TFIAM – NEBEI - ECLAIRE Workshop on

The valuation of damage to ecosystem services due to air pollution
24 – 25 October 2013
Zagreb, Croatia

I. INTRODUCTION

1. This report describes the results of the workshop held in Zagreb, Croatia on the valuation of damage to ecosystem services due to air pollution, that was jointly organised by the Task Force on Integrated Assessment Modelling (TFIAM), the Network of Experts on Benefits and Economic Instruments (NEBEI) and the EU Framework Project 'Effects of Climate Change on Air Pollution and Response Strategies for European Ecosystems (ECLAIRE). During the workshop the need for valuation of biodiversity and ecosystem services and the available methods were discussed. Presentations made during the meeting are available at: www.gains.iiasa.ac.at/TFIAM/past-meetings.html.

2. 44 experts from the following Parties to the Convention attended the workshop: Austria, Croatia, Denmark, Germany, Finland, France, Netherlands, Norway, Spain, Sweden, Switzerland, and The United Kingdom of Great Britain and Northern Ireland. Also the Network of Experts on Benefits and Economic Instruments (NEBEI), the Working group on Effects (WGE) of the Convention on Long Range Transboundary Air Pollution (CLRTAP), the Co-operative Programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe (EMEP), the EMEP Centre for Integrated Assessment Modelling (CIAM), the International Cooperative Programmes for Vegetation and for Mapping & Modelling, the European Environment Bureau, CONCAWE and RWE were represented.

3. Mr. R. Maas (Netherlands) and Mr. S. Åström (Sweden) chaired the meeting.

4. The chair of the EMEP Steering Body, Sonja Vidic, welcomed the participants to Zagreb and opened the meeting. The current co-chair of TFIAM, Anna Engleryd, announced that the Swedish co-chair will from now on be represented by Stefan Åström.

5. In identifying economic values it is important to distinguish between the stock (the natural capital), the flows (ecosystem services), the changes in the flow due to air pollution (damage to ecosystem services), and the (net) change in damage (or the net benefits to ecosystem services) due to air pollution policies. . Studies under the flag of 'The Economics of Ecosystems and Biodiversity'(TEEB) focus on the valuation of annual ecosystem services. A study for the EU valued the ecosystem services delivered by the Natura 2000 network (90 mn ha) at more than €300 bn/yr (IEEP, 2011). Values differ for different types of ecosystems, ranging from around €2000 per ha/yr for grasslands and forests to € 13.000 ha/yr for dunes and up to € 300.000 per ha/yr for wetlands. The damage to these ecosystem services due to air pollution also differs per type of ecosystem. Notable impacts of air pollutants on ecosystem services include effects on forest growth, and on the biodiversity of grasslands and inland waters.

6. The current modelling approach used in air pollution policy, including the concept of critical loads, is based on realising long term sustainability of ecosystems. It is important to relate (often short term) valuation of ecosystem services to the long term sustainability of ecosystems.

II. STATE OF THE ART IN THE VALUATION OF ECOSYSTEM SERVICES AND DAMAGE ASSESSMENTS

7. The ecosystem services approach can inform decision making in a number of ways. First, through simple identification of the services that are provided, recognising that stakeholders, including decision makers, will not be familiar with many of the ecosystems concerned in more than a superficial way. Secondly, by identification of those services that will be affected by air pollution. Thirdly, by consideration of the costs of abatement measures and the responses of ecosystems (and of ecosystem managers). The final step of the valuation of these responses is only one element in the analysis, and may not be the most important for informing decision makers.

8. Currently, monetary valuation can only be applied in a meaningful way to a small part of all relevant ecosystem services. Only for the provision of food, wood, carbon storage and clean water can a market price be derived easily and with wide applicability. The value of supporting services that are crucial for long term sustainability (photosynthesis, soil formation, nutrient cycling) is difficult to monetise. Monetary values for biodiversity based on willingness to pay surveys show large variations and inconsistencies. While the ecosystem service approach is useful in bringing economists and natural scientist together to increase understanding, it should not eliminate the use of physical endpoint indicators in decision making.

9. Experiments by the ICP Vegetation are able to provide quantitative data on the physical damage to ecosystem services due to ozone. Such data are today used for modelling of ozone impacts on crop production, timber production and carbon sequestration. Other air pollution effects such as potential impacts on flowering and pollination and on biodiversity require further study.

10. Recent results from the Coordination Centre on Effects suggest that decreasing nitrogen deposition will enhance biodiversity in Natura 2000 areas. Scenario analyses showed the possibility to quantify impacts on biodiversity as a consequence of either climate policies or air pollution policies or both. For Natura 2000 areas a favourable conservation status is required to halt the loss of biodiversity. This might require further reductions of nitrogen emissions in and around Natura 2000 areas, or additional restoration costs. Currently, National Focal Centres have been requested to submit data to operationalize the EU-target ‘no net loss of biodiversity’ in their country. An important element here is the choice of the reference year as well as the choice of specific species that are characteristic for Natura 2000 habitats.

11. The valuation of ozone damage to provisioning services (i.e. crop yields) was already included in the cost-benefit assessment of the Gothenburg Protocol (using actual market prices). However, the fertilising effect of nitrogen to wood production was not taken into account. The impacts of ozone and nitrogen on carbon

sequestration could be valued against the global carbon price that would be needed to meet the 2 degrees target. To provide robust guidance this should also be applied to the impacts of air pollution policy measures on changes in N_2O and methane emissions in order to provide a complete assessment of impacts on greenhouse gas emissions.

12. For biodiversity valuation studies show surprising results. A survey by Söderqvist & Hasselström (2008) showed a willingness to pay for ecosystem services provided by the Baltic sea of € 5 bn per year, where the willingness to pay was 10 times higher in Sweden than in Poland. Surveys show a relatively high willingness to pay for charismatic species, but a lower willingness to pay when several species are involved or for the protection of their habitats. The question is whether such surveys can be applied for complex systems and irreversible choices. The implicit values given by policy makers when nominating Natura 2000 areas (based on the mitigation or restoration costs needed for a favourable conservation status) could prove to be a useful alternative. A 'dose-response' relationship would have to be developed.

13. Future game changers could be the inclusion of damage to pollination and genetic pools due to air pollution and climate change in modelling and valuation. Also the modelling and valuation of impacts of biodiversity on human health could change results. Measures aiming at a more efficient use of nitrogen would also give benefits for water quality.

IV. EXPERIENCES IN VALUING ECOSYSTEM SERVICES

14. In August 2013 the Norwegian Expert Commission on Values of Ecosystem Services published a study showing the importance of ecosystem services for Norway. The concept of ecosystem services proved to be useful as a complement to already existing tools for nature management and for cost-benefit analyses of projects without irreversible long term consequences. However, decisions with long-term, potentially irreversible and large scale environmental consequences should be based on safe ecological limits and the precautionary principle. Given the often opposing views on the monetary value of (some) ecosystem services, the ecosystem service framework can form a basis for a deliberative approach aimed at collective decision making. A recommendation from the report is that cost-benefit analyses should focus on future circumstances and take into account expected GDP growth and future prices of natural resources and carbon.

15. Within the World Health Organisation an ecological perspective on public health is emerging. The quality of ecosystems and human wellbeing are interconnected and that environmental degradation has health risks, extending the range of ecosystem services for consideration. 'Ecological Public Health' brings environment and health experts together.

V. EXPERIENCES IN VALUING DAMAGE TO ECOSYSTEM SERVICES

16. The air pollution impacts on ecosystems and biodiversity were assessed under a service contract of the European Commission. Land use change and infrastructure

changes have been the dominating causes of biodiversity loss in Europe. For Natura 2000 areas however nitrogen is the dominant cause of changes in biodiversity. Climate change is expected to become important in the coming decades. It proved difficult to make a link between biodiversity and ecosystem services. Monetisation is only possible for a limited number of ecosystem services. Values for biodiversity based on the willingness to pay approach did not seem reliable. For European assessments it is important to distinguish a large number of different nature types, otherwise environmental degradation and biodiversity loss in specific geographic regions could be severely underestimated. Methods have been developed to link nitrogen and sulphur deposition to the change in species distribution and the loss of red list species. The costs of nature management policies to protect red list species and their habitats need to be identified.

17. The Wageningen University developed a conceptual model to value damage to ecosystem services. The model considers that air pollution damage should be interpreted as a change in capacity to deliver an ecosystem service, rather than a change in the actual flow of a certain ecosystem service. The relationships between air pollution and actual ecosystem services will generally not be linear. Also adaptation measures should be taken into account. Based on current understanding it is possible (although not always suitable) to quantify and value several ecosystem services such as forestry, carbon sequestration or tourism. Changes in the net economic value of an ecosystem should take into account that air pollution could decrease the capacity to deliver one ecosystem service (e.g. tourism) but increase another (e.g. forestry). Biodiversity is the most difficult ecosystem service to value.

18. As part of UK government decision support, assessment of impacts to ecosystem services is required. A guidance document describes the options for valuing air quality impacts. In the case of limit values the shadow price of a project can be estimated. These are the costs of additional (local) abatement measures needed to compensate for the air pollution generated by the project. Monetary valuation is used for 'first run' assessments. If results from monetary valuation studies highlight problems, in-depth studies will follow. The ecosystem services approach increases the consideration of relevant environmental values in policy planning and decision making. It also affects the choice of policy instruments and provides directions for further research.

19. Nitrogen impacts on ecosystem services including the cultural service 'Appreciation of Biodiversity' in the UK have been published in a recent peer review article (Jones et.al. 2013). Results of the study suggest that nitrogen abatement has benefits for biodiversity and reduces N_2O emissions. But it reduces the fertilisation of forests and grassland and will therefore have a negative effect on CO_2-sequestration, timber production and meat production. Without monetising the appreciation of biodiversity the annual net benefits to ecosystem services will be negative (- €50 mn/yr for the period 2005 to 2020). For a balanced approach it is important to capture the value of impacts on cultural services. The appreciation of biodiversity is derived from a willingness to pay survey in England and Wales. Further development of the methodology suggests that biodiversity benefits in the UK would be worth around €70 mn/yr for the period 2005-2020 for non-charismatic species. However, the study covers only 30% of the semi-natural ecosystems in the UK and did not include the valuation of charismatic species, which would lead to much higher benefit figures (at least a factor of 5 higher).

20. Monetised estimates suggest that ecological benefits of air pollution reduction would be small relative to health impacts. However, it must be recognised that the research is at an early stage and is far from complete. The limitations of the damage function, ecosystem service assessment and valuation approaches, particularly in relation to long term sustainability and interaction between stressors need further consideration before robust conclusions on the relative importance of health and ecological impacts can be drawn. In current estimates 98.5% of the benefits of air pollution policy in Europe in the period 2005-2020 are associated with health impacts. Reduced damage to crops contributes 1% to the total benefits and reduced damage to materials 0.5% (EC4MACS-report, 2013). For the UK the health benefits during this period were estimated to be around €15 bn. For comparison: the benefits due to increased appreciation of biodiversity, based on results currently available, would be between 0.5-5% of this amount.

21. According to the ICP Vegetation estimates, the mean yield loss of wheat in Europe would in 2020 be about 10% (based on current legislation emission trends). In the UK ozone fluxes are expected to increase in the period 2005-2020. The associated wheat yield losses were valued at €22 mn/yr. Ozone damage also leads to yield losses of other crops and reduces forest growth and lamb meat production (€0.2 mn/yr). Reduced forest growth will lead to less carbon sequestration (valued at €11 mn/yr).

22. In the Netherlands, the assessment of the Gothenburg Protocol revision was based on both physical indicators (exceedance of critical loads and loss of plant, birds and butterfly species) as well as monetary values. Benefits of the Gothenburg Protocol revision were expressed as reduced costs of restoration measures that would be needed to guarantee a favourable conservation status in Natura 2000 areas. Restoration costs can be as high as €5000 per ha/yr, depending on the frequency of the need for restoration. The higher the nitrogen deposition is, the more frequent and drastic nature management measures would have to be. Extrapolation of such costs to the whole Natura 2000 network would give a cost figure that is comparable to current health damage estimates. However, restoration measures often don't bring an ecosystem back in its original state. Policy decisions to protect nature areas when developing new infrastructure, reveal an implicit value that is sometimes more than €50.000 per ha.

23. In Sweden, the government is aiming at increased consideration of ecosystem services in decision making and dialogue with stakeholders on natural values. The Swedish government is planning to have a system for considering impacts on ecosystem services in decisions by 2018.

24. In Spain, ecosystem services have been extensively mapped and valued. Risks from air pollution are expected to be minor compared to climate related risks and difficult to monetise.

25. In France, although the precautionary principle is included in the Constitution, protection of ecosystems still needs to be supported by new tools for decision aid, such as the valuation of ecosystem services. Its advantages and drawbacks are being evaluated by the ministry of ecology and case studies have been carried out. In such a study (the economic valuation of services provided by wetlands of the alluvial flood plain of la Bassée), the monetary value of the ecosystem and its services was estimated via different (complementary) valuation methods and uncertainties were identified. Nevertheless, the monetisation process was considered a good way of communicating the importance of

ecosystem services and biodiversity. A complementary approach to existing methods for ecosystem assessment might consist of multi-criteria analyses.

V. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

26. The ecosystem services approach is not a replacement for approaches aimed at long term sustainability. It is important to continue long-term systems analysis to support goal oriented policy development. There was sincere doubt whether economic values derived from marketable services or from individual willingness to pay surveys should play a leading role in policy decisions related to a complex issue as biodiversity protection. As biodiversity is a public good that cannot be replaced, values for nature areas that were implicitly revealed in historical political choices (such as the designation of Natura 2000 areas) were according to several participants more appropriate than the stated preferences by (less informed) individuals.

27. However, there is a benefit in further exploring, mapping and quantifying the damage to ecosystem services as it could contribute to mutual learning and understanding of policy makers, stakeholders, economists and other scientists involved. Much of the research on Biodiversity and Ecosystem Services is still in the phase of identifying definitions, concepts, and development of framework for specific analysis.

28. The valuation of food, wood, water and carbon sequestration is more advanced than valuation for other ecosystem services. Consideration of the short term fertilisation effects of nitrogen on forest growth is important together with ozone impacts. However, the consideration of long term processes such as the depletion of base-cations reserves in the soil or water availability could show opposite effects on forest growth in the long run. The quantification of costs and benefits of air pollution abatement strategies should also take into account the synergies with other policy strategies, e.g. for biodiversity, water, climate & energy, and regional socio-economic development.

29. The valuation of biodiversity is still in its infant stages, current economic valuation techniques used in UK might prove useful if they can be linked to effect indicators used at the European level. Additional action is needed to explore usefulness and the extension towards other end-points, such as the protection of endangered species, charismatic species, and reduction of dominant non-desirable species (e.g. replacement of heathland plants by grasses) and the resilience of habitat types (including typical species).

30. As an alternative, also the shadow price approach (restoration costs or mitigation costs needed for a favourable conservation status of Natura 2000 areas) should be further explored in estimating potential benefits of air pollution policy.

31. Progress has been made in the past years in modelling impacts from acidification, eutrophication and ozone to biodiversity and ecosystem services. However, there is still work to be done in linking effect models to economic valuation approaches. Given the current state of knowledge, bold assumptions need to be made when estimating an economic value to ecosystem services. Explicit analysis of the sensitivity for the assumptions made will be important.

32. TFIAM and NEBEI should explore further the options to operationalize the available methods to value damage to biodiversity due to air pollution: what metrics and reference years should be used? How can we include restoration and long term recovery of ecosystems in decision taking? How can targets for the long term protection of Natura 2000 areas and red list species be used in assessing the benefits of air pollution policies? Updated information about on-going studies should be made available at the forthcoming TFIAM meetings. The possibility of a guidance document on the assessment of benefits of air pollution policy for biodiversity and ecosystem services might be considered.