps, and other data in its focus on land degradation and salinization. The data the Ministry of Land and Resources obtain are for internal use only. The State Forestry Administration acquires data based mainly on ground surveys, using Landsat TM images that focus on desertification. This organization's primary data and database are also designated for internal use only.[91] CAS uses a database based on Landsat TM images to monitor desertification evolution and trends in Northern China and provides multiple levels of data availability. The 1:200,000 and 1:500,000 scale maps are for internal use only, whereas the 1:4,000,000 scale maps are published and available for public use (ADB, 2005, p. 70).

Some institutions have collaborated with other Chinese institutes. For example, the "SFA and CMA have set up a consultative mechanism for prediction and forecasting of DSS events and early warning by combining land surface field observation information (land use, vegetation and land degradation dynamics, soil structure and moisture) provided by positioning monitoring stations and information on weather condition" (ADB, 2005, p. 74). This consultative mechanism has been considered a great success in improving the accuracy of DSS prediction and forecasting. Despite this development, data sharing among Chinese institutions remains limited. Such bureaucratic

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particles in the air. By measuring the scattered laser light, the vertical distribution of DSS particulate concentration, and the change with time, can be determined. By using polarized laser light, an estimation of the non-spherical character of airborne fine particles can be determined. The shapes of DSS particles are not spherical comparing with atmospheric pollutant particles, therefore with this method it is possible to distinguish DSS from atmospheric pollutants" (MOEJ, 2008, p. 7).

[91] The State Forestry Administration's statistical data are open for public use.

rivalry may have prevented Chinese scientists from building domestic epistemic communities.

Japan has also faced a lack of coordination that has hindered the growth of its knowledge base regarding DSS. In Japan, the major obstacle seems to be the involvement of so many types of organizations that play a part in monitoring DSS. Multiple governmental institutions play a role in DSS monitoring: the Japan Meteorological Agency (JMA), Ministry of the Environment of Japan (MOEJ), and the National Institute for Environmental Studies (NIES). JMA, an external agency of the Ministry of Land, Infrastructure and Transport of Japan, maintains an extensive network of meteorological stations throughout the country and monitors DSS based on visibility at 113 meteorological sites. In January 2004, JMA began releasing forecasts on DSS aerosol dust and has provided information about DSS aerosol distribution that could affect people's transportation and daily activities. The Ministry of the Environment of Japan also maintains a network of air monitoring stations. The Atmospheric Environment Regional Observation system (AEROS), also referred to as Soramamekun, has 1,541 stations in the network that collect PM_{10}, TSP, and other data from LIDAR monitoring (ADB, 2005, p. 75).

Whereas governmental agencies have dominated DSS monitoring in China, governmental research institutions and universities have played a substantial role in studying the meteorological and climatic phenomena of DSS in Japan. Governmental agencies provide research institutions and universities with financial support and work to raise public awareness about DSS in Japan. To address the participation of various types of organizations in DSS, "the ministries and agencies involved in DSS issues established a coordination meeting in February 2005" for "liaison and coordination among government agencies in Japan" (MOEJ, 2006).

In the ROK, the Ministry of Environment (MOEK), Korea Meteorological Administration (KMA), and National Institute of Environment Research (NIER) are involved in DSS monitoring throughout the country. Like China and Japan, the ROK is equipped with high-tech LIDARs. Located along the ROK's west coast, LIDARs are operated by KMA and NIER to measure periodic DSS (ADB, 2005, p. 77).

Despite these efforts from all three countries, Northeast Asia has not created a common monitoring system. As Masataka Nishikawa points out,

> On their own online systems, Japan uploads PM_7, and Korea and China have uploaded PM_{10} data. They can share information, but they cannot compare. All three countries have their own LIDARs, but it is hard to establish same mechanism.[92]

Nishikawa raises the topic of a more recent challenge to information sharing:

> The Chinese 2007 *Meteorology 13* prohibited researcher from giving any information to other countries. The only exception for this law is the agreement between Ministers of Environment, for example, TEMM. Under the TEMM, Meteorological Agencies and Ministries of Environment in Korea and Japan work together. However, for China, only the Ministry of Environmental Protection is participating under TEMM, no participation from the Meteorological Agency. This brings about high demand from Japan and Korea for more information from China.[93]

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[92] Interview with Dr. Masataka Nishikawa, Section leader of the Laboratory of Intellectual Fundamentals for Environmental Studies, Environmental Analytical Chemistry Section at National Institute for Environmental Studies in Japan, on March 8, 2011.

[93] Ibid. The *Meteorology 13* seems to be under the Administrative Regulations on Meteorological Data Sharing" which China Meteorological Administration (CMA) issued. The Meteorology Law of China came into effect on January 1st, 2000 "to regulate the meteorological activities on a legal basis" and to hold "meteorological departments responsible for discharging administrative management functions" (CMA, 2012).

Each country has amassed its own understanding of DSS over time because the DSS phenomena has existed for thousands of years even though it has increased significantly in recent years. Furthermore, no common understanding of the causes and consequences of DSS exists among participating countries due to their diverse methods of monitoring its different aspects. As a result of the lack of substantial knowledge about desertification that persists within UNCCD, countries have relied upon their own understandings and experiences on this issue, which has resulted in a great deal of controversy and disagreement over various aspects of DSS.

Although, as explained earlier in this chapter, "the scientific consensus is that the main sources of dust are the Taklamakan and Gobi desert regions" (Wilkening, 2006, p. 444), a great deal of uncertainty remains about the specific areas from which dust originates and the possible causes of the increased frequency of dust sandstorms, such as climate change or human-induced desertification. Another area of controversy is source-receptor relationships of DSS (Wilkening, 2006).[94] First, the extent to which Mongolia contributes to overall dust emissions is an important issue and area of controversy. If Mongolia is a significant source of the dust that spreads over China, then China would have more incentive to engage in cooperation with Mongolia to tackle desertification problems. Second, the atmospheric pathways of dust transport are uncertain. There seem to be two main paths of long-range transport of dust: "(1) an eastward route from the

[94] For desertification, China identifies human factors rather than natural factors as the major causes of desertification in its National Action Program of the UNCCD. The program states that along with climatic variation, human activities, such as "population growth, the pressure from economic development, poor awareness of the importance of the protection of ecosystem, over-grazing, over-cutting of fuelwood, deforestation and destruction of vegetation caused by reclamation on steppe, desert steppe and pasture land, inappropriate farming system on slope and the degradation of vegetative," have accelerated desertification in China (China National Committee for the Implementation of the UNCCD, 1996, p. 3).

Mongolian Plateau region over Manchuria, the Korean Peninsula, Japan, and the Pacific Ocean, and (2) a north-then-eastward route over the Tianshan Mountains and Lake Balkhash to about 50°N before turning eastward toward the Pacific Ocean" (Wilkening, 2006, p. 444).

In addition to uncertainty over the causes of increasing DSS, there has been little common understanding of its consequences. China, Japan, and the ROK have each developed its own knowledge regarding different aspects of DSS's effects. Nishikawa, a participant in the Joint Research of TDGM, states that "Japan has the most advanced knowledge on health effect of DSS. Korea is very good at financial estimation of DSS effects. China has developed the most knowledge on the protection of agriculture and forest."[95] Regarding each country's different areas of focus, he claims that Japan privileges "pure science" to the point that it lacks the broader understanding of DSS possessed by the ROK and China:

> Regarding DSS, among three countries, Korea is the most active state, particularly dealing with impact assessment. In fact, Korea is the only country to have set up standards on concentration of DSS for forecasting advisory and warning levels. It is because Korea suffers from damage for health, industry, and traffic. In fact, Korea is the only country to have measured financial effects of DSS. Scientists study in order to prevent health damage to the public. Policy makers study how to achieve more with little investment. Thus, countries should calculate financial aspects. Korea has the strongest perception on DSS. Japanese scientists tend to admire pure science without calculating how much economic damage would be caused by pollution. Korea and China are good at calculating in terms of money regarding environmental adverse impact.[96]

The Special Committee on dust and sandstorms in Japan has also recognized Japan's lack of understanding regarding the impact assessment of DSS:

[95] Interview with Dr. Masataka Nishikawa on March 8, 2011.
[96] Ibid.

> The interrelationships between DSS events and socioeconomic activities will become more complex as productivity in Northeast Asian region grows significantly. In future, forecasting in the field of economic and production activities will be an important component of the evaluation of the effects of DSS events. This field of study has already been launched by a Korean research group, and Japan should closely follow the progress of this research initiative. (MOEJ, 2006)

The TDGM meetings have also paid little attention to the costs of tackling DSS. At the First WG2 Meeting for Joint Research on DSS in 2008, the three countries presented their existing research to share their research results (TEMM, 2008). Based on the summary of the existing DSS research of these three countries, it seems that no country had specified the economic costs of implementing measures to abate DSS. The ROK presented its current research on planting trees and establishing pasture lands to combat desertification, which explained how tree species were selected and how the growth of plants in desertificated areas was measured. China introduced its past as well as current research projects, including research on the integrated control model, technical approaches of Eco-Asset Assessment, biodiversity conservation, and vegetation. Japan shared its research on “Desertification control and restoration of ecosystem services in grassland regions” and “Community-Based approaches for countermeasures in DSS” in DSS source areas. Both of these studies focused on developing support for people living in desertificated areas.

Unlike the individual countries themselves, the ADB tried to figure out the total cost for DSS mitigation measures, based on budgets of various Chinese projects. China’s 10th and 11th Five-Year Plans between 2001 and 2010 presented its strategies for DSS prevention and mitigation projects in specific counties, such as the Inner Mongolia

Autonomous Region (ADB, 2005, p. 170). For example, the "Law on Desertification Prevention and Treatment," issued in January 2002, stated that "government at all levels are responsible for the control of desertification and the central government should increase investment and create more favorable policies" (ADB, 2005, p. 172). In attempting to determine the cost aspect of DSS, ADB has emphasized the importance of measures that are available at reasonable costs over large source areas. According to its 2005 research, the total capital cost of the projects in the Hulunbir, Xilingol, Ordos, and Alashan areas of China were US$81,446,670, based on budgets allocated for these projects. Other than these project-based cost estimates, the report notes that "cost effectiveness, replicability, sustainability and technical ease of implementing the interventions and control measures has yet to be demonstrated on a scale that is commensurate with the area of land that needs to be treated in the DSS source areas" (ADB, 2005, p. 165). Yet without developing a common understanding of the causes and consequences of DSS, it will be difficult for the region to launch proactive research on costs of measures necessary for abating DSS.

Socialization

This section tests Hypothesis 3, which is that participating countries in regional environmental cooperation efforts are more likely to create formal and concrete collective action through regional cooperation if they adopt learning rather than adaptation as a process of socialization. As mentioned in chapter 1, through both the adaptation and learning processes of socialization, international actors can change their behaviors in response to new events. Through the adaptation process, international actors do so without making fundamental changes in their beliefs about underlying values and causal mechanisms, whereas through the learning process, they do so by raising questions about fundamental and implicit theories. Thus, more significant behavioral changes can be made by international actors who have a chance to examine their original values through the learning process of socialization.

The following sub-sections investigate which of the two processes of socialization, adaptation and learning, the participating countries have engaged in. To determine the socialization processes, this study qualitatively assesses the participation patterns of member countries in two ways: (1) whether the participation of countries in the region has been prompted by not intrinsic but indirect concerns about particular transboundary air pollution issues; (2) whether the delegates to international meetings have been allowed to have enough time to take the learning process of socialization. As mentioned in chapter 1 and 3, regarding the first way, it is considered that countries have engaged in the adaptation process of socialization if indirect political concerns have led them to participate in regional environmental cooperation on the acid rain issue; it is considered that countries have engaged in the learning process of socialization if they have found intrinsic motivations for their regional cooperation. Regarding the second way, it is considered that delegates are more likely to have engaged in the adaptation process of socialization if they have had the opportunity to attend international meetings for only a short period or in a sporadic manner, and to have engaged in the learning process of socialization if they have been able to attend international meetings for an extended period in a consistent manner.

For the first criteria of the participation patterns, this subsection investigates the international context that Northeast Asian countries faced before and while initiating their regional environmental cooperation regarding transboundary pollution. The implementation of the UNCCD signals a shared recognition that desertification and land degradation are global issues. Deserts in Asia are expanding in various countries, such as China, India, Iran, Mongolia, Pakistan, Syria, Nepal, and the Lao People's Democratic Republic. The UNCCD has successfully reminded the international community of the condition of Asia, which in terms of the number of people affected is the continent most severely impacted by desertification and drought.

Even though two source countries in Northeast Asia, China and Mongolia, have established their own National Action Plans as required by the UNCCD because they are in the process of desertification,[97] their participation in the international discussions partly seemed to have been driven by two political concerns: getting technical and financial assistance from developed countries and changing international reputation on their air quality. First, both China and Mongolia had particular national interests in the technical and financial assistance that they would receive through the participation in the UNCCD activities. According to ADB, "political commitment and increase in budgetary allocations to desertification control on the part of the central government in each country and technical and financial assistance from a number of donor agencies" have enabled China and Mongolia to generate good practices and mitigation approaches (2005a, p. 4-

[97] Even though Japan and the ROK have not established National Action Plans because they are not in the process of desertification, both countries submitted national reports to the UNCCD because Article 26 of the UNCCD stipulates that each party must submit a report on the domestic measures taken to implement the Convention. (For the national report of Japan, see MOEJ, 2000; for the national report of the ROK, see UNCCD, 2006a.)

2).[98] They have pursued "financial, technological, and capacity-building assistance" and relied on "help from outside organizations such as UN organizations, foreign aid agencies, and foreign foundations to beef up its scientific capability" (Wilkening, 2006, pp. 443-444). In particular, according to Wilkening, Mongolia's stagnant economy has brought "limited technological capacity in areas such as silviculture; a shortage of trained personnel; underdeveloped policy and legal structure relative to land use management; and a weak scientific capacity to forecast and give early warning of dust storms" (ibid., p. 443).

Second, China needed to change its poor reputation on its air quality through cleaning Beijing's air of dust in order to hold the 2008 Beijing Olympics. According to Wilkening, the "Olympics are a coming-of-age event for China similar to the 1964 Tokyo Olympics for Japan and the 1988 Seoul Olympics for South Korea. However, dust and dust storms could dirty the event" (2006, p. 443). In fact, Beijing failed to win the Olympics in its first bid partly due to its air pollution.

Japan also had political motivations in participating in the international discussions on desertification through the UNCCD. As mentioned in Table 4.4 above, Japan has been subject to few dust concentrations due to its geographical location, "downwind of the typical dust trajectories" and "its greater distance from the source regions" than the ROK (ibid., p. 448). Despite its little environmental impacts of

[98] Mongolia, in particular, has pursued "financial, technological, and capacity-building assistance" and relied on "help from outside organizations such as UN organizations, foreign aid agencies, and foreign foundations to beef up its scientific capability" (Wilkening, 2006, pp. 443-444). According to Wilkening, Mongolia's stagnant economy has brought "limited technological capacity in areas such as silviculture; a shortage of trained personnel; underdeveloped policy and legal structure relative to land use management; and a weak scientific capacity to forecast and give early warning of dust storms" (ibid., p. 443).

desertification and DSS, Japan has been the “the second largest donor country to the UNCCD” since it became a party of the Convention in 1998 (UNCCD, 2006b, p. 3). Japan explicitly stated its preference to ODA for environmental cooperation to practice its “partnership” for developing countries, based on the philosophy of “human security” as follows:

> At the 2002 World Summit on Sustainable Development (WSSD), Japan announced the policy for environmental cooperation mainly through its Official Development Assistance (ODA), entitled the "Environmental Conservation Initiative for Sustainable Development (EcoISD), as a revision of former Initiative, the "Initiatives for Sustainable Development toward the 21st Century (ISD) ". The philosophy of EcoISD consists of “Human Security”, “Ownership & Partnership”, and “Pursuit of Environmental Conservation & Development”. Environmental problems threaten the survival of human beings, so it is important to tackle them from the viewpoint of “Human Security”. It is vitally important that developing countries assume primary responsibility and role for tackling such problems through their own “Ownership” and that the various stakeholders in the international community work together in a spirit of “Partnership”. (UNCCD, 2006b, p. 3)

As Wilkening argues, “this seemingly incongruous support” of Japan has partly resulted from “the desire to curry favor among developing nations and the desire to export its expertise in forestry” (2006, p. 448).

The ROK seems to have genuine concerns for the international efforts on dealing with desertification because it has been subject to large dust concentrations due to its geographical location as “the closest downwind region along the typical atmospheric trajectories from the China-Mongolia dust source regions” without its own desert areas (Wilkening, 2006, p. 446).

Thus, it can be argued that China and Japan among the three countries have taken the adaptation process of socialization because the creation of a regional cooperative mechanisms, TDGM, was based not primarily on an environmental concern of these countries, but rather by their particular political and practical concerns. Participation in TDGM activities was a means for each country to achieve other objectives than an end to DSS issue itself. Little learning process of socialization has been observed in the participation of these three member countries.

In addition to these external international negotiation circumstances in Northeast Asia, this subsection examines the internal process of socialization through the participation patterns of delegates to international meetings, showing the way in which delegates to international meetings and negotiations have engaged in social interactions. This sub-section investigates the interconnectedness of participants of TDGM and ones of the UNCCD activities. This section argues that it is doubtful that the UNCCD activities enhanced the learning aspect of the socialization process among Chinese, Japanese and Korean Chinese experts in TDGM activities due to little interconnectedness of TDGM and UNCCD.

As stated in the above discussion of TDGM's development, the UNCCD seems to have awakened Northeast Asia to the necessity of regional cooperation regarding DSS through urging countries to conduct several research projects related desertification, but it did not create direct contributions to consolidating regional understanding of DSS issues due to the lack of participation of scientists, involved in UNCCD research activities, in the TDGM activities. Even though the UNCCD was created in response to concerns about African drought, Asian countries started to develop their own tools through participating in the UNCCD. As of May 2012, 194 countries and the European Union had become parties to the UNCCD. As shown in Table 4.7, all Northeast Asian countries signed and ratified the convention in the mid-late 1990s: China (1994/1997), Japan

(1994/1998), Mongolia (1994/1996), and the ROK (1994/1999). Given that China and Mongolia were the only two countries that had experienced significant desertification problems, they were the first countries in the region to adopt the UNCCD.

Table 4.7
Ratification of the UNCCD as of 2012

Country	Ratification Dates	Out of 195 Parties
Mongolia	September 03, 1996	42nd
China	February 18, 1997	64th
Japan	September 11, 1998	139th
ROK	August 17, 1999	159th
Russian Federation	May 29, 2003	187th
DPRK	December, 29, 2003	191st

Note: Adapted from "Update on Ratification of the UNCCD," by UNCCD. http://www.unccd.int/Lists/SiteDocumentLibrary/convention/ratification-eng.pdf)

In addition to China's having adopted UNCCD soon after its formation and participated in the submission of the National Action Plans to UNCCD, the large number of Chinese experts listed on the roster of experts for DSS illustrates China's active participation in UNCCD as well as its concern about desertification. As of September 2011, China boasted the largest number of experts on UNCCD's Roster of Experts, 234 out of 1,995 from 93 parties, almost 12% of the total number of experts, compared to Japan, 48; Mongolia, 3; and the ROK, 21 (UNCCD, 2011b). Article 24, paragraph 2, of the UNCCD[99] states that the "Conference of the Parties shall establish and maintain a roster of independent experts with expertise and experience in the relevant fields" based on "nominations received in writing from the Parties, taking into account the need for a multidisciplinary approach and broad geographical presentation."

[99] Visit http://www.unccd.int/en/about-the-convention/Pages/Text-Part-IV.aspx#art24.

To implement its National Action Plans, China guaranteed that it would put into place, at various levels, measures designed to mitigate desertification.[100] The Chinese government set up the China National Committee, composed of 16 ministries and commissions in the State Council of China for its implementation of these plans.[101] The participation of 16 Chinese ministries of State Council in the China National Committee for implementing the UNCCD (CCICCD) may have diversified domestic measures,

The Chinese National Focal Points for DSS are affiliated with the State Forestry Administration, helmed by Tuo Liu, Director General of the National Bureau to Combat

[100] According to the China National Action Plan to Combat Desertification, China has set up three phases to combat desertification: the first between 1996 and 2000, the second between 2001 and 2010, and the third between 2011 and 2050. These phases coincide with the schedule of the China National Economic and Social Developmental Plan. Each phase has different strategic objectives in terms of the magnitude of the area covered for rehabilitating lands affected by wind erosion, controlling lands affected by water erosion, revegetating degraded steppe and rangelands, treating salinized land, and establishing artificial plantation. To fulfill these objectives, China planned to launch several research centers such as National Desertification Monitoring Center and Early Warning System, National Training Center on Desertification, and National Research and Development Center on Desertification. It also planned to conduct numerous projects throughout the three phases, including 18 key projects to combat desertification caused by wind erosion; various projects to combat desertification caused by water erosion; 9 projects to achieve soil and water conservation at the middle reaches of the Yellow River and comprehensive watershed management of the upper reaches of Guanting, Miyun and Panjiakou Water Reservoirs; and various projects for controlling vegetative degradation and soil salinization.

[101] At the central governmental level, China developed desertification combating projects that were consistent with the National Industry Policy Outlines within the National Economic and Social Developmental Plan. The government also prepared the annual budget and encouraged low-interest-rate loans for projects involving ending desertification. It also included these research projects in its National Science and Technology Development Plan. China has promulgated several policies, laws, and regulations for the National Action Plan. These laws include a Forestry Law, Soil and Water Conservation Law, Water Law, Mineral Resources Management Law, Grassland Law, Land Management Law, Environment Protection Law, and Wild Life Protection Law. The government also established food security measures and social guarantee measures. The former guarantees food in areas affected by desertification disasters, and the latter guarantees dissemination of information to combat desertification at the root level, provision of alternative livelihoods for farmers affected by desertification, and support for the resettlement of farmers living in areas with fragile ecosystems. Local governments have also taken measures to implement the Local Action Programmes to Combat Desertification under the guidance of the National Action Plan to Combat Desertification at the local level through encouraging scientific research, high-level education, and technological extension and dissemination.

Desertification, and Jia Xiaoxia, Director of CCICCD. As Appendix III shows, none of the participants in TDGM meetings, including meetings of the Steering Committee or WG1&2, have been affiliated with the State Forestry Administration. Furthermore, none of the 234 Chinese experts listed on the UNCCD's Roster of Experts in 2011 has participated in TDGM meetings. None of the names of the 20 different delegates to various meetings of TDGM, including Steering Committee meetings in 2008 and 2013, WG1 meetings in 2008, 2009, 2010, 2011, and 2013, and a WG2 meeting in 2008, are included in the roster of Chinese experts for UNCCD.[102] As such, little learning process of socialization has been allowed to Chinese scientists.

Compared with China, the participants in UNCCD from Japan and the ROK enjoy somewhat better but not enough relationships with and the participants in TDGM. As shown in Appendix III, two of the 20 different Japanese delegates to TDGM meetings held in 2008, 2009, 2010, 2011, and 2013 are included in the list of the roster of experts for UNCCD: Ken Yoshikawa, Professor at Okayama University, and Masao Mikami from Meteorological Research Institute of the Japan Meteorological Agency. Yoshikawa attended the WG2 meeting in 2008 and the WG1 meeting in 2013. Mikami attended only one meeting, WG1 in 2008. As a result, the Japanese delegates have had little chance to engage in the learning mode of socialization due to their sporadic attendance at these international meetings.

The ROK's attendance paints a picture similar to Japan's. Only one out of 26 different Korean delegates to TDGM meetings in 2008, 2009, 2010, 2011, and 2013 is

[102] The lists of participants are available in these years only through TEMM websites and MOEK data sharing websites. TEMM has not updated meeting reports regularly. For more information, see http://www.temm.org/sub08/view.jsp?code=tm_jwg1&page=1&search=&searchstring=&id=36.

included in the roster of Korean experts for UNCCD: Yowhan Son of Korea University, who attended in 2013. No Korean delegates to the TDGM meetings have had an opportunity to work with the Korean experts at UNCCD, which has resulted in a lack of access to the learning method for Korean participants.

Similarly to the interconnectedness between national experts for UNCCD and delegates to the TDGM meetings, the participation patterns of delegates to the TDGM also exhibits the adaptation processes of socialization. As shown in the case of EANET, bureaucratic rotation systems in East Asia have led participating countries to engage in the adaptation rather than learning process of socialization. As in the case of EANET, there are two groups of delegates to the TDGM meetings: (a) governmental officials, usually selected from ministries of the environment for Steering Committee meetings, and (b) scientists or researchers, most often selected from universities and national research centers, such as meteorological agencies. Because, as stated above, information about attendees of Steering Committee meetings is not kept up to date, these figures may not be completely accurate regarding the frequency with which governmental official delegates change.

Even so, the lists of participants in the Steering Committee meetings in 2008 and 2013, also available in Appendix III, show that none of the Chinese, Japanese, or Korean delegates to the two Steering Committee Meetings attended the meetings in both years. Six Chinese delegates to the TDGM meetings (five for the Steering Committee meetings and one to a WG1 meeting) were from the Ministry of Environmental Protection. Other delegates to TDGM meetings were from the China National Environmental Monitoring Center (CNEMC), Chinese Research Academy of Environmental Sciences (CRAES), China Meteorological Administration (CMA), Liaoning Environment Monitoring Centre, and China-ASEAN Environmental Cooperation Center.

Japan is the only participating country that has sent the same delegates from the Ministry of Environment to the WG1 meetings for 2 consecutive years. Shintaro Fujii attended WG1 meetings in both 2009 and 2010, and Hitoshi Yoshizaki attended WG1 meetings in 2011 and 2013. Thus, it can be argued that few opportunities have been available for participants to take the learning rather than adaptation because the turnover rate of bureaucrats and diplomats is so high.

Unlike the frequent changes in national delegates to the Steering Committee meetings, the other group of delegates to the meetings of the working groups of TDGM, the scientists, has shown more consistent participation patterns. A few Chinese scientist delegates have attended WG1 and WG2 in consecutive years and have had opportunities to engage in the learning process. Xiaochun Zhang from the China Meteorological Administration attended the WG1 meetings for 3 consecutive years between 2009 and 2011. Additionally, three Chinese delegates attended WG1 meetings for 2 consecutive years.

Japanese scientist delegates have tended to exhibit even more consistent participation patterns than China. Three Japanese delegates attended WG1 meetings for 4 consecutive years: Masataka Nishikawa from Japan's National Institute for Environmental Studies (NIES), Nobuo Sugimoto from NIES, and Takashi Maki from Meteorological Research Institute of the Japan Meteorological Agency. Korean scientist delegates have shown participation patterns consistent with those of the Japanese. Youngsin Chun has attended WG1 meetings in the years 2009, 2010, 2011, and 2013, as well as one Steering Committee meeting in 2013. Sumin Kim from KMA also attended WG1 meetings held in 2009, 2010, 2011, and 2013, and Eun-Hee Lee from KMA has attended three WG1 meetings in 3 consecutive years.

As such, all three countries have allowed several scientist delegates to consistently attend the TDGM meetings and to have enough time to engage in the learning processes of socialization, whereas the governmental official delegates have not had the same opportunities. The political delegates may have consulted those scientist delegates who have built professional expertise through the scientific focus of the Joint Research of TDGM and longer terms of service. However, as the case of EANET illustrates, it is unclear whether the consistent patterns maintained by scientist delegates have helped governmental officials participate in the learning processes of socialization. The governmental official delegates, who have had only short terms of service due to bureaucratic rotation systems, are limited in the amount of interaction they can have with scientist delegates and thereby have taken the adaptation rather than learning processes of socialization.

Conclusions

This chapter has examined how political leadership, scientific knowledge, and socialization have affected the collective action of the countries in the region most affected by DSS. This chapter argues that TDGM has largely proven a failure in terms of generating broader cooperation and useful measurement data for the region. The TDGM has produced few research outcomes that might induce participating countries of the region to draft any practical policies to deal with environmental degradation caused by

DSS. Furthermore, a consideration of the various levels and degrees of collective action in the three cases examined by this dissertation reveals that the Joint Research under TDGM has developed a lesser degree of collective action than EANET due to its failure to establish solid financial arrangements and concrete collective action associated with joint research, even though it has realized formal collective action at the governmental level. The involvement of the ministries of environment of the three countries and their agreement on the Terms of Reference of the Steering Committee and the Working Groups for Joint Research on DSS have led TDGM to become a formal cooperative mechanism, yet TDGM has neither developed concrete obligations that participating countries are required to fulfill for the joint research program nor reached any legally binding agreements.

This study concludes that political leadership is the only variable positively associated with highly formal collective action. The ROK's political leadership, based on moderate but dominant financial contributions to the Joint Research of TDGM, has enabled participating countries in the region to structure their cooperation. Specifically, the financial assistance the ROK extended to China for the Joint Research on Prevention and Control of DSS has allowed China to participate in the joint research of TDGM. However, it is evident that the political leadership exerted by the ROK within the TDGM is much weaker than that by Japan within EANET in terms of the magnitude of its financial contributions in a year (in U.S. dollars, Japan's roughly $400,000 contributions for the secretariat and another $400,000 for the network center dwarf the ROK's $75,000). The ROK's limited exercise of leadership in TDGM seems to explain the organization's lesser degree of formal and concrete collective action.

This chapter's findings do not support the second hypothesis, which predicts that countries in the region will achieve more formal and concrete collective action if they build greater commonly shared knowledge. The lack of shared scientific knowledge about DSS among the participating countries of TDGM cannot explain why TDGM has succeeded in establishing the formal mode of collective action through creating the first governmental-level, multilateral cooperative mechanism that focuses exclusively on DSS issues in Northeast Asia in a relatively short period of time, from 2007 to the present.

The third hypothesis, which predicts that it is more likely that participating countries in regional environmental cooperation efforts will create formal and concrete collective action through regional cooperation if they take the learning rather than the adaptation process of socialization, cannot also explain the formal mode of collective action of TDGM.

Yet the examination of these two variables—shared scientific knowledge and socialization processes—reveals the social mechanisms between these variables and contributes to an explanation for why TDGM has not developed into a legalized cooperative mechanism and instead continues to focus on science. As became evident in the EANET case, political leadership alone has not led participating countries to engage in the learning process of socialization. The lack of shared scientific knowledge among regional scientists, especially about the causes of DSS and the consequences directly related to economic loss driven by DSS, has not motivated the countries participating in TDGM to develop a more regulatory regional regime. Along with the lack of knowledge, the lack of overlap or interconnectedness between national experts for UNCCD and delegates to the TDGM meetings, and the too-frequent turnover among governmental officials and diplomats because of bureaucratic rotation systems has led countries in the region to engage in the adaptation rather than learning process of socialization.

CHAPTER 5

JOINT RESEARCH ON LONG-RANGE TRANSBOUNDARY AIR POLLUTANTS IN NORTHEAST ASIA (LTP)

Introduction

This chapter deals with regional efforts focusing on identifying the diffusion of emissions of specific transboundary air pollutants such as SO_2 and NOx through the Joint Research on Long-Range Transboundary Air Pollutants in Northeast Asia (LTP). A joint research project among China, Japan, and the ROK, the LTP was initiated by the National Institute of Environment Research (NIER) of the ROK. It aims to "understand the state of air quality in Northeast Asia, laying a foundation for research on long-range transports, to develop the scientific basis for environmental decision-making, and ultimately to improve air quality in Northeast Asia" (TEMM, 2010, p. 37). Experts in monitoring and modeling, and governmental officials from these three countries, have held annual meetings for the LTP project since 1995. The 2010 Tripartite Environment Ministers Meeting among the ROK, China, and Japan (TEMM) agreed that these meetings have helped the participants reach "a common understanding on a worsening of air quality in the region" through "conducting joint research on LTP monitoring and modeling as well as emission inventory" (2010, p. 37).

The participating countries agreed to carry out ground monitoring and aircraft observation and to review the gridded emission data for SO_2, NOx, and Volatile Organic Compounds (VOC) at their First Sub-Working Group Meeting in 1999 (Secretariat of

Working Group for LTP Project, 2010a, p. 4). As shown in Figure 5.1, China chose Dalian and Xiamen, Japan chose Rishiri and Oki, and the ROK chose Gangwha, Taean, and Gosan[103] as their monitoring sites based on the Terms of Reference of LTP adopted at the First Sub-Working Group Meeting in 1999.

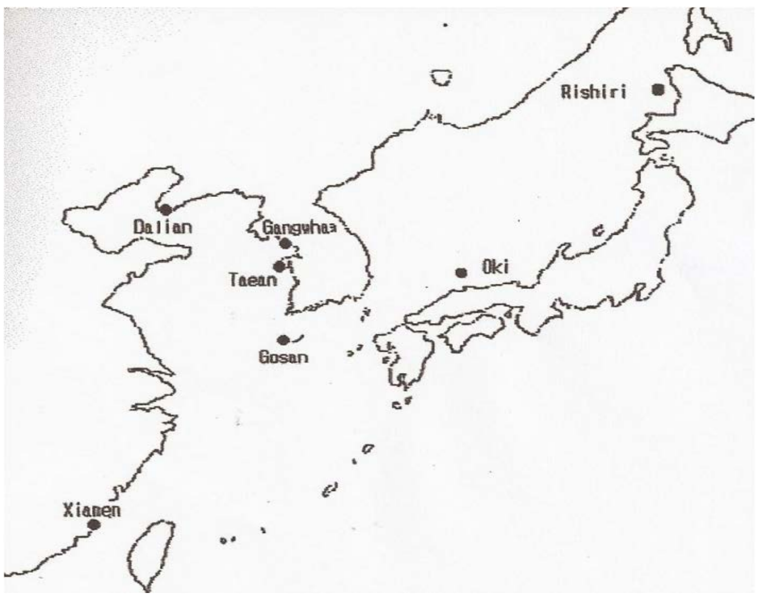

Figure 5.1. Locations of monitoring sites for LTP. Adapted from *Annual Report: The 10th Year's Joint Research on Long-range Transboundary Air Pollutants in Northeast Asia*, by Secretariat of Working Group for LTP Project, 2010a, p. 13.

Despite two decades of continuous effort, however, LTP, like EANET and TDGM projects, has been largely a failure in terms of generating broader cooperation and producing useful measurement data that could lead to the creation of a regional environmental regime. Unlike EANET and TDGM, however, LTP has established neither formal nor concrete forms of collective action in the region. The LTP participants have

[103] The ROK changed its monitoring sites from these three locations to Gosan and Dukjeok at the Eighth Expert Meeting in 2005.

reached no agreement about the program's organizational structure, whereas the participants of EANET and TDGM created joint announcements specifying their structures in their early years, 2000 and 2007, respectively. Due to the lack of formal characteristics of cooperation, the participating governments have been reluctant to endorse the annual reports presented by the Secretariat of the Working Group for LTP, and therefore no research results have been officially published. Another reason the research findings have not been endorsed is that the Chinese and Japanese governments appear to regard LTP as simply one of the many scientific research projects in which they are engaged.

In addition to this lack of formal mode of collective action, LTP has established few concrete forms of collective action. It has developed neither common methods for monitoring essential items nor shared modeling programs for its modeling research activities. The failure to move from joint research to more substantive forms of environmental policy cooperation can be explained by the absence of all three of the previously identified factors that contribute to meaningful regional cooperation: the absence of political leadership, the inability to mobilize scientific research results for creating shared knowledge, and the absence of learning as a socialization process.

The following sections examine the limited extent of LTP's political leadership, shared knowledge, and socialization activities, especially in comparison to the greater success of EANET and TDGM. This chapter thus considers possible reasons for the LTP program's having developed the least extent of collective action. This relative failure is puzzling given that the ministries of environment of all the three countries have affirmed their commitment to LTP program as well as EATNET in their joint communiqué of the TEMM:

> Regarding air pollution, the Ministers noted that acid deposition is still a serious problem in the region and reaffirmed their commitment to promoting the activities of the Acid Deposition Monitoring Network in East Asia (EANET) and joint research on Long-range Trans-boundary Air Pollutants in Northeast Asia (LTP). The Ministers stressed the importance of information exchange, capacity building and joint research and showed great expectation for the future development of EANET and LTP. (TEMM, 2006)

Development of LTP

In 1995, the government of the ROK organized an international workshop titled the First Northeast Asian Workshop on Long-range Transboundary Pollutants which was held in Seoul. At this workshop, participants from China, Japan, and the ROK agreed to "launch a working group composed of government officials and experts from each of the three countries to support a joint research on LTP" and to "establish an interim secretariat at the National Institute of Environmental Research in Korea for supporting LTP organization and affairs of the working group" (Secretariat of Working Group for LTP Project, 2010a, p. 3). Two working group meetings were held in the following years to prepare for a full-fledged launch of the joint research (Table 5.1).

Table 5.1

List of LTP Meetings

Year	Working Group Meetings	Sub-Working Group Meetings	Location
1995	Northeast Asian Workshop on Long-range Transboundary Pollutants		Seoul, ROK

1996	1st Expert Meeting[a]	-	Seoul, ROK
1997	2nd Expert Meeting	-	Seoul, ROK
1999	-	1st	Seoul, ROK
2000	3rd Expert Meeting	2nd	Seoul, ROK
2001	4th Expert Meeting	3rd	Seoul, ROK
2002	5th Expert Meeting	4th	Gyeongju, ROK
2003	6th Expert Meeting	5th	Jeju, ROK
2004	7th Expert Meeting	6th	Xiamen, China
2005	8th Expert Meeting	7th	Seogwipo, ROK
2006	9th Expert Meeting	8th	Daegu, ROK
2007	10th Expert Meeting	9th	Busan, ROK
2008	11th Expert Meeting	10th	Unknown, ROK
2009	12th Expert Meeting	11th	Jeju, ROK

Note: Adapted from *Annual Report: The 10th Year's Joint Research on Long-range Transboundary Air Pollutants in Northeast Asia*, by Secretariat of Working Group for LTP Project, 2010a, pp. 3-7; press releases from MOEK in various years.

[a] The full title of the meeting is the First Expert Meeting for Long-range Transboundary Air Pollutants in Northeast Asia. Since 2000, the LTP has separated the Expert Meetings for Long-range transboundary Air Pollutants in Northeast Asia into two groups of meetings: Working Group Meetings and Sub-Working Group Meetings. For example, the 10th Expert Meeting for Long-range Transboundary Air Pollutants in Northeast Asia was divided into the 10th Working Group and the Ninth Sub-Working Group Meeting.

At the First Expert Meeting of LTP in 1996, the participating countries agreed to perform joint research involving both monitoring and modeling and to upgrade the interim secretariat to an official secretariat to support the activities of the working group. At the Second Expert Meeting for LTP in 1997, two sub-working groups were created: one for monitoring and another for modeling. At the First Sub-Working Group Meeting in August of 1999,[104] the participants agreed to launch the Five-Year (September 1999-December 2004) Plan for the Joint Research to discuss research plans and methods for conducting three stages of research and to adopt the Terms of Reference (TOR) for the Joint Research.

The three agreed-upon stages were (a) building an International Co-operation Platform for monitoring, modeling, and emission inventory to be accomplished between 1999 and 2004; (b) focusing on the analysis of LTP monitoring data, development of LTP emission inventories, and model evaluation of transboundary transport of sulfur and source-receptor relationships of SO_2 between 2005 and 2007; and (c) continuing analysis of monitoring data and development of emission inventory and moving on to investigate the source-receptor relationships of NOx, Ozone, and PM between 2008 and 2012.[105]

Each working group consisted of nine members, including three delegates (governmental officials, researchers, or professors) nominated by each country. Since the two sub-working groups were established at the Second Expert Meeting in 1997, the sub-working group for monitoring has been led by Japan, and the sub-working group for modeling has been led by China and Japan (Chang, 2012). The National Institute of Environmental Research (NIER) in the ROK has served as the secretariat of LTP.

[104] In 1999, no working group meeting was held.
[105] According to Lim-Seok Chang, the LTP deals with anthropogenic particulate matter, excluding dust and sandstorms, to avoid duplication of work between the LTP and the TDGM. (Interview with Lim-Seok Chang on March 31, 2010.)

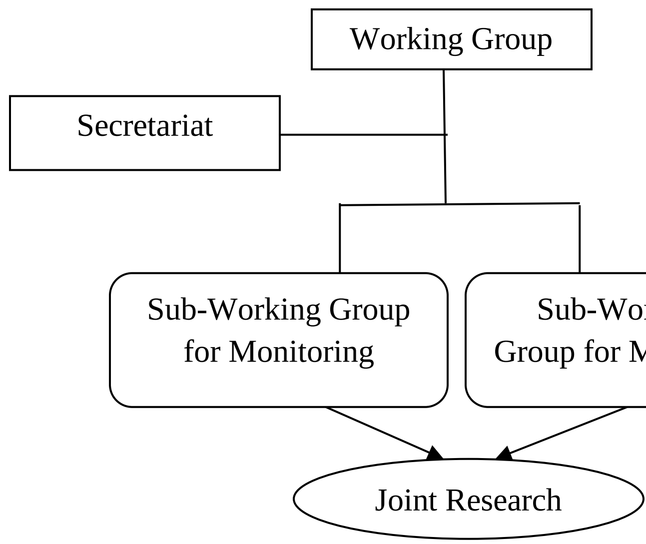

Figure 5.2. Organization of LTP. Adapted from "LTP Project Assessment and Future Activity," by Lim-Seok Chang, 2012. http://www.iges.or.jp/en/gc/pdf/activity20121207/LIM-SEOKCHANG.pdf.

LTP's Achievements and Limitations

As the organizational chart in Figure 5.2 shows, LTP project has established basic organizational settings for monitoring, including which items to monitor and how to share the collected data. LTP can be categorized as a formal cooperative program because governmental officials and experts from all three countries have participated in the meetings. The Working Group includes working-level officials, most from ministries of environment, and experts at the national research institutes, such as the National Institute of Environmental Research (NIER) in the ROK, the National Institute of Environmental Studies (NIES) in Japan, the Chinese Research Academy of Environmental Sciences (CRAES), and professors in academia. The Working Group was established to play the role of governing body. Although the main actors in the LTP programs are drawn from the staff of environmental research institutes in the three countries, active involvement by officials from the countries' ministries of environment gives LTP greater status as a form of international cooperation than that of a research institution (Chu, 2005; MOEK, 2009a).[106] Furthermore, in February 2000, the LTP project became one of the nine projects managed by Tripartite Environment Ministers Meeting (TEMM),[107] indicating that the LTP project has become recognized as an official cooperative activity rather than simply a joint research project conducted by scientists from three countries.

There are two kinds of monitoring activities: intensive monitoring and long-term monitoring. Through its long-term monitoring, LTP collects three kinds of data: existing continuous monitoring station data; PM (2.5 or 10), SO_2, O_3, NOx, and meteorological data; and precipitation data (pH, EC, anion, cation, rainfall) (Kim, 2008). The items to be measured and periods over which intensive monitoring would take place were agreed upon at the annual expert meeting. For example, the participants in the 10th Expert Meeting in 2007 agreed to measure specific air pollutants: SO_2, NO_2, PM_{10}, and ionic components (O_3 and $PM_{2.5}$ optional). They also agreed to conduct intensive monitoring from May 20 to May 29, 2008, and from October 9 to October 18, 2008.

In 2012, the LTP Secretariat made a presentation on "LTP Project Assessment and Future Activity" at the Better Air Quality (BAQ) Conference in Hong Kong. The Secretariat argued that LTP has contributed to creating research plans and capacity building on transboundary air pollutants and to enabling central compilation of

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[106] For China, the organization is the Ministry of Environmental Protection rather than the Ministry of Environment.

[107] The nine projects are (a) Korea/China/Japan Tripartite Joint Environmental Training; (b) Fresh Water Pollution Prevention Project; (c) Korea/China/Japan Environmental Industry Round Table; (d) The Tripartite Environmental Education Network; (e) TEMM Web Site; (f) Long-range Transboundary Air Pollutants in Northeast Asia (LTP); (g) The Acid Deposition Monitoring Network in East Asia (EANET); (h) Tripartite Ecological Conservation in Northwest China; and (i) Northeast Asian Center for Environmental Data and Training (MOEK, 2009).

monitoring results and regional analysis results based on modeling, fulfilling one of its objectives, improving regional understanding on long-range transport of air pollutants.

Nonetheless, this chapter argues that LTP falls far short of achieving formal collective action as defined in this study because it lacks the following three characteristics: (a) a clear division of labor within its organizational entities; (b) clear financial arrangements for its joint research; and (c) endorsement of the joint research reports by member countries. As to the first characteristic, there is little indication of the assigned tasks and responsibilities of different units within the organization. Specifically, it is unclear whether the Working Group has fulfilled its role as the organization's formal governing body. Although the Terms of Reference (TOR) for the joint research were agreed upon at the First Sub-Working Group Meeting in 1999, the specific duties of the separate organizational entities have not been further clarified. In a 2012 presentation of a self-evaluation of LTP at the Better Air Quality Conference in Hong Kong, Lim-Seok Chang, a key participant from the ROK, pointed out that the responsibilities of the Working Group and the Sub-Working Group need to be clarified for the LPT to develop further. He also advised that the Working Group should focus on determining the work scope and budgetary issues of LTP and that the Sub-Working Group should concentrate on research activities, including an examination of the specifics of monitoring and modeling.

Regarding the second characteristic, no financial arrangement has been set up for conducting the joint research projects. As will be discussed in the political leadership section, little cost sharing has occurred, and the ROK, as the initiator of the organization, has shouldered most of the financial burden. Although the Secretariat and the Network

Center of the EANET have reported their expenditures each year to the member countries at the Intergovernmental Meetings, no such reporting system has been established for LTP and none of the three countries has requested or shared financial information about their participation in the LTP project at the annual meetings. For instance, even though the ROK has provided financial assistance for China to participate in the joint research project, it has no information about how China has used this financial assistance because there is no forum for discussing the LTP's financial arrangements. This problem has been recently recognized by the Secretariat of the LTP Working Group, which has recommended that the Working Group focus not only on the scope of the work to be done but also on budgetary issues (Chang, 2012).

The third of these characteristics, a lack of willingness to endorse research results, also demonstrates LTP's limited extent of formal collective action. Participating countries have not endorsed the publication of the annual reports as official, regional-level announcements, and thus the reports are for internal use only. Nam and Lee contend that this "low visibility and limited access to its information for outsiders" has meant that "LTP has rarely been a subject for scholarly discussions on atmospheric governance in North-East Asia" (2012, p. 2). By agreement, the LTP-related press releases of each country include only its own national research results without mentioning those of any other country. For example, the ROK's Ministry of Environment has issued press releases that include only the modeling results from the research conducted by ROK researchers (MOEK, 2009b).

In addition to having developed little formal structure, LTP has established few concrete forms of collective action. If we consider its stated main objectives, it becomes clear that the LTP project has failed to develop concrete forms of collective action over two decades. Those five objectives are the following:

1. To present and discuss the results of the preceding year of research with a form of national report being submitted by each country
2. To discuss the needs of scientific research required to clarify uncertainties and gaps in our knowledge
3. To improve our understanding on long-range transport of air pollutants in Northeast Asia
4. To contribute to laying a foundation for the research on long-range transports of air pollutants
5. To provide policy-makers with science-based information, aimed to prevent or reduce adverse impact on the environment of Northeast Asia. (Secretariat of Working Group for LTP Project, 2010a, p. 3)

Concerning the lack of formulating concrete forms of collective action, the Secretariat of the LTP Working Group has recommended that the Sub-Working Groups "examine the specifics of modeling and monitoring" for more consistent research across countries (Chang, 2012).

For instance, the method and frequency of long-term monitoring in the three countries vary (Table 5.2). Aircraft measurement is optional and based upon its availability in each country rather than fixed measurement periods.

Table 5.2

Description of Monitoring Methods for Essential Items

		China		Japan		ROK	
		Method	Freq.	Method	Freq.	Method	Freq.
Wet	pH	pH Meter	D or P	Glass Electrode	Daily	pH Meter	Daily
	EC	EC Meter	D or P	Conductivity Cell	Daily	EC Meter	Daily

	Precipitation	Rain Gauge	D or P	Rain Gauge	Daily	Rain Gauge	Daily
	Anions	IC	D or P	IC	Daily	IC	Daily
	Cations	AAS	D or P	IC	Daily	AAS	Daily
	NH4+	IC	D or P	IC	Daily	UV	Daily
Dry	SO2	UV Fluorescence (Dalian) DOAS-open Path (Xiamen)	C	UV Fluorescence	Hourly	UV Fluorescence	C
	NOx	Chemiluminescence (Dalian)	C	Chemiluminescence	Hourly	Chemiluminescence	C
	NO	DOAS-open Path (Xiamen)					
	PM mass	N/A	-	TEOM, ß-ray	Hourly	N/A	-
	O3	N/A	-	UV Photometry	Hourly	UV Photometry	C
	PM10	ß-gauge (Dalian) TEOM (Xiamen)	C	N/A		ß-gauge	C
	PM2.5	N/A	-	N/A		3 Stage Filter Pack System	-
	CO	N/A	-	N/A		NDIR	C
	PM2.5, PM10, comp.	N/A	-	N/A		IC and AA	–

C: Continuous
D or P: Daily or when precipitation
N/A: Not Analyzed
TEOM: Tapered Element Oscillating Microbalance

DOAS: Differential Optical Absorption Spectrometry
Note: Adapted from *Annual Report: The 10th Year's Joint Research on Long-range Transboundary Air Pollutants in Northeast Asia*, by Secretariat of Working Group for LTP Project, 2010a, p. 17.

Furthermore, comparing the research results presented by the various participants can be difficult given that monitoring methods and air pollutants are unique to each country. This lack of comparability of monitoring results is problematic. According to Levy, coordination of national research programs is “the bedrock” of all activities under CLRTAP because “it ensures comparability of results across Europe” (1993, pp. 87-88). He contends that

> Without standardization of data collection, measurement, and analysis procedures, even those countries with an active interest in acidification would be unable to pool their results. With harmonized research methods it is possible to make comparative assessments of environmental quality, and to make better assessments of changes over time. It also enhances the credibility of national research in foreign capitals. (Levy, 1993, p. 88)

The participants in LTP meetings from different countries have discussed their own research results at the annual meetings, and their research reports have been compiled in the annual reports by the secretariat of LTP. Moreover, at the Third Working Group and the Second Sub-Working Group Meetings in 2000, the participants agreed to “acknowledge all the activities of LTP and identify the need for annual reports in addition to LTP meeting proceedings” (Secretariat of Working Group for LTP Project, 2010a, p. 4). Since then, the participants have presented their individual research results at the annual meetings and discussed the format and contents of the annual reports and the work plan.[108]

Despite these efforts, the annual reports have become merely a collection of national reports submitted to the Secretariat of LTP, who combines and reorders each country's research results according to the previously agreed-upon format and contents. Thus, the annual reports do not include any evaluations or comparisons between nations. Moreover, the submission of data is voluntary, and the monitoring methods to be used and the types of air pollutants to be monitored in long-term monitoring are determined by each country because no specific guidelines and requirements have been defined. The only common feature of the countries' monitoring is the use of common units of density for a few air pollutants, which was agreed upon in 2004.[109]

This is very different from European practices on data sharing through Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). As described in chapter 6, EMEP has not only succeeded in establishing reliability of monitoring results of participating countries in various verification manners but also produced a matrix of emission trajectories with which "it is possible to identify where a country's deposition originates and where its emissions finally end up" (Levy, 1993, p. 88). In contrast, as far as modeling is concerned, each participating country of Northeast Asia has adopted its own model for analyzing source-receptor relationships rather than creating a common model. Because of

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[108] The expert meetings have been held late in the year, such as October or November, and the annual reports have been released early the next year, such as in February or March.
[109] Specifically, the participants agreed to use common units of density of air pollutants--ppb for SO2, NOx (or NO2), and O3; µg/m³ for PM--at the Seventh Expert Meeting held in 2004.

the lack of standard methods for monitoring and research results for modeling, this chapter argues, LTP has developed less concrete collective action than EANET has.

Largely as a result, there appears to be little common understanding developed among the participating countries, even though the modeling results of each country have not been that different, as described in the knowledge section later in this chapter. Chan-woo Kim, Director-General for International Cooperation at Ministry of Environment of the ROK, has recognized this challenge and asserted that LTP "should double its efforts to produce any meaningful outcome for policy-makers" (Kim, 2009, p. 29).

Responding to this challenge, participating countries have begun to search for answers to the question of how countries can perform a central compilation of monitoring and modeling data despite the current lack of organization. The recent *Proposal for the Future Development of the LTP Project*, presented at the 2012 meeting, "suggests forming a Science Advisory Committee that consists of authoritative experts from the three countries that would be in charge of publishing a comprehensive report for policymakers by integrating and analyzing reports by countries" (Nam & Lee, 2012, p. 10), which bodes well for the future development of LTP activities; however, it is too early to evaluate whether the committee can achieve its purpose.

In relation to the fourth objective of laying a foundation for research on transboundary air pollutants, the Secretariat has concluded that LTP has succeeded in accumulating and distributing datasets it produces, in publishing national/regional reports/clinical manuals and scientific papers on LTP," and in supporting and developing websites and computer software for data interpretation and modeling. For the fifth objective, providing policy-makers with scientific information, the Secretariat has determined that the LTP project has enabled policy-makers to learn about estimates of the influence and severity of long-range air pollutants in Northeast Asia through their national reports.

Despite the LTP Secretariat's insistence that the LTP project has made contributions, however, how much it has actually accomplished over two decades remains unclear. I would argue that its objectives are not specific enough, particularly regarding the scope of the countries' research and the role of science beyond providing policy-makers with "science-based information" that can lead them to act to "prevent or reduce adverse impacts on the environment of Northeast Asia." It is difficult to anticipate what kinds of action plan can be drawn based on the LTP joint research, particularly regarding the policy-making processes of each country. Some participants in Northeast Asian environmental cooperation on transboundary air pollution are not sure of the LTP's objectives, which remain somewhat general. For example, during an interview, one key Japanese participant in the EANET expressed uncertainty about the goals of the LTP project: "Japan asked Korea of what their next step, but it was not sufficiently clear.. What would Korean colleagues be willing to do with LTP?" [110]

A recent scientific paper, "Sulfur Deposition Simulations Over China, Japan, and Korea: a Model Intercomparison Study for Abating Sulfur Emission," (Kim et al., 2012) seems to show some progress in the clarification of the LTP objectives and production of

[110] Interview with Katsunori Suzuki on April 23, 2010. He has had various occasions to meet the LTP participants from Japan and the ROK.

shared research results. Unlike the somewhat vague objectives of LTP, this article states the objectives of LTP more explicitly:

> The trilateral agreements among China, Japan, and Korea have launched the Long-range Transboundary Air Pollutants in Northeast Asia (LTP) project, aimed at lowering sulfur and nitrogen emissions by setting a target percentage level of deposition for each country. To do so, the concept of critical loads was utilized. Critical load is the maximum allowable depositions without increasing the probability of damage to the soil ecosystem. . . However, the critical loads approach requires a simulation based on a high resolution acid deposition model in order to diagnose the current acidic loadings for the purpose of maximizing cost effectiveness in abating emissions. Toward this end, the primary focus of the LTP project was agreed to better understand the capabilities of regional comprehensive acid deposition models for quantification of source-receptor (S–R) relationships. (Kim et al., 2012, p. 4074)

This might be the first explicit statement of LTP objectives that indicates a specific role of science and direction for LTP research activities. Along with clarifying the objectives of LTP, this scientific article (Kim et al., 2012) contributes to the development of shared views on modeling activities. Even though the participants of the three countries have performed model inter-comparisons since 2007 and agreed to calculate source-receptor relationships for total nitrate with the Method III of EMEP in 2008, they have not produced research results upon which they can agree; therefore, the recent publication of this paper (Kim et al., 2012) jointly authored by 21 researchers from Northeast Asia (most of whom have attended annual expert meetings of LTP as representatives of each government), is significant.

A senior researcher at NIER, the Secretariat of Working Group for LTP project, states that:

> Scientific research has been conducted for the future, when China changes their attitudes and becomes more cooperative on regional environmental cooperation. Science tries to prepare for the answers to the future questions that China might raise for the evidences of transboundary pollution. As of now, there is no organization to put the transboundary concerns on the table except the TEMM which has no regulatory power in practice. We need to create the table for us to discuss transboundary pollution issues. (Interview with Lim-seok Chang on August 17, 2009)

Finding "answers to the future questions that China might raise for the evidences of transboundary pollution" may result in the evolution of shared knowledge about source-and-receptor relationships on transboundary air pollutants in Northeast Asia.

This paper (Kim et al., 2012) might serve as a cornerstone for the development of common understanding among China, Japan, and the ROK about transboundary air pollutants in Northeast Asia. Although it is uncertain whether this scientific research paper can represent the accomplishment of the LTP objectives, this jointly authored article could be a late but essential starting point for developing common ground for further policy initiatives, particularly in a situation in which there has been no official publication of the joint research results.

To summarize, LTP has developed little formal collective action because of the lack of a clear definition of the functions of the Working Group as the governing body and of the financial responsibilities of individual countries and has developed only a small degree of concrete collective action because of the varying research methods employed by participating countries and lack of specific guidelines for performing joint research. Although the participation of governmental officials and experts from national research institutes and academia in its annual meetings demonstrate that LTP has been recognized as an official international mode of cooperation (Chu et al., 2005), LTP has faced many challenges in its attempts to build formal and concrete collective action. The following sections examine how the three factors - political leadership, shared scientific knowledge, and socialization - have affected the least development of formal and concrete collective action in the LTP project among the three regional cooperative mechanisms that this dissertation deals with.

Political Leadership

This section tests Hypothesis 1, which predicts that the stronger the political leadership exercised by individual participating countries in regional environmental cooperation efforts, the more formal and the more concrete the collective action in the region will be. This study aims to investigate whether stronger political leadership taken by any country in the region, regardless of its material power, increases the likelihood of developing more formal and concrete collective action.

Since the inception of the LTP project, the ROK, as its initiator, has exerted the most significant political leadership. The ROK has exerted extensive structural leadership through making dominant financial contributions and hosting most of the annual expert meetings of LTP. It has also exercised a small amount of directional leadership through its delivery of a variety of monitoring activities, such as aircraft monitoring. However, no country has wielded instrumental leadership within the organization. Despite the participation of governmental officials from the ministries of environment, most participants have tended to be scientists, who have focused on developing scientific projects rather than crafting structures of LTP or on applying diplomatic skills in international meetings. Neither China nor Japan has shown any interest in exerting any form of leadership for LTP. These two countries might consider LTP as a scientific research organization rather than an international cooperative effort.

Structural Leadership in LTP

As stated in the previous chapters, this dissertation assumes that any state in the region could exercise any form of political leadership if it were willing to do so, regardless of its material power. Based on this assumption, this study regards political leadership as independent of rather than predetermined by a state's material capabilities. This contention differs from the realists' assertion that political leadership can only come from the most powerful country and be exercised by the international structure or the powerful countries themselves.

The structural leadership of LTP can be investigated in terms of two aspects: contributions toward its financing and meeting venues. In this, the LTP's structural leadership resembles that of TDGM in the sense that the ROK government has shouldered the majority of the costs. Without the assignment of specific financial responsibilities, the ROK has provided the dominant financial contributions to supporting the joint research and meetings, and also travel expenses for meeting participants from China.

Even though LTP is a joint research program, member countries have not reached any official form of financial agreement similar to EANET's *Decision on the Further Financial Arrangement for EANET*. The Terms of Reference (TOR) is the only shared document that affirms the organizational structure of LTP, and thus, as mentioned earlier, it has no forum similar to the intergovernmental meetings of EANET at which to discuss financial issues and report expenditures for the joint research. As the initiator, the ROK government has been the only financial contributor to the joint project, providing around US$600,000 a year between 2000 and the mid-2000s and around US$1,000,000 in 2007 for joint research. The ministry of environment in the ROK expected the Korean government to spend US$950,000 in 2011 and US$1,450,000 a year between 2012 and 2014 (MOEK, 2009a). China and Japan have not added funding for LTP activities to the LTP budgets. On the contrary, the ROK government has provided China with 6% of the LTP total budget to assist China in its research.

Although Japan has allocated US$10,000 a year to the LTP's activities, it is used only to reimburse its own scientists for travel costs incurred to attend the various LTP meetings beyond that provided by the NIER. As a senior researcher in charge of the LTP projects in Japan emphasized, however, "even this amount of budget is included in the budget for domestic monitoring, rather than being recognized as separate for LTP."[111]

The vast difference in expenditures made by Japan (US$10,000 a year) and the ROK (around US$1,000,000) for LTP clearly demonstrates that the ROK has exercised considerable structural leadership. This making of a dominant contribution by one participating country resembles the financing of EANET, in which Japan has contributed more than 94% for the Secretariat and 99% for the Network Center, and of TDGM, in which the ROK was the only financial source for joint research on the prevention of DSS in Working Group II. The commonality among all of these cases is that the initiating country makes the largest financial contribution. This dominant structural leadership

[111] Interview with Keiichi Sato, a senior researcher at the Atmospheric Research Department and Data Management Department of Asia Center for Air Pollution Research (ACAP) on February 8, 2011.

exerted by one member country is quite different from the financing of the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP), as will be discussed in chapter 6.

In addition to its dominant financial role, the ROK has also provided most of the meeting venues of LTP. As Table 5.1 shows, all meetings except the Seventh Expert Meeting have been held in the ROK. The Seventh Expert Meeting was the only meeting hosted by China, supported by the SEPA. It thus appears that not only the financing but the organizational efforts have not been shared equally by all participating countries.

Based on the financial contributions and the provision of meeting venues, the ROK's structural leadership of LTP has not been shared by the other two countries. Unlike China's various domestic efforts to reduce its emissions, its participation in LTP has not been that strong; rather, it has been the recipient country of financial support for the joint research. Nor has Japan paid any significant amount of attention to LTP, although it has made a minor gesture toward sharing the financial burden. The ROK seems to be the only country that has exercised structural leadership and displayed formal interest and concrete action in strengthening LTP activities. Thus, it can be argued that the ROK's significant political leadership has not driven formal and concrete collective action in the LTP project.

Directional Leadership in LTP

As defined earlier, directional leadership is the ability to provide other member countries with a direction for their participation in international cooperation. There are two paths to exerting directional leadership. States can either generate intellectual capital or provide substantive solutions based on knowledge, thereby changing the perceptions of risks and particular information, or they can present a good example of policy implementation for other countries to follow through unilateral policy implementation related to certain issues. Providing an example of success can increase other countries' perceptions of what is both desirable and possible.

Because LTP is a joint research project without well-established policy goals, as previously described, it does not offer examples of participating countries taking the second path to directional leadership. As this leaves only the first path, increasing influence through knowledge, this study analyzes the amount of monitoring data that each country contributes to the annual reports. As shown in Table 5.3, participating countries have submitted significantly different types and amounts of information regarding monitoring results. Although for some categories, the number of reports has been the same across countries, the length and detail of information in those reports (as measured by pages) has varied considerably.

Table 5.3

Contributions of Each Country to Monitoring Data, in Number of Pages

	Item of Measurement	China		Japan		ROK	
Annual Reports		2010	2005	2010	2005	2010	2005
Long-term Monitoring	Gaseous measurements	2	1	3	3	7	3
	Particulate matter	1	1	2	3	2	1
	Surface meteorology	Not submitted	Not submitted	4	3	3	2
	Precipitation	2	2	7	6	2	2

Intensive Monitoring	Gaseous measurements	Not submitted	N/A	2	2	8	3
	Particulate matter	7	6	9	8	42	5
	Surface meteorology	Not submitted	Not submitted	5	4	5	2
	Precipitation	Not submitted	N/A	2	1	1	N/A
	Satellite data and remote sensing	N/A	N/A	N/A	N/A	2	N/A
	Aircraft measurement	N/A	N/A	N/A	N/A	17	N/A
Total Pages Contributed		9	10	29	30	80	18

China has reported very limited monitoring results, while Japan has made moderate contributions to the annual reports in terms of the specificity of information in its research. The ROK has exhibited more effort in preparing its national reports for the LTP project, substantially increasing the contents of its results in the 2010 annual report compared to those in the 2005 report. Most of this increase can be attributed to the intensive monitoring of particulate matter and aircraft measurement. The ROK was the only country that conducted aircraft measurements after the countries agreed at the Twelfth Expert Meeting in 2009 to conduct aircraft observation as an option for monitoring activities, depending on their monitoring capabilities and “situations of the participating countries” (Secretariat of Working Group for LTP Project, 2010a, p. 7). For China and Japan, conducting aircraft measurements might exceed their capabilities or willingness since it requires using complicated equipment, time performing data analysis, and expenditures. This excerpt from the ROK's report displays the complexity involved in aircraft measurements:

> The aircraft used for measurements was Chieftain (PA31-350) made by Piper Co. In the cabin of aircraft, GPS (GARMIN, GPS II) was installed to monitor the longitudes, latitudes and altitudes. To analyze the concentration of SO2, NOx and O3, the equipments by THERMO Co. were set up. Ambient air was introduced into the cabin of the aircraft through a stainless steel tube connected to the inlet of a bottom of the airplane and into gas analyzers, which were automatically saved in a computer data logger for each 5 seconds. (Secretariat of Working Group for LTP Project, 2010a, p. 133)

The Japanese consider their participation in LTP monitoring activities supplementary to those they conduct for the EANET. A Japanese participant in LTP revealed that to prepare their national report for LTP, the Japanese use their EANET monitoring results for the long-term monitoring. For the intensive monitoring of LTP, the Japanese tend to ask EANET's monitoring sites in Japan to send equipment rather than keeping them in their own institute.[112] Japan thus duplicates some areas of work for LTP and EANET rather than investing extra effort and resources in building monitoring capacity specifically for LTP activities, which may explain why it has not conducted the optional aircraft measurements. According to Levy, one of benefits of collective research programs is that "they foster research efforts in countries that might not otherwise undertake them" (Levy, 1993, p. 88). However, LTP does not seem to have fostered Japan's research efforts through LTP's research activities.

[112] Interview with Keiichi Sato.

Since 2002, China has participated in long-term monitoring at three sites in Dalian and two sites in Xiamen; since 2003, it has also participated in the 10-day semi-annual intensive monitoring program held in Dalian in the spring and in Xiamen in the fall (Meng & Yang, 2012). However, China's sharing of monitoring results has been very low, as can be seen in the missing information and lack of elaboration in the annual LTP reports in Table 5.3.

On the other hand, the ROK's 2009 aircraft measurement may offer new possibilities for the measurement of transboundary air pollutants. In fact, these aircraft measurement results have already helped the region better understand how the air stream affects the transportation of air pollutants through tracking the air stream and back trajectory analysis by region. The ROK's 2009 flight measurements during the intensive monitoring period found that long-range air pollutants were transported in various patterns (Secretariat of Working Group for LTP Project, 2010a, p. 140). This ROK stand-alone measurement might serve as an excellent example of the development of measurement methods for monitoring transboundary air pollutants in the region. If so, it can be argued that the ROK has exerted directional leadership for LTP, particularly regarding monitoring. Some might argue that the ROK's aircraft measurements reflect a lack of Korean directional leadership since no other countries have adopted this practice. However, because aircraft measurement is a relatively new practice, it might be too early to deem the ROK's initiative a failure. If the data derived from the aircraft measurement is used in an efficient way, the ROK might become an exemplar of a country that has tried an expensive measurement method resulting in advancements in monitoring.

Instrumental Leadership in LTP

As discussed earlier, instrumental leadership consists of using negotiating skills during institutional bargaining processes. Countries with instrumental leadership function as agenda setters for certain issues, popularizers of issues to which they draw attention, inventors of innovative policy options, or brokers of various negotiation deals. As LTP has had a limited negotiating agenda for policies due to its focus on research rather than policy development, no participants in the expert meetings seem to have pursued instrumental leadership. No country has exerted instrumental leadership in regards to research activities.

For example, when participants at the 10th Expert Meeting in 2007 agreed to prepare a manuscript describing model results of deposition and concentration of transboundary air pollutants in Northeast Asia in a peer-reviewed scientific journal, none of the countries showed any notable level of instrumental leadership. Participants agreed to exclude the sensitive source-receptor relationship, even though it is the most critical issue of the LTP project. No country has stepped up to lead the way in bringing the issue of source-receptor relationships into the joint research.

As stated in chapter 2, participating countries have been more willing to extend the scope of air pollutants, geographical areas, and time periods for the LTP's monitoring joint research project than for EANET's monitoring activities. At the Sixth Expert Meeting in 2003, the participants agreed to carry out a model simulation for March and July of 2002 cases; to assess source-receptor relationships for sulfur in five regions, including North Eastern China (Region 1), Central Eastern China (Region II), South China (Region III), the ROK (Region IV), and Japan (Region V); and to conduct model intercomparison (Figure 5.3). Since then, the experts for modeling have attempted to expand their studies on sulfur deposition. At the Seventh Expert Meeting in 2004, the participants decided to extend the area to be included in the LTP model domain from 20-50° N latitude and E 115-150° longitude to 20-50° N latitude and 100-150° E longitude to better simulate the long-range transport process.

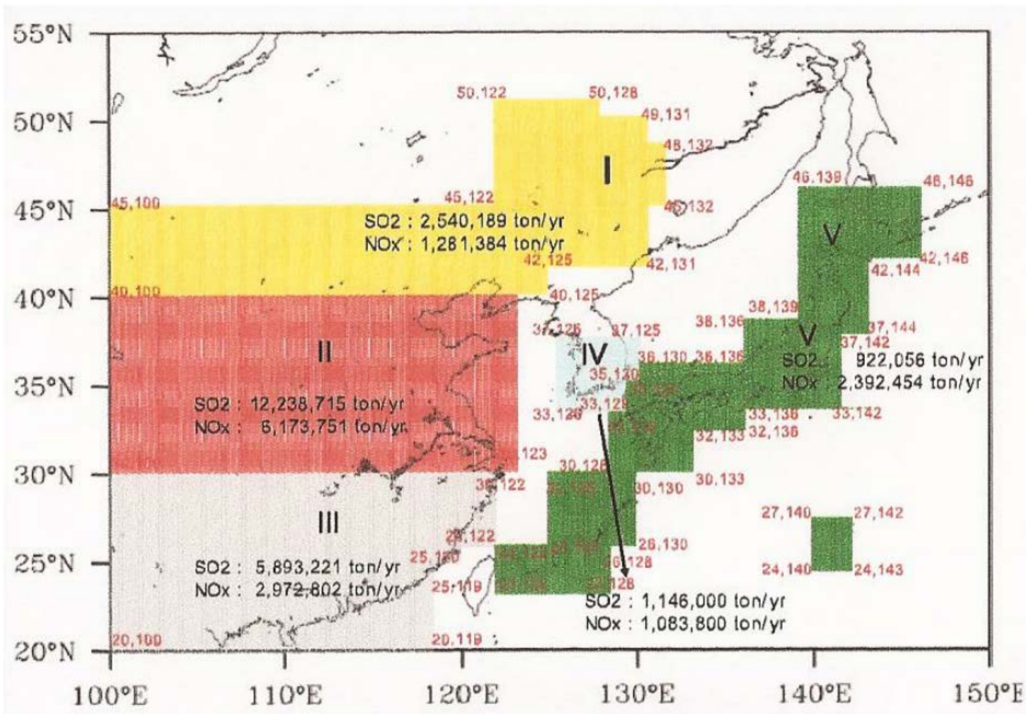


Figure 5.3. Five regions for model simulation in LTP. Adapted from “Joint Research Project on Long-range Transboundary Air Pollutants in North East Asia: Progress and Outcomes,” by Jeong-Soo Kim, 2008, p. 18. http://www.neaspec.org/documents/airpollution/PDF/S3_18am_JeongSoo_Kim(NIER)_LTP.pdf.

The countries also agreed to include 4 more months of model simulation (January, April, August, and October of 2002) at the Eighth Expert Meeting in 2005, and an additional 6 months (February, May, June, September, November, and December of 2002) to include the full year for calculating concentration and deposition at the Ninth Expert Meeting in 2006. At the 10th Expert Meeting, the participants finally agreed to compile all of the results of the simulation for 2002 and to perform model inter-comparison. In addition to the source-receptor relationship for sulfur, countries agreed to examine the source-receptor relationship for total nitrate for 4 months (March, July, October, and December of 2006) at the 11th Expert Meeting in 2008.

As explained in chapter 3, China's objection to the extension of the scope of EANET has circumscribed Japan's intention to exercise instrumental leadership. China has stressed the step-by-step process on the issue of extending EANET's scope in terms of substances to be monitored and activities to be performed. In the case of LTP, the potential for extending the scope of air pollutants for monitoring was addressed in the opening remarks by Suk-jo Lee, Director General of Climate and Air Quality Research Department at National Institute of Environmental Research in the ROK, at the LTP meetings in 2010:

> Up to now, LTP project has focused on sulfur and nitrogen compounds to quantify the impact of acid pollutants on the ecosystem. Now, it is the time to consider entering a new stage of the LTP project. We confront new challenges of short-lived climate forcers such as ozone and particulate, as well as new hazardous pollutants of Hg, PAH and POPs. (Secretariat of Working Group for LTP Project, 2010b, p. 3)

Unlike their response to EANET, however, China has not expressed opposition to the LTP's ambitions to extend the scope of its research because, as argued in chapter 2, the LTP project is more research-oriented, and also because China might consider itself less threatened by the ROK's firm exertion of leadership as compared to its more competitive relationship with Japan. The fact that participating countries may be willing to extend the scope of the LTP research project even without any country at the helm is another reason to doubt that any of the countries have exercised firm instrumental leadership.

In short, the ROK has practiced political leadership within LTP. As the initiator, it has exercised structural leadership through making significant financial contributions and hosting most LTP meetings over the past two decades. It has also demonstrated directional leadership through providing the most effective monitoring data in its national reports, as well as developing a new aircraft measurement method. However, no country seems to have pursued instrumental leadership, as seen in the failure to address the sensitive issue of the source-receptor relationship that would allow for more understanding about transboundary air pollutants.

Knowledge

The main objective of LTP is to accumulate scientific knowledge to provide greater understanding of long-range transport of air pollutants in Northeast Asia and science-based information to policy-makers to help them design policies that will reduce adverse effects of air pollutants on the regional environment. This section examines why the cooperative joint research LTP has conducted over the past two decades has brought little common understanding on the topic

Each country used its own model for conducting research on source-receptor relationships of SO_2 for 2003 and NOx-related deposition for 2006. China used the Community Multi-scale Air Quality (CMAQ) regional air quality model, Japan used the Regional Air Quality Model (RAQM), and the ROK used the Comprehensive Acid

Deposition Model (CADM). These three models were used to run a simulation for the same period, domain, and emission data to identify air pollutants' trajectories. According to former Secretary of LTP, Ilsoo Park, "It would be good to have a common model like Europe. However, it might be better to regard the medium results of different models as more appropriate results. As three countries apply same emission data, the modeling results have been similar." [113] Since the countries first agreed to perform model inter-comparison at the 10th Expert Meeting in 2007, participants have "attempted to investigate the sensitivity to model variability arising from different model types, assumptions, and meteorological parameterizations including microphysics, cloud schemes, and other surface boundary forcing parameterizations" (Kim et al., 2012, p. 4086). As part of the LTP project, two scientific articles compared these three models, focusing on sulfur deposition simulations for the year 2002 (Kim et al., 2012) and on the sulfur concentrations over Northeast Asia (Kim et al., 2011) to examine the models' discrepancies. Both articles confirm that there are "lower aggregated uncertainties between the three models" (Kim et al., 2011, p. 399).

The three chemical models calculate "concentrations of chemical species in the gas phase, ion concentration in cloud droplets and rainwater, and amounts of wet and dry depositions" (Kim et al., 2012, p. 4075). The only parameters shared by the three models were the emission rates for SO_2 and NOx, obtained from the national reports for the LTP project. This model inter-comparison study revealed "overall similarity between models" (Kim et al., 2012, p. 4083). The ensemble average of total sulfur depositions over the

[113] Interviewed on March 29, 2010

three countries for 2002 revealed “only a small deviation (5-7%) among the three models,” and “nearly identical sulfur deposition patterns” (Kim et al., 2012, p. 4083).

Before the recent publication of these two articles, little common understanding on transboundary air pollutants existed among the three countries. As noted earlier, annual LTP reports have been published by collating national reports presented at the annual expert meetings, and these reports have not been adopted as official international findings. Thus, the joint research of LTP appears to be unlike the 1970s OECD study that became a cornerstone for CLRTAP and concluded that “air quality in any European country is measurably affected by emissions from other European countries” and that “if countries find it desirable to reduce substantially the total deposition of sulphur within their borders individual national control programmes can achieve only a limited success” (Semb, Eliassen, & Dutchak, 2004, p. 9).

That these articles, drafted by multiple LTP meeting participants, have been published does point toward the expansion of shared knowledge on transboundary air pollutants in Northeast Asia. Yet this is a very recent phenomenon, and more importantly, it remains uncertain whether this academic version of research will be accepted by three governments as official findings. It is doubtful if countries would understand the similarities of the rest of research results as shared understanding among countries just because this model inter-comparison study showed the overall similarity between models on the accumulated total sulfur deposition.

Furthermore, the source-receptor relationships calculated by the three different models have yielded some controversial results among member countries (see Table 5.4

and Table 5.5). Northwesterly March winds favor long-range transport from the continent in general, and wet deposition in downwind regions in particular, along with high precipitation. In contrast, the continent's influence on downwind countries lessens because the synoptic pattern in summer is "characterized by a subtropic high over the ocean south of Japan and low pressures over most of continent, combined with cyclones moving northward over west Pacific ocean" (Secretariat of Working Group for LTP Project, 2005, p. 212). Equipped with this knowledge, the three countries pay particularly close attention to the contribution rate of source to receptor for sulfur and nitrate depositions.

Tables 5.4 and 5.5 compare the research results of the three countries and show the models' significantly different results. The sulfur depositions in the downwind regions, Region IV (the ROK) and Region V (Japan), vary in each country's research results. According to the ROK's modeling research results, 8.3% of sulfur deposition in Region IV is attributable to sulfur emissions from Region III (South China), while the Japanese model attributes only 3% and the Chinese model only 0.1% to that source. For the total nitrate depositions in the downwind regions, the ROK modeling research results indicate that 23.3% of nitrate deposition in Region IV is due to the nitrate emissions from Region III, while the Japanese and Chinese model results indicate only 7% and 12.8%, respectively. That the most sensitive issue of source-receptor relationships of the transboundary air pollutants has not been commonly understood among countries might explain why they agreed to exclude the source-receptor relationship section from published modeling results of the sulfur concentration and deposition in Northeast Asia in a peer-reviewed journal.

Table 5.4

Sources and Receptors for Total Sulfur Deposition in March 2002 (%)

Source receptor	Region I			Region II			Region III			Region IV			Region V		
	C	J	K	C	J	K	C	J	K	C	J	K	C	J	K
Region I	74.7	73	62.6	4.3	4	36.9	1.5	1	0.1	10.3	6	0.1	10.3	9	0
Region II	24	26	1.3	92	91	91.2	18	20	7.3	14.5	10	0.2	14.5	16	0
Region III	1.2	1	0	3.5	5	26.3	80.4	76	73.2	3.8	3	0.1	3.8	3	0
Region IV	0.1	0	3.7	0.2	0	38.2	0.1	3	8.3	69.2	80	49.1	69.2	11	0.3
Region V	-	0	12.2	-	0	36.4	-	0	9.6	2.2	1	20.1	2.2	61	19.9

Note: C stands for research results from China; J for research results from Japan; K for research results from ROK, revised from Secretariat of Working Group for LTP Project, 2005.

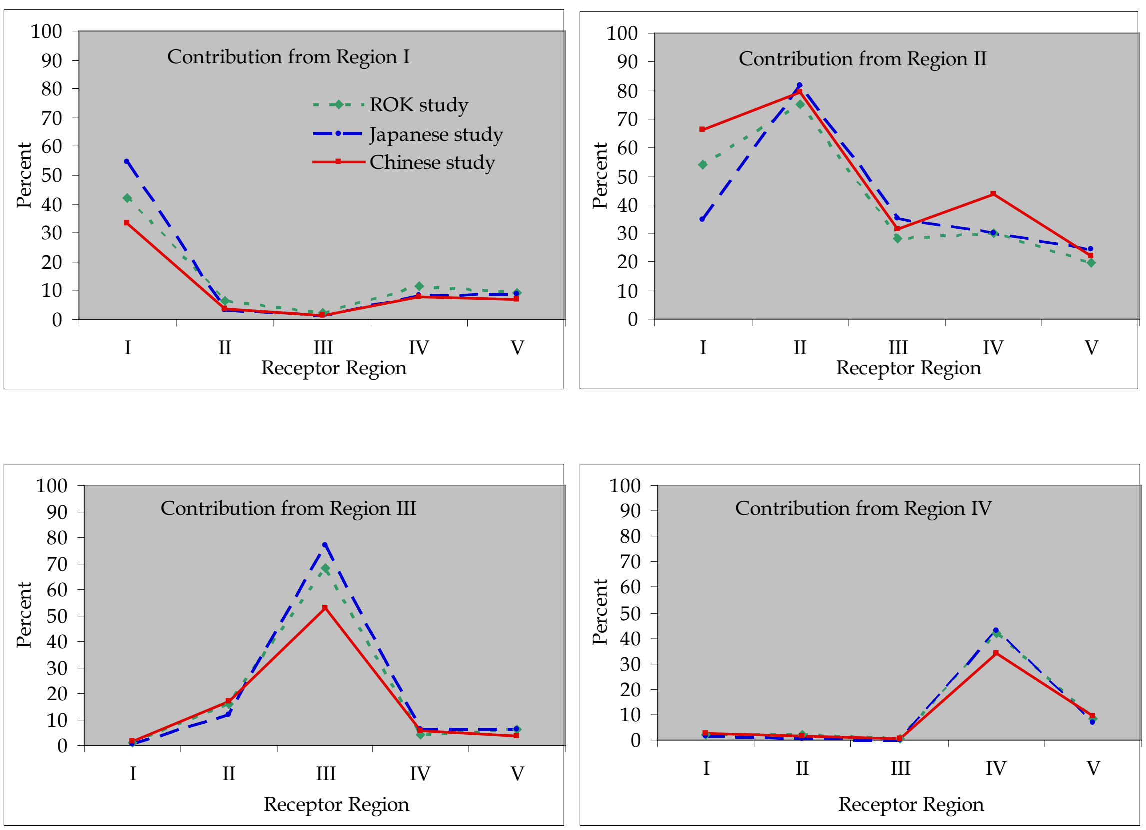
Table 5.5

Sources and Receptors of Total Nitrate Deposition in March 2006 (%)

Source receptor	Region I			Region II			Region III			Region IV			Region V		
	C	J	K	C	J	K	C	J	K	C	J	K	C	J	K
Region I	37.7	39	35.9	2.6	2	60.3	1.1	1	1.5	10.7	11	1.5	10.1	13	0.9
Region II	49.8	55	8.3	70.9	61	69.7	29.7	19	16.1	55.3	64	2.2	33.7	55	3.6
Region III	0.3	4	2.0	20.2	37	26.4	56.5	80	70	4.3	16	0.3	4.07	10	1.3
Region IV	1.8	1	14.9	0.6	0	29.9	0.1	0	5	12.8	7	23.3	10.7	7	26.8
Region V	0.3	0	17.6	0.2	0	24	0.1	0	3.3	5.6	2	11.8	33.3	15	43.2

Note: C stands for research results from China; J for research results from Japan; K for research results from ROK, revised from Secretariat of Working Group for LTP Project, 2010.

Despite these differences in results, according to Nam and Lee, "the value disparity among the countries has been in fact narrowed compared to the past" (2012, p. 6).[114] Based on the most recent annual report from 2012 of the LTP project, Nam and Lee tried to show discrepancies among the three countries' modeled average values over February, May, June, and November of 2006 for the source-receptor relationships for total nitrate dry and wet depositions (Figure 5.4).



[114] For specific degrees of discrepancies of different research projects on the source-receptor relationships, see Kim, 2007.

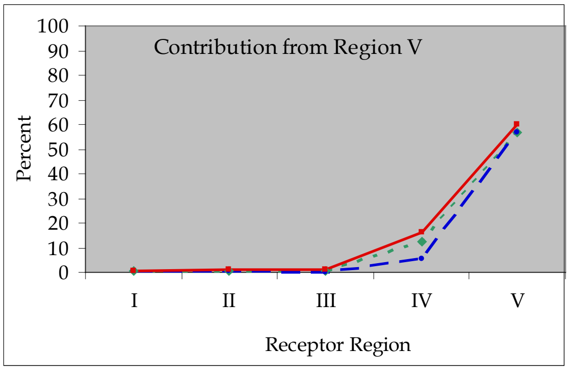


Figure 5.4. Relative contribution from sources to receptors for total nitrate dry and wet deposition. Adapted from "Reverberating Beyond the Region in Addressing Air Pollution in North-East Asia," by Nam and Lee, 2012, p. 6.

In addition to the disparity between assessments of source-receptor relationship for sulfur and nitrate in the five regions since 2003, LTP has not identified the extent to which its research activities should be expanded to provide policy makers with science-based information. Reducing "emissions of acidifying substances usually is accomplished by setting ambient-air-quality standards and then specifying specific fuels or technologies to ensure that those standards were met" (Clark, Jäger, Cavender-Bares, & Dickson, 2001, pp. 32-33). Europe has taken ambitious efforts since the early 1990s to "design 'effects-based' acid rain management strategies that scale emission decreases to estimates of the 'critical loads' of deposition that down-wind ecosystems can tolerate" (Clark et al., 2001, p. 33).

LTP has also discussed the method of critical load related to the impact of long-range transboundary air pollutants. At the Eighth Expert Meeting in 2005, the participants agreed to begin considering the critical load in relation to the impact of long-range transboundary air pollutants in Northeast Asia and "check the capacity of current research and potential activities on critical load in each country" (Secretariat of Working Group for LTP Project, 2005, pp. 5-6). Until recently, however, no specific research outcomes have been shared. This slow development of understanding the critical load in the region contrasts with Europe's speedy development. It took only a decade for the CLRTAP to utilize the concept of critical load in its protocols. In the mid-1980s, Scandinavians promoted the concept of critical loads which was developed in Canada (Levy, 1993). The Protocol on Further Reduction of Sulfur Emissions, adopted in 1994, was the first protocol which was based on the critical loads approach to identify differentiated emission reductions on the basis of the effects of air pollutants. Even though the research on critical load appears significant, it might also lead LTP to study the topic endlessly without actually providing the region with useful scientific criteria for taking political action. For that reason, one ROK participant in the Working Group maintains that

> It is important to determine the scope of the research to identify research phases. If we have research objects, it would be good enough to understand the current status and its implications of pollutants to achieve scientific goals that could provide political momentum for consensus. For example, if we aim to understand critical load, it would take 10 more years to achieve scientific goals.[115]

To summarize, Northeast Asian countries have developed very little shared understanding about transboundary air pollutants through the LTP cooperative mechanism. Even though LTP is a joint research program of these three countries, each country has developed its own model for conducing impact assessment of air pollutants in Northeast Asia and calculating the source-receptor relationship for sulfur and nitrate

[115] Interview with Jinseok Han on March 31, 2010.

depositions. Despite relying on different modeling tools, researchers from the three countries agree that source-receptor results for sulfur are “similar among the three models” (NEASPEC, 2012d, p. 12). Nonetheless, this similarity of the research results has not influenced policy making for dealing with long-range transboundary air pollutants. LTP is still hesitant to adopt conclusive formal or official research results, stating that “the final result of full year simulation still needs one or two years to become available” (NEASPEC, 2012d, p. 12). The ambitious study on the critical load has not produced any conclusive research results that call for specific policy options. Given the lack of clear research objectives and an agreed-upon scope of research activities beyond some recent clarification in an academic journal article, LTP appears to have a long way to go to gain the type of shared knowledge necessary to successfully meet its goals.

Socialization

This section examines Hypothesis 3, which holds that if participating countries in regional environmental cooperation efforts adopt the learning rather than the adaptation as a process of socialization, they are more likely to create more formal and concrete collective action through regional cooperation. Following Ernst Haas’s classification, through the adaptation process, it holds, international actors can change their behavior by responding to new events without questioning their beliefs about underlying values or basic causal mechanisms. In contrast, through the learning process, international actors can change their behaviors by engaging in new thinking that reflects a more fundamental process than adaptation because they can question their originally held theories and values through learning.

This section investigates which of the two processes of socialization, adaptation and learning, the participating countries have engaged in. To determine the socialization processes, this study qualitatively measures the participation patterns of member countries through navigating two questions: (1) whether countries are more likely to have engaged in the learning process of socialization if they have found intrinsic motivations for their regional cooperation rather than indirect political concerns; (2) whether delegates are more likely to have engaged in the learning process of socialization if they have been able to attend international meetings for an extended period in a consistent manner. It is found that Northeast Asian countries have taken the adaptation process of socialization rather than the learning mostly due to the lack of consistent participation patterns.

Regarding the first measurement of participation patterns, it is difficult to explain the political motivations for China and Japan to participate in LTP activities because these two countries appear to regard LTP as simply one of the many research projects in which the Chinese and Japanese scientists are engaged in, as stated above. The political motivations of the ROK's initiative are not that clear as shown in the discussion of LTP's objectives. One possible explanation might be that the ROK was alarmed by the Japanese initiative for the first regional cooperative mechanism in East Asia through the creation of EANET. The ROK might have not been comfortable with the Japanese leadership for regional environmental cooperation due to its distrust resulting from the legacy of the colonial and World War II eras which has affected "virtually all of these countries' international relations, not just environmental issues" (Wilkening, 2006, p. 445).

Regarding the second measurement of the participation patterns, this subsection analyzes the socialization processes of two groups of participants in the Expert Meetings: (a) governmental officials from the three countries, mostly drawn from ministries of environment, and (b) scientists from national research institutes and academia. As in the cases of EANET and TDGM, the bureaucratic rotation systems have affected participation possibilities for public officers in the LTP meetings.

Governmental officials among the delegates, mostly from ministries of environment of China, Japan, and the ROK, hold the same positions for a limited time period and are rotated every year or year and a half. In fact, no governmental officials from any of the three countries' ministries of environment attended more than one Expert Meeting during 2003, 2009, or 2010, the only years for which information is available (see Table 5.6).

Table 5.6
Participants in Expert Meetings of LTP (Name /Affiliation)

	6th Expert Meeting in 2003	**12th Expert Meeting in 2009**	**13th Expert Meeting in 2010**
China	Zelin Wang / MEP Gang Li / CNEMC Dagang Tang / CRAES	Jun Yu / MEP Bing Liu / CNEMC Fan Meng / CRAES Xiaoyang Yang / CRAES Min Hu / Peking University Jianjun Li / CRAES Youjiang He / CRAES Lei Duan / Tsinghua University	Haibo Liu / MEP **Fan Meng** / CRAES **Min Hu** / Peking University Shuai Wang / CNEMC Youjiang He / CRAES Yuanhang Zhang / Peking University **Lei Duan** / Tsinghua University

Japan	Wada Tokuya / MOEJ Shiro Hatakeyama / NIES Tsuyoshi Ohizumi / ADORC Matsuda Kazuhide / ADORC Hiromasa Ueda / Kyoto University Kannari Akiyoshi / Independent researcher	Nobuhiro Kino / MOEJ Akinori Takami / NIES Hiroaki Yagoh / ADORC Keiichi Sato (ADORC) Mizuo Kajino / University of Tokyo	Kazuhiro Yoshikawa / MOEJ Tsuyoshi Ohizumi / ACAP Yayoi Inomata / ACAP **Akinori Takami** / NIES **Keiichi Sato** / ACAP Toshihiro Kitada / Toyohashi University of Technology
ROK	Moon-soo An / MOEK Seok-jo Lee / NIER Il-soo Park / NIER Jin-seok Han / NIER Tae-young Lee / Yonsei University Shang-Gyoo Shim / KIST	Cheon-gyu Park / MOEK Lim-seok Chang / NIER Shang-Gyoo Shim / KIST Young-jun Kim / GIST Cheol-hee Kim / Busan University Jung-heon Woo / Kunkuk University	Sang-jin Lee / MOEK Shang-Gyoo Shim / KIST Young Sunwoo / Konkuk University **Lim-seok Chang** / NIER Min-do Lee / NIER Young-joon Kim / GIST **Cheol-hee Kim** / Busan National University **Jung-hun Woo** / Konkuk University

Note: Information based on MOEK, 2003, 2009; Secretariat of Working Group for LTP, 2010. Names of 2010 repeaters from 2009 bolded to show lots of moving around in the government agencies.
ACAP: Asia Center for Air Pollution Research in Japan (former ADORC)
ADORC: Acid Deposition and Oxidant Research Center in Japan
CNEMC: Chinese National Environmental Monitoring Center
CRAES: Chinese Research Academy of Environmental Sciences
GIST: Gwangju Institute of Science and Technology in the ROK
KIST: Korea Institute of Science and Technology
NIER: National Institute of Environmental Research in the ROK
NIES: National Institute for Environmental Studies in Japan

As mentioned in chapter 3, due to the brief period for which governmental delegates are seated in the national focal points of the LTP meetings, it can be assumed that these participants have put most of their effort into absorbing their predecessors' self-understandings and their perceptions of the other participants, especially those from other countries. Frequent rotation are unlikely to give successors enough time to question their understandings, underlying values, or the basic causal mechanisms of regional cooperation, processes that would lead to a learning process that move beyond adaptation. Because 1 or 2 years are not long enough for governmental officials to engage in such a learning process, they adapt themselves to the international settings. This adaptation process might create little room for resolving misunderstandings or difficulties among participants from other countries, particularly on formerly disagreed-upon issues, such as whether to endorse the annual reports of LTP or whether source-receptor relationships should be included in a joint research paper. Under these circumstances, few of the behavioral changes necessary for the further development of LTP can be expected to take place among government participants.

In contrast, the participation of national scientist delegates has been relatively stable as shown, as also shown in Table 5.6. Five of the seven ROK scientists who attended the 13th Expert Meeting in 2010 had participated in earlier meetings in 2003 and 2009. Five out of six participating Chinese scientists and three out of five Japanese scientists had attended earlier meetings and participated in research activities in previous years. Thus, scientist delegates, who have participated in the learning process through more consistent and diverse involvement in the various international meetings, have engaged in the learning process of socialization.

In addition to their relatively continuous participation in the Expert Meetings of LTP, the scientist delegates from all three countries have enjoyed greater opportunities to meet their counterparts from other countries and discuss transboundary air pollution in various cooperative mechanisms than have the governmental official delegates. For example, the North-East Asian Subregional Programme for Environmental Cooperation (NEASPEC) has organized international meetings as a part of its project activities on Mitigation of Transboundary Pollution from Coal-fired Power Plants in North East Asia. The NEASPEC meetings include International Conference on Transboundary Air Pollution in North-East Asia in 2008, Expert Consultation Meeting on NEASPEC Activities in the Field of Transboundary Air Pollution in North-East Asia in January 2011, and a Workshop on Transboundary Air Pollution in North-East Asia in November 2011 (Table 5.7).

Table 5.7
List of Participants in Meetings Organized by NEASPEC (Name/Affiliation)

	2008 (in Japan) International Conference on Transboundary Air Pollution in North-East Asia	Jan. 2011 (in ROK) Expert Consultation Meeting on NEASPEC Activities in the field of Transboundary Air Pollution in North-East Asia	Nov. 2011 (in ROK) Workshop on Transboundary Air Pollution in North-East Asia
China	Fan Meng / CRAES Jun Wang / CEC Hezhong Tian / Beijing Normal University	-	Sheng Chen / MEP Fan Meng / CRAES Xiaoyang Yang / CRAES Youjiang He / CRAES Lei Duan / Tsinghua University Min Hu / Peking University Xuesong Wang / Peking University Shuai Wang / CNEMC
Japan	Hiroshi Hayami / CRIEPI Hiroshi Moritomi / Gifu University Hirofumi Aizawa / MOEJ Shigehiro Matsuda / Tokyo Electric Power	Jesada Luangjame / ACAP	Ken Yamashita / ACAP

	Company Akira Nitta / ADORC		
ROK	Lim-Seok Chang / NIER Cheol-Hee Kim / Pusan National University Ki-Suh Park / Korea Cottrell Company Jeong-soo Kim / NIER	Lim-Seok Chang / NIER Heung-Kyeong Park / Ministry of Foreign Affairs and Trade Seog-yeon Cho / Inha University Changsub Shim / Korea Environment Institute	Lim-Seok Chang / NIER Jong-Choon Kim / NIER Seog-yeon Cho / Inha University Sinae Choi / NIER Sang-Woo Kim / Seoul National University Jung-Hun Woo / Konkuk University Young-il Ma / Konkuk University Younha Kim / KonKuk University

Note: Information based on NEASPEC 2008; 2011a; 2011b.

Two out of 11 ROK scientist delegates and five out of 13 Chinese scientist delegates to the LTP Expert Meetings in 2003, 2009, and 2010 had attended one of these three NEASPEC meetings. This attendance pattern shows that some participants with science backgrounds have had first-hand experiences with the LTP and taken time to think critically about its roles and limitations. Some of the 21 participants from the three countries who authored a recent journal article (Kim et al., 2012) have attended the expert meetings of the LTP and the NEASPEC conferences and workshops. Three (Cheol-Hee Kim, Lim-Seok Chang, and Shang-Gyoo Shim) of the 11 ROK co-authors attended the LTP meetings, and three (Cheol-Hee Kim, Lim-Seok Chang, and Jeong-Soo Kim) of 11 attended the meetings organized by the NEASPEC. Four (Fan Meng, Youjiang He, Jun Xu, and Lei Duan) out of six Chinese authors attended the LTP meetings, and three (Fan

Meng, Youjiang He, and Lei Duan) attended the NEASPEC meetings. All four of the Japanese authors had attended the LTP meetings.

In contrast to the participation of Chinese and ROK scientists, Japan has sent only a few delegates to the NEASPEC meetings. No Japanese delegates to the LTP expert meetings had attended the NEASPEC meetings. Only one Japanese delegate participated in the meeting in January 2011 and another in November 2011.[116]

Thus, it can be argued that the scientist delegates to the LTP expert meetings have had a greater opportunity to meet and discuss their research with participants from other countries and to understand the developments reported in others' studies on transboundary air pollution. Scientists from the region have more access to communication with each other through various scientific meetings than do governmental officials who are rotated frequently.

As mentioned above, the article co-authored by Kim et al. in 2012 demonstrates that progress is being made toward solidifying the LTP objectives and addresses the significant similarities of the modeling methods among the three countries. Although it does not represent an official government-level position on transboundary air pollutants, it does prove that scientists from three countries are capable of sharing information about transboundary air pollution and that each country's studies can be considered and accepted by other countries in the pursuit of deeper understanding. This progress can be attributed to the learning process that scientist delegates to the LTP expert meetings have taken in various international settings.

[116] Five Japanese delegates participated in the International Conference on Transboundary Air Pollution in North-East Asia in 2008, but the relatively large number of Japanese delegates to this meeting may have been a result of the meeting's having been held in Japan, while the other two meetings were held in the ROK.

In summary, the two groups of participants at the LTP meetings have experienced different socialization processes. The group of governmental officials from the three countries has taken the adaptation process due to bureaucratic rotation systems that allow them to maintain their positions for only a year or so. Meanwhile, the group of scientist delegates has taken the learning process of socialization because they have had chances to communicate with scientist delegates from other nations through a variety of channels, such as international conferences and workshops organized by other regional environmental cooperative mechanisms.

However, as the case of EANET and TDGM showed, it is unclear whether the learning process of socialization of scientist delegates through their consistent patterns of participation have helped governmental officials engage in the more learning process of socialization. The short terms of service of the governmental official delegates due to bureaucratic rotation systems have limited the amount of interaction that they can have with scientist delegates and thereby have taken not the learning but the adaptation processes of socialization.

Conclusions

This chapter examined how political leadership, scientific knowledge, and socialization have affected the extent of collective action regarding transboundary air pollutants. Even though LTP developed as a regional cooperative mechanism through the active involvement of governmental officials from ministries of environment of China, Japan, and the ROK, it was found that LTP has attained little in the way of either formal or concrete collective action. The Working Group has not functioned well as the governing body due to a lack of job clarification and budgetary power. The two Sub-Working Groups have been unable to agree upon common monitoring and modeling methods for joint research. Furthermore, the three countries have used different monitoring methods and modeling tools, making it difficult to directly compare research results.

This chapter concludes that political leadership is not positively associated with this lack of the extent of formal and concrete collective action, yet the lack of shared scientific knowledge regarding transboundary air pollutants among the participating countries of LPT and the adaptation process of socialization are positively associated with the little development of formal and concrete collective action. Regarding political leadership, the slow and limited development of the LTP project as a regional cooperative mechanism in Northeast Asia seemed odd because the ROK has practiced significant structural leadership of the organization through making dominant contributions for financing the joint research activities and hosting more annual meetings than any other country. The ROK has also wielded directional leadership through trying a new method for monitoring activities, its aircraft measurement for the LTP research.

It is surprising to see that the ROK's extensive political leadership for the organization's joint research activities has not produced any formal and concrete collective action over the past two decades. Considering comparative magnitudes of financial contributions made by leadership countries, the ROK's structural leadership for LTP (US$1,000,000 a year) is significantly less than Japan's for EANET (US$16,000,000 a year). Nonetheless, the ROK's financial contributions to LTP projects can be seen as significant considering the smaller number of participating countries –

only three for LTP and 13 for EANET. In addition, its expenditures for LTP are much larger than its contributions for the TDGM (US$75,000 a year), which has succeeded in achieving formal cooperation in only half a decade, a relatively short period of time. Therefore, the hypothesis that political leadership contributes to developing more formal and concrete collective action is not supported by the LTP case.

In contrast, this chapter upholds the hypothesis on shared knowledge that the greater the commonly shared knowledge among participating countries in regional environmental cooperation efforts, the more formal and the more concrete will be the collective action found in the region. The LTP case confirms that the lack of commonly shared knowledge among participating countries can explain the limited extent of collective action. It also supports the hypothesis on socialization, which asserts the less the learning process among participants in regional environmental cooperation efforts, the less formal and the less concrete will be the collective action found in the region even if a participating country exerts significant political leadership. Thus, little development of shared scientific knowledge and the learning process of socialization can explain the lack of the extent of collective action in the joint research conducted by LTP.

This chapter confirms the social mechanisms between these variables that were found in the previous two chapters. The case of LTP also shows that strong political leadership alone does not lead participating countries to engage in the learning as the socialization process. The adaptation process of socialization among participants in the regional cooperative mechanisms is attributable to the lack of shared scientific knowledge.

CHAPTER 6

NOT LIKE EUROPE:

COMPARING EUROPEAN EXPERIENCES TO NORTHEAST ASIAN ONES REGARDING TRANSBOUNDARY AIR POLLUTION

Introduction

To better understand Northeast Asian experiences in dealing with transboundary air pollution issues, this chapter compares those experiences to Europe's. To explain the differences between the two regions, this chapter analyzes political models that European countries have employed to tackle transboundary air pollution problems through examining the three major factors examined in the previous chapters: the exertion of state leadership, the development of shared scientific knowledge, and adoption of socialization processes.

The chapter argues that unlike Europe, which has achieved positive institutional and environmental outcomes in reducing air pollution by developing better air quality management mechanisms within regional regulatory regimes, Northeast Asia has failed to generate broader cooperation and produce useful measurement data that could lead to the creation of a regional environmental regime despite two decades of efforts. The previous three chapters have analyzed the varying degrees of collective action or negotiated outcomes accomplished by three different cooperative mechanisms, EANET, TDGM, and LTP.

This is the first study to specifically compare Europe and Northeast Asian efforts to deal with transboundary air pollution. Most comparative studies in the field have focused on economic cooperation, as it has been the most institutionalized area of regional cooperation. Europe has expanded its regional cooperation from economic issues to constitutional integration within the European Union, and North America's regional cooperation was also initiated through economic collaboration, including the Automotive Pact and the Defense Sharing Agreement in the 1960s, the North American–Canadian Free Trade Agreement in 1988, a and the North American Free Trade Agreement between Mexico, Canada, and the United States in 1992 (Akaha, 1999, p. 4). The history of economic collaboration in the West may explain why most studies on regional intergovernmental collaboration in Asia have focused on trade liberalization, trade facilitation, and economic cooperation (see for example, Ravenhill, 2001). Although numerous studies have focused largely on European successes in environmental cooperation, this study compares Europe's cooperative experiences with those of Northeast Asia.

By examining the differences in those experiences, the findings in this chapter can contribute to efforts to improve regional environmental cooperation in other regions as well as in Asia. As the previous chapters have shown, Northeast Asia (and in a wider sense, East Asia) has developed various environmental cooperative mechanisms regarding transboundary pollution even though those mechanisms have not yet succeeded in reaching any binding regional agreement. Nonetheless, these regional efforts in Northeast Asia have inspired other regions to also initiate environmental cooperation regarding transboundary air pollution, including in Latin America since 2007 and in Africa since 2008, through the Global Atmospheric Pollution Forum (GAPF), a partnership of international organizations and regional air pollution networks.

In Africa, these efforts have led to the development of the Eastern Africa Regional Framework Agreement on Air Pollution, the Air Pollution Information Network for Africa (APINA), and the Clean Air Initiatives in Sub-Saharan Africa (CAI-SSA). Latin America has established the Meeting of the Latin American and Caribbean Inter-Governmental Network on Air Pollution, the Clean Air Initiatives in Latin America (CAI-LA), and the Inter-American Network for Atmospheric and Biospheric Studies (IANABIS). Given the presence of these cooperative frameworks, a greater understanding of the regional environmental cooperation within Northeast Asia as the first region outside Europe to adopt cooperation on acid rain and other environmental issues can provide other regions of the developing world with specific guidance on what lessons can be drawn from the European experience that may be applicable to their own regions.

Summary of the Northeast Asian Experiences

Based on the findings of the previous chapters, this section examines the political models that Northeast Asian countries have taken to deal with transboundary air pollution issues. The preceding three case chapters examined the varying forms and degrees of collective action developed by the participating countries in terms of their formalization, specificity or concreteness, and legalization. Given that none of these cooperative mechanisms have developed into regulatory regimes, the rest of this section examines the formalization and specificity of their collective action.

Negotiated Outcomes: Empirical Findings

This dissertation has examined the hypothesized effects of leadership, shared knowledge, and the learning mode of socialization on variations among different regional environmental cooperative mechanisms in terms of their degree of formalization, concreteness, and legalization.[117]

Based on its analysis of the three modes of leadership—structural, directional, and instrumental—within the three regional environmental cooperative mechanisms, this study finds that a single participating country has dominated the political leadership of each one. In the case of EANET, Japan's contributions toward the financing of the secretariat constituted 94% of the total expenditures of the secretariat and 99% of the budget of the network center. In the other two cooperative mechanisms examined, the TDGM and the LTP, the ROK has been the dominant financial contributor to joint research projects and borne the cost of most annual meetings and the traveling expenses of Chinese participants.

In terms of shared scientific knowledge, Northeast Asia has been struggling with a lack of scientific standardization despite continuous research efforts for more than two decades. To examine the socialization processes within these cooperative mechanisms, this study investigated the external and internal contexts that have shaped cooperation around environmental issues in the region. These external contexts included international pressures or situations that Northeast Asian countries faced before initiating their regional cooperation efforts regarding their own particular environmental issues related to transboundary pollution. The analysis of internal contexts included an examination of the participation patterns of delegates to the international meetings of the three mechanisms and revealed that they have engaged in the adaptation rather than learning processes of socialization, primarily because of the bureaucratic rotation systems in China, Japan, and the ROK. This study asserts that the frequent turnovers in and inconsistent participation

[117] Table 6.2 shows the results of these variables in the three cases along with the European case.

of delegates have decreased the chance of developing socialization patterns that could enhance international cooperation and encourage behavioral changes by the participating states by building personal relationships among representatives.

Negotiated Outcomes: Analytic Findings

An analysis of these empirical findings indicates that all three independent variables are partly associated with varying degrees of collective action as measured by formal and concrete collective action. Regarding the political leadership, the cases of EANET and TDGM provided strong evidence supporting my hypothesis that the stronger the leadership, whether structural, instrumental, or directional, exercised by a participating country in a form of regional environmental cooperation, the more formal and the more concrete will be the collective action developed in the region. That EANET demonstrated the most formal organization and of concrete outcomes among the three regional cooperative mechanisms are positively associated with Japan's outstanding political leadership. The ROK's dominant but more modest political leadership within the TDGM also appears to be associated with the development of formal but less concrete collective action. The hypothesis is not supported, however, by the failure to develop formal and concrete collective action on the part of LTP despite the ROK's significant exercise of political leadership.

The knowledge model was also partly upheld by the three cases. The hypothesis, which predicts that the greater the commonly shared knowledge among participating countries in regional environmental cooperation efforts, the more formal and the more concrete will be the collective action found in the region, was not supported by the EANET case because it has achieved the most successful extent of formal and concrete collective action without commonly shared scientific knowledge. The TDGM case did not uphold the knowledge model either because the lack of shared scientific knowledge about DSS among the participating countries of TDGM cannot explain why TDGM has succeeded in establishing the formal mode of collective action through creating the first governmental-level, multilateral cooperative mechanism that focuses exclusively on DSS issues in Northeast Asia in a relatively short period of time, from 2007 to the present. However, the LTP case upheld the knowledge model because the lack of shared scientific knowledge regarding transboundary air pollutants among the participating countries are positively associated with the little development of formal and concrete collective action.

The data show that despite their continuous monitoring and modeling efforts over two decades, scientists in the region have not reduced uncertainties about the significant adverse consequences of acid deposition through EANET, the major causes of DSS beyond natural phenomena through TDGM, and the shared source-receptor relationships of air pollutants between countries through LTP. The lack of a common understanding of impacts and anthropogenic causes of atmospheric phenomena has led participating countries to prefer voluntary participation over developing the cooperative mechanisms into regulatory regimes. The socialization model was also partly upheld by the three cases. The hypothesis, which asserts that that it is more likely that participating countries in regional environmental cooperation efforts will create formal and concrete collective action through regional cooperation if they take the learning rather than the adaptation process of socialization, was not supported by the EANET case because the adaptation process of the participating countries in EANET cannot explain the most successful collective action in terms of formalization and concreteness. The TDGM case also did not uphold the socialization model because TDGM achieved formal mode of collective action without the learning process of socialization. However, the LTP case upheld the socialization model because LTP did not develop formal and concrete collective action with the adaptation rather than learning process of socialization.

The earlier chapters have shown that external and internal contexts of Northeast Asia and the participating countries' other experiences in global and regional environmental cooperation have not led the countries in the region to take the learning process of socialization. Responding to external and internal political contexts of the region, the countries in the region chose to create and participate in EANET for their own political reasons rather than out of a genuine concern for tackling the acid deposition problem. For the creation of EANET, Japan chose the issue of acid deposition as a subject of regional environmental cooperation because of its enough scientific accumulation to lead regional environment, rather than its recognition of the acid deposition as a serious environmental problem in Japan. Both China and the ROK also recognized joining the EANET as their chance to achieve their own political objectives such as Japan's investment in building the Sino-Japan Friendship Center for Environmental Protection in China and Japan's agreement on the ROK's initiative for NEASPEC. In the process of developing regional cooperation on DSS, China had particular political interests such as acquiring the technical and financial assistance from the international community and changing its poor reputation on its air quality to hold the 2008 Beijing Olympics. Japan also had political motivations in participating in the international discussions on desertification through the UNCCD such as increasing its reputation among developing nations and aiming to export its expertise in forestry. It is difficult to explain the political motivations for the participation of China and Japan in the LTP projects because both countries appear to regard LTP as simply one of the many scientific research projects in which their scientists are engaged in. One possible explanation for the political motivations of the ROK's initiative might be that the ROK was alarmed by the Japanese initiative for EANET and was uncomfortable with the Japanese leadership due to its distrust.

There has also been little interaction between the national experts in the UNCCD and delegates to the TDGM meetings and between participants of various NEASPEC meetings related to transboundary air pollution and delegates to the LTP meetings. Moreover, the frequent turnover among participating governmental officials and diplomats because of bureaucratic rotation systems has led countries in the region to engage in the adaptation process of socialization by giving participants little physical chance to engage in the learning process of socialization.

Although these three hypotheses are only partly supported by the data, the examination of these variables has uncovered two useful insights. First, it has demonstrated that strong political leadership is not itself sufficient to lead member countries to engage in the learning process of socialization and that a lack of shared scientific knowledge is positively associated with the adaption process of socialization among participants in the cooperative activities of these three regional mechanisms. The second is that the lack of shared knowledge and of the learning mode of socialization helps explain why all three regional cooperative mechanisms have failed to advance to become legally binding cooperative mechanisms.

It thus can be argued that knowledge and socialization barriers are key determinants of the development of regulatory regional environmental regimes. Even given strong political leadership by a participating country, a region is unlikely to develop a legally binding regional environmental regime without shared scientific knowledge and engagement in the learning process of socialization.

Environmental Outcomes

As noted in the previous chapters, the reduction in airborne pollutants emissions in Northeast Asia has not been impressive. Since the beginning of its modernization in the mid-19th century, Japan has achieved rapid economic growth as a result of industrialization and urbanization. During 1955-64, the economic development of Japan was supported by tripled energy consumption, resulting in various air pollution problems that peaked in the 1960s. However, Japan's technological innovation, institutional development, and collaboration between government and industry led to a significant decrease in SO_2 emissions, nearly 40%, between 1974 and 1987 (UNEP, 2001, p. 32). Since the first half of the 2000s, Japan's SO_2 and NOx emissions have shown downward trends (Figure 6.1).

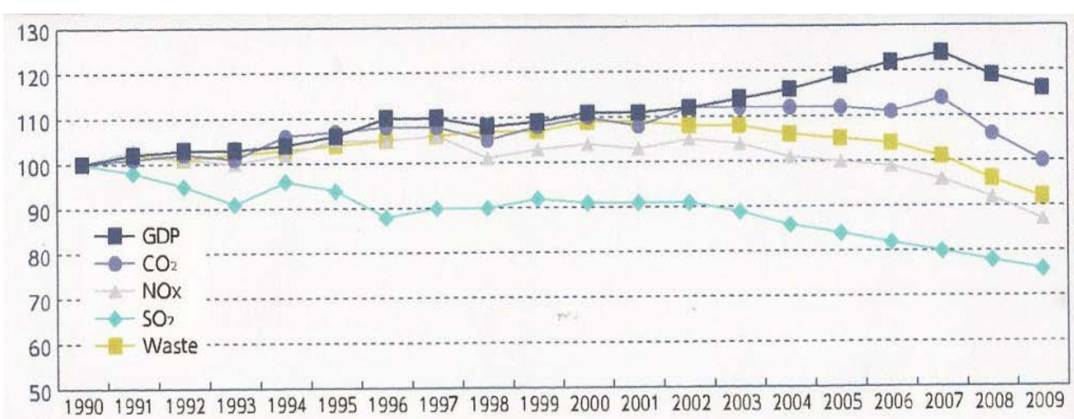


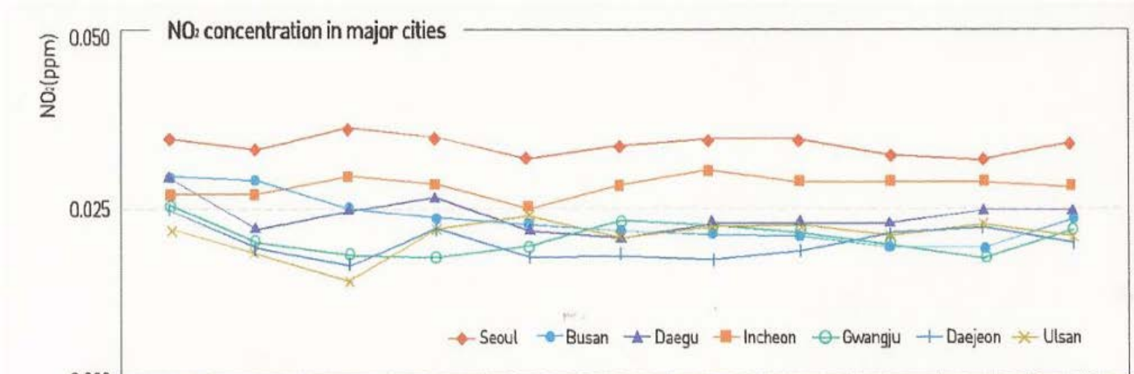
Figure 6.1. Emissions of SO_2 and NOx in Japan. Adapted from "Current Situation of Japan and the World (1)," *Annual Report on the Environment, the Sound Material-Cycle Society and the*

Biodiversity in Japan 2012, by Ministry of Environment of Japan, 2012, p. 12. http://www.env.go.jp/en/wpaper/2012/pdf/03_chpt1-1.pdf.

As discussed in chapter 2, the ROK has dealt with severe air pollution problems since the early 1980s through various domestic measures such as the 1981 Standard for Sulfur Content, the 1985 Prohibition of Solid Fuel Use, and the 1988 Clean Fuel Use Duty. Particularly owing to the government's continuous efforts to strengthen fuel regulations, the concentration level of SO_2 in the major cities of the ROK has been constantly improving (Figure 6.2). The emission reductions for NOx are not as significant as those for sulfur, but the Korean government emphasizes that NO_2 emissions have been controlled at a certain level (Figure 6.3).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average for 10 years
Seoul	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.005	0.005
Busan	0.008	0.007	0.006	0.007	0.006	0.006	0.006	0.006	0.005	0.006	0.006
Daegu	0.008	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.005	0.006
Incheon	0.007	0.006	0.007	0.007	0.007	0.007	0.008	0.007	0.007	0.007	0.007
Gwangju	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Daejeon	0.006	0.004	0.004	0.005	0.005	0.004	0.005	0.004	0.005	0.004	0.005
Ulsan	0.012	0.010	0.011	0.010	0.008	0.007	0.008	0.008	0.008	0.008	0.009

Figure 6.2. Concentration levels of SO_2 in ROK. Adapted from *ECOREA: Environmental Review 2011, Korea*, by Ministry of Environment of Korea, 2012, p. 18. http://eng.me.go.kr/board.do?method=view&docSeq=9728&bbsCode=law_law_paper&currentPage=1&searchType=&searchText=. SO_2 annual average air quality standard is 0.020ppm.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average for 10 years
Seoul	0.037	0.036	0.038	0.037	0.034	0.036	0.038	0.038	0.035	0.034	0.036
Busan	0.030	0.029	0.026	0.024	0.023	0.023	0.022	0.022	0.021	0.021	0.024
Daegu	0.030	0.023	0.026	0.026	0.023	0.023	0.024	0.024	0.024	0.025	0.025
Incheon	0.027	0.027	0.030	0.028	0.025	0.029	0.031	0.030	0.030	0.030	0.029
Gwangju	0.026	0.021	0.019	0.019	0.021	0.024	0.023	0.022	0.021	0.020	0.022
Daejeon	0.025	0.020	0.018	0.022	0.020	0.020	0.019	0.020	0.022	0.023	0.021
Ulsan	0.022	0.019	0.016	0.022	0.024	0.022	0.023	0.024	0.022	0.023	0.022

Figure 6.3. Concentration level of NO_2 in ROK. Adapted from *ECOREA: Environmental Review 2011, Korea*, by Ministry of Environment of Korea, 2012, p. 19. http://eng.me.go.kr/board.do?method=view&docSeq=9728&bbsCode=law_law_paper&currentPage=1&searchType=&searchText=. NO_2 annual average air quality standard is 0.03ppm.

The rapid industrialization and urbanization in China have continued to significantly increase energy demand, resulting in large anthropogenic SO_2 emissions from the combustion of coal. After a relatively stable trend of SO_2 emissions in China during 1995-1999, such emissions increased by 53% from 2000 to 2006, with an annual growth rate of 7.3% (Lu et al., 2010). This change was driven by an increase in fossil fuel consumption due to the economic boom during this period. To deal with this increasing use of fossil fuels, the Chinese government reaffirmed its commitment to reduce SO_2 emissions in its 11th Five-Year Plan during 2006-2010, relative to the 2005 level and set emission reduction requirements that resulted in the wide installation of flue-gas desulfurization (FGD)[118] devices in coal-fired power plants in China. Since July 2007, the government has encouraged the use of FGD equipment through multiple measures such as "the installation of the continuous monitoring systems in all power plants with FGD devices, and the implementation of a premium/penalty scheme of electricity price that varies with the FGD's operation rate" (Lu et al., 2010, p. 6316). As a result, even though GDP and energy consumption in China continued to grow after 2006, its SO_2 emissions began to decrease due to phasing out small, high-emitting power generation units as well as the application of FGD technology.

In contrast, NOx emissions in China have been constantly increasing due to the country's rapid increase in energy consumption and its soaring number of motor vehicles (Figure 6.4).

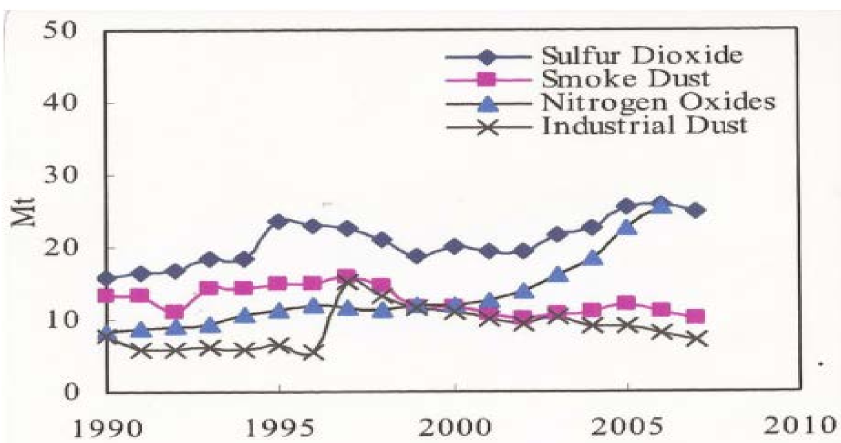


Figure 6.4. Trends of air pollutants emissions in China. Adapted from "Trend of Energy Use and Nitrogen Oxides Emissions in China," by Tian, 2008. http://www.neaspec.org/documents/airpollution/PDF/S2_17pm_Tian[1].pdf.

Despite the lack of regulatory regimes to tackle airborne pollutants problems in Northeast Asia, China, Japan, and the ROK have achieved steady decreases in sulfur

[118] FGD is a set of technologies used to remove SO_2 from exhaust flue gases of fossil-fuel power plants and from other emitting processes.

emissions resulting from domestic measures taken on their own initiative. Even though Japan achieved a nearly 40% reduction of SO_2 emissions between 1974 and 1987, this figure was not impressive compared to the reductions that have been made by many industrialized European countries. Moreover, even though Japan has shown a decrease in NOx emissions resulting from domestic measures since the mid-2000s, the increase in NOx emissions in China has been high enough to degrade the general state of NOx emission conditions in Northeast Asia. The geographical location of China as a source makes this increase particularly worrisome given the dominant downwind in the region in the spring season.

In addition to the problems associated with specific air pollutants that both EANET and TDGM have focused on, environmental problems related to DSS have also increased in the region, as discussed in chapter 4. The frequency and intensity of these problems have been worsening for a few decades. Without international regulatory regimes, numerous bilateral projects have been so sporadic that they have not produced fruitful results, particularly regarding forestation.

Thus, we can conclude that Northeast Asia has not advanced its management system regarding transboundary air pollution in the absence of a regulatory regional environmental regime. This result is different than has been the case in Europe, which has developed better air quality management with the regulatory regime created by the 1979 Convention on Long-Range Transboundary Air Pollution (CLRTAP). In particular, it took only a decade for Europeans to go from recognizing the problem to negotiating a binding agreement, whereas Northeast Asian countries are still working for scientific understanding and standardization since they started to discuss transboundary air pollution in the early 1990s. It took Europe less than a decade after initiating two key joint research projects in 1972 to adopt a framework convention in 1979 and less than two decades to adopt binding regulatory protocols in the 1980s and 1990s. In contrast, Northeast Asia did not start its own joint research until the early 1990, and their efforts over the past two decades have not culminated in a framework treaty or regulatory protocols. To better understand why, the following sections analyze the ways in which the differences in the speed of development and the degree of collective action between Europe and Northeast Asia can be attributed to political leadership, shared scientific knowledge, and modes of socialization.

Summary of European Experiences: CLRTAP

Unlike most regional cooperative mechanisms regarding transboundary air pollution in Northeast Asia that fall into UNEP's second category of such mechanisms with permanent structure and a science focus but without legally binding agreements, CLRTAP has developed as the most successful regional cooperative structure with not only formal and concrete collective action but also legal infrastructure and a policy focus. The following subsections introduce the major treaties, briefly explain how well they have worked in terms of compliance, environmental emission declines related to particular protocols, and the effectiveness of the CLRTAP system in general.

Development of CLRTAP

The CLRATP was a framework convention that established "a basis for continuing research and information sharing, and policymaking" (Selin & VanDeveer, 2011, p. 67). The convention itself merely stated that the monitoring activity and information exchange should start with sulfur dioxide without specifying any particular pollutants that should be controlled. Since then, eight subsequent protocols have been established, six of which are relevant to atmospheric environmental problems associated with sulfur, nitrogen, and VOCs. Table 6.1 lists these protocols with a brief description of their major provisions and information on signatories and implementation.

Table 6.1
CLRTAP and Its Protocols

1979	*CLRTAP*: Adopted in Geneva, November 13, 1979; entered into force March 16, 1983; 51 parties as of August 18, 2013
1984	*EMEP Protocol*: Creates a multilateral trust fund for the long-term financial support of EMEP activities; adopted in Geneva September 28, 1984; 44 parties as of August 18, 2013
1985	*Protocol on the Reduction of Sulfur Emissions or Their Transboundary Fluxes (First Sulfur Protocol)*: Adopted in Helsinki July 8, 1985; entered into force September 2, 1987; 25 parties as of August 18, 2013
1988	*Protocol Concerning the Control of Nitrogen Oxides or Their Transboundary Fluxes (Nitrogen Oxides [NOx] Protocol)*: Adopted in Sofia October 31,1988; entered into force February 14, 1991; 34 parties as of August 18, 2013
1991	*Protocol Concerning the Control of Emissions of Volatile Organic Compounds or Their Transboundary Fluxes (VOCs Protocol)*: Adopted in Geneva 18 November 1991; entered into force September 29, 1997; 24 parties as of August 18, 2013
1994	*Protocol on Further Reduction of Sulfur Emissions (Second Sulfur Protocol)*: Adopted in Oslo June 14, 1994; entered into force August 5, 1998; 28 parties as of August 18, 2013
1998	*Protocol on Heavy Metals*: Targets three particular harmful metals—cadmium, lead, and mercury—and aims to cut emissions from industrial sources, combustion processes in power generation and road transport, and waste incineration; adopted in Aarhus, Denmark June 24, 1998; entered into force December 29, 2003; 33 parties as of August 18, 2013
1998	*Protocol on Persistent Organic Pollutants (POPs)*: Targets 16 particular substances including industrial chemicals and byproducts/contaminants; adopted in Aarhus, Denmark June 24, 1998; entered into force October 23, 2003; 33 parties as of August 18, 2013
1999	*Protocol to Abate Acidification, Eutrophication, and Ground-Level Ozone (multipollutant/multieffect protocol)*: Adopted in Gothenburg November 30, 1999; entered into force May 17, 2005; 25 parties as of August 18, 2013

Note: Adapted and expanded from "Institutional Linkages and European Air Pollution Politics," by Selin & VanDeveer, 2011, pp. 68-69.

As other researchers have noted, these protocols have “become more complicated over time” (Lidskog & Sundqvist, 2011, p. 7) and represent “a steady development” in which they have progressively covered “more substances with regulations that are gradually becoming both binding and specific and more fine-tuned to ecological and economic variations between the countries” (p. 47). The so-called first-generation protocols, including the 1985 Sulfur Protocol, the 1988 NOx Protocol, and the 1991 VOCs Protocol, were based on the flat-rate reduction of emissions of pollutants, which meant that all member countries were expected to achieve the same emission cuts. In contrast, the second-generation protocols, including the 1994 Second Sulfur Protocol and the 1999 multipollutant/multieffect Protocol, “focused on varying national reduction rates based on the approach of critical loads—that is, effects in relation to what nature can withstand-and cost effectiveness” (Lidskog & Sundqvist, 2011, p. 8). In particular, the 1985 Helsinki Protocol mandated uniform reductions of 30% in sulfur dioxide emissions from 1980 levels by 1993, but the 1994 Oslo Protocol mandated country-specific cuts of sulfur dioxide emissions based on the critical loads concept that indicates “regionally-specific emissions targets below which there would be no observable environmental effects from sulfur emissions,” resulting in considerably varying emission-reduction targets among countries based on “weather patterns and country sizes and locations” (Forster, 2010, p. 5).

Organization

Since its initiation, the LRTAP convention has built “a multilayer organization to arrange for the various countries’ participation and to include scientific assessments on the numerous technical and scientific questions of air pollution" (Siebenhüner, 2011, p. 97). The Executive Body, composed of representatives of all parties to the convention, is the CLRTAP's final decision-making entity and meets at least annually to review the implementation of the convention and to adopt plans. Under the Executive Body, there are three main operating bodies: the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) Steering Body, the Working Group on Effects, and the Working Group on Strategies and Review.[119]

The CLRTAP secretariat has only about five full-time positions and organizes meetings, prepares annual work plans, and collects information from member states. It sends technical emission data to EMEP for compilation in EMEP reports. The EMEP Steering Body "oversees the activities of the EMEP programs, including an environmental monitoring system and the collection of emission data, measurement of air and precipitation quality, and modeling of atmospheric transport and deposition of air pollution" (Selin & VanDeveer, 2003, p. 24). The EMEP Steering Body meets and reports to the Executive Body on its activities annually.

Compliance with Regulatory Protocols: Emissions Reductions

Wettestad has characterized national compliance with those protocols as high overall (2011, p. 47). In the 1985 Helsinki Protocol, states agreed to reduce sulfur emissions or their transboundary fluxes by 30% from 1980 levels by 1993. Compliance

[119] The earlier Working Group on Abatement Technologies was dissolved and the Working Group on Strategies was renamed the Working Group on Strategies and Review after some major restructuring following the 1999 Gothenburg Protocol "in order to extend its responsibility to the review of the current protocols and for possible revisions and initiatives" because the main task of Working Group on Abatement Technologies was limited to the "preparation of technical annexes to the protocols" without concern for integrated assessment modeling (Siebenhüner, 2011, pp. 102-103).

with sulfur emission reduction commitments by many countries, including both some Western European and some transition countries in Eastern Europe, was high and in fact marked by "substantial overcompliance" (ibid.). As a result, Europe achieved a reduction of more than 70% in sulfur emissions between 1980 and 2004 (55Tg to 15Tg) (Vestreng, et al., 2007).

The Oslo Protocol was conceived of as "a more effective treaty through focusing the issue on environmental rather than political objectives, thus increasing participation and compliance" (Forster, 2010, p. 5) due to the introduction of differentiated obligations based on the concept of a critical load, which is defined as "a quantitative estimate of an exposure to one or more pollutants below which significantly harmful effects on specified sensitive elements of the environment do not occur according to present knowledge" (Levy, 1993, pp. 101-102).

For the 1991 VOC Protocol, the UNECE argued in a more recent review that progress was very good regarding VOC reductions given that emissions had decreased 41% by 2006 and exceeded the 2010 target of 40% (Wettestad, 2011, p. 49). For the most recent 1999 Gothenburg Protocol, Wettestad notes that the 2010 UNECE review indicated that emissions of ammonia decreased by 22%, greater than the 17% reduction target, and he also argues that "in the period covered by the Gothenburg Protocol (i.e., with a 1990 baseline), by 2006 such emissions had been reduced by 65 percent" (2011, p. 47).

There are, however, pessimistic views on the extent of successful compliance of CLRTAP. For example, for the reduction in SO_2 emissions, it has been suggested that the reduction of industrial emissions may be attributable to "economic reasons or during recent years to air pollution control" such as developing technical measures to limit their dependence on oil and to switch from coal and oil to gas, nuclear, and biomass as a consequence of the 1973 oil crisis, rather than to compliance with the protocols (UNESC, 2004, p. 162). A more pessimistic view of the Helsinki Protocol's contributions to the reductions in sulfur dioxide emissions is taken by Finus and Tjøtta (2003), who contend that they resulted primarily from a non-cooperative abatement policy. According to this argument, many countries had already achieved the targeted reduction when they signed the agreement, and all signatories not only met the target in 1993 but reduced emissions well above beyond the required 30% (Appendix IV).

Reducing nitrogen oxides, however, proved more challenging than reducing sulfur dioxides. Despite other scholars' criticism of the Sofia Protocol for adopting only a freeze (Levy, 1993), a recent implementation review by UNECE argues that progress in NOx reductions has been substantial. NOx levels dropped by average 35% between 1990 and 2006, a little less than the average target of a 41% cut (Wettestad, 2011, p. 49). In comparison to sulfur emissions, it appears that in the case of reductions in NOx emissions, "environmental control requirements have played a much more important role and other reasons have been of less importance" (UNESC, 2004, p. 162).

Compliance with Protocol Obligations

Along with high compliance with emissions reduction requirements, compliance monitoring has also been high, even though some countries have failed to report. As the organizational entity that manages the monitoring of sulfur dioxide, nitrogen dioxides, ground-level ozone, and other substances, EMEP has coordinated all the monitoring data for CLRTAP. According to Lidskog and Sundqvist, EMEP has become a "channel for exchanging standardized scientific information and empirical data" that has enabled the "growth and spread of a common knowledge base concerning both the seriousness of the acid rain issue and ecosystem mechanisms" (2011, p. 9).

EMEP measures pollutant levels at about a hundred stations throughout Europe, and each participating government also reports emission levels to EMEP. Given EMEP's verification procedures, its data monitoring has reached a high level of reliability; according to Levy, "there has never been any suspicion that nations cheat on their emissions reports" (1993, p. 89). In particular, measuring sulfur dioxide emissions by converting fuel consumption figures is so relatively simple that participating countries have high confidence in the EMEP data.[120]

In 2007, the Implementation Committee, established at the 1994 Second Sulfur Protocol to review implementation of and compliance with the protocol, reported an improvement in countries' compliance with reporting obligations. According to the Implementation Committee in its report in 2007, the degree of compliance with protocol obligations was good and improving (Selin & VanDeveer, 2011).

Effectiveness

In terms of effectiveness, Wettestad gave CLRTAP only a "medium" rating in comparison to the regime to protect the ozone layer, which has achieved more significant behavioral change, and to the climate-change regime, which has achieved little behavioral change and seems unlikely to accomplish much productive problem solving in the near future (2011). To measure effectiveness of international institutions, scholars

[120] When it comes to reporting NOx and VOCs levels, however, the performance of participating countries has been poor because CLRTAP "offers few binding and/or stringent emissions reduction requirements" (VanDeveer, 2006, p. 39).

applied the two perspectives: problem characteristics and problem-solving capacity (for example, see Underdal, 1999; Wettestad, 2011).[121] Wettestad determined that CLRTAP's high malignity was attributable to its "perhaps not more than medium success" (Wettestad, 2011, p. 50). In addition to the malign problem characteristics, its problem-solving capacity is moderate in terms of its "institutional aspects such as a limited and stable secretarial capacity. . . and a consensual decision-making style," despite some flexibility in the consensual requirements which was possible because countries were reluctant and had not signed the protocols were holding back the remaining countries (Wettestad, 2011, p. 50). [122]

Potential Explanations for Differences between Environmental Cooperation in Europe and Northeast Asia

This section defends the structural comparability of the regions. It might be argued that the differences between environmental cooperation in Europe and Northeast Asia can be explained by that these two regions have experienced different degrees of regionalism and that they have achieved different levels of economic development within each of the two regions. It sheds light on these two potential explanations and explains why this dissertation focuses on the political leadership, knowledge, and socialization

[121] As Underdal points out, "a problem may be difficult to solve in two different respects: it may be intellectually complex or poorly understood, and it may be politically malign" (1999, 55). Thus, an analysis based on problem characteristics emphasize the "fundamental aspects of the environmental problems addressed by the regimes," and an analysis based on problem-solving capacity focuses on "a combination of the institutional efforts established and the entrepreneurial efforts made to address and solve the environmental or resource problems (Wettestad, 2011, pp. 42-43).

[122]According to Wettestad, this flexibility was possible because countries were reluctant and had not signed the protocols were holding back the remaining countries.

instead of focusing on the influence of comparative regionalism on regional environmental cooperation and the influence of disparity in economic development.

<u>Comparative Regionalism</u>

Scholars who argue that environmental cooperation is a dependent variable in the development of regionalism tend to highlight the under-institutionalized and disjointed features of Northeast Asia, as discussed briefly in chapter 2. Those who claim that environmental cooperation is an independent variable for broader regionalism, argue that the differences in environmental governance result from different political cultures of the regions, characterized in Northeast Asia by a preference for soft agreement, reciprocal promises without formal clauses, a "distaste for legalization," and "consensus-based decision making practices" (Yoon, 2013, p. 43).

The relative lack of cooperative regional mechanisms in Northeast Asia is in great contrast to those among European states, who have also established the European Union (EU), which Akaha calls "the most developed stage of regional integration in the world to date" (1999, p. 31). Akaha attributes the elaborate organizational structure and the timely expansion of membership in the EU to a "combination of enlightened political leadership, common civilizational background, shared security concern during the Cold War era, and common economic interests" (p. 33).[123] In contrast, according to Akaha, Northeast Asia is characterized by "state-to-state conflicts and rivalries, with nationalism remaining a powerful force that commands the loyalty of citizens" (p. 42). As a result of "multiple territorial disputes, jurisdictional conflicts, and ethnic animosities," Akaha argues,

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[123]By "enlightened state intervention" Akaha means the belief that "the state should actively remove barriers to trade, investment, and other forms of economic exchange" rather than controlling "how the economies of the region interact with each other" (1999, p. 45).

> The States in the region lack experience in collective problem solving; they are suspicious of each other; and they rarely encourage their citizens to engage with one another without their direct control or monitoring. As a result, "Northeast Asia" remains today a geographic referent rather than a political, much less a cultural community. (p. 42)

The uneven power distribution among states in the region, along with the diversity of political systems and cultural backgrounds, has resulted in the development of slow, deliberate, and incremental processes toward regional cooperation. To encourage greater cooperation, Akaha suggests,

> A realistic framework would start with issues that are removed from issues of national sovereignty, political independence, or territorial integrity. Issues of economic development, trade liberalization, technical cooperation, environmental changes would be more palatable as initial agenda items. Deep integration at the level of a common market or an economic union would be distant goals, if ever. (Akaha, 1999, p. 45)

Although cooperation on issues of economic development and trade liberalization may, as Akaha suggests, appear to be the most promising areas for increased cooperation, even that has proven difficult or fragile because of the rivalries among countries in the region. As discussed in chapter 1, China and Japan are currently competing for the status of the world's second largest economy in terms of GDP. At the same time, Japan's economic challenges have offered the ROK opportunities to improve its economic situation. The Yen's high exchange rate, for instance, is beneficial to Korean exporters who compete with the Japanese in the global market. Examples of such competition can be seen in the rivalries between Hyundai and Toyota and between Samsung and Sony. According to Lee and Moon, the "intensified competition" among Northeast Asian countries that "have been moving into more value-added, capital- and technology-intensive industries" has strengthened a "swarming sparrow" economic pattern marked by “deepening economic competition among regional rivals” rather than a “flying geese” model predicated upon “a harmonious intra-industrial division of labor among countries in the region” (2008, p. 49).

An overriding concern for sovereignty has also influenced the development of regionalism in Northeast Asia. In the case of China, for instance, the “sovereignty issue has always been a central concern of the Chinese government in its diplomatic activities,” according to Zhao, and its “historical memories of victimization” in the late 19th century and the early 20th century have led to a “deeply rooted fear among Chinese elites” about the possible erosion of sovereignty by outsider powers (2011, p. 64). Therefore, “China has preferred an informal and soft approach toward regional cooperation to avoid legally binding resolutions that could infringe on the sovereignty of member states” (Zhao, 2011, p. 64).

Yet China’s preponderant concern with maintaining its sovereignty has been shared by many Northeast Asian countries. Northeast Asian regionalism has emphasized “a consensus decision-making process, consultative procedures, voluntarism, and non-interference in member states’ internal affairs” (Zhao, 2011, p. 65). This so-called soft approach “is different from North American and European regionalism where formal procedures, rule-making and enforcement are emphasized” (Zhao, 2011, p. 65). Yoon describes the relatively informal nature of regional environmental cooperation in Northeast Asia as follows:

> While the agreements entail reciprocal promises or actions for implementation on the part of the individual parties, none of them contains formal clauses that describe the parties’ commitments as binding obligations or legal sanctions for non-compliance. Consequently, the interpretation and implementation of the agreements are largely up to the governments of the member countries and their

> practices are not subject to formal scrutiny under the agreements. (Yoon, 2013, p. 2)

Although this dissertation focuses on the variations among different regional environmental cooperative mechanisms in Northeast Asia rather than on regional characteristics in general, it does not disregard regional characteristics in explaining regional environmental cooperation, as some factors in that cooperation may be more closely related to regional characteristics than to characteristics of the issues themselves.

Disparity of Economic Development among Participating Countries

It also might be argued that the differences between Europe and Northeast Asia have resulted from different levels of economic development within each of the two regions. Certainly, with the exception of Hungary, the gap in economic development among European countries when CLRTAP was founded in 1979 or the NOx Protocol was signed in 1988 was not very significant, as shown in Figure 6.5. In contrast, Northeast Asian countries demonstrate dramatically different levels of economic development, as shown in Figure 6.6. It is well-known that GDP per capita of Eastern European countries was much lower than GDP per capita of Western European countries. However, it would be argued that the difference is not as great as the difference between Japanese per capita GDP and Chinese per capita GDP.

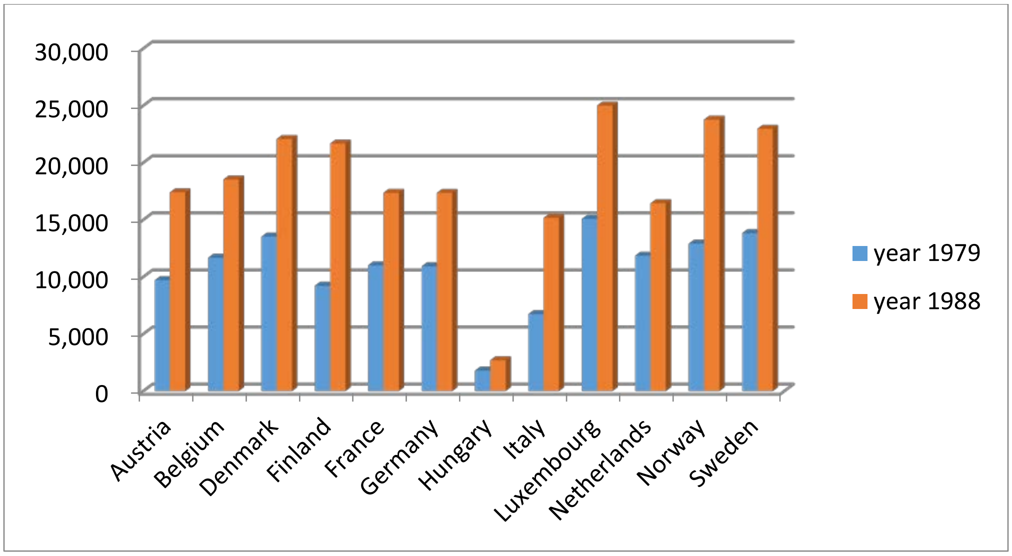

Figure 6.5. GDP per capita of European countries in 1979 and 1988 in 2013 value of US$. Data gathered at the World Bank. http://databank.worldbank.org/ddp/home.do?Step=3&id=4. The World Bank did not have data for many Eastern European countries such as Czech Republic, Estonia, Slovak Republic and Ukraine.

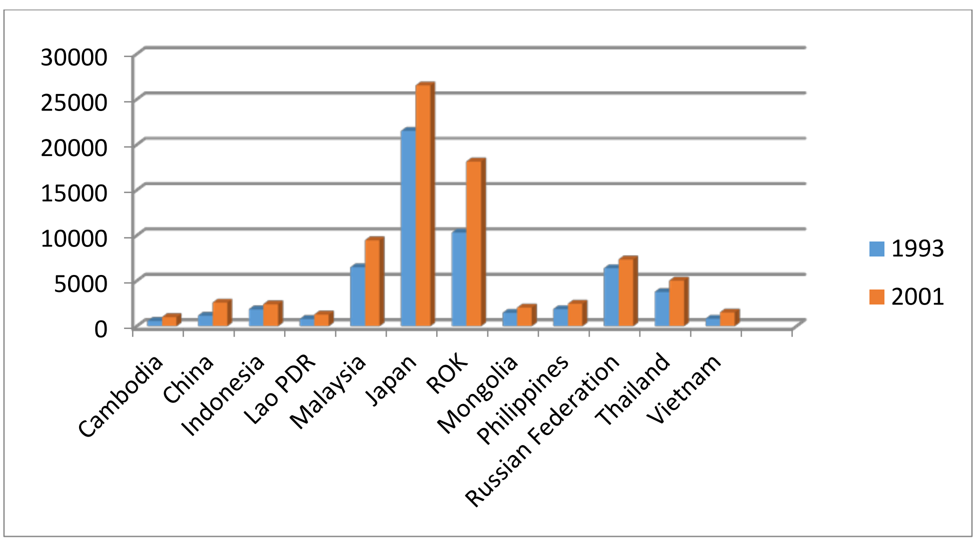

Figure 6.6. GDP per capita in East Asia (EANET member countries) in 1993 and 2001 in 2013 value of US$. Data gathered at the World Bank. http://databank.worldbank.org/ddp/home.do?Step=3&id=4.

The relationship between the environment and development has been exhibited in an inverted-U Kuznets curve, which indicates that environmental quality initially worsens as per capita income rises, but at some point eventually begins to decline (Panayotou, 1993; Rock, 2002). Grossman and Krueger (1993) estimated that the “turning points” for atmospheric concentrations of suspended particulate matter (SPM) and sulfur dioxide (SO_2) were under US$5,000 (in 1985 value). Many studies observed this same pattern despite finding different turning points for different air pollutants.[124] With the exception of most Eastern European countries, the GPD of European countries exceeded US$5,000 in 1979 when they first reached an agreement on international environmental cooperation.

Some countries in Northeast Asia have demonstrated a similar pattern. In Japan, as mentioned above, domestic institutional development and collaborations between government and industry began a significant decrease in sulfur dioxide emissions when its GDP per capita tipped US$5,000 in 1974. During the ROK’s post-1965 high-growth era, “energy consumption increased two times faster than it did for other upper-middle-income countries,” leaving “little doubt that their early structural shifts in the composition of production contributed to rising portions of inverted-U environmental Kuznets curves” (Rock, 2002, p. 10). After rising, the pollution intensities of industrial activity declined because of shifts in the composition of industrial output as well as the introduction of various domestic measures to limit pollution in the 1980s. The ROK’s turning point regarding pollution coincided with the year in which it attained a GDP per capita of US$5,000. That the GDP per capita of China did not tip US$5,000 until around 2010 (Figure 6.7) may help explain why it had not been prepared to control air pollution and take regional initiatives for decreasing transboundary air pollution in Northeast Asia

[124] Selden and Song estimated the turning points for these two air pollutants to be US$8,000, but they asserted that the turning point estimates for NOx and carbon monoxide (CO) “appear quite sensitive to the method of estimation” even though “aggregate emissions of these pollutants also appear to peak at moderately high levels of income” (1994, p. 154).

to that point. Indeed, the Kuznets curve may predict that China will further develop its air pollution measures since its recent turning point. How China's economic development may influence its political leadership, shared knowledge, and socialization regarding environmental cooperation will prove an interesting topic for future research.

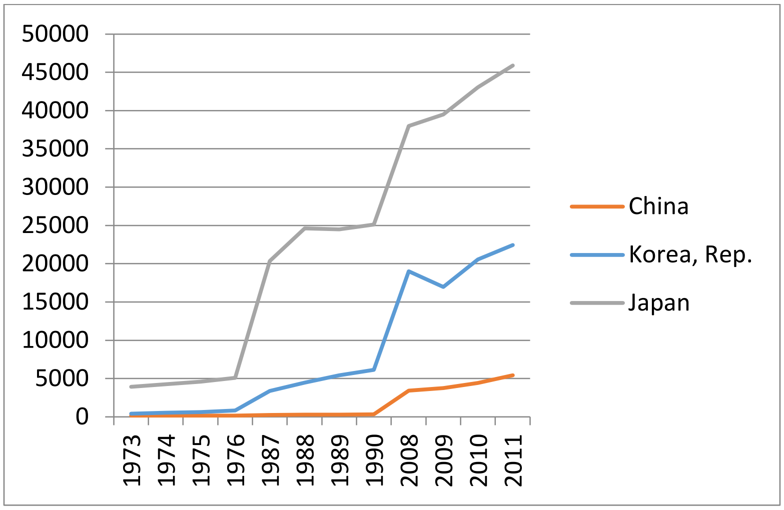

Figure 6.7. GDP per capita in China, Japan, and the ROK in 2013 value of US$. Data gathered at the World Bank. http://databank.worldbank.org/ddp/home.do?Step=3&id=4.

The findings of this dissertation do not rule out the potential influence of varied degrees of economic development among the nations of Northeast Asia. Indeed, this factor might explain China's apparent lack of willingness to contribute financially to the operations of the TDGM and LTP joint research projects. As discussed in chapter 1, this study instead focuses on the political models that each region has established to tackle transboundary environmental problems. The following sections investigate whether the success of European cooperation through CLRTAP can be attributed to the exertion of political leadership, development of shared scientific knowledge, and engagement in the learning process of socialization.

Political Leadership

This section examines whether the European case supports Hypothesis 1, that the stronger the leadership (whether structural, instrumental, or directional) by a participating country (not necessarily a hegemon or the regionally dominant state actor) or a group of countries in a form of regional environmental cooperation, the more formal and the more concrete the collective action developed in the region will be. As discussed earlier, this study assumes that leadership is a necessary component of international cooperation and that any country can lead regardless of its material capability.

This dissertation has identified three types of political leadership: structural, instrumental, and directional. For the purposes of this study, contributions to the financing of the regional cooperative mechanisms are treated as evidence of structural leadership under the assumption that states will spend more freely to exercise structural leadership. Instrumental leadership is demonstrated by "negotiating skills to frame issues in ways that foster integrative bargaining and to put together deals that would otherwise elude participants endeavoring to form international regimes through institutional bargaining" (Young, 1991, p. 293). Intellectual or directional leadership refers to developing substantive solutions based on knowledge and changing perceptions of risks.

As this section will show, political leadership in the CLRTAP has been shared by numerous countries. This is particularly true in the Cooperative Program for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). Unlike EANET, TDGM, and LTP, which have been dominated by a single Northeast Asian country, the Nordic countries exerted their leadership in the 1970s through CLRTAP, and this initial Nordic instrumental leadership coalition "has increased over time, related primarily to the catalytic change in German air policies" (Wettestad, 2011, p. 51).

Structural Leadership

This sub-section investigates the contributions made to the CLRTAP Trust Fund or in kind through EMEP to examine which countries have exercised structural leadership within CLRTAP. The 1984 EMEP Protocol created a multilateral trust fund for the long-term financial support of EMEP activities that entered into force on January 28, 1988. According to the CLRTAP Executive Body's 1999 report on contributions for the financing of the EMEP Program between 1988 and 1998 (Appendix V), many countries shared in the burden of supporting the EMEP and no single country dominated the contributions. Between 1988 and 1998, Germany, the Russian Federation, and France were the most significant contributors (contribution US$2,639,228, US$2,434,909, and US$2,212,388, respectively).[125] Several other countries contributed smaller but still significant amounts, including the United Kingdom (US$1,649,635), Italy (US$895,136), Spain (US$691,451), the European Community (US$596,184), and the Netherlands US$594,327). Twenty out of the 39 countries each contributed over US$100,000 during this period (UNESC, 1999).[126]

Although it could be argued that these financial arrangements resulted from the mandatory characteristics of the 1984 EMEP Protocol and the high level of economic development of European countries, a closer examination of EMEP's financial arrangements shows that contributions were not mandatory and were marked by extra-

[125] This data is 12 years old. I believe it is relevant to comparing because it refers to a similar period since conclusion of the initial agreements Northeast Asia today.

[126] The 39 parties include the European Community and two voluntary members (Canada and the United States, which had not made any contributions for during this period).

budgetary funds, such as in-kind donations, voluntary contributions of non-signatories, and arrears on the part of many countries. Member countries participated to different extents and contributed varied amounts to the EMEP.

Several countries made extra budgetary contributions to the Meteorological Synthesizing Center–West (MSC–W) and the Chemical Coordinating Center (CCC). Norway and the United Kingdom contributed to the MSC–W in 1994 (US$278,660), in 1995 (US$795,100), and in 1996 (US$811,460). Norway contributed US$1,181,030 and the United States donated US$30,000 in 1997. Additionally, Norway contributed US$616,292, or 51% of the total expenditures, in 1998. The host institute, the Norwegian Institute for Air Research (NILU), made contributions to the CCC in 1994 (US$40,606), in 1995 (US$238,920), and in 1996 (US$186,115). In 1998, Belarus and Bulgaria also made in-kind contributions to the work of the Meteorological Synthesizing Center–East (MSC–E) (UNESC, 1999).

Along with EMEP, the Working Group on Effects oversees another series of research programs, and a lead country operates each International Cooperative Program (ICP) on a voluntary basis (Levy, 1993; UNECE, 2013b). There are six ICPs, each under the leadership of a certain country: forests (Germany), waters (Norway), materials (Sweden), vegetation (United Kingdom), integrated monitoring (Sweden in collaboration with Finland), and modeling and mapping (Germany in collaboration with the Netherlands). National governments are encouraged to participate in these programs voluntarily. Participating countries pay their own research costs, and the lead countries provide the coordinating expenses of the research programs (Levy, 1993). Levy notes that the voluntary nature of these financial contributions may have led the CLRTAP protocols to become “instruments of normative persuasion instead of as regulatory rules” (1993, p. 132), arguing that although the protocols’ instruments appeared to be rules, they served the function of normative persuasion, which was a key determinant to CLTRAP’s success.

In contrast to these voluntary extra-budgetary contributions, the contributions of several countries were in arrears in various years, amounting to a total in cash arrears in during 1991-1998 of US$ 464,920.[127] Arrears for contributions in kind from the Ukraine totaled an additional US$283,445 even though most countries have contributed their expected amounts for the financing of the EMEP. Reservations of the positions on the mandatory contributions which means delayed payments, made by the biggest contributors, including Germany and France, illustrate the limited nature of the mandatory contributions to the EMEP Trust Fund. In 1995, “the Executive Body approved the use of the United Nations formula for assessments as a basis for the annual revision of the cost sharing for the financing of the EMEP programme, starting in 1998” (UNESC, 1999, p. 2).[128] This decision was made “taking into account the announcement of the Russian Federation that from 1998 it would pay its mandatory contribution in cash to the Trust Fund” (ibid.).

However, at the 16th session of the Executive Body in 1998, “Germany reserved its position on its 1999 and 2000 mandatory contributions calculated on the basis of the

[127] The former Yugoslavia had arrears in cash for 1991, Italy and the former Yugoslavia for 1992, Yugoslavia for 1993 and 1994, Italy for 1995, Bosnia and Herzegovina, Italy and Yugoslavia for 1996, 1997 and 1998 (UNESC, 1999).

[128] The United Nations scales of assessment are decided by the UN General assembly for all UN Member States. EMEP calculates its scale of contributions on the basis of the UN scale of assessment. For example, Germany took part in 8.662% of the UN assessment rate in 2004, and 20.8952% of the EMEP scale of contributions. Based on this calculation, Germany was scheduled to contribute US$447,860 in 2007 for the financing of the EMEP programme (UNECE, 2006).

United Nations scales of assessments for these years, which would lead to a steep increase in Germany's contributions" (ibid.). In the following sessions of the Steering Body, Germany reemphasized its disagreement on the use of the United Nations scales for the allocation of EMEP contributions. The reservations have been continued by now. The French and German delegations "expressed their reservations regarding the 10 per cent increase for the EMEP budget and regarding their contributions for 2008" at the 25th session of the Executive Body in 2007 because in their view the current allocation of the EMEP budget "represented a disproportionate share of the budget" (UNECE, 2012, p. 5). Even though the Executive Body encouraged Germany and France to drop their reservations, Germany reaffirmed its reservation with regard to its financial contribution for 2009 at the 26th session of the Executive Body in 2008. Again, the Executive Body encouraged Germany to give up its reservation as soon as possible.

In short, the financing of the EMEP program based on the 1984 EMEP Protocol has led many member countries to share the financial burden for running the program through making contributions as pledged. Even though Germany, the Russian Federation, and France were the biggest contributors, most other countries also took responsibility based on the United Nations assessment scales. On the other hand, Germany and France opposed what they considered to be an excessive share for the EMEP budget. Despite their reservations, the EMEP operated on funding from other countries and voluntary extra-budgetary contributions of a few countries. Shared responsibility rather than reliance on a few dominant countries has buttressed the sound financial conditions of the EMEP and other research programs under the Working Group on Effects. It can be argued that the structural leadership of the CLRTAP has been shared by several countries rather than exerted by only one or two wealthy countries.

Instrumental Leadership

The instrumental leadership of the CLRTAP also has been shared by several countries. In the early phases of the CLRTAP, the Nordic countries exerted considerable instrumental leadership through active participation in various CLRTAP bodies. According to Wettestad, "Nordic negotiators and scientists have over time acquired a strong standing within the various CLRTAP bodies" (2004, p. 91). Examples include the Norwegian chairman of the Executive Body in the late 1990s and the Swedish chairmen of the Working Group on Strategies and the CLRTAP secretariat. Germany has also exerted instrumental leadership after the "catalytic change in German air policies" due to the domestic forest dieback problem (Wettestad, 2011, p. 51). Wettestad argues that

> German leadership added considerable political weight to the processes in the 1980s and 1990s and was exercised with continuity at the point in the regime development process where several Nordic countries' interests became much more complicated and the initial Nordic leadership coalition broke down (from the mid-1980s on) (2011, p. 51).

Thus, I contend that Germany and the Nordic countries have shared instrumental leadership for CLRTAP. This instrumental leadership exerted by several countries must have been helpful in developing CLRTAP which had few specific provisions with ample room for policy development in the first place and added later more specific protocols.

Directional Leadership

In terms of directional or intellectual leadership, Norway has played a major role in establishing and implementing CLRTAP. As Siebenhüner has noted, "the complexity of ecological systems with their interconnectedness, numerous causal mechanisms, synergies, and accumulation effects between different substances and abrupt system changes" meant that rigorous research and monitoring was necessary to cope with limited scientific knowledge and great uncertainties (2011, p. 93). As a result, the "weight given to enhancing scientific knowledge in the Convention necessitated the establishment of a substantial 'complex' of scientific and technological working groups," making Norway, which already had "interests and substantial scientific/technical competence in this issue area," the obvious candidate to take a "formal and informal leadership role" in the early phase of the CLRTAP (Wettestad, 2004, p. 91). In fact, the Norwegian Institute for Air Research took responsibility for coordinating the founding of two international projects: the Organization for Economic Cooperation and Development (OECD) Program on Long-Range Transport of Air Pollutants (1972-1977) and the Norwegian research project Aid Precipitation – Effects on Forest and Fish (1972-1980).

Despite this strong Norwegian intellectual leadership, the member countries of CLRTAP seem to have shared intellectual leadership through international bodies such as the International Institute of Applied Systems Analysis (IIASA), which developed and implemented the RAINS model (Siebenhüner, 2011). As discussed in the following section, the RAINS model gained prominence quickly, and other alternative models were unable to keep pace with its advancements, leading to its adoption in much of the CLRTAP research.

Thus, this study's analysis of the three modes of political leadership finds that Hypothesis 1 is proven. Strong leadership has been provided by participating countries, allowing the CLRTAP to deal successfully with transboundary air pollution issues in Europe. From CLRTAP's founding, European countries have shared leadership responsibilities rather allowing one country to dominate the leadership, unlike the Northeast Asian cooperative mechanisms examined in this study, in which one country, usually the initiator, has dominated the leadership. This analysis confirms Hypothesis 1, which predicts that the stronger the political leadership that one participating country or a group of countries in the region exert, the more formal and the more concrete the collective action in the region will be. Furthermore, it is not strong leadership alone but shared leadership among participating countries that most enhances regional environmental cooperation.

Knowledge

This section tests Hypothesis 2, which asserts that the greater the commonly shared knowledge among participating countries in regional environmental cooperation efforts, the more formal and the more concrete will be the collective action found in the region. After Europe launched various research projects in the early 1970s, it took only a decade for the participating European countries to agree on a framework convention and another decade to agree on a series of regulatory protocols. In contrast, Northeast Asia has not reached any conclusive scientific findings although it has undertaken a variety of research efforts since the early 1990s. The rest of the section reviews the status of scientific knowledge in Europe.

Although Robert Smith's 1872 *Air and Rain: The Beginnings of a Chemical Climatology* had introduced research on acid rain as early as the mid-19th century, acid rain did not become a policy concern until the 1930s and 1950s, when European researchers first launched studies on aquatic ecosystems and the relationships between the loss of alkalinity in surface waters, precipitation acidity, and fossil fuel emissions. In the 1960s, Svante Odén, a soil scientist working at Sweden's Agricultural College, synthesized diverse strands of research and concluded (a) that acid rain was a large-scale phenomenon across Europe, (b) that many areas were indeed experiencing the increasing acidity of precipitation, and (c) that this increase would cause detrimental effects on fish, forests, and materials (Clark et al., 2000). These hypotheses were pursued by scientists sponsored by the Swedish government, which led to the presentation of a case study on "Air Pollution across National Boundaries: The Impact of Sulfur in Air and Precipitation" at the 1972 Stockholm U.N. Conference on the Human Environment.

Following these early Scandinavian efforts, two research projects shaped scientific discussions in the earlier phases of CLRTAP: the Organization for Economic Cooperation and Development (OECD) Program on Long-Range Transport of Air Pollutants (1972-1977) and the Norwegian research project on Aid Precipitation – Effects on Forest and Fish (1972-1980). The results of the OECD study, published in 1977, confirmed that the air quality in every European country was affected by the emissions of other European countries and that air pollutants were transported long distances. It further concluded that "if countries find it desirable to reduce substantially the total deposition of sulphur within their borders individual national control programmes can achieve only a limited success" (OECD, 1977, quoted in Semb, Eliassen & Dutchak, 2004, p. 9). CLRTAP participants and analysts agreed with and supported these findings. According to VanDeveer,

> The OECD research constituted an important contribution to awareness raising among many Western European policymakers and publics. Importantly, it helped to de-legitimize flat denials of the occurrence of transboundary pollution transport, such as those previously voiced by British and West German officials. .

> . . In this way, the OECD study altered the foreign policy of some opponents of air pollution cooperation, establishing the understanding that pollutants were being transported across borders and shifting the debate toward issues of assessing damages and policy proposals. (2006, p. 29)

Following the OECD reports and growing public and media attention, in 1977 a number of European states began negotiating an international convention to deal with the long-range transboundary transport of air pollutants. The United Nations Economic Commission for Europe (UNECE) was selected as the appropriate forum "because of the perception that it was the only existing organization with both environmental and economic interests that also included national members from both East and West" (VanDeveer, 2006, p. 30).

These initial negotiations and took place largely between highly committed Nordic states, including Sweden, Norway, Denmark, Finland, and other, more reluctant Western European parties, including West Germany and the United Kingdom. Even though the Soviets had begun an initiative to promote cooperation in nonmilitary spheres for détente at the 1975 Helsinki Conference on Security and Cooperation in Europe, the Soviet Union and Central and Eastern European nations played a minor role in the negotiations for a monitoring and regulatory program regarding transboundary air pollutants pushed by Sweden and Norway.

As noted earlier, the initial CLRTAP expressed only "an intent of the signatories to limit and gradually decrease transboundary air pollution to the extent that technologies and economics allowed" (Clark et al., 2000, p. 33) and did not spell out any specific or binding commitments for pollution control or reduction, "leaving all specifics of multilateral environmental policy development for subsequent international agreements" (VanDeveer, 2006, p. 30). Even so, Clark et al. argue that CLRTAP successfully brought major players to the table and "enhanced the foundations of monitoring and assessment on which alter action would build, expanding EMEP to include all of Europe, establishing a number of ongoing multilateral assessment processes, and providing an institutional home for subsequent international efforts" (Clark et al., 2000, p. 33).

In this process, shared scientific knowledge on transboundary air pollutants played a key role. Especially crucial was the additional scientific knowledge produced from cooperative monitoring results by EMEP. EMEP led the discussions about emission reductions based on "yearly calculated blame matrices, from which the overall export/import budgets for all countries in Europe could be considered" and "formed a platform for negotiations on emission reductions" (Erisman et al., 2004, p. 160). Through "the large participation and commitment from the European countries to the EMEP programme" and the participation of both scientists and policymakers, European countries were able to "reach a common understanding of the problems and solutions (ibid.).

EMEP was this effective because it combined monitoring and modeling and established source-receptor relationships for acidic substances across the member countries. The EMEP network monitoring acidic gas and the wet deposition of acidic species has quantified the patterns of acid deposition and compared them to its adverse effect measures (e.g., critical loads). This has enabled EMEP to quantify both the extent of the acidification problem and trends in improvement. In addition to the notable success of this monitoring, the construction of emission inventories has provided an "extremely important building block of the modelling work" (Williams, 1999, p. 777). Although the individual parties to the convention carried out a large amount of the work in their own countries, the EMEP program provided an important coordination function and quality assurance, including acquiring data in a consistent form that made cross-country comparisons possible. As a result, the EMEP emission inventories for various air pollutants, including SO_2 and NOx, "have found wide use and application not just in the CLRTAP area, but amongst scientists and researchers in many other areas in Europe and elsewhere" (ibid.). Through all these efforts, EMEP provided the shared scientific knowledge on which the specific and regulatory protocols developed in the early years of the CLRTAP were based.

As mentioned above, it took less than a decade for Europe to transform this shared scientific knowledge into regulatory protocols, unlike the slow development of shared scientific knowledge through the efforts of Northeast Asian environmental cooperative mechanisms. This was facilitated in part by European scientists' development of the critical-loads approach in response to criticism of the flat-rate reduction protocols (both 1985 First Sulfur Protocol and 1988 Nitrogen Oxides Protocol). Europe has taken a significant step toward "differentiated commitments" and away from the "common cuts" called for in the 1994 Second Sulfur Protocol by employing the critical loads concept.

This process of knowledge development was facilitated by the Regional Acidification Information System (RAINS), an integrated assessment model. It was developed by IIASA in 1983 as a "scenario-generating device" for the reduction of acidification and other damaging effects on a regional scale. In Europe, the yearly calculated source-receptor matrix (the so-called "blame matrix") buttressed scientific discussions and negotiations, making it possible for European participants to build a common understanding of the transboundary pollution problems and to formulate solutions. The RAINS team attempted to facilitate understanding among policymakers by presenting model results clearly and simply. In doing so, the team rejected the EMEP atmospheric transfer model (ATM), which is complex and demanding in terms of time to collect data, and instead designed the blame matrix to help others visualize and identify pollution emitters and receivers. The RAINS model has also been improved through competition with alternative models such as the Abatement Strategies Assessment Model developed by the Imperial College London and the Coordinated Abatement Strategy Model developed by the Stockholm Environment Institute, which forced the RAINS team to clarify the model's differences and merits and thereby made it "more relevant and acceptable to the policymakers" (Ishii, 2011, p. 184) than other models. As a result, the "RAINS model was finally chosen as the guiding model, and other models were used for checking (or relativizing) its runs and outputs" (ibid.).

In short, European countries reached a scientific consensus about their vulnerability to and the extent of transboundary air pollution in Europe before agreeing on a framework convention. Despite initial opposition to these findings from a few countries, including the United Kingdom and Federal Republic of Germany, European countries agreed to adopt specific protocols to regulate air pollutants for the following decade. This analysis thereby confirms Hypothesis 2, which posits that a region will develop more formal and more concrete forms of collective action if the participating countries in its environmental cooperation efforts develop greater shared scientific knowledge.

Socialization

This study defined socialization as the internalization of the values, roles, and understandings. This study examines adaption and learning as the two different processes of the internalization of norms that operate within these regional cooperative mechanisms. While, according to Haas (1990) and Johnston (1996), the adaptation process refers to the acceptance and adoption of preexisting, external norms and behaviors without changing the broad goals of countries, the learning process refers to a more transformative process which brings behavioral changes because actors question and examine fundamental and original values.

This section examines Hypothesis 3, which asserts that participating countries in regional environmental cooperation efforts are more likely to create formal and concrete collective action through regional cooperation if they adopt learning rather than adaptation as a process of socialization. To examine which of these two processes of socialization the participating countries have engaged in, this section qualitatively measures the participation patterns of member countries through navigating two questions: whether the participation of countries in the region has been prompted by indirect, rather than intrinsic, concerns about particular transboundary air pollution issues; and whether delegates are more likely to have engaged in the adaptation process of socialization if they have had the opportunity to attend international meetings for only a short period or in a sporadic manner, and to have engaged in the learning process of socialization if they have been able to attend international meetings for an extended period in a consistent manner. It is found that European countries have engaged in both the learning and adaptation processes of socialization while committing to the CLRTAP activities.

Regarding the question of the political motivations for European countries to participate in the CLRTAP, I argue that there were two groups of European countries engaged in different processes of socialization. The countries which had varying political motivations and reasons to participate in implementing the CLRTAP can be argued to have engaged in the adaptation process. According to Levy (1993), Denmark, the Soviet Union, and the United Kingdom had all different non-environmental reasons for making the reductions associated with the participation in the CLRTAP: Demark because of its membership in the Nordic Council, which was also participating; the Soviet Union because it perceived CLRTAP as an important political issue for advancing détente; and the United Kingdom so as to change its image from the “dirty man of Europe” and in response to “political pressure from a wide variety of sources” (pp. 123-124). Other countries which were highly motivated to solve the problem of acid rain internationally can be argued to have been engaged in the learning process of socialization. Norway, Sweden, and later Germany are good example countries for this process in the 1970s and early 1980s.

For the NOx protocol, Germany also seemed to have political motivations. Reducing NOx emissions by any significant magnitude “would require strict automobile emission standards” because nitrogen oxides are emitted both from power plants and automobiles (Levy, 1993, p. 95). For Germany, which had already required catalytic converters in automobiles through 1983 legislation, reductions in nitrogen oxides would not particularly difficult, and thus it supported the Scandinavians’ efforts to add a nitrogen oxides protocol immediately following the adoption of the sulfur protocol in 1985. But the United Kingdom, France, and Italy did not support a protocol to reduce nitrous oxides, as their automakers argued that emission standards would place them at a comparative disadvantage with Germany, which was already able to produce “much of the equipment needed to meet strict standards, such as fuel injectors and catalytic converters” (Levy, 1993, p. 95). Likewise, Eastern Europe and the Soviet Union opposed nitrous oxide reductions because their automobile manufacturing industries were rapidly expanding and they foresaw that reducing automobile emissions would have negative economic consequences in the near future.[129] These varying political motivations of many European countries show that they have engaged in the adaptation process of socialization to some extent.

Regarding the second measurement of the participation patterns, unlike the inconsistent participation of governmental official delegates to international meetings in the Northeast Asian environmental cooperative mechanisms examined in this study, the patterns of delegates’ participation in Europe’s CLRTAP can be described as significantly consistent. This section analyzes the participation of delegates to the EMEP Steering Body between 2008 and 2011 because of its role as the organization’s governing body. As it shows, most of the European countries have sent the same delegates to these meetings for a number of years (Appendix VI). Many delegates have been dispatched by

[129] Since reaching the 1988 Nitrogen Oxides Protocol, the average European reductions in NOx emissions have reached around 25%, while Eastern Europe, Germany, and Switzerland have achieved a nearly 50% reduction. According to European Environment Agency, the reduction in NOx mainly resulted from technical measures within the transport and industrial sectors, including the installation of catalytic converters in gasoline-fueled cars, the introduction of motor modifications in diesel-fueled cars, and “the introduction of combustion modification technologies (such as use of low NO_X burners), implementation of flue-gas abatement techniques (e.g., NO_X scrubbers and selective…and non-selective…catalytic reduction techniques) and fuel-switching from coal to gas” (2012b).

their ministers of environment or similar institutions, and most hold a high rank, such as heads of departments, within their organizations. Through continuous participation by delegates who have remained the same for a long period of time and who hold decision-making power within the organizations with which they are affiliated, member countries have imbued the organization's proceedings and decisions with considerable credibility. Moreover, delegates have been able to build and expand their own understandings of EMEP activities and issues through accumulated experiences with the EMEP.

Appendix VI shows the recent participation patterns of participants in the annual meetings of EMEP Steering Body, which are also similar to those exhibited during the first decade of the CLRTAP. As Siebenhüner argues, "one of the main success factors for the CLRTAP and its assessments has been the continuity of a large percentage of its personnel, especially in the first decade of its existence," and that "[n]ewly acquired technical and procedural knowledge could thereby be kept inside the process and passed on through individuals" (2011, p. 105). Given this continuity, participating members have been able to engage in learning as a socialization process, which can change the behaviors of international actors through allowing them to question fundamental theories and their values.

At the same time, it should be noted that there were considerable discrepancies in the participation in international meetings by major Western countries, such as Germany, the Netherlands, Norway, Sweden, and the United Kingdom, and by the Central and Eastern Europe (CEE) countries. Whereas early scientific interest in environmental issues in the West was spurred by identifiable and observable environmental effects, scientists in CEE countries had developed little interest in these issues because they had "little access to mass media or domestic public policymaking" (VanDeveer, 2006, p. 40). Only a small number of delegates from the CEE participated in the two major international conferences on acidification research and policies that were sponsored by the Dutch government in cooperation with UNECE. In fact, only 10 delegates from five CEE countries—around 4.3% of all the delegates attending —participated in the 1986 conference, and only three delegates from Eastern Europe participated in the 1991 conference.[130]

In contrast, conference delegates from the five big player countries in CLRTAP made up 60% and 85% of attendees in 1986 and 1991, respectively. Most European states sent national representatives to meetings of CLRTAP's high-level bodies, such as the Executive Body, Working Group Strategies, and EMEP Steering Body. Whereas attendance of delegates from some transition states "has been generally less frequent and more sporadic," 14 out of the 16 states with perfect attendance at mid-1990s working group meetings were from Western Europe (VanDeveer, 2006, pp. 41-42). Despite these discrepancies in the delegation size between the big player countries and CEE countries at international CLRTAP meetings, delegates from the CEE countries might have had enough time to develop personal relationships with national and governance-level delegates from other countries if they had been able to participate consistently and to gain scientific knowledge through iterative communication with various scientists.

The positive effect of continuity among a large percentage of national delegates and personnel for the implementation of CLRTAP has been reinforced by the learning process of socialization among scientists and political negotiators. The "continuous,

[130] These 10 delegates included one participant from Czechoslovakia, two from Hungary, three from Poland, two from the Soviet Union, and two from Yugoslavia.

iterative communication among scientists and negotiators" has been recognized by other scholars as "one of the crucial preconditions for the successes of the convention process" (Siebenhüner, 2011, p. 104). Through formal and informal communication and relationships among the working groups and the Executive Body, which are mostly mediated through the Working Group on Strategies and Review, scientific and technical information has flowed into the negotiation processes.

Political decision makers as well as scientists have engaged in the learning process of socialization. For instance, in the negotiations for the Second Sulfur Protocol, the political decision makers were able to learn "all the possible scenarios for emission reductions and their likely outcomes" from the scientists, and the scientists urged the negotiators to agree on a clear emission target for the protocol (Siebenhüner, 2011, p. 104). According to Siebenhüner, this case "demonstrates the strong impact that scientists had on the actual decision making, which became possible through the good informal communication networks and the trust that negotiators had in the scientists" (2011, p. 105).

In an examination of how advisory scientists to the CLRTAP regime have learned collectively throughout the process of scientific assessment, Atsushi Ishii (2011) argues that the scientists similarly learned diplomacy as well as science. For instance, throughout the process of developing the critical loads approach and the RAINS model, advisory scientists "abandoned their positivistic paradigm and shifted to a more diplomacy-oriented paradigm that would hold them accountable to country parties, which is a prerequisite in diplomatic settings and makes scientists adhere to the overall norm of usefulness in the diplomatic context" (Ishii, 2011, p. 184).

The process of defining the critical loads also shows how participants have reconciled scientific understandings with political applicability. Given the criticism of the flat-rate reduction protocols, Scandinavian scientists and 30 experts gathered for a workshop in Oslo sponsored by the Nordic Council of Ministers and adopted a scientific definition of critical loads for sulfur and nitrogen: “the highest load that will not cause chemical changes leading to long-term harmful effect on the most sensitive ecosystems” (Ishii, 2011, p. 177). However, the last part of this definition, “most sensitive ecosystems,” was changed to “significant harmful effects” and the phrase “according to present knowledge” was added to the final definition by a workshop held by the CLRTAP’s Working Group on Effects in 1988, a change that, Ishii argues, “broadened the political applicability and strengthened the robustness of the scientific assessments” of the critical loads concept (2011, p. 178). This change followed “the definition agreed upon by the UNECE Working Group on Nitrogen Oxides in February 1988 in a deliberation in which both negotiators and scientists participated” (ibid.), and Ishii points out that the development of the RAINS model also involved communication among a wide range of various stakeholders. The “interactive learning among potential users” of the RAINS model was one of the key guidelines for its development, and thus “the RAINS team did not consider learning from external actors as ‘residual,’ but rather incorporated it into the modeling process as an inherent component from the outset to win policymakers’ acceptance of the RAINS model” (Ishii, 2011, p. 181).

In short, the first measurement of participation patterns of the participants in the CLRTAP activities through examining the existence of indirect political concerns and motivations rather than intrinsic interests in regional cooperation to solve transboundary air pollution problems indicates that some countries have engaged in the learning process of socialization and other countries in the adaptation. The second measurement of participation patterns through examining the existence of enough consistent participation and interactive communication with delegates from other countries shows that both governmental officials and scientists alike have engaged in the learning process. Accordingly, comparing with the Northeast Asian case studies which have shown only the adaptation processes of socialization, it can be argued that the learning process of socialization among participants in the CLRTAP have contributed to its development into what the UNEP categorizes as the highest level regional entities with an established infrastructure and a policy focus. For the first measurement of participation patterns, both Northeast Asia and Europe seemed to have been motivated by varying political interests in participating in regional environmental cooperation, which showed that they have been engaged in the adaptation process of socialization to some extent. However, unlike Northeast Asia, Europe has presented consistent participation and interactive communication with delegates from other countries, which showed the learning process of socialization among European countries. In this sense, European experiences through the CLRTAP support Hypothesis 3: If participating countries in regional environmental cooperation efforts adopt learning rather than adaptation as a process of socialization, they are more likely to create formal and concrete collective action through regional cooperation.

Conclusions

This study makes two sets of conclusions regarding: (1) the general utility of the three hypotheses for explaining regional environmental governance; (2) the specifics of Northeast Asian cooperation, with the question of why the driving forces identified in the hypotheses have not been as influential there as in Europe. For the first set of conclusions, this study contends that shared scientific knowledge and the learning process of socialization are key determinants of the development of regulatory regional environmental regimes. It means that even given strong political leadership by a participating country, a region is unlikely to succeed in creating a legally binding regional environmental regime without development of shared scientific knowledge and engagement in the learning process of socialization. Table 6.2 summarizes the findings of four case studies including EANET, TDGM, and LTP in Northeast Asia, and CLRTAP in Europe.

Table 6.2
Summary of Findings of Case Studies

	Independent Variables			Dependent Variables		
	Leadership	Knowledge	Learning Mode	Formal	Concrete	Legal
EANET	Yes	No	No	Yes	Yes	No
TDGM	Some	No	No	Yes	No	No
LTP	Yes	No	No	No	No	No
CLRTAP	Yes	Yes	Yes	Yes	Yes	Yes

Note: As indicated in Table 1.4, the "formal" degree of collective action is measured through examining the permanent structures of cooperative mechanisms, such as a secretariat, and the division of labor of their entities, such as the secretariat, governing body, and scientific advisory body, as well as formal financial structures shared by member countries. The "concrete" degree of collective action is measured through examining the existence of agreed-upon shared formats and guidelines for joint monitoring and modeling activities. The "legal" form of collective action is measured through examining the existence of legally binding agreement among participating countries.

This study argues that Europe has succeeded in reducing air pollution through developing better air quality management with regional regulatory regimes, whereas Northeast Asia has encountered increasing air pollution due to the rapid growth of energy consumption in China. The trends of NOx emissions in Europe and Northeast Asia clearly show this contrast in the state of air pollution in the region. A comparative analysis between cooperative efforts in Northeast Asia and Europe demonstrates that the Northeast Asian cooperative efforts through EANET, TDGM, and LTP have failed to generate broader cooperation and produce useful measurement data that could lead to the creation of a regional environmental regime with a solid infrastructure and a policy focus such as that which European cooperative efforts have achieved through CLRTAP.

An analysis of these empirical findings indicates that all three independent variables are only partly associated with varying degrees of collective action as measured by formal features and concrete collective action in Northeast Asia. However, political leadership is more associated with varying degrees of collective action in terms of formal and concrete collective action because none of the three cooperative mechanisms has developed shared knowledge and the learning process of socialization. Although the ROK's dominant and significant exercise of political leadership did not explain why the LTP exhibited the least amount of formal and concrete collective action, the cases of EANET and TDGM provide strong evidence for the hypothesis that the stronger the leadership by a participating country in a form of regional environmental cooperation, the more formal and the more concrete will be the collective action developed in the region,.

For the second set of conclusion, this study examined whether political leadership and shared scientific knowledge are necessary or sufficient factors for the engagement in the learning process of socialization of participating countries in the first place, and whether the learning process of socialization can lead the region to achieve more formal and concrete collective action. The study's comparison of the varying degrees of collective action in Northeast Asia and Europe and among the three studied Northeast Asian environmental cooperative mechanisms focusing on these two questions discovers two useful insights.

First, the analysis supports the hypothesis on social mechanisms among political leadership, shared knowledge, and socialization, which asserts that the stronger the political leadership and the greater the shared knowledge in the region, the more likely participants in regional cooperation are to engage in the learning process of socialization and thereby create the most formal and concrete collective action. The study finds that strong political leadership is not itself sufficient to lead member countries to engage in the learning process of socialization and that a lack of shared scientific knowledge is positively associated with the adaptation process of socialization among participants in the cooperative activities of these three regional mechanisms.

Another insight is that the combination of lack of shared knowledge and the learning mode of socialization helps explain why all three regional cooperative mechanisms have failed to advance to become the legally binding regional environmental regimes rather than the comparatively higher degrees of collective action in terms of formalization and concreteness among regional entities within the UNEP's second category of regional action. This study argues that knowledge and socialization barriers are key determinants of the development of regulatory regional environmental regimes. Without shared scientific knowledge and engagement in the learning process of socialization, even given strong political leadership by a participating country, it is not likely for a region to develop a legally binding regional environmental regime. Strong political leadership exercised by a participating country itself did not explain the different extents of collective action between Northeast Asia and Europe because the three Northeast Asian cases have had strong political leadership by initiator countries, as has the CLRTAP.

Based on these findings, this study suggests that if their regional environmental cooperative mechanisms are to advance to the next stage of development, Northeast Asian countries must build sound infrastructures to ensure consistent participation of the same delegates of member countries to international meetings to increase the chance that the learning process of socialization will take place, enhancing international cooperation and resulting in more fundamental behavioral changes by states in the region. Additionally, this infrastructure should also reinforce greater interactive communication between the two groups of delegates, political negotiators and scientists, participating in international meetings by achieving more consistent participation in international meetings. The significance of consistent participation by delegates to the CLRTAP and particularly the EMEP is a key lesson that Northeast Asian countries can take from the European case, as the consistent attendance of European delegates has created personal relationships among delegates that seem to have contributed to their developing common understanding on scientific issues and reaching agreements on specific budgetary issues.

The examination of institutional linkages has proven that the governance and actor linkages between CLRTAP and EU air policy have contributed to strengthening their regulatory policies in Europe (Selin & VanDeveer, 2011). Thereby it can be suggested that Northeast Asian cooperative mechanisms need to develop strategies for creating synergistic effects among their existing overlapping research projects. While the EMEP focuses on three activities, including collection of emission data, measurements of air quality and modeling of atmospheric transport, and deposition of air pollutants, the EANET focuses only on measurements of acid deposition and the LTP on measurements and modeling of the source-and-receptor relationships of SO_2 and NOx emissions, which may explain why these two Northeast Asian cooperative mechanisms have lacked the driving force necessary for moving beyond their current research activities. According to Haas and Stevens,

> studies of international environmental assessments and science panels suggest the need for fluid bodies that can bring together multiple sources of information and are not beholden to one single funder or political sponsor. . . . Studies of national-level environmental policy processes have convincingly argued against relying on individual institutions for research and policy advice because they may bias the information flow and control resources (2011, p. 129).

In the CLRTAP, no single source of policy advice dictates the production of knowledge; instead, “the European Monitoring and Evaluation Programme (EMEP), the working groups, and the Network on Air Pollution and Health (AIRNET) all serve to identify research questions and guide science with some degree of autonomy from the policy process” (ibid., pp. 129-130). This suggests another lesson for Northeast Asia: EANET and LTP are not necessarily competitive with each other. The two should be combined into a single organization like EMEP with possessing autonomy from the policy process through serving to identify research agendas.

In addition to the strategies of combining existing cooperative efforts into a more efficient entity of regional cooperation, Northeast Asia needs to address concerns about the flow of biased information both within a country and with other countries. Chinese participants in the International Experts Workshop on International Framework and Co-benefits Approach to Promote Air Pollution Control in East Asia, held in January 2011 in Japan, argued that studies by international bodies demonstrating the urgency and necessity of international cooperation would be most effective in persuading the Chinese government to participate in regional environmental cooperation, while scientists from other countries argued that more active advocacy for regional cooperation by Chinese scientists would be necessary because the Chinese government tends to be suspicious of scientific research conducted by scientists from other countries. This kind of ping pong-style discussion can be counter-productive and suggests that rather than blaming one another for the lack of development of shared scientific knowledge, regional scientists need to collaborate more efficiently and effectively to produce research outputs.

In addition to these horizontal institutional linkages, vertical institutional linkages also need to be developed in Northeast Asia. Two key comprehensive cooperative mechanisms mentioned in chapter 2, the Tripartite Environment Ministers Meeting among the ROK, China, and Japan (TEMM) and the North-East Asia Sub-regional Program for Environmental Cooperation (NEASPEC), should develop clear objectives and strategies for implantation of issue-specific cooperative projects to reduce duplication of research projects in different organizations and to create synergistic effects among various cooperative mechanisms.

A delegate to the Korean government stated in an interview that money does not matter at this point for regional environmental cooperation as both the Japanese and Korean governments have shown their willingness to become key financial resource countries through EANET and LTP, respectively. What seems to matter most for environmental cooperation in Northeast Asia is to share the leadership among participating countries, relaxing the ownership for the cooperative mechanisms that countries initiated and to support each other among participating countries. In doing so, it is necessary for Northeast Asian countries to develop shared scientific knowledge among participating researchers in cooperative programs, and to create bureaucratic supports for the learning process of socialization among policy makers and scientists both within each country and with other countries.

APPENDIX I

LIST OF INTERVIEWS

Country	Name	Interview Date	Affiliation
Japan	Nobuhiro Kino	05/10/2010	Ministry of Environment
	Katsunori Suzuki	4/23/2010	Kanazawa University
	Shohei Yonemoto	3/1/2010	Tokyo University
	Hajime Akimoto	6/1/2010	ADORC
	Norichika Kanie	8/27/2010	Tokyo Institute of Technology
	Shunji Matsuoka	10/5/2010	Waseda University
	Alice Kim	10/6/2010	Waseda University
	Mark Elder	10/6/2010	Institute for Global Environmental Strategies (IGES)
	Xiaofeng Zhou	10/6/2010	IGES
	Asami Miyazaki	10/4/2010	Osaka University
	Atsushi Ishii	10/17/2010	Tohoku University
	Atsushi Shimizu	12/17/2010	National Institute for Environmental Studies (NIES)
	Nobuo Sugimoto	12/17/2010	NIES
	Ken Yamashita	2/8/2011	Asia Center for Air Pollution Research (ACAP)
	Hajime Akimoto	2/8/2011	ACAP
	Keiichi Sato	2/8/2011	ACAP
	Tsuyoshi Ohizumi	2/8/2011	ACAP
	Toshimasa Ohara	3/8/2011	NIES
	Masataka Nishikawa	3/8/2011	NIES

China	ZHOU Jun	11/23/2010	Policy Research Center for Environment and Economy
	He Youjiang	11/23/2010	Chinese Research Academy of Environmental Sciences
	XIE Shuyan	11/23/2010	China National Environment Monitoring Center
	Haibin ZHANG	01/18/2011	Peking University
Republic of Korea	LimSeok Jang	8/17/2009, 12/23/2010	National Institute of Environmental Research (NIER)
	Chu Jang Min	12/30/2009, 12/29/2010	Korea Environment Institute
	Il-Soo Park	3/29/2010	Hankuk University of Foreign Studies
	Jinseok Han	3/31/2010	NIER
	Seog-Yeon Cho	10/29/2009, 11/22/2010	Inha University
	Su-Hee Hwang	11/22/2010	Ministry of Environment (MOEK)
	Chang-Keun Song	8/17/2009	NIER
	Yong-Seung Chung	12/24/2010	KCAER
	Sang-Joon Lee	12/23/2010	MOEK
	Kyu Il Park	12/23/2010	MOEK
	Dong Young Kim	12/28/2010	Korea Development Institute
	Suh-Yong Chung	12/28/2010	Korea University
	Sangwoo Park	12/29/2010	Ministry of Foreign Affairs and Trade
Indonesia	Agus Harya SETYAKI	11/23/2010	Ministry of Environment
Malaysia	Wan Izar Haizan Wan Rosely	11/22/2010	Ministry of Natural Resources and Environment
Switzerland	Krzysztof Olendrzynski	11/23/2010	UNECE

APPENDIX II

LIST OF DELEGATES TO THE INTERGOVERNMENTAL MEETING OF EANET 2001-2010

	IG3 2001, Thailand	IG4 2002, Thailand	IG5 2003, Thailand	IG6 2004, Cambodia	IG7 2005, Japan	IG8 2006, Vietnam	IG9 2007, Lao PDR	IG10 2008, Thailand	IG11 2009, Thailand	IG12 2010, Japan
Cambodia		Chea Sina / MOE	Heng Nareth / MOE	Hang Dara / MOE	Khong Samnuon / MOE	Hang Dara / MOE		Ngoun Kong / MOE	same	Khieu Muth / MOE
			Chrin Sokha / MOE	same	Heng Nareth / MOE		Thiv Sophearith / MOE	Ken Choviran / MOE	same 2009	Lonh Heal / MOE
					Long Rithirak/ MOE	same	same			Ken Choviran / MOE
China	Li Xue / MOE / MOE		Tang Dingding / MOE	Wang Ruibin / CNEMC	same	Tang Dingding / MOE	same 2004, 2005	same	Lin Jun / MOE	Zhu Jianping / MOE
	Guo Jing / MOE	same	Fang Li / MOE	same	same	Xia Yingxian / MOE	same			
					Dong Yao / MOE	Zhou Guomei / MOE	Xia Yingxian / MOE	Liu Shusheng / MOE	same 2005	He Youjiang / CRAES
						Zheng Haohao / CNEMC	Gu Li / MOE	same		Xie Shuyan / CNEMC
							Zhou Jun / MOE	same	same	Same

Indonesia	Sri Kaloka Prabotosari / National Institute of Aeronauties and Space (LAPAN)	Gunardi / MOE	Liana Bratasida / MOE	0	Sulisty-owati / MOE	Halimah Syafrul/ MOE	same	same	Nixson F. Silalahi / MOE	Agus Harya Setyaki / MOE
	Sigit Sadiono / Indoneshian Embassy		Tjang Mushadji Sutami-hardja / Professor		Kusmu-lyani Sugiarto / MOE	same	same 2003	same 2005-2006	same	
	Ina Binari Pranoto / MOE							Ratnasari Anwar / MOE		
Japan	Hideki Okumura / Embassy of Japan, Thailand	Kenichi Kamae / Embassy of Japan	Shinichi Arai / MOE	same	Yuriko Koike and 8 officials / MOE	Hiroyasu Tokuda / MOE	Yasuhiro Shimizu / MOE	Satoshi Tanaka / MOE	Toshiro Segawa / MOE	Shintaro Fujii / MOE
	Hajime Endo/ MOE	Tokuya Wada/ MOE	same	Keiko Segawa / MOE	same	Reiko Sodeno / MOE	same	same	Nobuhiro Kino / MOE	Tetsunori Hatta with 8 more / MOE
	Chieko Tatsumi / MOFA	same	Yoshiko Endo / MOFA	Taira Iwasaki / MOFA	Takaaki Kato/ MOFA	same	Toshihisa Kato / MOFA	same	same	Same
							Norichika Kanie / TIT	same	same	Same
							Yukari Takamura, Ryukoku University	same		Same

Lao PDR	0	0	Mone-many Nhoybou-akong / MOE	same	same	Phakka-vanh Phissamay / MOE	same 2003	Bounthanh Bounvilay / MOE	Setouvanh Phantha-vongsa / MOE	Same
			Sisoup-hanh Luangrath / MOE	same	same	same	same	Darounny Vilaythong / MOE	same 2003-2007	same 2008
					Sakhone Chaleu-nvong / MOE					
Malaysia	Letchumanan Al Ramatha / MOE				Muhamad Bin Awang / Professor	Lian Kok Fei/ MOE	Che Kodir Baharum / MOE	Danial Lee Abdullah / MOE	Engku Mustaffa / MOE	Wan Rosely / MOE
	Chow Peng Leong / Meteorolo-gical Service	same	same	same	same		Maznorizan Mohamad / Malaysian Meteorolo-gical Department	Siniarovina Urban / Malaysian Meteorolo-gical Department	Olivia Chin Su Fung / Attorney General's Chambers	Nik Myhamad Majid / University Putra Malaysia
	Che Asmah Ibrahim / Dep. of Environment				Wong Fook Lian / Dep. of Chemistry	same				

Mongolia	Zamba Batjargal / Ambassador	Enebish Dugerjav / MOE Ministry of Nature and Environment	Enkhtuv-shin Gombo-suren / MOE	Erdenebul-gan Davaa / MOE	Erdene-baatar Enkhmend / MOE	Enkhtuv-shin Sevjid / NAMHEM	same	Tseesodrol-tsoo Dashdorj / NAMHEM	Bayarsaik-han Purevjav / NAMHEM	Uranchi-meg Ochirbat / MOE
	Lamjav Batnyam/ NAMHEM	Bulgan Tumen-demberel / Central Laboratory of Environ-mental Monitoring	Batbayar Tsemeen-myadar /Ministry of Nature and Environ-ment	Dugarsuren Enkhtuul / MOE		Erdenebat Eldev-Ochir/ NAMHEM	same	same	same	Same
Myanmar						Maung Maung Tun / MOT	Tin Ngwe / MOT	Sein Maw Oo / MOT	Tin Hla / MOT	Same
						Kyaw Moe Oo / MOT	Tun Thein / MOT		Htwe Htwe Win / MOT	Same
Philippines	Erlinda A. Gonzalez/ MOE	Pio Lofamia Tejada / MOFA	Fernan-dino Y. Concep-cion / MOE		Alan Benito de Gala/ MOE	Samuel R. Penafiel / MOE	Julian D. Amador / MOE	Letecia R. Maceda / MOE	same 2007	Same
	Ella S. Deocadiz/ MOE	same	Adrian B.C. Candolada / Embassy	Regina Perol/ Embassay	Corazon C. Davis /MOE		Cesar Siador, Jr. / MOE	Jean N. Rosete / MOE	same	Same
										Demetrio L. Iganacio, JR / MOE

ROK	Seog-Yeon Cho / Professor	same	same	same	same	Yeonsoon Ahn / MOE	Park Kwang-Suk / MOE	Lee Seung Han / MOE	same 2001-2005	Same
	Jin-Seok Han / NIER	same	same	same	Park Ju Young / MOFA	Jin-Seok Han / NIER	Park Jeong-Su / MOE	Kang Seuk Woo / MOE	Kim Jeong-Soo / NIER	Chang Lim-Seok / NIER
	Se Chang Ahn/ MOE	Soo Yun Ma/MOE	Lee Suk-Jo /NIER	Lee Jae-Hyun/MOE	Kim Kyung-Sik /MOE	Beom-Sik Yoo/MOE		Oh Heum Jin / MOE		same 2004
			Yang Jae-Moon /MOE	same	same			Ahn Joon Young / NIER		Hwang Suhee / MOE
Russia	Valery V. Chelukanov / RFSHEM	Dzhumshid Dzhangirov / Environ-ment Pollution Monitoring Department	same 2001	same	same	Marina Kotlya-kova / RFSHEM	same 2001, 2003-2005	same	same	Yuri Peshkov / RFSHEM
	Serguei A. Gromov /Institute of Global Climate and Ecology	Veronika Ginzburg / RFSHEM	same	same	same	same	same 2001	same	same	Same
	Tamara V. Khodjer / research institute									
Thailand	Suvit Yodmani/Asian Disaster Preparedness Center		Mingquan Wichayar angsaridh/ MOE	same	Monthip Sriratana Tabuca-non/MOE	Mingquan Wichaya-rangsa	Phunsak Thera-mongkol / MOE	Nisakorn Kositratna / MOE	same 2007	

	Sirithan Pairoj-boriboon / MOE				Pichaid Atipakya/ MOE	Unnop Buranasate / MOFA	Chatri Archjana-nun / MOFA	Wijarn Simachaya / MOE	same	Pornsook Chongpra-sith / MOE
	Supat Wangwongwatana /MOE	same	same	same	same	same	Same	same	same	Same
					Seksan Sangdow / MOE			Chavanart Thang-sumphant / MOFA	Alisa Chobisara / MOFA	
									Pichaid Atipakya/ MOE	Same
Vietnam	Vu Van Tuan /Hydromete-orological Service	Nguyen Van Tue/ Hydrome-teorological Service	Vu Van Tuan Deputy / Hydrome-teorolo-gical Service	same	Duong Hong Son / MOE	Tran Thuc General / MOE	Ngo Thi Hang / National Institute of Meteroloy Hydrology and Environ-ment	Dinh Thai Hung / National Institute of Meterology Hydrology and Environ-ment		same 2006
	Hang Thu Pham /Hydrome-teorological Service	Hoang Manh Hoa / Hydrome-teorological Service	Tran Van Sap/Hy-dromete-orological Service	Le Nguyen Tuong/ MOE	Be Thi Nguyen / MOE	Nguyen Khac Hieu / MOE		same 2003		Duong Hong Son / MOE (same 2005)
						Nguyen Le Tam / MOE			same 2006	
						Duong Hong Son /MOE	Same		same 2006-2007	
UNEP/ ROAP							Ahn Moon-Soo		Wanhua Yang	Young-Woo Park
							Manjit Iqbal			

UNECE		Keith Bull	same	Catherine S. Masson	Krzysztof Olendrzyn-ski
UN ESCAP			Sangmin Nam		
UNEP head-quarters				M.Iynga-rarasan	Same
ScandEnvi-ronment				Lars Nordberg	

Note: China National Environmental Monitoring Center (CNEMC); For Lao PDR, MOE is Science Technology and Environment Agency; For Malaysia, MOE is Ministry of Science, Technology and the Environment; For Mongolia, MOE is Ministry of Nature and Environment; NAMHEM: National Agency for Meteorology, Hydrology and Environment Monitoring of Mongolia; MOT: Ministry of Transport; HMS: Hydrometeorological Service; RFSHEM: Russian Federal Service for Hydrometeorology and Environmental Monitoring, a service in the Ministry of Natural Resources and Environment; For Thailand, MOE is Ministry of Science, Technology and Environment; UNEP/ROAP: UNEP Regional Office For Asia and the Pacific

APPENDIX III

LIST OF PARTICIPANTS OF TDGM MEETINGS

	2008			2009	2010	2011	2013	
	Steering Committee	**WG II**	**WG I**	**WG I**	**WG I**	**WG I**	**Steering Committee**	**WG I**
China	Yingxian Xia / MEP	Fahe Chai / CRAES	Ruibin Wang / CNEMC	Ruibin Wang / CNEMC	Xiaochun Zhang (CMA)	Jianjun Li / CNEMC	Xuefeng Sun / MEP	Benfeng Pan / CNEMC
	Yanchao Tong / CNEMC	Yunjiang Yu / CRAES	Yanchao Tong / CNEMC	Haohao Zheng / CNEMC	Haohao Zheng / CNEMC	Dandan Cui / MEP	Yao Dong / MEP	Wei Wang / CNEMC
	Qingxin Zhang / Liaoning Environment Monitoring Centre	Wei Wang / CRAES	Qingxin Zhang / Liaoning Environmental Monitoring Center	Feng Shi / CNEMC	Feng Shi / CNEMC	Deqian Fu / CNEMC	Jun Lin / MEP	
		Shihai Lv / CRAES		Xiaochun Zhang / China Meteorological Administration (CMA)		Xiaochun Zhang (CMA)	Jun Yu / MEP	
							Shihai Lv / CRAES	
						Wei Wang / CNEMC	Wei Wang / CNEMC	
							Xia Li / China-ASEAN Environmental Cooperation Center	
Japan	Satoshi Tanaka / MOEJ	Ken Yoshikawa / Okayama University	Masataka Nishikawa / NIES	Masataka Nishikawa / NIES	Masataka Nishikawa / NIES	Masataka Nishikawa / NIES	Hana Otsuka / MOEJ	
	Masataka Nishikawa / NIES	Toshiya Okuro / University of Tokyo	Nobuo Sugimoto / NIES	Nobuo Sugimoto / NIES	Nobuo Sugimoto / NIES	Nobuo Sugimoto / NIES	Hidemasa Yamamoto /	Hidemasa Yamamoto / MOEJ

						MOEJ	
Ken Yoshikawa / Okayama University	Norikazu Yamanaka / Tottori Univeristy	Itsushi Uno / Kyusyu University	Shintaro Fujii / MOE	Shintaro Fujii / MOE	Hitoshi Yoshizaki / MOEJ	Hitoshi Yoshizaki / MOEJ	Hitoshi Yoshizaki / MOEJ
		Takashi Maki / Japan Meteorological Agency	Takashi Maki / Japan Meteorological Agency (JESC)	Takashi Maki / Japan Meteorological Agency	Takashi Maki / Meterological Research Institute	Masataka Nishikawa / NIES	Masataka Nishikawa / NIES
		Masao Mikami / Meteorological Research Institute	Katsuyuki Takahashi / Japan Environmental Sanitation Center (JESC)			Toshiya Okuro / University of Tokyo	Nobuo Sugimoto / NIES
			Masakazu Kusakabe (JESC)				Takashi Maki / Japan Meteorological Agency
			Aya Horiuchi / Overseas Environmental Cooperation Center				Itsushi Uno / Kyusyu University
							Masao Mikami / Meteorological Research Institute
							Ken Yoshikawa / Okayama University

								Yukari Hara / Kyusyu University
ROK	Youngjin Kim / MOEK	Byung-Ho Yoo / NIER	Seungbum Kim / KMA	Youngsin Chun /KMA	Youngsin Chun /KMA	Sumin Kim / NIMR	Sanghoon Kim / MOEK	Sumin Kim / NIMR
	Yong-Ho Jeong / Korea Forest Research Institute	Yong-Ho Jeong / Korea Forest Research Institute	Jeong-Soo Kim / NIER	Seungbum Kim / KMA	Seungbum Kim / KMA	Eun-Hee Lee / NIMR	Bongwoo Shin / MOEK	Bongwoo Shin / MOEK
	Seungbum Kim (KMA)	Jang-Min Chu / Korea Environment Institute	Hee-Jin In / KMA	Sumin Kim / KMA	Sumin Kim / KMA	Youngsin Chun / National Institute of Meteorological Research (NIMR)	Youngsin Chun / NIMR	Youngsin Chun / (NIMR
		Ji-Youn Im (Korea Forest Service)	Mee-Hye Lee / Korea University	Mee-Hye Lee / Korea University	Mee-Hye Lee / Korea University		Young-San Park / NIMR	Jong-Chul Ha / NIMR
		Chang-Seok Lee / Seoul Women's University		Soo Yeon Park /KMA	Soo Yeon Park /KMA		Jaebok Lee / NIMR	Sang-Sam Lee / NIMR
				Eun-Hee Lee / KMA	Eun-Hee Lee / KMA		Kyong ha Kim / Korea Forest Research Institute	
				13 participants[131]			Yowhan Son / Korea University	Yowhan Son / Korea University
							Suh-Yong Chung / Korea University	Hye Jun Shin / NIMR

[131] They are from KMA, Center for Atmospheric and Environmental Modeling, Korea, Korea University, Pusan National University, Environment Energy Engineering.

Mongolia				Jugder Dulam / National Agency for Meteorology and Environment Monitoring	Jugder Dulam / National Agency for Meteorology and Environment Monitoring			Munkhtsetseg Erdenebayar / National University of Mongolia
				Munkhtsetseg Erdenebayar / National Agency for Meteorology and Environment Monitoring (NAMEM) & 4 researchers from NAMEM	Munkhtsetseg Erdenebayar / NAMEM			
				Munkhtsetseg Tungalag / Omnogobi Province				

APPENDIX IV

HISTORICAL EMISSIONS AND STATUS OF SIGNATURE AND RATIFICATION

Country (1)	Emission 1980 (2)	Emission 1985 (3)	Emission 1993 (4)	Reduction 1980–85 (%) (5)	Reduction 1980–93 (%) (6)	Signature/ ratification (7)
Austria	397	195	71	51	82	Ge,H,O,(Go)
Belarus	740	690	382	7	48	Ge,H
Belgium	828	400	294	52	64	Ge,H,O,(Go)
Bulgaria	2050	2314	1426	−13	30	Ge,H,(O),(Go)
Croatia	150	165	114	−10	24	)Ge(,O,(Go)
Czech Republic	2257	2277	1419	−1	37	)Ge(,)H(,O,(Go)
Denmark	450	339	156	25	65	Ge,H,O,(Go)
Estonia	239	239	145	0	39	)Ge(,)H(
Finland	584	382	124	35	79	Ge,H,O,(Go)
France	3338	1470	1121	56	66	Ge,H,O,(Go)
Germany	7514	7732	3153	−3	58	Ge,H,O,(Go)
Greece	400	500	545	−25	−36	Ge,O,(Go)
Hungary	1633	1404	756	14	54	Ge,H,(O),(Go)
Ireland	222	140	157	37	29	Ge,O,(Go)
Italy	3800	1733	1490	54	61	Ge,H,O,(Go)
Latvia	57	57	44	0	23	)Ge(,(Go)
Lithuania	311	304	125	2	60	)Ge(
Luxembourg	24	17	15	29	38	Ge,H,O,Go
Netherlands	490	261	157	47	68	Ge,H,O,(Go)
Norway	140	97	35	31	75	Ge,H,O,(Go)
Poland	4100	4300	2725	−5	34	Ge,(O),(Go)
Portugal	266	198	300	26	−13	Ge,(Go)
Rep. of Moldova	308	282	128	8	58	)Ge(,(Go)
Romania	1055	1255	928	−19	12	Ge,(Go)
Russian Federation	7161	6191	3456	14	52	Ge,H,(O),
Slovakia	780	613	325	21	58	)Ge(,)H(,O,(Go)
Slovenia	234	241	183	−3	22	)Ge(,O,(Go)
Spain	3319	2190	2071	34	38	Ge,O,(Go)
Sweden	508	266	101	48	80	Ge,H,O,(Go)
Switzerland	116	76	34	34	71	Ge,H,O,(Go)
Turkey	860	322	354	63	59	Ge
Ukraine	3849	3463	2194	10	43	Ge,H,(O)
UK	4913	3766	3185	23	35	Ge,O,(Go)
Yugoslavia	406	478	401	−18	1	)Ge(
Other countries	1527	1527	1539	0	−1	
Natural sources	4318	4318	4409	0	−2	
Total	59 345	50 202	34 061	15	43	

Note: Adapted from "The Oslo Protocol on Sulfur Reduction: the Great Leap Forward?" *Journal of Public Economics*, by Finus & Tjøtta, 2003, p. 2035. Emissions (columns 2–4) are expressed in 1,000 tons SO2 / year. Reductions (columns 5–6) are expressed as percentage reduction with respect to 1980 annual emissions. Parentheses means that a country is a signatory but has not ratified the agreement yet; reverse parentheses indicate that a country was a non-signatory but succeeded later. Ge=1979 Geneva Framework Convention; H=1985 Helsinki Protocol; O=1994 Oslo Protocol; and Go=1999 Gothenburg Protocol. "Other countries" includes Africa, Albania, Bosnia, Cyprus, Georgia, Iceland, Kazakhstan, Liechtenstein, and the FYR Macedonia. Natural sources include the Baltic Sea, the Mediterranean Sea, the North Sea, the remaining N.E. Atlantic, Natural Oceanic, and Volcanic. It is notable that even the non-signatories such as Ireland and Spain had reduced their annual sulfur emissions by more than 30% by 1985.

APPENDIX V

CONTRIBUTIONS FOR THE FINANCING OF THE EMEP PROGRAMME BETWEEN 1988 AND 1998

Party	EMEP Protocol Ratification	Contrib. 1988-1998	Arrears by 1998	Contr. 1999 US$ Expected	Contr. 1999 US$ Received	2000 US$ Expected
Austria	04.06.1987	297,164		44,865	44,865	45,490
Belarus	04.10.1985	99,923		3,910		2,753
Belgium	05.08.1987	417,216		52,589	52,589	53,313
Bosnia and Herzegovina	06.03.1992	928	1,763	238		241
Bulgaria	26.09.1986			906	906	531
-till 1998		56,769				
Canada	04.12.1985	48,816		voluntary		voluntary
Croatia	08.10.1992	15,570		1,716	1,716	1,449
Cyprus	20.11.1991	5,367		1,621	1,614	1,642
Czech Republic	01.01.1993	98,547		5,769	5,769	5,167
Denmark	29.04.1986	254,057		32,946		33,417
Finland	24.06.1986	201,762		25,842	25,842	26,222
France	30.10.1987	2,212,388		311,816	311,816	316,063
Germany, since 1991	07.10.1986	2,639,228		467,629		476,002
-former GDR till 1990		155,052				
-FRG till 1990		567,427				
Greece	24.06.1988	172,585		16,735	4,685	16,950
Hungary, since 1992	08.05.1985	52,659		5,721	5,721	5,795
-till 1991 (in kind)		22,695				
Ireland	26.06.1987	88,085		10,680	10,680	10,817
Italy	12.01.1989	895,136	424,710	258,989		262,557
Latvia	18.02.1997	3,321		1,144	1,144	821
Liechtenstein	01.05.1985	3,648		286	286	290
Luxembourg	24.08.1987	19,800		3,242	3,242	3,284
Malta	14.03.1997	395		667		676
Monaco	27.08.1999					193
Netherlands	22.10.1985	594,327		77,763		78,810
Norway	12.03.1985	240,677		29,084	27,904	29,457
Poland, since 1994		107,327		9,869	9,869	9,465
-1988-1993	14.09.1988	122,337				
Portugal	10.01.1989	59,504		19,882	19,882	20,813
Russian Fed., since 1998		172,421		70,898	70,881	52,009
-1992-1997		2,434,909				
-former USSR till 1991	21.08.1985	1,076,522				
Slovakia	28.05.1993	35,651		1,859	1,859	1,690
Slovenia	06.07.1992	14,815		2,908		2,946
Spain	11.08.1987	691,451		123,439	123,439	125,121
Sweden	12.08.1985	477,379		51,683		52,106
Switzerland	26.07.1985	418,469		57,929	57,929	58,673
Turkey	20.12.1985	115,220		20,978	20,978	21,248
Ukraine, since 1999	30.08.1985			14,399		9,175
-1988-1998		180,164	283,445			
United Kingdom	12.08.1985	1,649,635		242,683		245,896
United States	29.10.1984	79,850		voluntary		voluntary
Yugoslavia, since 1993	28.10.1987	5,618	19,473	1,621		1,256
-former Yugoslavia		21,643	18,974			
European Community	17.07.1986	596,184		68,192	68,192	68,158
Former Czechoslovakia		104,405				
Total (all)	38 Parties	17,527,046	748,365	2,040,498	871,808	2,040,496
Total, in cash			464,920	2,022,189		
Total, in kind		4,252,776	283,445	3,910	0	2,753
Total; EB agreed amount				2,040,495		2,040,495

Notes: EMEP Protocol has been in force since 28.1.1988.

Shaded areas: Contributions in kind.

Germany reserved its position concerning 1999 and 2000 (see EB.AIR/GE.1/1999/2, para. 52).

Note: UNESC, 1999, p. 5.

APPENDIX VI

PARTICIPANTS IN THE ANNUAL MEETINGS OF EMEP STEERING BODY 2008-2011

	2008	2009	2010	2011
Armenia	A. Turlikyan	Same	Same	Same
Austria	M. Ritter	Same	Same	C. Nagl
	J. Schneider			
Azerbaijan	R. Guliyev	Same	0	Same
Belarus	A. Pilipchuk	Same	Same	Same
Belgium	M.-R. V. D. Hende	Same	Same	0
Bosnia and Herzegovina	0	0	R. Radic	0
Bulgaria	I. Angelov	0	0	0
Canada	P. Blanchard	0	C. Banic	0
Croatia	S. Vidic	Same	Same	Same
Cyprus	S. K.	Same	Same	Same
Czech Republic	J. Macoun	Same	Same	Same
	J. Santroch			
Denmark	T. Ellermann	Same	Same	Same
	C.L. Fogh		Same	
	O. K. Nielsen			
Estonia	0	T. Pauklin	0	0
Finland	H. Hakola	0	Y. Viisanen	Same
France	J. P. Chang			

	L. Rouil	Same	Same	Same
Georgia	M. Tushishvili	0	0	0
Germany	E. Bieber	Same	Same	Same
	M. W. Fiebig			
Greece	A. Papastamou	0	Same	0
Hungary	P. Z. Ferenczi	Same	0	Same
Italy	S. Doytchinov	Same		0
		N. Pirrone	Same	
Kyrgyzstan	0	0	0	A. Syrgakova
Montenegro	0	0	P. Djuraskovic	0
		Nicola Pirrone	Same	
Netherlands	P. Ruyssenaars	Same	Same	Same
		R. Maas	Same	Same
				J.-P. Hettelingh
Norway	T. Johannessen	Same	Same	Same
		V. Vestreng		B. Kvaeven
				B.L.S. Monsen
Poland	G. Mitosek	A. Degorska	Same	G. Mitosek
Portugal	0	0	P. Torres	0
Republic of Moldova	V. Balan	0	0	V. Balan
Serbia	D. Djordjevic	Same	Same	Same
Slovakia	M. Mitosinkova	Same	Same	Same

Slovenia	M. Logar	Same	Same	Same
Spain	A. G. Ortiz	Same	Same	Same
	X. Querol	Same	Same	Same
Sweden	P. Grennfelt	Same	Same	Same
	K. Kindbom		M. Ullerstam	
Switzerland	R. Ballaman			
	R. Gehrig	Same	Same	Same
	R. Weber	Same	Same	Same
The former Yugoslav Republic of Macedonia	0	0	A. Stefanovska	Same
Ukraine	L. Kozak	Same	Same	Same
United Kingdom	P. Cassanelli	C. Dore	Same	Same
			P. Coleman	Same
				H. Harmens
USA	R. Dennis	T. Keating	Same	Same
			S. Anenberg	

Note: UNECE, 2008; 2008; 2010; 2011. "Same" denotes same participants to previous years, and "0" denotes no delegations.

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