The Twenty-eighth Session of the Intergovernmental Meeting (IG28)
on the Acid Deposition Monitoring Network in East Asia (EANET)
24-26 November 2026, Niigata, Japan

Consideration of Strategy Papers developed by Task Forces under the SAC

Chairpersons of the Task Forces
Secretariats of the Task Forces

I. Background

1. To strengthen the scientific activities of EANET in response to emerging environmental challenges, the Scientific Advisory Committee (SAC) reformed its task force structure in 2022. As a result, the former Task Force on Dry Deposition Monitoring (TFMDD), Task Force on Soil and Vegetation Monitoring (TFSM), Task Force on Monitoring Instrumentation (TFMI) and Task Force on Research Coordination (TFRC) and were reorganized into three new task forces: the Task Force on Monitoring and Assessment of Atmospheric Environment (TFAE), the Task Force on Monitoring and Assessment of Environmental Effects (TFEE) and Task Force on Atmospheric Environmental Quality Management (TFAEM). The reformation aimed to enhance coordination among monitoring, assessment, and research activities and to strengthen EANET's capacity to address a broader range of atmospheric and ecological issues beyond acid deposition.

2. Following the adoption of the Medium-Term Plan for the EANET (2026–2030), the three task forces reviewed their existing strategic frameworks and identified priorities for future activities. The TFAE prepared the "Strategy Paper on the Future Direction of Monitoring and Data Evaluation for Air Pollutants and Atmospheric Deposition in East Asia (2027–2032)," which provides a medium-term framework for strengthening atmospheric monitoring, data evaluation, and policy-relevant assessment of air pollutants and atmospheric deposition in East Asia.

3. At the same time, the TFEE reviewed and updated the "Strategy Paper for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances." While maintaining the long-term direction of ecological monitoring and assessment, the TFEE updated the activities for 2026–2030 in accordance with the new Medium-Term Plan, including activities related to atmospheric reactive nitrogen deposition, ozone and particulate matter impacts in forest

ecosystems, and assessment of ecosystem recovery from acidification and eutrophication.

II. Discussions of Strategy Papers at SAC26

4. The draft Strategy Papers were presented and discussed at the Twenty-sixth Session of the Scientific Advisory Committee (SAC26) in October 2026. Regarding the Strategy Paper developed by TFAE, it was noted that the proposed strategy provides a framework for strengthening and harmonizing atmospheric monitoring networks, improving quality assurance and quality control (QA/QC), enhancing atmospheric deposition estimation and long-term data evaluation, and providing policy-relevant scientific information. No specific comments were raised by SAC members on the contents of the Strategy Paper.

5. Regarding the updated Strategy Paper developed by TFEE, the future direction of ecological impact assessment activities under EANET was discussed. Several SAC members emphasized the importance of maintaining and strengthening activities related to ecosystem impacts, noting that long-term monitoring data collected through EANET provide a valuable basis for assessing the effects of air pollution on forests, inland waters, and other ecosystems. It was also emphasized that ecological impact assessment should remain one of the priority areas of EANET.

6. SAC26 also discussed the relationship between the TFEE Strategy Paper and information exchange activities on human health. Clarification was provided that the updated TFEE Strategy Paper focuses on ecological impacts and does not include human health assessments. Human health-related activities under TFEE are limited to information exchange, in accordance with the mandate provided by the Intergovernmental Meeting (IG). SAC members further encouraged TFEE to strengthen scientific assessment of ecological impacts using EANET monitoring data and relevant scientific knowledge.

7. Following the discussions, SAC26 adopted the “Strategy Paper on the Future Direction of Monitoring and Data Evaluation for Air Pollutants and Atmospheric Deposition in East Asia (2027–2032)” developed by TFAE and the updated “Strategy Paper for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances” developed by TFEE, and agreed to recommend both documents to IG28 for consideration and endorsement.

III. Drafts and outlines of the Strategy Papers developed by TFAE and updated by TFEE.

8. The final drafts of "Strategy Paper on the Future Direction of Monitoring and Data Evaluation for Air Pollutants and Atmospheric Deposition in East Asia (2027–2032)" is attached in Annex 1, and "Strategy Paper for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances" is attached in Annex 2. The outlines of both Strategy Papers are shown in the presentation file.

IV. Action required

9. The Twenty-eighth Session of the Intergovernmental Meeting (IG28) is invited to review the final draft of "Strategy Paper on the Future Direction of Monitoring and Data Evaluation for Air Pollutants and Atmospheric Deposition in East Asia (2027–2032)" and "Strategy Paper for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances" and consider for endorsement of both Strategy Papers.

EANET/ IG28/6/3
Annex 1

Strategy Paper on the Future Direction of Monitoring and Data Evaluation for Air Pollutants and Atmospheric Deposition in East Asia (2027-2032)

[Final Draft]

Drafted by the Task Force on Monitoring And Assessment of Atmospheric Environment of the EANET

November 2026
Network Center for the EANET

Strategy Paper on the Future Direction of Monitoring and Data Evaluation for Air Pollutants and Atmospheric Deposition in East Asia (2027-2032)

Table of Contents

I. Introduction……. 1

II. Current status…….. 2

III. Objectives……..... 5

IV. Activities to be implemented to achieve the objectives from 2027 to 2032…….... 6

V. Capacity building of atmospheric monitoring activities …… 10

VI. Collaboration with relevant networks/organizations……11

Appendix: Members of the Monitoring And Assessment of Atmospheric Environment of the EANET …... 13

References…….. 14

I. Introduction

1. The Acid Deposition Monitoring Network in East Asia (EANET) was established in 2001 as an intergovernmental initiative in response to growing concerns over acid deposition in the region during the 1990s, driven by rapid industrialization and increasing emissions of air pollutants. Its primary objectives have been to develop a common understanding of the state of acid deposition, support evidence-based decision making, and promote regional cooperation among participating countries.

2. Since its establishment, EANET has developed a coordinated regional monitoring network covering multiple countries in East Asia, supported by standardized monitoring methodologies, capacity building, and data sharing frameworks. Over more than two decades, these efforts have contributed significantly to improving the availability, comparability, and scientific reliability of air quality and deposition data, enabling regional assessments of atmospheric pollution and its impacts on ecosystems.

3. Within this framework, the Task Force on Monitoring for Dry Deposition (TFMDD, established in 2008 under the Scientific Advisory Committee of EANET) has played a central role in advancing monitoring and data evaluation methodologies. Its responsibilities have included the development of Quality Assurance and Quality Control (QA/QC) procedures, technical manuals, and strategic guidance for dry deposition monitoring and assessment.

4. TFMDD and EANET have progressively elaborated their approaches to monitoring and data evaluation. Key milestones include the development of Strategy Papers, which introduced stepwise approaches to dry deposition monitoring (1999, 2005, 2010, and 2015 editions). These approaches began with the identification and standardized monitoring of priority pollutants (e.g., SO_2, O_3, NOx, NH_3, PM components), followed by the development of inferential methods for estimating dry deposition flux, and then the expansion of monitoring coverage, enhancement of QA/QC procedures, and integration of monitoring data with research activities.

5. In parallel, TFMDD and EANET have developed and implemented technical manuals, including the Technical Manual on Dry Deposition Flux Estimation (2013 and 2022) and the Technical Manual for Air Concentration Monitoring (2013 and

2022) (Technical Manual for Air Concentration Monitoring in East Asia (Second Edition)), which provide standardized methodologies for monitoring and data evaluation across participating countries. These tools have enabled routine estimation of dry deposition flux using the inferential method, combining air concentration data with meteorological observations, and have supported long-term trend analysis, model validation, and regional assessments.

6. Through these accumulated efforts, EANET has generated extensive datasets on air pollutants and atmospheric deposition. These datasets have been widely used for understanding atmospheric processes, assessing regional pollution trends, and supporting scientific and policy-related analyses. However, challenges remain, including limited spatial coverage, insufficient availability of high-time-resolution data, and uncertainties in deposition estimates due to methodological and data constraints.

7. In response to evolving challenges for atmospheric environment, EANET has expanded its scope beyond acid deposition. In 2021, participating countries agreed to include a broader range of atmospheric pollutants, such as fine particulate matter ($PM_{2.5}$), surface ozone (O_3), nitrogen oxides (NOx), and ammonia (NH_3), reflecting increasing concerns about their impacts on human health, ecosystems, and meteorological change.

II. Current status

8. The Medium-Term Plan for the EANET (2026–2030) was adopted at the Twenty-seventh Session of the Intergovernmental Meeting in November 2025. This plan represents a major milestone in the development of EANET, and it formalizes the expansion of its scope from a primary focus on acid deposition to a broader framework addressing air pollution and atmospheric deposition as an integrated issue.

9. Under the MTP (2026–2030), priority pollutants for monitoring and assessment include $PM_{2.5}$ and its components, surface ozone (O_3), nitrogen oxides (NOx), ammonia (NH_3), and related substances, which is within the EANET scope. The plan also emphasizes strengthened monitoring networks, improved QA/QC systems, enhancement of data management and dissemination, and the integration of emerging monitoring technologies such as satellite observations, low-cost sensors.

10. In parallel, the role of data evaluation within EANET is becoming increasingly important. Monitoring data are expected to be more effectively analyzed and integrated with emission inventories and atmospheric models to support scientific assessments and evidence-based policy making. This reflects a broader transition of EANET from a monitoring-focused network toward a comprehensive platform for integrated assessment and science–policy interface.

11. Viewing beyond the MTP implementation period, medium- and long-term directions for monitoring and data evaluation in East Asia are summarized as follows:
    - Achieving comprehensive and sustainable monitoring coverage of priority pollutants across the region;
    - Improving data quality and comparability through harmonized methodologies and enhanced QA/QC frameworks;
    - Advancing the understanding of atmospheric processes, including interactions among air pollution, atmospheric deposition, ecosystems, and climate;
    - Strengthening integrated data analysis and assessment capabilities to provide policy-relevant information;
    - Promoting usage of satellite based air pollutant estimation within the EANET framework to improve integration of air pollution data, and therefore enable better policy-relevant information; and
    - Promoting regional and international cooperation, including data sharing, capacity building, and collaboration with related networks and initiatives.

12. Thus, the current status represents a transitional stage in the evolution of EANET. While maintaining its established foundation in acid deposition monitoring, EANET is advancing toward a more integrated, adaptive, and policy-relevant system for monitoring and data evaluation of air pollutants and atmospheric deposition. The implementation of the MTP (2026–2030) provides a strategic framework for this transition and sets the direction for further development toward a sustainable and comprehensive regional monitoring and assessment system. The Task Force on Monitoring and Assessment of Atmospheric Environment (TFAE), established in 2023, assists activities related to monitoring and assessment in EANET.

III. Objectives

13. Considering the evolving scope of EANET and the adoption of the Medium-Term Plan for the EANET (2026–2030), this Strategy Paper aims to provide a clear and strategic framework for guiding the future development of monitoring and data evaluation for air pollutants and atmospheric deposition in East Asia. In particular, it seeks to support the transition of EANET from a network primarily focused on acid deposition monitoring to a comprehensive system that integrates monitoring, data evaluation, and policy-relevant assessment of atmospheric environmental issues. Through this Strategy Paper, priority directions, methodologies, and collaborative approaches are defined to enhance the effectiveness, consistency, and sustainability of EANET activities in responding to current and emerging challenges. To achieve this purpose, the following objectives are shown:

i) To strengthen and harmonize monitoring systems for air pollutants and atmospheric deposition across the EANET region, including enhancement of spatial coverage via increment of monitoring sites and integration of satellite based estimations, expansion of monitored parameters, and improvement of QA/QC frameworks to ensure reliable and comparable data;
ii) To advance data evaluation methodologies and integrated analysis by improving approaches for atmospheric deposition estimation, long-term trend analysis, and the integration of monitoring data with other research analyses to deepen scientific understanding of atmospheric processes;
iii) To enhance the utilization of monitoring and assessment results for policy support and regional cooperation by improving data accessibility, promoting science–policy interfaces, and strengthening collaboration, capacity building, and information exchange among participating countries and relevant organizations, not limited merely to the observation network, but also model data.

IV Activities to be implemented to achieve the objectives from 2027 to 2032

14. The Network Center (NC) for the EANET has encouraged and assisted EANET participating countries to conduct air concentration monitoring at EANET monitoring sites. Moreover, the following items should be conducted in order to achieve the objectives shown in Chapter III. To provide a clear overview of the

workflow before detailing each component, the integrated framework governing these activities is illustrated below (Figure 1):

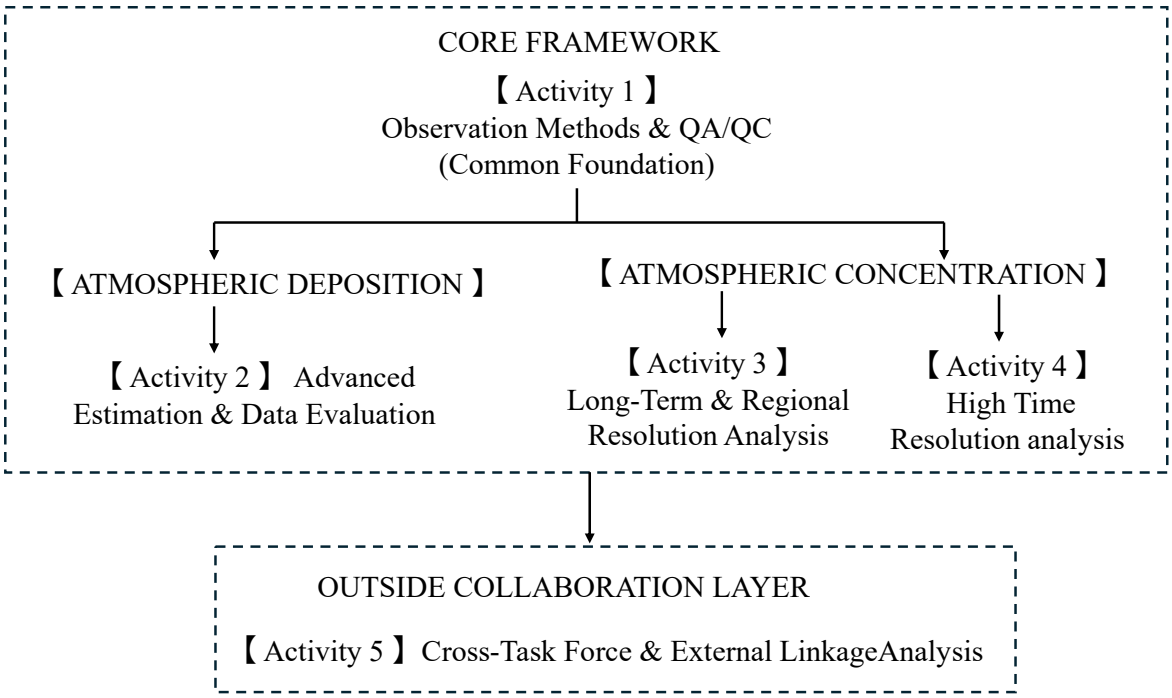


Figure 1. Conceptual framework illustrates the interrelationships among the five activities of the Task Force.

i) Integrated Enhancement of Atmospheric Observation Methods and QA/QC

17. The current Technical Manuals for air concentration monitoring in the EANET region provide a fundamental basis for standardized monitoring practices. However, they do not sufficiently address emerging priority pollutants identified under the Medium-Term Plan (MTP) 2026–2030, such as $PM_{2.5}$ components withing the EANET scope details are shown in the ANNEX of the Supplementary Document to the Instrument (2021), ozone (O_3), nitrogen oxides (NOx), and ammonia (NH_3), nor do they explicitly incorporate the use of supplementary data sources such as satellite observations and low-cost sensors.

18. In addition, significant variations remain among participating countries in terms of monitoring instruments, measurement frequencies, analytical methods, and data evaluation approaches. For instance, differences in ozone metrics (e.g., hourly values versus maximum 8-hour averages), as well as disparities in $PM_{2.5}$ component

measurements and NH_3 monitoring techniques, may hinder the comparability and consistency of observational data across the region.

19. To address these challenges, the TFAE will review current practices, identify technical gaps, discuss future directions, and provide recommendations on the following topics:
    - Review and evaluate the existing Technical Manuals (Technical Manual for Air Concentration Monitoring in East Asia (Second Edition)) in accordance with priority pollutants under MTP 2026–2030, with particular attention to $PM_{2.5}$ chemical components, O_3, NOx, and NH_3, and identify area where future harmonization is needed.
    - Assess the comparability of monitoring approaches among participating countries, including measurement techniques, calibration procedures, data reporting formats, and temporal resolution. Based on the assessment results, the update of the detailed measurement methodologies described in the relevant technical manuals will be updated. Furthermore, provide recommendations for improving consistency of monitoring data within EANET.
    - Review the current QA/QC framework of EANET and discuss priorities for future updates of technical manuals and guidance documents, including ozone calibration, PM2.5 component measurements, NOx and NH_3 monitoring.
    - Review existing calibration practices and establish harmonized recommendations for ozone monitoring and calibration within the EANET.
    - Discuss approaches for enhancing monitoring coverage of priority pollutants, including the applicability of simplified monitoring methods and their potential contribution to regional assessments.
    - Review the potential role of supplementary data sources, including satellite observation, model data and low-cost sensors, and discuss their possible use for spatial assessment, data interpretation, and complementary analysis within EANET activities.

20. Review the current scope of PM2.5 component measurements within EANET, discuss future monitoring priorities and analytical approaches, and provide recommendations to support harmonized implementation among participating countries.

21. These activities will be undertaken in close collaboration with participating countries and expert groups through technical discussions and assessments. The outcomes will contribute to the future revision of the Technical Manuals and the development of harmonized recommendations and QA/QC guidelines for the EANET. As a result, improved comparability, reliability, and applicability of atmospheric monitoring data across East Asia are expected.

ii) Advanced Estimation and Data Evaluation Methods for Atmospheric Deposition in EANET

22. The estimation of atmospheric deposition fluxes in the EANET region has primarily relied on the inferential method, which combines air concentration data with meteorological parameters (Clarke et al., 1997, Hicks et al., 1991). However, the application of this method remains limited in many participating countries due to insufficient availability of high time-resolution meteorological data, constrained monitoring infrastructure, and uncertainties related to deposition velocity parameterizations, particularly for reactive nitrogen species.

23. Moreover, current methodologies are not fully suited for sites with limited temporal resolution data, such as those based on filter-pack sampling, and the existing Technical Manual on Dry Deposition Flux Estimation requires further refinement to reflect recent scientific developments and regional conditions in EANET.

24. To overcome these challenges, the Task Force will review existing estimation methodologies, assess emerging approaches, and provide recommendations on the following topics:
    - Review approaches for promoting integrated monitoring of atmospheric pollutants and meteorological parameters at EANET sites, recognizing that the combined availability of concentration and meteorological data is essential for reliable deposition flux estimation.
    - Assess the applicability and usefulness of supplementary meteorological datasets, including reanalysis and model-derived data, particularly for sites where in situ meteorological observations are limited.
    - Review and discuss potential improvements to the inferential method, with particular emphasis on nitrogen deposition (e.g., NH_3, HNO_3), and review key

parameterizations such as deposition velocities based on recent scientific findings and regional characteristics.

- Examine potential approaches for utilizing monitoring data with limited temporal resolution data (e.g., weekly or biweekly measurements), including the simplified estimation approaches and the potential use of auxiliary datasets.

25. These activities will be conducted through technical discussion, experts consultation, workshop, and collaborative assessments involving EANET participating countries.

26. The outcomes will contribute to the revisions of the Technical Manual on Dry Deposition Flux Estimation in East Asia, related guidelines and technical documents.

27. As a result, broader spatial coverage, improved accuracy, and enhanced usability of atmospheric deposition data in East Asia are expected, supporting both scientific assessment and policy-relevant applications.

iii) Review and Update of Methods for Long-Term Trend Analysis and Regional Comparison Using EANET Data

28. EANET will review and update the methodologies for long-term trend analysis of air pollutants and atmospheric deposition. This includes statistical approaches and rigorous data screening criteria to ensure data consistency across the network. Special attention will be given to the long-term trends of $PM_{2.5}$ components, O_3, NH_3, and NOx.

29. To overcome spatial data gaps and better understand regional characteristics, systematic evaluations will be conducted on the variations of key pollutants across multiple dimensions. These comparisons will analyze data from urban vs. rural vs. remote areas, inland vs. coastal regions, and specific sub-regions such as Northeast Asia vs. Southeast Asia.

30. The outcomes and data derived from these trend analyses and regional comparisons will serve as core scientific contributions to the upcoming EANET Periodic Report covering the period from 2025 to 2029.

iv) Promotion of Atmospheric Process Understanding Using High-Time-Resolution Data

31. Utilizing high-resolution data from automated continuous monitoring systems, the Network Center (NC) and participating countries will analyze the dynamic behaviors of surface ozone (O_3) and fine particulate matter ($PM_{2.5}$).

32. Research efforts will focus on investigating atmospheric chemical mechanisms and dry/wet deposition processes. Particular emphasis will be placed on capturing and parameterizing the diurnal and seasonal variability of these processes, which is essential for reducing the uncertainties inherent in previous inferential models.

33. EANET will strengthen its collaboration with external modeling and emission inventory research communities, such as the Model Inter-Comparison Study for Asia (MICS-Asia). This will be achieved through active data sharing and joint numerical analyses, which will also directly support the synthesis of the EANET Periodic Report (2025–2029).

v) Strengthening Collaborative Research through Coordination with Other Task Forces

34. Define cross-cutting research themes (e.g., nitrogen deposition and ecosystem impacts; health impacts of O_3 and $PM_{2.5}$) Moving beyond isolated atmospheric monitoring, TFAE will collaborate with other EANET Task Forces to define and implement cross-cutting research themes. Key priority areas include evaluating the ecosystem impacts of nitrogen deposition (SO_4^{2-}, NO_3^-, NH_4^+) and methodological study on the human health impacts of O_3 and $PM_{2.5}$ exposure.

35. The scientific findings obtained from these collaborative research projects will be widely disseminated through EANET-sponsored projects, scientific workshops, and targeted capacity-building activities for participating countries.

36. This cross-cutting collaboration will foster integrated environmental analyses, combining monitoring data, emission inventories, and ecological impact models, providing a comprehensive foundation for the EANET Periodic Report (2025–2029).

V. Capacity building of atmospheric monitoring activities

37. The NC will continue to support participating countries to build capacity in atmospheric monitoring activities. For example, the NC will make an effort to hold on-site training courses/workshops/seminars for responsible persons of atmospheric monitoring and QAQC. The NC should also make full use of training courses organized by international cooperation organizations such as Global Atmosphere Watch (GAW) programme of the World Meteorological Organization (WMO), Asia-Pacific Clean Air Partnership (APCAP) and Japan International Cooperation Agency (JICA).

38. The NC will maintain and further develop a roster of national experts in atmospheric monitoring, assessment, and related scientific fields across East Asia. This expert network will facilitate the exchange of information on recent scientific and technical developments, best practices, and research activities related to air concentration monitoring, atmospheric deposition assessment, data analysis, and emerging monitoring methodologies among EANET participating countries.

VI. Collaboration with relevant networks/organizations

39. Regional and international collaboration is essential for strengthening scientific understanding, enhancing monitoring and assessment capacities, promoting data utilization, and supporting evidence-based policy development on air pollution and atmospheric deposition. The cooperation with relevant regional and global networks, programmes, and organization will be actively promoted. The objectives of such collaboration are to:

- Enhance scientific and technical exchanges on monitoring methodologies, QA/QC systems, atmospheric deposition assessment, and data analysis;
- Improve understanding of regional and inter-regional transport of air pollutants and their impacts on human health, ecosystems;
- Promote the integration of monitoring data with emission inventories, atmospheric modelling, satellite observations, and other complementary information sources;
- Facilitate joint research, capacity-building activities, and expert exchanges.

40. The NC and participating countries will continue to strengthen cooperation with existing partners, including the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) under the Convention on Long-range Transboundary Air Pollution (CLRTAP), the Global Atmosphere Watch (GAW) Programme of the World Meteorological Organization (WMO), the Clean Air Status and Trends Network (CASTNET), the National Atmospheric Deposition Program (NADP), and other relevant regional and international networks and initiatives. Such cooperation will support the exchange of methodologies and data, joint assessments, capacity-building activities, and scientific collaboration on air pollution, atmospheric deposition, ecosystem impacts, and sustainable nitrogen management.

Appendix

Members of the Task Force on Monitoring and Assessment of Atmospheric Environment
(As of June, 2026)

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References

Acid Deposition Monitoring Network in East Asia (EANET), Technical Manual for Air Concentration Monitoring in East Asia (2013), Network Center for the EANET, 155p.

Acid Deposition Monitoring Network in East Asia (EANET), Technical Manual for Air Concentration Monitoring in East Asia Second Edition (2022), Network Center for the EANET, 176p.

Acid Deposition Monitoring Network in East Asia (EANET), Technical Manual for Dry Deposition Flux Estimation in East Asia (2010), Network Center for the EANET, 61p.

Acid Deposition Monitoring Network in East Asia (EANET), Strategy Paper for Future Direction of Dry Deposition Monitoring of EANET (1999), Network Center for the EANET, 20p.

Acid Deposition Monitoring Network in East Asia (EANET), Strategy Paper for Future Direction of Dry Deposition Monitoring of EANET Second Edition (2005), Network Center for the EANET, 13p.

Acid Deposition Monitoring Network in East Asia (EANET), Strategy Paper on Future Direction of Monitoring for Dry Deposition of EANET (2011-2015) (2010), Network Center for the EANET, 15p.

Acid Deposition Monitoring Network in East Asia (EANET), Strategy Paper on Future Direction of Monitoring for Dry Deposition of the EANET (2016-2020) (2015), Network Center for the EANET, 16p.

Acid Deposition Monitoring Network in East Asia (EANET), The Supplementary Document (ANNEX) to the Instrument for Strengthening the Acid Deposition Monitoring Network in East Asia (EANET) (2021).

Clarke, J.F., Edgerton, E.S., Martin, B.E., (1997) Dry deposition calculations for the clean air status and trends network. Atmospheric Environment, 31, 3667-3678.

Hicks, B.B., Hosker Jr., R.P., Meyers, T.P., Womack, J.D. (1991) Dry deposition inferential measurement techniques—I. Design and tests of a prototype meteorological and chemical system for determining dry deposition. Atmospheric Environment A, 25, 2345-2359.

Task Force on Research Coordination (TFRC), Scientific Advisory Committee (SAC), Acid Deposition Monitoring Network in East Asia (EANET) (2015) Review on the State of Air Pollution in East Asia, Network Center for the EANET, 411p.

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EANET/ IG28/6/3
Annex 2

Strategy Paper for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances

Updated at the 3rd Meeting of the Task Force on Monitoring and Assessment of Environmental Effects and adopted by the Scientific Advisory Committee of the EANET at its 26th Session

Network Center for the EANET

Strategy Paper for
Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances
(Updated in 2026)

Table of Contents

I. Introduction.....1

II. Objectives of soil and vegetation monitoring of EANET.....1
II-1. The initial objectives…….....1
II-2. The long-term objective…….....2

III. Issues to be implemented to achieve the objectives.....2
III-1. Issues for the initial objectives…….....2
III-2. Issues for the long-term objective.....6

IV. Collaboration with relevant networks/organizations…….……9

V. Overall strategy…….....9

VI. Acknowledgements.....10

Annex: Specific activities for the period from 2026 to 2030

Appendix: Members of the Task Force on Monitoring and Assessment of Environmental Effects of the EANET

I. Introduction

1. *The Strategy Paper for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances* was adopted as the long-term directions of the EANET monitoring by the Scientific Advisory Committee at its 14th Session in 2014. Simultaneously, the specific activities for the period from 2015 to 2020 were set as the annex.

2. In the discussion about adopting the *Strategy Paper* above, importance of collaboration with relevant research projects and other international initiatives was suggested to accomplish the objectives, although the issues described in the *Strategy Paper* seemed to be too ambitious for the EANET. Moreover, importance of considering multiple air pollutant factors, such as ozone and particulate matter, was suggested to evaluate ecological changes.

3. The *Strategy Paper* had already described importance of air pollutants, such as ozone, and particulate matter, as the long-term directions of the EANET monitoring, which are consistent to the *Medium-Term Plan (MTP) for the EANET (2026-2030)*. Therefore, the main text should not significantly be changed, while slight modifications may be necessary to adjust to the latest discussion in the EANET community and scientific knowledge.

4. As shown in the title, the Strategy Paper is expected to cover the direction of inland aquatic environment monitoring in addition to soil and vegetation monitoring. However, some descriptions in the previous version had not been adjusted to reflect inland aquatic environments. In this update, those descriptions have been revised with reference to the *Technical Manual for Inland Aquatic Environment Monitoring in East Asia-2010 (EANET 2010).*

5. Additionally, importance of monitoring reactive nitrogen (Nr) species, such as NOx, NH_3, and their ionic species, in rural and forest areas are clearly stated in this update, since the *MTP for the EANET (2026-2030)* recommended to strengthen monitoring these Nr species to contribute to the global discussion on “sustainable nitrogen management”.

6. Specific activities for the term from 2026 to 2030 are mainly updated as the annex. Selected activities taking account of their feasibilities are described there.

II. Objectives of soil, vegetation, and inland aquatic environment monitoring of EANET

II-1. Initial objectives

7. The initial objectives of soil and vegetation monitoring, "establishment of baseline data" and "early detection of possible impacts" described in the *Guidelines for Acid Deposition Monitoring in East Asia (2000)* and *Technical Manual for Soil and Vegetation Monitoring in East Asia (2nd ISAG, 2000)* can be interpreted as follows.

8. Establishment of baseline data is to describe the present status on plants and terrestrial ecosystems by the basic survey, which was described in chapter 2 of the *Technical Manual*. As the baseline data, the following data should be accumulated:
   - Chemical properties of soil
   - Growth of trees (by description of trees)
   - Species composition of understory vegetation

   The basic survey should consider climatic zones in the participating countries.

9. Early detection of possible impacts requires establishing the methodologies for detecting decline symptoms on plants in the early stage. To avoid serious damage on plants and terrestrial ecosystem and enable recovery from the problem, the symptoms should be detected in the early stage. In the EANET region, information on forest decline, plant sensitivities, and their implication with air pollution have not been sufficiently accumulated.

10. With a philosophy similar that of soil and vegetation monitoring, the objectives of inland aquatic environment monitoring, as defined in the *Technical Manual for Inland Aquatic Environment Monitoring in East Asia-2010*, are described as follows:
    - To accumulate baseline data on inland aquatic environment and to evaluate the current situation
    - To detect possible impacts of acid deposition on inland aquatic environment in early stages

II-2. The long-term objective

11. The long-term objective of soil and vegetation monitoring is "To assess impact of acid deposition on terrestrial ecosystem in a comprehensive and systematic manner through development and maintenance of a good quality database", which is described in the *Guideline for Acid Deposition Monitoring in East Asia (2000)*.

12. The long-term objective of soil and vegetation monitoring can be achieved by evaluating spatially and temporally the impacts of air pollution/acid deposition on terrestrial ecosystems in the EANET region by understanding the processes (mechanisms) in the ecosystems that are related to air pollution/acid deposition.

13. For quantitative evaluation of air pollution/acid deposition impacts, as the first step, the present status of ecosystem should be described by input-output budget analysis and ecosystem modeling in the respective monitoring sites (e.g. catchment areas). Taking account of the above budget analysis and the present status of soil and vegetation by the basic survey, spatial and temporal evaluation should be promoted by appropriate methods for upscaling monitoring data.

14. The *Technical Manual for Inland Aquatic Environment Monitoring in East Asia-2010* did not clearly describe long-term objectives; however, it recommended the promotion of catchment-scale analysis as one of the future directions. Since inland waters can be regarded as outputs of biogeochemical processes within watersheds/catchments, the importance of evaluating data at the watershed/catchment scale has been emphasized.

III. Issues to be implemented to achieve the objectives

III-1. Issues for the initial objectives

III-1-1. Issues for establishment of baseline data

Promotion of continuous monitoring:

15. Accumulation of the data on soil, forest vegetation, and inland water is the first step for establishment of the baseline data, and monitoring in the current sites should be carried out continuously. Protection/conservation of the monitoring site is important so that long-term data can be accumulated over several decades.

16. Financial and human resources in the respective countries are essential for continuous monitoring. Countries should make efforts to source funds from both national and international organizations. Networking and capacity building of relevant experts should also be promoted to accumulate human resources at both national and regional levels.

Improvement of monitoring system:

17. The number and location of monitoring sites should be reviewed considering climatic zones and the concept of the multi-stage sampling. Monitoring sites should be established systematically even though the numerous monitoring sites could not be established on small grids.

18. The EANET region is a latitudinally wide area and consists of varied climatic zones. It can be recommended that one area should at least be selected for representative climatic zones in the respective countries. For each area, two types of soil are selected if possible, and plots and subplots are established according to the multi-stage sampling system on soil monitoring.

19. Support by experts on soil, forest vegetation, and inland aquatic environment is essential for the monitoring, and such experts should be involved continuously. In most participating countries of EANET, one expert may not be able to complete all work involved in soil, forest vegetation, inland water, and ecosystems monitoring, and therefore needs cooperation with other experts. The continuous involvement of these experts in monitoring activities, and establishment of an appropriate system for regular reporting to a national committee involving relevant agencies involved in EANET activities should be considered.

III-1-2. Issues for early detection of possible impacts, especially for vegetation

20. The *Sub-Manual on Forest Vegetation Monitoring in EANET* was endorsed by SAC at its 6th Session in 2006. The *Sub-Manual* proposed modified methods on observation of tree decline and some additional methodologies for early detection of possible impacts. Observation of tree decline should be conducted at least once a year according to the *Sub-Manual*. The methodologies described in the *Sub-Manual* should be utilized to collect information on possible impacts.

    General information of tree decline symptoms in the participating countries:

21. Prior to discussion of air pollution/acid deposition impacts, general information of tree decline symptoms should be accumulated; where, from when, which tree species, how decline, what cause, etc. Since impacts of air pollution and acid deposition may appear in combination with other factors, such as meteorological events and insect/fungus infections, the information should be obtained widely. Literature surveys for scientific publications should be adopted to collect reliable information.

    Ozone concentration in agricultural and forest areas and its effects:

22. High concentrations of ozone have become one of the hot topics in the EANET region due to increase in concentrations of its precursors, such as NO_x and Volatile Organic Compounds (VOCs). Effects of ozone on vegetation including agricultural crops should be discussed with those of acidic substances, since ozone formation in the troposphere is closely related to other air pollutants. To evaluate effects of acidic substances precisely, effects of ozone on vegetation should also be considered.

23. The data of ozone concentration in forest areas is very limited due to accessibility and lack of power supply in the EANET countries. Similar situation exists in agricultural and other rural areas where no power supply is available. Ozone concentration in those areas should be measured/estimated by utilizing various methods. Ozone concentrations could be measured in forest areas by using less-expensive methods, such as passive samplers, since diurnal variation may relatively be limited in forest/mountainous areas.

24. However, hourly data is necessary to calculate indices of ozone concentrations, such as AOT40 and SUM06[1]. In the case that electrical supply is available near those areas, the automatic ozone monitor should be installed. Low-cost sensors (LCSs), for which a technical manual and guideline were recently adopted by EANET, are another option. Moreover, numerical modeling of ozone concentrations may be useful to discuss spatial distribution and the regional risk on ecosystems.

25. Visible ozone injury should be assessed by field observation or microscopic observation as field evidence of ozone effects. The International Co-operative Programmes in Europe, such as ICP Forests and ICP Vegetation, have been accumulating a lot of information on the visible injury. Referring to the knowledge in Europe, information of the visible injury should be accumulated in the EANET region. A case study or trial campaign for measurement of ozone concentrations in forest area and assessment of visible ozone injury should be promoted. The areas where tree decline symptoms were reported may be likely candidates for the case study.

26. Further steps for assessment of ozone effects should be considered taking progress in other regions such as Europe and US into account. Effects on agricultural crops should also be discussed in the near future. Moreover, critical levels using AOT40 or POD_Y[2] should be discussed with relevant EANET bodies, such as the Task Force on

[1] AOT40, Accumulated dose Over a Threshold of 40 ppb; SUM06, a cumulative index of ozone concentrations over a specified threshold (0.06 ppm).

[2] POD_Y, Phytotoxic Ozone Dose above a threshold flux of Y nmol m^{-2} PLA s^{-1}, where PLA is

Monitoring and Assessment of Atmospheric Environment.

Potential effects of particulate matter on ecosystems

27. Dry deposition of particulate matter is an important deposition process of sulfur and nitrogen, e.g. $(NH_4)_2SO_4$ and NH_4NO_3. In terms of acidification and eutrophication also, particulate matter should be taken into consideration. Moreover, dry deposition of particulate matter into forest area is a removal process of those from the atmosphere, which may be considered as one of ecosystem services of forest, especially for urban trees. The information on concentration/flux of particulate matters in forest area, particularly those of fine particles, should be accumulated.

28. It has been reported that occlusion of stomata due to deposited particles may occur resulting in acceleration of water loss from leaf surface, although relatively coarse particles (> several μm) may mainly be related to this mechanism. Effects of fine particles (< 2.5 μm, so-called $PM_{2.5}$) on tree species are still not well understood in the region, although both hygroscopic particles such as $(NH_4)_2SO_4$ and other particles such as black carbon (BC) and heavy metals may have harmful effects. Updated scientific information on laboratory/field studies should carefully be considered.

29. Atmospheric aerosols and regional haze may decrease yields of agricultural crops due to reduction of surface irradiance, while the aerosols may increase the diffuse fraction of solar radiation that enhances photosynthesis. Both negative (by reduction of direct radiation) and positive (by increase of diffuse radiation) effects should be considered to evaluate net effects of radiation changes on crop yields. Updated scientific information should be considered.

Compilation of information on early detection:

30. Procedures to collect information on plant sensitivities and dose-response relationships should be discussed. The information on ozone has been accumulated well in China and Japan. The dose-effect relationship for the air pollutants in other countries is necessary to discuss possible risks on plants on the regional scale. The information on epiphytic plant species, such as mosses and lichens, should also be collected since they have been used as indicators of air pollution including acid deposition. The *Sub-Manual* provides possible methodologies to collect the information on lichens. Practical solutions to utilize such methodologies should be

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projected leaf area.

discussed. It should also be discussed to collect basic information on fauna (e.g. forest insects).

Information on biomass burning:

31. Forest fire and/or burning of agricultural residues emit a large amount of greenhouse gases and gaseous/particulate air pollutants, resulting in significant increase in air concentrations of these pollutants. Simultaneously, air pollutants emitted from the fire affect remaining/surrounding forest trees and agricultural crops. People living in the area suffer from high concentrations of air pollutants. A large amount of emissions may affect global climate and air pollution of neighboring countries. Information of biomass burning in the region should be compiled and shared in the EANET community. Precise data on biomass burning may contribute to air pollution modeling in the region, too.

III-2. Issues for the long-term objective

Promotion of regular catchment-scale monitoring

32. The case studies have been conducted in several reference catchment areas by the Network Center (NC) in cooperation with some participating countries. Elemental budget and biogeochemical processes have been discussed in the study catchments to evaluate effects of atmospheric deposition on the forest ecosystems. Based on the experience above, the *Guideline for Catchment-scale Monitoring* (EANET 2010) was developed by the Task Force and endorsed by the Scientific Advisory Committee of EANET at its 10th Session.

33. Regular catchment monitoring is conducted in the Lake Ijira catchment in Japan and the La Mesa Watershed in the Philippines in accordance with the *Guideline for catchment-scale monitoring*. The catchment-scale data are informative for discussion of atmospheric deposition impacts quantitatively and qualitatively. It is expected that the regular catchment monitoring will be conducted in other countries.

Enhancement of reactive nitrogen monitoring in forest areas

34. The biogeochemical cycle of reactive nitrogen (Nr) is identified as one of the most important earth-system processes in the concept of “planetary boundaries” and has already transgressed its boundary. Atmospheric deposition is a major pathway of nitrogen transfer process from the atmosphere to terrestrial ecosystems. The EANET has been monitoring Nr species, including NO_x, NH_3 and their ionic species, as major

components of acid deposition since 2001. The EANET therefore has the potential to contribute to a better understanding of regional nitrogen cycles in relation to atmospheric deposition.

35. For this purpose, as described in the MTP for the EANET (2026-2030), efforts should be made to obtain and assess data on atmospheric Nr deposition as well as its ecological effects within the scope of EANET. Total nitrogen deposition, as the sum of wet and dry deposition, should be assessed at rural and remote EANET sites where air concentrations of gaseous and particulate pollutants are monitored using the filter-pack method. In addition, NH_3, which is an important precursor of $PM_{2.5}$, is emitted in significant amounts from agricultural areas and undergoes bidirectional exchange (both deposition and emission) in forest areas. Therefore, monitoring of NH_3 air concentrations in rural and forest areas should also be promoted.

Catchment analysis and simulation modeling on soil and inland water:

36. Based on the elemental budget and biogeochemical process in the study catchments, possible impacts of acid and nitrogen loads resulting from atmospheric deposition should be evaluated. Disturbance of biogeochemical processes due to atmospheric deposition, including “nitrogen saturation”, is also one of issues to be evaluated.

37. Isotope ratios of some elements, such as sulfur, nitrogen/oxygen of NO_3^- and metals, are specific for their sources and/or changes through biological, geochemical or geophysical processes. Isotopic analysis of the elements from rainwater to stream water in a catchment may be informative for discussion of possible sources and biogeochemical processes in the ecosystems. Use of such techniques should also be considered for catchment analysis.

38. Simulation models on soil and/or inland water acidification should be developed based on the catchment analysis above. Changes in chemical properties in the acidification process should be simulated in the model. Simulation modeling may help us evaluate the current situation of the ecosystems. A common simulation model applicable for the diverse ecosystems in the EANET region is highly desired. Trends of soil and/or inland water acidification should also be predicted in future.

39. Direct effects of air pollution on plants may also induce hydrological and biogeochemical effects in ecosystems. For example, it was suggested that ozone altered watershed hydrology due to its effects on leaf transpiration and water use of plants. Physiological changes of plants caused by air pollution may affect microbial communities in soil. In the future simulation model, direct effects of air

pollution/acid deposition on plants, and their relations to hydrological/ biogeochemical processes should also be considered.

40. The quality of inland waters is being measured at several sites under the inland aquatic environment monitoring of EANET. In the *Technical Manual for Inland Aquatic Environment Monitoring in East Asia-2010*, importance of rivers/streams and their catchments is highlighted. The manual should be referred for catchment monitoring in addition to the *Guideline*. Accordingly, in Russia, inland water data from the Komarovka River and Pereemnaya River have been assessed on a catchment scale to evaluate the impacts of atmospheric deposition.

Identification of the areas susceptible to air pollution including acid deposition

41. Areas or regions susceptible to air pollution/acid deposition should be identified to conduct the monitoring effectively. As one of the previous activities in line with the *Strategy Paper*, a map of watershed sensitivity to acid deposition was developed by the NC in cooperation with the Task Force members, taking acid neutralizing capacity of soil and surface geology into consideration. The initial goal of the activity has been accomplished.

42. However, spatial distribution of air pollution/atmospheric depositions should also be taken into account to identify actual risks in the region. As a trial harmonized with this subject, one of the EANET countries developed the risk maps on acidification of soil and watershed and the maps of estimated growth reduction by ozone for representative species in their country. In the case of ozone, sensitivity of each tree species was also taken into consideration. In the trial above, outputs from numerical models on atmospheric depositions and ozone concentration were utilized to estimate the risks.

43. Possibility of utilizing numerical models for spatial distribution should be considered to estimate actual risks at the national levels as well as regional levels. Moreover, spatial datasets on plant growth, such as NPP (net primary production), have recently been available by satellite observations for discussion on effects of climate change. Such datasets may also be informative for discussion on possible risks on nitrogen deposition, since the growth rate must be related to nitrogen uptake in plants.

Up-scaling of the monitoring data and spatial evaluation

44. For spatial evaluation towards the long-term objective, up scaling of the monitoring data should be discussed as the next step. Use of the following methodologies should

be discussed.

45. Based on the data in the basic survey and the catchment analysis, the condition of the region should be estimated by the appropriate spatial modeling and then described on a map of the region. Regional data on air pollution and atmospheric deposition may also be required for the evaluation.

46. Regional assessment of possible impacts on ecosystems requires spatial data on air pollution atmospheric deposition. Emission inventory and numerical model on transport and chemical processes in the atmosphere are essential for this work. Further steps should be discussed in the EANET community.

47. Remote sensing technology may be helpful to describe the present condition on forest health decline based on the data from the basic survey. The *Sub-Manual* provides possible methodologies to utilize remote sensing technology. Satellite image analysis is one of the potential tools to detect changes in tree conditions, such as phonology, vitality of trees, etc. For the susceptible areas to air pollution/acid deposition, which were identified by the previous work in the Task Force, applicability of the technique should be considered. Use of the existing datasets by remote sensing technology should also be considered. Practical solutions to utilize such methodologies should be discussed in coming years.

IV. Collaboration with relevant networks/organizations

48. In Europe and North America, much experience has accumulated. In particular, the Working Group on Effects (WGE) and its International Co-operative Programmes (e.g. ICP Forests, ICP Vegetation, ICP Waters, ICP Integrated Monitoring, etc.) under the CLRTAP (Convention on Long-range Transboundary Air Pollution) in Europe can provide much useful information for the East Asian activities, including its existing monitoring manual for UNECE region. Information exchange and scientific collaboration with regional networks should be further enhanced.

49. In the research field, the International Union of Forest Research Organizations (IUFRO) Research Unit 8.04.00, "Air pollution and climate change", the International Long-Term Ecological Research Network (ILTER) and its national networks, such as Japan LTER network (JaLTER) and Philippines LTER network, and Asian Air Pollution and Climate Change Workshop (AAPC) can provide access to the latest scientific information on terrestrial ecosystems. The latest scientific knowledge should be obtained through participation in relevant meetings and

workshops, subject to the availability of external funding.

50. Collaboration with these relevant networks/organizations should be promoted for future development of the EANET activities.

V. Overall strategy

51. The overall strategy to achieve the initial and long-term objectives described above can be described as shown in Figure 1.

52. The initial objective is to describe the present status on soil, vegetation, and inland water in the EANET region, and it can also be one of steps toward the long-term objective.

53. For the long-term objective, another approach should also be promoted, especially for description of present status on ecosystem. To achieve these steps, some issues, such as promotion of catchment analysis and modeling, should be implemented.

54. Then, up scaling of these data should be discussed for spatial evaluation of impacts of acidifying species and related chemical substances in the EANET region.

VI. Acknowledgements

55. This *Strategy Paper* is a product of the scientific discussions of the members of the Task Force on Monitoring and Assessment of Environmental Effects. The brief history of the *Strategy Paper* is as follows:

- *Strategy Paper for Future Direction of Soil and Vegetation Monitoring of EANET*: adopted by SAC at its 2nd Session in 2002
- *Strategy Paper for Future Direction of Soil, Vegetation and related Ecosystems Monitoring of EANET (2009-2014)*: adopted by SAC at its 8th Session in 2008
- *Strategy Paper for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forests and Inland Water by Acidifying Species and Related Chemical Substances*:
  - *The first edition:* adopted by SAC at its 14th Session in 2014
  - *The updated version in 2020*: adopted by SAC at its 20th Session in 2020
  - *The update version in 2026*: (to be) adopted by SAC at its 26th Session in 2026

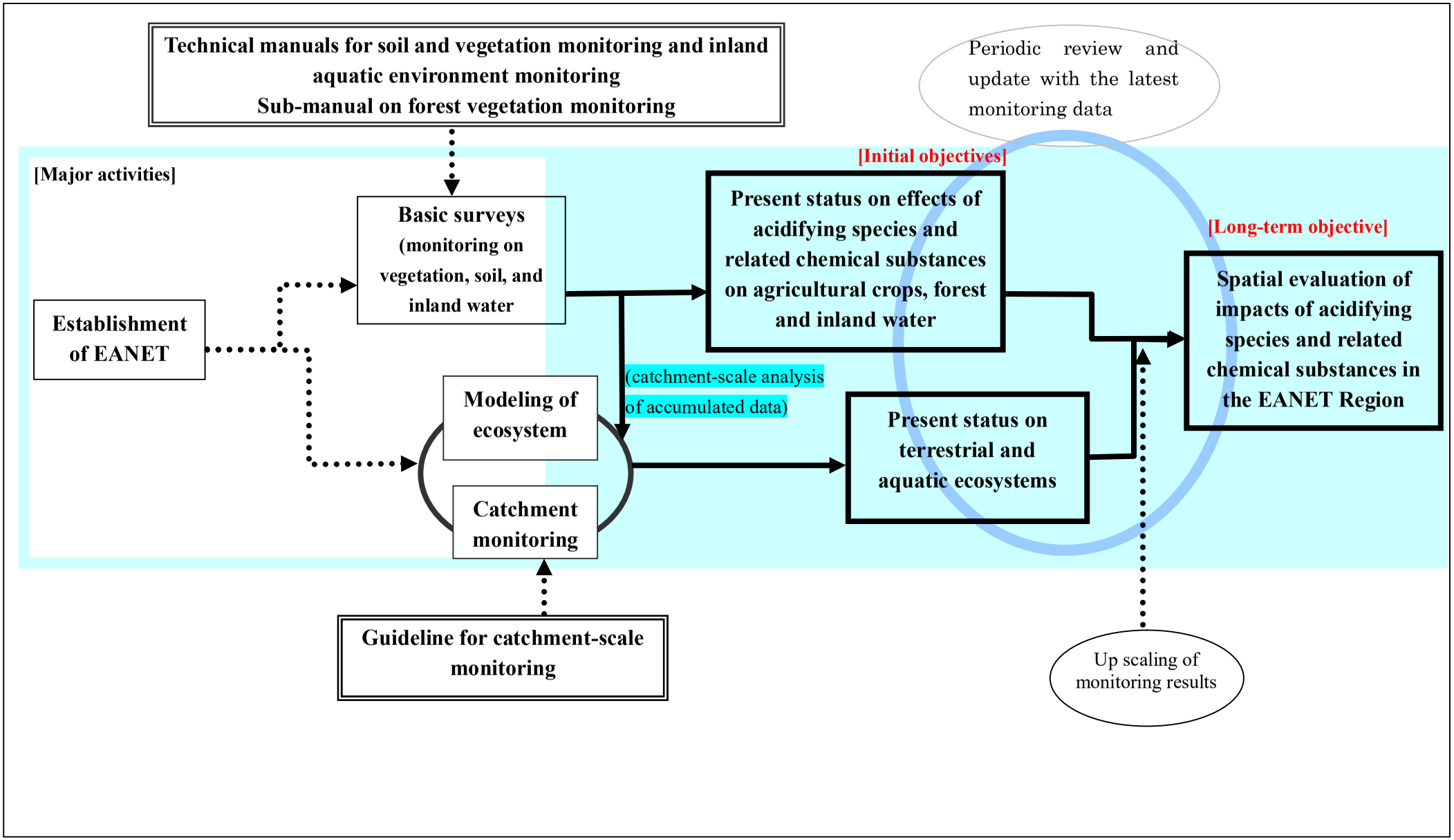


Figure 1. Overall strategy for Future Direction of EANET on Monitoring of Effects on Agricultural Crops, Forest and Inland Water by Acidifying Species and Related Chemical Substances

Annex

Specific activities for the period from 2026 to 2030

1. The following activities were selected as the specific works to be promoted for the period from 2026 to 2030, in accordance with recommendations of the MTP for the EANET (2026-2030). Most of the activities may need additional external funds to reach their milestones. To realize them, the activities are expected to be implemented by forming sub-groups, if necessary. The interactions between air pollution and climate change should also be taken into consideration for the subjects above.

i. Strengthening efforts to obtain and assess data on atmospheric Nr deposition

2. Total nitrogen deposition, defined as the sum of wet and dry deposition, will be assessed particularly at rural and remote EANET sites. Air concentration data for gaseous and particulate pollutants obtained using the filter-pack method can be applied to estimate dry deposition fluxes by the inferential method. Efforts should be made to obtain meteorological data, with as high a time resolution as possible, in the vicinity of EANET sites to calculate deposition velocities.

3. The NC should provide technical support to experts in the Participating Countries (PCs) to implement flux estimation. If the budget is available, the NC's technical missions will be dispatched to the PCs for this purpose.
Implementation target years: from 2026 onward

4. NH_3, an important precursor of $PM_{2.5}$, is emitted in significant amounts from agricultural areas and tends to remain in the gas phase as emissions of SO_2 and NO_x have decreased. In addition, NH_3 undergoes bidirectional exchange (both deposition and emission) in forest ecosystems. Thus, the behavior of NH_3 in rural and forest areas has not yet been sufficiently clarified. Monitoring of NH_3 air concentrations in these areas should therefore be further promoted for sustainable nitrogen management.

5. To obtain additional NH_3 data in rural and forest areas where electricity is unavailable, passive samplers can be utilized. Project-based activities led by the NC, in cooperation with voluntary PCs, will be considered for conducting passive NH_3 sampling. Methodological studies, including comparisons with other observational techniques, such as the filter-pack method and the denuder method, as well as assessments using satellite observations, should be implemented in collaboration with external researchers.
Implementation target years: from 2027 to 2029 (through the launch of an EANET Project or other external research projects)

6. Atmospheric Nr data in rural and forest areas should be shared with other regional networks, such as ICP Forests, to gain broader perspectives on the global issue of

sustainable nitrogen management. Online or hybrid workshops, as well as collaborative research papers, should be developed using the accumulated data.
Implementation target years: 2029/2030

ii. Compilation of scientific knowledge on air pollutants, including acidifying species, ozone, and PM, in agricultural and forest areas

7. Effects of air pollutants on agricultural crops and forest trees remain a major concern for the EANET Participating Countries. Scientific knowledge on the impacts of air pollutants, including acidifying species, ozone, and PM, on agricultural crops and forest ecosystems needs to be further consolidated. In addition, linkages between individual plant responses at the stand scale and broader ecosystem responses at the catchment scale should also be taken into consideration.

8. Ozone is currently the most serious phytotoxic stressor at present. In fact, the recently updated ozone air quality standard in Japan aims to address effects on vegetation in addition to impacts on human health. Information on ozone concentrations and their effects on crops and trees in rural and forest areas will be accumulated as extensively as possible. Combined effects of ozone and nitrogen deposition should also be considered.

9. Forest fires emit substantial amounts of PM into the atmosphere, which is closely linked to air quality and climate change. Satellite observations, low-cost sensors (LCS), and simulation modeling are useful tools for evaluating regional PM conditions, including haze events.

10. An online seminar on effects of air pollutants, including acidifying species, ozone, and PM, will be planned to share the latest scientific knowledge.
Implementation target years: 2028/2029

iii. Confirmation of ecosystem recovery from acidification and eutrophication

11. Phenomena suggesting ecosystem recovery associated with reductions in air pollution and atmospheric deposition should be continuously investigated. This is also important for validating relevant measures and policies in the region and in each country. Not only acidification, mainly due to sulfur deposition, but also eutrophication (or disruption of nitrogen biogeochemical cycles) caused by nitrogen deposition in forest ecosystems should be carefully assessed based on long-term data.

12. Regular catchment-scale monitoring at existing EANET sites will be continued by the respective countries. Long-term inland water data will also be assessed at the catchment scale. Technical and scientific cooperation among relevant countries is

important for the continuous monitoring and assessment of the data obtained. Online technical meetings led by the NC may be held periodically to discuss technical issues related to field monitoring and data assessment.
Implementation target years: from 2026 onward, at least once a year

13. Efforts should be made to obtain competitive research grants to further promote catchment analysis under changing meteorological conditions, such as increases in extreme weather events.
Implementation target years: from 2026 onward

Appendix

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