Fine dust and sustainability in Northeast Asia

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WINTER IN KOREA is infamous for its harsh cold and bone-dry air. The colorful blooms and budding leaves of spring that follow those long winter months are a welcome presence to many people. For some, however, spring has now become synonymous with wearing dust masks to ward off the dreaded yellow dust and fine dust blowing in from China. The harmful effects of fine dust have come into light in recent years, fueling widespread anxiety over the issue. Fine dust, with a particle size of 2.5μm ($PM_{2.5}$) and under, infiltrates the body through the skin and the respiratory system, leading to asthma, vascular disease, heart failure, and cancer. According to an article published in the March issue of *Nature,* 3.45 million people died from issues related to air pollutants worldwide in 2007.[1] This article highlights the startling fact that Korea, North Korea, Japan, and Mongolia have a collective yearly death rate of 30,900 due to fine dust originating from China. The Batelle Memorial Institute and Columbia University are utilizing satellite imagery to show that the eastern regions of China have the highest concentration of fine dust in the world. These images also clearly indicate that the wind carries the dust into Korean territory.[2]

Once it was revealed that China was the main cause of air pollution within Korea, some environmental organizations filed lawsuits against China, demanding compensation for damages and losses caused by fine dust. According to the Korean government, an estimated 30-50% of Korea's air pollutants come from China each year. On the other hand, others argue that measures should first be taken to deal with thermo-electric power plants and vehicle exhaust fumes, which are known to be the leading domestic causes of air pollution. It is nearly impossible to calculate exactly how much fine dust in Korea is produced domestically and how much blows in from China. Before we focus on the place of origin, however, it is essential to take this opportunity to examine the close connection between Northeast Asia and fine dust, as well as the importance of inter-state cooperation in solving this issue.

Northeast Asia houses over 15 million people and has a higher population density than any other region in the world. Unsurprisingly, it is also accompanied by a high risk of environmental pollution. The region has been experiencing rapid development over the past few decades, and it is expected that the development will further continue at unprecedented speed in the future. From arid lands to tropical rain forests, Northeast Asia covers a range of diverse climates and ecological areas. Consequently, it is highly susceptible to various types of natural disasters such as hurricanes and earthquakes. According to research conducted by the Asia Center at Seoul National University (based on data from EM-DAT of the Centre for Research on the Epidemiology of Disasters), annual damage costs caused by natural disasters in Northeast Asia increased from $600 million in 1983 to $53.7 billion in 2013.[3] In other words, damages jumped an astonishing 86.8 times over a span of thirty years. 1.26 million lives were lost to natural disasters during that time period, and approximately 3.4 billion people across the region were affected both directly and indirectly. By contrast, the global sum of natural disaster damages merely increased seven-fold from $16.7 billion in 1983 to $118.4 billion in 2013. Northeast Asia succeeded in achieving revolutionary economic development, but that victory unfortunately came at the cost of environmental destruction, pollution, and disaster.

As descendents of a common civilization based on Chinese characters, nations within Northeast Asia have historically shared a considerable degree of cultural homogeneity. Over the past century, however, each country has been pursuing individual forms of progress, leading to an increase in economic and political discord. Recent issues such as the territory disputes between Korea, China, and Japan, the threat of North Korea, and the potential of China to overturn the global order have driven political and diplomatic uncertainty in Northeast Asia to its peak. As a result, the region is failing to come together to address environmental dilemmas, despite suffering from the highest level of damage and disaster. It is crucial to recognize that active inter-state cooperation is the key to solving the ever-growing issue of air pollution. Once that cornerstone is established, the gates will surely open for widespread sustainable development in Northeast Asia.

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References

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3 https://tinyurl.com/chosun87times

Left: Distribution of fine dust in Asia (Average of PM2.5 (2001-2010) from the Batelle Memorial Institute and CIEN (2013) by administrative district)

Japan's long-range transboundary $PM_{2.5}$ problem

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Polluting Industries in urban Japan. Photo reproduced under a creative commons license courtesy of shinobu sugiyama on Flickr.

FINE PARTICULATE matter ($PM_{2.5}$), a long-range transboundary air pollution (LRTAP) substance, first emerged as a major social issue in Japan in early 2013.[1] Severe $PM_{2.5}$ pollution in areas of China including Beijing was reported in Japan through broadcast and print media in January. At the end of the month, high concentrations of $PM_{2.5}$ exceeding environmental quality standards were detected across western Japan, with concentrations of $PM_{2.5}$ in Fukuoka city (in Fukuoka Prefecture) reaching levels three times the norm. Every year, western Japan experiences damages to quality of life due to yellow dust coming from China and, in recent years, has experienced damage to forests due to acid rain and acid fog and issued warnings for photochemical smog, all of which are believed to have originated in China. Under these circumstances, as a new LRTAP substance coming from China, $PM_{2.5}$ has aroused a high degree of public interest all at once.

In the past, the environmental quality standard for Suspended Particle Matter (SPM) in Japan was set at PM_{10} levels.[2] However, considering the risks to health such as lung cancer, a discussion on the necessity of regulating the finer $PM_{2.5}$ particles ensued, and in September 2009, environmental quality standards were designated at less than or equal to 15μg/m³ as the annual average standard and less than or equal to 35μg/m³ as the 24 hour standard.[3] Furthermore, in accordance with the increased public interest in 2013, the Japanese Ministry of the Environment proposed provisional guidelines of a 24 hour standard of 70μg/m³ for public warnings in February of that year. This value has become the standard for guidelines (revised in November 2013 and November 2014) to warn citizens to avoid unnecessary and non-urgent outdoor activity and strenuous outdoor exercise for extended periods of time. In comparison, the environmental quality standard for $PM_{2.5}$ in urban areas in China is set at 75μg/m³.

When the problem first arose as a social issue in January 2013, the 24 hour average concentration of fine particulate matter in Beijing exceeded China's environmental quality standard of 75μg/m³ and Japan's provisional guideline of 70μg/m³ for public warnings, resulting in air quality conditions that pose a serious risk to health. Although China's severe $PM_{2.5}$ problem garnered the world's attention in the winter of 2013, the composition of air pollutants in the country did not change suddenly in that year. Outbreaks of extreme air pollution had been and remain common in China. It was only that the winter of 2013 was marked by lower than usual temperatures and weak surface winds, providing optimal conditions for fog to form. The combination of these weather conditions inhibited the diffusion of air, leading to the detection of higher than usual concentrations of $PM_{2.5}$.

Research has been conducted on the influence of China's $PM_{2.5}$ problem on concentrations of fine particulate matter in Japan. According to Kanaya et al. (2013), for example, the percentage contribution of China on average yearly concentrations of $PM_{2.5}$ in Japan by region is estimated at 61 percent in the Kyushu region (9 prefectures), 59 percent in the Chugoku region (5 prefectures), 59 percent in the Shikoku region (4 prefectures), and 55 percent in the Kinki region (6 prefectures). Thus, over half of the $PM_{2.5}$ in western Japan is thought to have originated in China. On the other hand, the percentage contribution of China on average yearly concentrations of $PM_{2.5}$ in the Kanto region (7 prefectures, including Tokyo) was 39 percent, and 51 percent is estimated to have originated domestically in Japan.

In the case of ozone (O_3), another LRTAP substance, the frequency of photochemical smog warnings dropped below 100 days per year around 1990 but shot up to a steady 170 to 180 days per year around 2010. The influence of China was discussed in Japan on this matter as well. However, according to Kanaya et al., the percentage contribution of transboundary ozone from China was estimated to be 12 percent while ozone of domestic origins and ozone originating in North America and Europe were estimated to be 22 percent and 7 percent, respectively. Therefore, in the case of ozone, there is a need to consider the movement patterns of pollutants on a much larger, global scale.

The Convention on Long-range Transboundary Air Pollution (CLRTAP) in Europe can serve as a reference for dealing with LRTAP problems such as $PM_{2.5}$ in East Asia. This convention opened for signature in 1979 in response to transboundary damages from acid rain in Europe, entered into force in 1983, and formed a regime to respond to transboundary air pollution issues through the continued adoption of various protocols. At present in East Asia, there are also regional efforts such as the Acid Deposition Monitoring Network in East Asia (EANET), but the effectiveness of those efforts remains to be evaluated.

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References

1 $PM_{2.5}$: fine particles with a diameter of 2.5μm or less

2 PM_{10}: inhalable coarse particles with a diameter between 2.5 and 10μm

3 "The annual standard for $PM_{2.5}$ is less than or equal to 15.0μg/m³. The 24 hour standard, which means the annual 98th percentile values at designated monitoring sites in an area, is less than or equal to 35μg/m³. (Notification on September 9, 2009)" The Ministry of the Environment page on Environmental Quality Standards in Japan - Air Quality. https://www.env.go.jp/en/air/aq/aq.html