Experiences from acid rain abatement in Europe

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The European starting point

1960-1970: Large scale fish death reported in lakes and rivers in Norway and Sweden (fishkill episodes were reported in salmon rivers in Southern Norway already in 1900-1920)

1980s: Severe dieback of forest were reported in central Europe
Integrated Monitoring was needed to establish dose/response relationships and quantify related damage, as well as document effects of policy changes.
Long range and transport across borders

Sulfur

Nitrogen

Deposition of sulphur and nitrogen in Norway in 1997, in 1000 tonnes, SFT 2000
The UN ECE Convention on Long-range Transboundary Air Pollution

Ratified in 1979
30 European countries, USA and Canada participated

Monitoring programs under the Convention:
EMEP (Air and Precipitation)
UN-ICP-Waters
UN-ICP-Forest
UN-ICP-Integrated Monitoring
Monitoring program design

Example from Norway

- **Intensive sampling, Integrated monitoring sites (5-10)**
- **Annual samples, Regional monitoring (200 lakes)**
- **Survey, large scale (1500 lakes)**

Increasing sampling frequency

Increasing number of sites
Monitoring design in Norway

Intensive Survey

Annually

Survey
Emission reduction protocols developed as more knowledge was acquired from the monitoring programs.

- **1985 Helsinki:** Sulphur, flat percent reduction
- **1988 Sophia:** NOx, flat percent reduction
- **1994 Oslo:** Sulphur, effect based (critical loads)
- **1999 Gothenburg:** Multi-pollutant Multi-effects:
  - Acidification
  - Eutrofication
  - Ozone

EMEP monitoring program
Effect-based emission reduction: More environmental improvement for less costs
The Multi-effect Protocol
(or Gothenburg protocol)

- **Effect targets:**
  - Acidification
    (From 930 000 km² to 150 000 km²)
  - Eutrophication
    (From 1 650 000 to 1 080 000 km²)
  - Tropospheric ozone
    (Reduce no. of exceeded days to half)

- **Emission ceilings in 2010 for:**
  - Sulphur
  - NOx & NH₃
  - VOCs
Declining Sulphur deposition

S-deposition in southern Norway

S dep (g/m²)

Extent of critical load exceedance have decreased.
Main Conclusions

• The long term monitoring programs have been the primary scientific basis for the European emission reduction policy.

• A combination of integrated monitoring, regional monitoring and surveys is necessary.

• A similar approach will enable China to develop the most efficient abatement strategies.
Effect based acid rain reduction policy should be developed in China

- China makes efforts to reduce acid rain and air pollution
  - The environmental benefits should be optimized!

- Integrated monitoring as well as research is necessary

- Adapt acid rain simulation models to Chinese conditions
  - Natural environment very different
    - Climate, soils, vegetation
  - Pollution is very different
    - Alkaline dust
What is it that China needs that Norwegians experts are especially good at?

– Experience on Acid rain research!
  • > 30 years of lessons learned
    – Opportunity of doing it right the first time around
  • Norwegian institutes have international and regional monitoring responsibilities
    – ICP, EMEP
  • Successful scientific interdisciplinary cooperation
Integrated Monitoring Program on Acidification of Chinese Terrestrial Systems
Aim and Approach

- Transfer the *Toolbox* needed for the Chinese authorities to prepare and implement an *effect based acid rain policy* in order to reach the social-economic optimal emission level of S and N
  - Conducting *Critical Load* assessment adapted to Chinese environmental conditions
- Established sites with intense and integrated monitoring as well as conducted research
  - Identify acid sensitive species and key parameters explaining variation in vegetation
  - Identify key processes controlling the composition of water when passing through acid sensitive watersheds
    » Adapt simulation and prediction models to Chinese environmental conditions
      ▸ Establish dose-response relationships of the soils by use of habituated prediction models
      ▸ Assess potential ecological impact under different scenarios of acid rain deposition
- Generate high quality chemical data
- Measure deposition and air quality, also in remote areas
- Improve economic analysis of acid rain damage
Chinese Institutional Structure
Conclusion

The Sino-Norwegian IMPACTS-project enable the establishment of an Effect based acid rain mitigation policy in China through the implementation of Intensive integrated monitoring sites
Final Conference
Acid rain and Air pollution abatement in China: Policy development from Science and monitoring

• 2 days in mid November
• **Day 1 Acid rain and policy**
  – Plans for energy production in China and interaction with air pollution control (NDRC)
  – The IMPACTS monitoring programme: Main results and further plans
  – Air pollution control in China (SEPA)
  – Air pollution control at province level (Provincial EPB(s))
  – Monitoring data as fundament in optimal air pollution reduction control: Experiences from Europe and potential for transfer to China
  – Ideas for mid-term and long-term acid rain abatement plans in China
  – Air pollution and forestry (State Forest Administration)
  – Long term environmental monitoring (MOST)
  – Effects of air pollution on agriculture (Ministry of Agriculture)
  – China’s participation in International air pollution monitoring (CNEMC)
  – Related projects... ADB, UNIDO, UNEP
• **Day 2 Scientific results and findings**
Crisis = Danger + Possibilities