Environmental Impact of Acid Rain and "Acid Deposition Monitoring Network in East Asia (EANET)"

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Introduction

What are "Global Atmospheric Environmental Problems"? An answer to the question may be "Air pollution of which the cause and effect spreads not only inside of a country, but also beyond the borders of countries, and sometimes reach global or semi-global scale". Typical issues include acid rain, ozone layer depletion, climate change, persistent organic pollutants (POPs) and other regional atmospheric problems. As mentioned in the preamble of the Earth Charter[1)] , "We stand at a critical moment in Earth's history, a time when humanity must choose its future". Let us begin to think globally and take actions toward the challenge of our common future.

History of Acid rain in Europe and North America[2)]

Scientifically, "acid rain" is a part of "acid deposition", but it is a very common concept and used as a representative cause of the acidification. In Northern Europe and North America, pH of lake water decreased in 1970's compared with that of 1930's and damage resulting from this decrease, such as declining fish populations, was reported. The cause of this pH decline is believed to have been deposition of acidic substances into lakes in excess of their neutralization or buffering capacity. Acid deposition due to acid precipitation and acidic gases may cause soil acidification, nutrient imbalance, and/or direct damage to plants, and may become a cause of forest decline.

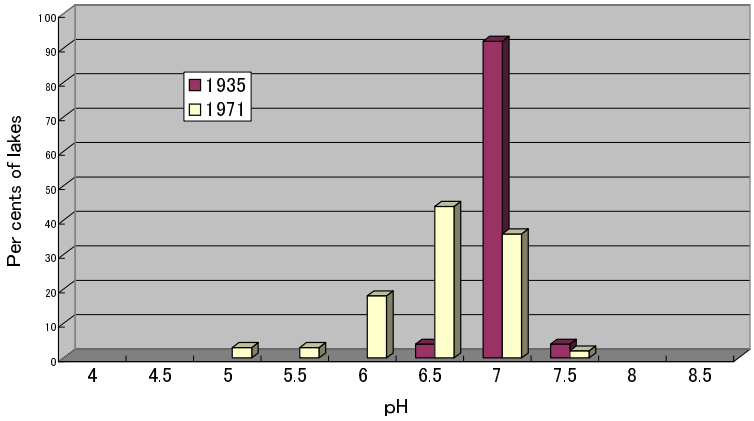

Fig. 1 Acidification of Lake Water in Southern Sweden

Sulfur dioxide and oxides of nitrogen released into the air when coal and oil are burned can be carried many hundreds of miles by wind currents before being deposited, either as precipitation or as dry deposition. Since such deposition often occurs through mixing with precipitation, and the damage is often caused through the mechanism of acidification, this phenomenon came to be known as “acid rain”. In this way, oxides of sulfur and nitrogen form acids, which can damage materials and aquatic and terrestrial ecosystems. However, this term now is used to refer to both wet and dry depositions.

Swedish researchers had already started monitoring freshwater acidity levels in the 1940’s. In the 1950’s and 1960’s they began to notice significant increases in these levels. In 1968, the Swedish scientist Svante Oden published a paper in which he argued that precipitation over Scandinavia was becoming increasingly acidic, thus inflicting damage on fish and lakes. Most importantly, he asserted that acidic precipitation was to a large extent caused by sulfur compounds from British and Central European industrial emissions (Fig.2).

The issue of acid rain entered various international agendas as a result of a sustained campaign by Scandinavian countries, especially Sweden followed by Norway. Governments in both Norway and Sweden became concerned about the acidification of their lakes and forests due to transboundary air pollution because valuable fish stocks and forest resources were threatened. Their concern led to a spate of diplomatic activity aimed at getting the issue of acid rain and long-range transport of air pollutants placed on the political agenda of the international community.

Although alerted by Swedish research and diplomatic efforts of Scandinavian countries to the threat of acid deposition, polluting countries continued to wait until the end of the 1970’s for more convincing proof of the damage being caused. At the 1972 United Nations meeting in Stockholm, the Swedish government presented its evidence on the extent of long-range transport of pollutants and the damage that was being caused to soil and lakes. In same year the OECD started the first internationally coordinated large-scale research program on the long-range transport of air pollutants. The results of this study, published in 1977 with a revised and expanded version appearing in 1979, provided the first independent international verification of Scandinavian charges that in southern Norway and Sweden imported sulfur was primarily responsible for the acidification of lakes. Five of the eleven European countries participating in the study received more pollution from abroad than domestic sources.

After these long negotiations, the ECE Convention on Long-range Transboundary Air Pollution (LRTAP) was signed by 35 Contracting Parties (34 countries and EC Commission) in Geneva in November 1979. In light of what they considered to be convincing evidence of the need for decisive international action, the Scandinavian countries proposed that countries should undertake reduce SO_2 emission of 30 percent below 1980 levels by the year 1993. The 30 percent proposal was adopted as an official protocol to the LRTAP Convention at the third meeting of the Executive Board in Helsinki in July of 1985. The protocol stipulated a reduction of emissions/transboundary fluxes of sulfur dioxide as soon as possible, and by 1993 at the latest, with 1980 levels taken as the baseline.

As shown in Fig. 3 and Fig. 4, many EU countries reduced their sulfur emission to the atmosphere

drastically in these two decades. Within the LRTAP Convention, the European Monitoring and Evaluation Programme (EMEP) was established. The main objective of the EMEP is to regularly provide governments and subsidiary bodies qualified scientific information to support the development and further evaluation of the international protocols on emission reductions negotiated within the Convention. The main focuses of the EMEP are: (1) acidification and eutrophication, (2) ground level ozone, (3) persistent organic pollutants (POPs), heavy metals, and particulate matter.

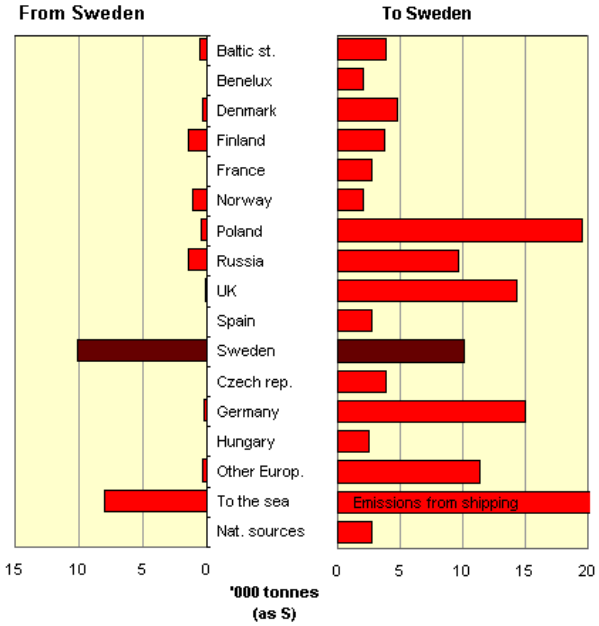

Fig. 2 Export and import of atmospheric sulfur emission

Note: In 1998 Sweden discharged a total of some 24,000 tons of sulfur into the atmosphere, but sulfur deposition in this country that same year exceeded 143,000 tons (by Swedish Eviron. Protec. Agency).

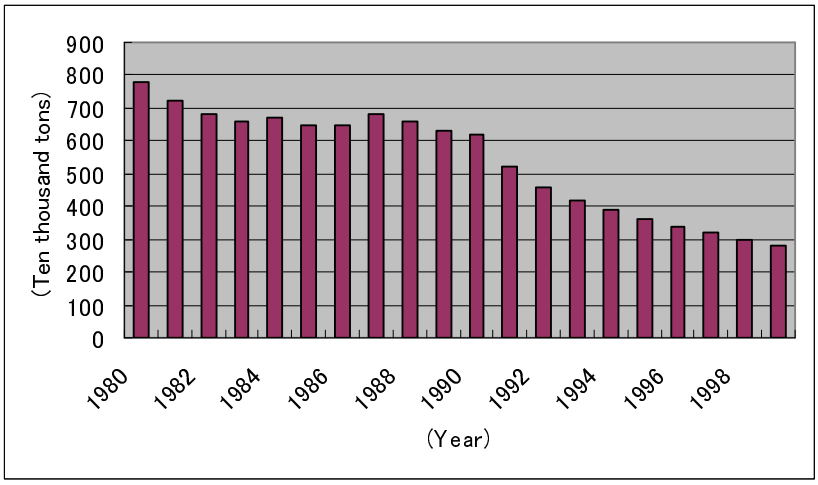

Fig. 3 Sulfur dioxide (SO_2) emission in Germany

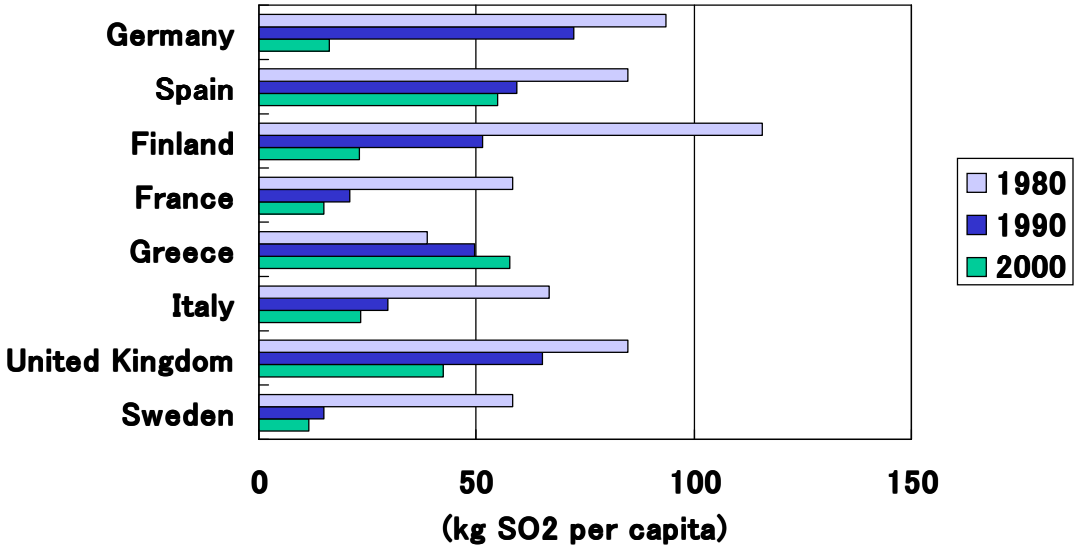

Fig. 4 Trends of SO_2 Emissions in EU countries

Acid rain in East Asia and the Acid Deposition Monitoring Network in East Asia (EANET)[3)]

In recent years, the East Asian region has been facing increasing risks of problems related to excess deposition of acidic substances as a result of rapid industrialization. At the First Intergovernmental Meeting on the Acid Deposition Monitoring Network in East Asia (EANET) held in March 1998 an agreement was made to implement the preparatory-phase activities of the Network on an interim basis. After the preparatory-phase activities (1998-2000), the Second Intergovernmental Meeting resulted in a decision to start regular monitoring from 2001 using their experiences obtained through the preparatory-phase. For the implementation of the regular phase activities, three bodies namely the i) Scientific Advisory Committee (SAC), ii) Secretariat, and iii) Network Center (NC), were established. The SAC consists of scientists/experts nominated from each participating country and implements tasks concerning the scientific aspects of the regular phase activities. The UNEP RRC.AP (United Nations Environment Programme, Regional Resource Centre for Asia and the Pacific, Bangkok) was designated as the Secretariat, and the Acid Deposition and Oxidant Research Center (ADORC) in Japan was designated as the NC.

Acid deposition monitoring of the EANET covers four environmental items – wet deposition, dry deposition, soil and vegetation, and inland aquatic environment. Monitoring for wet and dry deposition is being implemented in order to observe concentrations and to evaluate fluxes of acidic substances onto the land surface, while monitoring for soil/vegetation and inland aquatic environment was implemented to assess adverse impacts on terrestrial and aquatic ecosystems. These monitoring data will be utilized to evaluate the state of acid deposition as well as impacts on ecosystems.

As shown in Fig. 5, more than 40 wet deposition monitoring sites are operated by 12 participating countries.

Fig. 5 Wet deposition monitoring sites of the EANET(2003)

Conclusion

The impact of the global air pollution on the climate and ecosystem is recognized as a threat to the sustainable development of the world. Acid rain in Europe and North America were mitigated as a result of international cooperative measures and now the East Asian region is a new focus.

As described in the Earth Charter[1], "preventing harm is the best method of environmental protection, and when knowledge is limited, apply a precautionary approach. Take action to avoid the possibility of serious or irreversible environmental harm even when scientific knowledge is incomplete or inconclusive".

References

1) The Earth Charter- Values and Principles for a Sustainable Future, Earth Charter Commission Japan (2003).

2) Arild Underdal and Kenneth Hanf, International Environmental Agreements and Domestic Politics – The case of acid rain, Ashgate, England (2000).

3) Data Report on the Acid Deposition in the East Asian Region 2004, Network Center for EANET (2005).