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

DRAFT EANET PROJECT COMPLETION REPORTS IN 2025

I. INTRODUCTION

1. The Twenty-sixth Session of the Intergovernmental Meeting of the Acid Deposition Monitoring Network in East Asia (EANET) (IG26), held in Kuala Lumpur, Malaysia, on 27 and 28 November 2024, approved the implementation of the following EANET Fund projects for 2025:

   [2025-01] Methodological study on developing $PM_{2.5}$ measurement techniques, source apportionment, and capacity building within EANET;
   [2025-04] Strengthening Monitoring and Discussion on Nitrogen Cycle and Management within the EANET;
   [2025-05] The collaboration of Technical and Training (TNT) and capacity building program for personnel of the Participating Countries on monitoring;
   [2025-07] Seminar on utilizing Satellite Monitoring including access to Dust and Sand Storm;
   [2025-09] Sharing information on early warning for local and regional air pollution for the Mekong sub-region;
   [2025-10] Studies on the effects of atmospheric deposition on ecosystems, from a catchment scale to a regional scale as a methodological study; and
   [2025-12] Fellowship for building leadership in Atmospheric Environment and Air Quality Management in East Asia.

2. All projects were completed during 2025. Pursuant to the EANET Project Guidelines, the respective Completion Reports were reviewed at the EANET Working Group meeting held in August 2026 and subsequently at the Scientific Advisory Committee (SAC) meeting held in October 2026. Following these reviews, the Completion Reports are submitted to the Twenty-eighth Session of the Intergovernmental Meeting (IG28) for consideration and endorsement.

3. This document provides a list of EANET project completion reports and the full reports themselves (**Attachment 1**).

II. ACTIONS REQUIRED

1. IG28 is invited to review and may wish to discuss, consider, provide guidance, and endorse the report, as appropriate.

Attachment 1: Project Completion Reports (PCR) of EANET Project Activities in 2025

EANET Project Completion Reports
In 2025

This EANET Project Completion Reports document includes projects completed in 2025, as listed below. The progress of ongoing projects in 2026 is reported in the Draft Progress Report of the EANET Projects in 2025 and 2026 (EANET/WG2026/5/1).

Project Number	Project Name	Implementation status	Remarks
[2025-01]	Methodological study on developing $PM_{2.5}$ measurement techniques, source apportionment, and capacity building within EANET	Completed in 2025	
[2025-04]	Strengthening Monitoring and Discussion on Nitrogen Cycle and Management within the EANET	Completed in 2025	
[2025-05]	The collaboration of Technical and Training (TNT) and capacity building program for personnel of the Participating Countries on monitoring	Completed in 2025	
[2025-07]	Seminar on utilizing Satellite Monitoring including access to Dust and Sand Storm	Completed in 2025	
[2025-09]	Sharing information on early warning for local and regional air pollution for the Mekong sub-region	Completed in 2025	
[2025-10]	Studies on the effects of atmospheric deposition on ecosystems, from a catchment scale to a regional scale as a methodological study	Completed in 2025	
[2025-12]	Fellowship for building leadership in Atmospheric Environment and Air Quality Management in East Asia	Completed in 2025	

PROJECT COMPLETION REPORT 2025-01

General Information

Project Title	Methodological study on developing $PM_{2.5}$ measurement techniques, source apportionment, and capacity building within EANET
Agreement start/end date	Start (January/2025) … End (December/2025)
Reporting period	From (January/2025) … To (December/2025)
Location of Activities (Cities, Countries)	Phnom Penh, Cambodia, Niigata, Japan
Project Lead (PL)	Network Center for EANET, Asia Center for Air Pollution Research
Project Lead Contact Details (including address, telephone, and email address)	Dr. Keiichi Sato, Department Head, Atmospheric Research Department, Asia Center for Air Pollution Research, Address: Sowa 1182, Nishi-ku, Niigata City, Japan Telephone: +81-25-263-0557 Email address: ksato@acap.asia

Background Information:

Background and Rationale:

- Exposure to $PM_{2.5}$ has been linked to respiratory and cardiovascular diseases, and it can also impact visibility, ecosystems, etc. Its sources include both natural processes and human activities. Given the complexity and diversity of $PM_{2.5}$ sources, identifying specific contributors is challenging but essential for considering effective air quality control measures.
- In many EANET countries, current methodologies for measuring $PM_{2.5}$ components and analyzing their sources remain limited, which hinders efforts to establish air quality management practices. There is an urgent need for standardized, reliable methods that can distinguish between different $PM_{2.5}$ sources, quantify their contributions. This project addresses these needs by conducting a preliminary survey to establish methodologies for $PM_{2.5}$ component measurement, source apportionment, and its capacity building.

Objectives:

- To develop and establish reliable methodologies for measuring the components of $PM_{2.5}$

- To conduct research on $PM_{2.5}$ source apportionment analysis methods
- To enhance capacity building for local stakeholders in $PM_{2.5}$ monitoring and source apportionment techniques

Expected outputs:

- Standardized Methodologies for $PM_{2.5}$ Component Measurement: A set of validated, reliable protocols for $PM_{2.5}$ sampling and component analysis, designed for use in EANET countries.
- Source Apportionment Information: Information on sources of $PM_{2.5}$, including quantitative contributions from each source type and insights into seasonal and regional variations.
- Trained Local Personnel and Stakeholders: Skilled local stakeholders, equipped with the knowledge and technical abilities needed to monitor $PM_{2.5}$ levels and conduct source apportionment independently.
- Sustainable Capacity for Long-term $PM_{2.5}$ Monitoring: Established local capacity for ongoing, independent monitoring of $PM_{2.5}$ and analysis of its sources, enabling air quality management and policy support.

Activity/deliverable summary:

A five-day hybrid training program on $PM_{2.5}$ component analysis and source apportionment was conducted from 1–5 December 2025 in Niigata, Japan, under the collaboration between the EANET Project and the Science and Technology Research Partnership for Sustainable Development (SATREPS) project. The training involved seven researchers and government officers from Cambodia, together with experts from Kanazawa University, Nagasaki University, and the EANET Network Center. In total, 232 participants joined onsite and online. The training contributed to strengthening analytical and technical capacity for $PM_{2.5}$ monitoring and source apportionment in EANET participating countries, particularly Cambodia.

1. Introductory sessions on project frameworks and regional cooperation

On Day 1, introductory lectures were delivered on the SATREPS project and EANET activities. These sessions outlined the objectives, achievements, and future directions of regional air quality management, including expansion of monitoring scope and the Medium-Term Plan

(2026–2030).

Deliverable:

- Improved understanding among participants of regional frameworks for air pollution management and collaboration
- Shared knowledge on ongoing research and monitoring initiatives in Southeast Asia

2. Practical training on $PM_{2.5}$ component analysis (Ion Chromatography)

On Days 2–3, hands-on laboratory training was conducted on inorganic ion analysis of $PM_{2.5}$ samples using Ion Chromatography (IC). The sessions covered sample pretreatment, analytical procedures, data processing, and Quality Assurance/Quality Control (QA/QC).

Deliverable:

- Improved understanding among participants of regional frameworks for air pollution management and collaboration
- Shared knowledge on ongoing research and monitoring initiatives in Southeast Asia

3. Training on $PM_{2.5}$ source apportionment using PMF

On Days 3–4, lectures and practical exercises on the Positive Matrix Factorization (PMF) method were conducted. Participants learned theoretical concepts, key source indicators, and application procedures including model installation, execution using demonstration datasets, and interpretation of results. Case studies from Japan and Southeast Asia were also introduced.

Deliverable:

- Acquisition of skills to perform PMF-based source apportionment
- Improved ability to interpret emission sources and their contributions
- Knowledge transfer of regional case studies supporting policy applications

4. Lectures on haze prediction and VOC monitoring

On Day 5, lectures were provided on haze detection and prediction technologies, including satellite observation, emission inventories, and chemical transport models. In addition, methodologies and current achievements of VOC monitoring under EANET were introduced,

along with future plans for developing technical guidance.

Deliverable:

- Increased understanding of advanced air pollution monitoring and prediction approaches
- Knowledge of VOC measurement techniques and their relevance to secondary aerosol formation
- Awareness of future regional monitoring frameworks

5. Overall outcomes of training activity

The training program successfully strengthened capacity in $PM_{2.5}$ monitoring and source apportionment by combining theoretical lectures and practical exercises. It provided participants with skills necessary to conduct chemical analysis, apply receptor models, and interpret pollution sources. These outcomes were disseminated in the EANET Web site.

(https://www.eanet.asia/joint-satreps-eanet-training-advances-pm2-5-source-apportionment-capacity-in-cambodia/)

Key deliverables:

- Trained personnel capable of conducting $PM_{2.5}$ component analysis and PMF modeling
- Transfer of standardized methodologies for $PM_{2.5}$ measurement and analysis
- Strengthened collaboration between EANET and SATREPS stakeholders
- Foundation for sustainable air quality monitoring and management in Cambodia and Southeast Asia

Performance remarks and highlights:

1. Significant enhancement of technical capacity in $PM_{2.5}$ analysis

The project achieved a major outcome in strengthening technical capacity for $PM_{2.5}$ component measurement and source apportionment through a joint EANET–SATREPS training program conducted in December 2025 in Niigata, Japan. The training gathered 232 participants (onsite and online), including researchers and government officials from Cambodia, and provided both theoretical lectures and hands-on laboratory sessions.

Through practical exercises on ion chromatography (IC), participants improved their skills in sample pretreatment, analytical procedures, and data calculation. Particular emphasis was placed on Quality Assurance and Quality Control (QA/QC), which is essential for ensuring the

reliability and comparability of $PM_{2.5}$ measurement data.

2. Strengthened capacity in $PM_{2.5}$ source apportionment using PMF

A key highlight of the training was the successful transfer of knowledge and techniques for $PM_{2.5}$ source apportionment using the Positive Matrix Factorization (PMF) method. Participants gained a comprehensive understanding of PMF theory, source indicators, and analytical workflows, followed by hands-on practice including model installation, execution with demonstration datasets, and interpretation of factor profiles.
The inclusion of case studies from Japan and Southeast Asia further enhanced participants' ability to relate model outputs to real-world emission sources, thereby improving their competence in applying PMF results to air quality management.

3. Integration of advanced monitoring and analytical approaches

The training program also introduced advanced topics beyond basic $PM_{2.5}$ analysis, including haze detection and prediction techniques using satellite observations, emission inventories, and chemical transport models (CTMs).
In addition, methodologies and current progress in VOC monitoring under EANET were presented, covering both manual and automatic measurement techniques and field applications in several Asian countries. These sessions broadened participants' understanding of the role of precursor gases and secondary aerosol formation in $PM_{2.5}$ pollution.

4. Contribution to regional capacity building and standardization

The project significantly contributed to capacity building in EANET participating countries, particularly Cambodia, by providing standardized knowledge and practical methodologies for $PM_{2.5}$ monitoring and analysis. The combination of lectures and hands-on training ensured effective knowledge transfer and skill acquisition.
Furthermore, the training strengthened regional collaboration among research institutions and government agencies, supporting harmonization of monitoring and analytical approaches within the EANET framework. The outcomes also aligned with future regional priorities, including the expansion of monitoring activities and the development of technical guidance.

Impacts/benefits achieved (for the final report, only):
1. Strengthened human capacity for $PM_{2.5}$ monitoring and analysis

The training program significantly enhanced the technical capacity of participants in $PM_{2.5}$ monitoring and analysis. Through a combination of lectures and hands-on laboratory sessions, participants acquired practical skills in sample pretreatment, ion chromatography (IC) analysis, and data processing. Emphasis on Quality Assurance and Quality Control (QA/QC) improved their ability to produce reliable and comparable analytical results.
This capacity development enables participating countries, particularly Cambodia, to independently conduct $PM_{2.5}$ component analysis and improve the quality of their monitoring data.

2. Enhanced capability for source apportionment and data interpretation

The training provided participants with practical knowledge of the Positive Matrix Factorization (PMF) model, a key tool for identifying $PM_{2.5}$ emission sources. By learning the full workflow from model installation to result interpretation, participants gained the ability to conduct source apportionment analysis using real-world data.

3. Improved understanding of secondary air pollution and precursor pollutants

Through lectures on haze formation, satellite monitoring, emission inventories, and chemical transport models, participants gained a broader understanding of the mechanisms of air pollution, particularly secondary $PM_{2.5}$ formation.
In addition, knowledge of VOC monitoring techniques and their role as precursors of secondary aerosols was enhanced. This contributes to a more comprehensive understanding of air pollution processes beyond primary emissions and supports integrated air quality management.

4. Promotion of standardized methodologies $PM_{2.5}$ measurement and analysis within EANET

The training contributed to the dissemination of standardized methodologies for $PM_{2.5}$ measurement and analysis across EANET participating countries. The use of common analytical techniques, QA/QC procedures, and PMF approaches promotes consistency and comparability of monitoring data within the region.

Challenges and management actions:

- The implementation of the project faced limitations primarily due to budget constraints, which restricted the scope of activities. Although the original plan included a broader range of research and capacity-building components, including extended field observations, detailed source apportionment studies, and wider dissemination activities, these could not

be fully implemented within the available financial resources. As a result, the project focused mainly on capacity building through a training program.

- To address these constraints, the project strategically prioritized activities with the highest impact under limited resources, namely the organization of an intensive training program on $PM_{2.5}$ component analysis and source apportionment. By combining lectures with hands-on exercises, the training was designed to maximize knowledge transfer and practical skill development within a short period. In addition, the training was conducted in a hybrid format, allowing broader participation (both onsite and online) and improving cost-effectiveness. This approach enabled the project to reach a larger audience and enhance regional capacity despite financial limitations.

Budget Performance:

Name of Activities	Budget (Financial and in-kind)	Expenditure	Balance
Contribution by SATREPS program	15,000 (in-kind)	15,000 (Used for hands-on training in Japan)	0
Project Implementation			
Personnel Cost for hybrid training in Niigata	5,000 (in-kind)	5,000	0
Total	20,000	20,000	0

Signatures:

Name and title of the responsible person:

Keiichi Sato, Department Head, Atmospheric Research Department

Name of Project Lead (PL)

organization: Network Center for EANET, Asia Center for Air Pollution Research

Signature_____ Date__March, 30 2026__

Name and title of the Secretariat for the EANET : Ms. Yujeong Kim, Senior Programme Management Officer, UNEP, and Ad Interim Coordinator, Secretariat for the EANET

Signature_____ Date____March 30 2026_____

PROJECT COMPLETION REPORT 2025-04

General Information

Project Title	Strengthening Monitoring and Discussion on Nitrogen Cycle and Management within the EANET
Agreement start/end date	1st January 2025 – 31st December 2025
Reporting period	1st January 2025 – 31st December 2025
Location of Activities (Cities, Countries)	Online Seminar, from Niigata, Japan
Project Lead (PL)	Asia Center for Air Pollution Research
Project Lead Contact Details (including address, telephone, and email address)	Dr. Hiroyuki Sase, Head of Ecological Impact Research Department, Asia Center for Air Pollution Research Sowa 1182, Nishi-ku, Niigata 950-2144, Japan +81-25-263-0560 sase@acap.asia

Background Information:

Background and the existing problem:

- Reactive nitrogen (Nr) including ammonia (NH3) and nitrogen oxides (NOx) have been produced by anthropogenic activities. Release of Nr to the environment is thought to pose substantial threats to human and ecosystem health. Therefore, to achieve sustainable nitrogen utilization, it is necessary to reduce Nr loss to the environment (Hayashi et al. 2021, *Environmental Pollution*).
- To tackle the above issue, under the resolution "Sustainable Nitrogen Management," adopted at the United Nations Environment Assembly (UNEA 5.2) in March 2022, countries are expected to formulate national action plans on sustainable nitrogen management and recommend that countries accelerate their policies to significantly reduce nitrogen emissions by 2030 and beyond.
- In addition, based on UNEP 4.14 and UNEA 5.2 resolutions, the United Nations Environment Programme (UNEP) has established a working group on nitrogen management (hereinafter referred to as the "Nitrogen WG") and accompanying expert meetings, discussions on frameworks for promoting international policy coordination related to nitrogen management and discussions on planning formats are being held.
- Thus, sustainable nitrogen management has become a global environmental issue.

Rationale of the proposal and reasoning for implementation:

- Nitrogen oxides from fuel/waste combustion are precursors of photochemical oxidants and PM2.5, with adverse effects on human health and terrestrial ecosystems. Ammonia emitted into the atmosphere from agricultural activities also contributes to the formation of PM (e.g., NH_4NO_3, $(NH_4)_2SO_4$). Excessive nitrogen input from the atmosphere has adverse effects on terrestrial ecosystems and inland waters, including acidification and eutrophication (Yamashita et al. 2022, *Science of the Total Environment*). Thus, the Nr problem is also an atmospheric environmental problem.
- The EANET has been monitoring atmospheric deposition of these Nr species, because they are also important as acid deposition. The EANET has the potential to contribute to the understanding of nitrogen flows and cycling from the atmosphere to ecosystems and to the discussion on sustainable nitrogen management.
- However, this potential has not been fully recognized by the EANET community.

Specific solution ways and how to address the problem:

- The online seminar will be held to advertise the EANET data and activities and to understand discussion points of the relevant agenda in UNEA7 (December 2025).

Objectives:

- To create common understanding on sustainable nitrogen management in the EANET community
- To enhance discussions on sustainable nitrogen management in the EANET community, which may contribute to preparation of the National Action Plan by each country.

Activity/deliverable summary:

Activity records:

1) The Sustainable Nitrogen Management Seminar 2025 – Accumulation of Nitrogen Data in EANET was held online on December 22, 2025.

2) The key outcomes of the online seminar were published as a web story on the EANET website.

Summary of the online seminar:

(More detailed discussions can be found in Attachment 1, Report of the seminar)

1) Date

Date: December 22, 2025

Time: 13:00 to 15:00 (UTC+7) (15:00 to 17:00 (JST, UTC+9))

2) Number of participants

58 participants (registered number: 82)

3) Contents of the seminar

Opening:

- **Dr. Toshimasa Ohara,** Director General of Asia Center for Air Pollution Research (ACAP), delivered the opening remarks.

Presentation Session: Accumulation of nitrogen data in EANET

- **Dr. Hiroyuki Sase,** ACAP, delivered the Introductory remarks: EANET's potential for contributing to sustainable nitrogen management.
- **Professor Kazuhide Matsuda,** Tokyo University of Agriculture and Technology, Japan, made a presentation, "Regional assessment of atmospheric nitrogen deposition using EANET monitoring data."
- **Dr. Yongjoo Choi,** Hankuk University of Foreign Studies, Korea, made a presentation, "Spatio-temporal distribution of Ammonia over Korea using CrIS Satellite: Validation with in-situ Measurements and Bias Correction."

General Discussion: how to promote nitrogen deposition monitoring in EANET, constraints and possible solutions

The following two points were mainly discussed:

- Monitoring techniques for nitrogen deposition
- Ammonia (NH3) deposition and bidirectional exchange

Closing:

- **Dr. Fan Meng**, Deputy Director General of ACAP, made the closing remarks.

4) Remarks

- Guest speakers delivered detailed presentations on nitrogen monitoring.
- Professor Kazuhide Matsuda discussed the challenges in accurately measuring nitrogen deposition, especially for ammonia, and advocated for the use of passive samplers.
- Dr. Yongjoo Choi presented a study using CRIS satellite data combined with machine learning to map and analyze ammonia concentrations over Korea, identifying key agricultural emission sources.
- The seminar concluded by emphasizing the need for enhanced monitoring, improved data analysis techniques, and international collaboration to effectively manage reactive nitrogen pollution in the region.

Performance remarks and highlights:

1) The online seminar was successfully completed, highlighting the EANET's potential to contribute to understanding the nitrogen cycle in the region.
2) Directions for the future development of the EANET were identified through discussions with experts, including the promotion of ammonia monitoring and enhanced collaboration with satellite data.
3) The knowledge obtained in the seminar is expected to serve as seeds for future EANET project activities.
4) The web story was published in the EANET website: https://www.eanet.asia/sustainable-nitrogen-management-seminar-2025-highlights-eanets-role-in-tackling-nitrogen-pollution/ . Presentation materials of experts are also available there.

Impacts/benefits achieved (for the final report, only):

- Nitrogen pollution is closely interconnected with various environmental media, including the atmosphere, soil, forests, and inland water. The issue spans across the entire spectrum of air pollution, encompassing both air quality and its effects on ecosystems. EANET monitoring already covers the primary nitrogen flow from the atmosphere to ecosystems, and its data contributes significantly to understanding the nitrogen cycle in the context of air pollution. This critical perspective was shared not only within the EANET community but also among experts from the broader nitrogen-related community.

- The new Medium-Term Plan (2026-2030) positions EANET to strengthen nitrogen management by expanding monitoring and assessment of NOx, NH_3, and their ionic species, with a particular focus on their atmospheric concentrations, deposition, and ecological impacts. It identifies these nitrogen-related pollutants as priority substances and promotes integrated analysis with PM2.5 and surface ozone. The MTP further highlights that enhancing data collection and assessment in these areas will enable EANET to contribute to global discussions on "sustainable nitrogen management." In addition, it specifies that methodological and practical exchanges on new technologies—such as satellite observations, low-cost sensors, and AI—will be advanced through capacity-building initiatives, including via a South-South cooperation platform to support countries with limited monitoring capabilities.

- The online seminar, held shortly after the adoption of the new MTP, provided a valuable opportunity to highlight EANET's potential to contribute to understanding the nitrogen cycle. A wide range of experts attended, not only from the EANET community but also from other scientific communities.

Challenges and management actions:

- Unfortunately, a new resolution on sustainable nitrogen management was not submitted to UNEA-7 for adoption at the beginning of December 2025. As a result, the

global discussion on nitrogen management did not gain significant momentum after UNEA-7.

- Nevertheless, the decision by EANET to support sustainable nitrogen management by strengthening nitrogen-related monitoring in the new MTP represents a major achievement for the regional air pollution network. EANET is expected to further enhance cooperation with other regional networks and the scientific community to advance related discussions.

- One of the guest speakers, Professor Matsuda, was invited to ACAP in Niigata City to further discuss future collaboration. His idea of measuring ammonia using passive samplers will be considered as a potential project-funded activity in the coming years.

Budget Expenditure:

Name of Activities	Budget (Financial and in-kind)	Expenditure	Balance
Seminar concept note	Personnel expenses: 500	Personnel expenses: 500	Personnel expenses: 0
Nitrogen seminar 2025	Direct expenses: 3,000 Personnel expenses: 1,000	Direct expenses: 511 Personnel expenses: 1,000	Direct expenses: 2,489 Personnel expenses: 0
Sub-total	Direct expenses: 3,000 Personnel expenses: 1,500	Direct expenses: 511 Personnel expenses: 1,500	Direct expenses: 2,489 Personnel expenses: 0
Total	4,500 USD	2,011	2,489

Signatures:

Name and title of the responsible person:

Dr. Hiroyuki Sase, Head of the Ecological Impact Research Department, Asia Center for Air Pollution Research (ACAP)

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Name of Project Lead (PL)

organization: Network Center for the EANET, Asia Center for Air Pollution Research

Signature  Date March 30 2026

Name and title of the Secretariat for the EANET: Ms. Yujeong Kim, Senior Programme Management Officer, UNEP, and Ad Interim Coordinator, Secretariat for the EANET

Signature  Date March 30 2026

PROJECT COMPLETION REPORT 2025-05

General Information

Project Title	The collaboration of Technical and Training (TNT) and capacity building program for personnel of the Participating Countries on monitoring
Agreement start/end date	January 2025 – December 2025
Reporting period	January 2025 – December 2025
Location of Activities (Cities, Countries)	Niigata (Japan); Osong, Seoul, Ulsan, Yangpyeong, and Jeju (Republic of Korea)
Project Lead (PL)	Network Center for the EANET (ACAP) and NIER (Republic of Korea)
Project Lead Contact Details (including address, telephone, and email address)	Dr. Meihua ZHU, Department Head, Planning and Training Department, Asia Center for Air Pollution Research, Postal address: Sowa 1182, Nishi-ku, Niigata City, Japan Telephone: +81-25-263-0556 Email address: mhzhu@acap.asia Dr. Kwon-ho Jeon, Senior Researcher, Climate and Air Quality Research Department, Global Environment Research Division Postal Address: 22689, Hangyeong-ro 42, Seo-gu, Incheon, Republic of Korea Telephone: +82-32-560-7320 Email address: jeon0119@korea.kr

Background Information:

This Capacity Building Program represents the latest iteration of a capacity-building legacy established in 1999. While historical training focused on traditional acid deposition parameters, the 2025 program was specifically redesigned to address the 2021 EANET scope expansion. This evolution incorporates monitoring for Volatile Organic Compounds (VOCs), Ammonia, and Carbon Monoxide (CO), alongside the validation of satellite-based monitoring platforms like GEMS. The program is fundamentally rooted in the necessity of maintaining Monitoring Quality and responding to the technical gaps inherent in a diverse regional network.

To ensure systematic capacity building, the project adhered to five strategic objectives:

- Monitoring: To maintain and improve national monitoring systems through the acquisition of the latest technical skills and essential equipment maintenance protocols.
- Analysis of Sample and Data: To ensure laboratory analysis and data management procedures satisfy Data Quality Objectives (DQO) and align with international standards.
- Emission Inventory: To obtain the knowledge required to collect standardized datasets and understand the multifaceted applications of emission inventories in air quality management.
- Forecasting: To improve the accuracy of regional forecasting systems and explore numerical modeling applications to characterize regional air pollution.
- Policy Development: To assist trainees in building evidence-based air quality management measures and foster a collective understanding of joint international responses to transboundary pollution. These objectives directed the intensive technical modules executed during the 2025 sessions in Japan and the Republic of Korea.

Activity/deliverable summary:

The program utilized a dual-session structure to capitalize on specialized regional facilities. Session 1 focused on the "Standardized Foundation" of monitoring at ACAP in Japan, while Session 2 emphasized "Advanced Application" and technological integration at NIER and its partner institutes in the Republic of Korea.

Training at ACAP focused on fundamental laboratory rigor and QA/QC.
Key modules included:

- QA/QC and SOPs: Comprehensive lectures on the Inter-laboratory Comparison Project and the strict implementation of Standard Operating Procedures (SOPs).
- Hands-on Analytical Chemistry: Intensive laboratory sessions including the technical process of making Filter Pack (FP) filters, FP extraction, and rain sample filtration.

- Ion Chromatography (IC): Practical training on IC analysis, featuring critical checks for ion balance and conductivity to ensure data integrity.
- Ecological Monitoring: Field practices for soil, vegetation, and inland aquatic environment monitoring to track the impacts of atmospheric deposition.





The NIER component provided exposure to cutting-edge monitoring and policy tools.
Key modules included:

- NAIR (Osong): Orientation on the Clean Air Policy Support System (CAPSS) for national emission inventory management.
- Seoul National University (SNU): Practical laboratory sampling for PM2.5 mass concentration, trace metals, and elemental/organic carbon.
- UNIST (Ulsan): High-level engagement with GEMS (Geostationary Environment Monitoring Spectrometer) research and satellite validation using ground-based Pandora instruments.
- Jeju Air Environment Research Institute: Field observation of real-time monitoring systems and background site operations for tracking transboundary pollution. All activities were executed in full alignment with the TNT Proposal 2025. No significant deviations from the original plan were observed, ensuring the program's intended technical depth was successfully achieved.



Session 1(Republic of Korea)



Session 2 (Republic of Korea)

Performance remarks and highlights:

- Overall Performance and Program Structure

The TNT & Capacity Building Program 2025 demonstrated strong overall performance in both content delivery and participant satisfaction. Feedback from trainees in both sessions indicated that the program was well-organized, balanced, and effective in achieving its objectives. Most participants agreed that the structure—combining lectures, site visits, and practical sessions—was appropriate and supported learning, with sufficient time allocated to key topics.

A key strength was its integrated learning approach, which combined theoretical instruction with practical and field-based experiences. Hands-on training in sampling, laboratory analysis, and instrument handling enhanced understanding of air quality monitoring processes, while real-world practices such as particulate matter sampling, ion chromatography (IC), and filter handling reinforced the importance of procedural accuracy and QA/QC.

- Technical Learning and Exposure

The program was particularly effective in exposing participants to advanced monitoring technologies and methodologies. Trainees gained knowledge in areas such as satellite-based monitoring (e.g., GEMS and Pandora), real-time automatic systems, and low-cost sensors, broadening their technical perspectives and understanding of integrated monitoring approaches.

Site visits to leading institutions—including emission inventory centers, universities, and monitoring facilities—were highlighted as a major strength. These visits provided valuable insights into how data collection, analysis, and policy implementation are interconnected, deepening participants' understanding of the full air quality management cycle.
In addition, sessions on regional frameworks such as EANET and ACAP strengthened awareness of standardized methods, data sharing, and cross-border collaboration, emphasizing their role in national capacity building and evidence-based policymaking.

- Capacity Development and Areas for Improvement

The program contributed significantly to professional development and capacity enhancement. Participants reported improved technical skills in emission inventory development, data management, atmospheric deposition monitoring, and analytical procedures. It also encouraged critical thinking through discussions on environmental challenges and reflection on national contexts.
While overall feedback was positive, some participants suggested improvements, including more time for hands-on practice, deeper exploration of specific topics (e.g., modeling, VOC monitoring, and data analysis), and additional opportunities for group discussion. These suggestions were constructive and did not diminish the program's overall success.

Impacts/benefits achieved (for the final report, only):

The TNT & Capacity Building Program 2025 generated significant impacts both at the individual and institutional levels, contributing to enhanced technical capacity and improved regional cooperation in air quality management.

- Individual Capacity and Practical Skills Development

The TNT & Capacity Building Program 2025 generated significant impacts both at the individual and institutional levels, contributing to enhanced technical capacity and improved regional cooperation in air quality management.
At the individual level, participants reported substantial improvements in their technical competencies and practical skills. The training enabled them to better understand complex

monitoring processes, including air pollutant sampling, laboratory analysis, data validation, and reporting.

Many trainees highlighted that the knowledge gained—particularly in QA/QC procedures, instrument calibration, and data analysis—would directly improve the accuracy and reliability of their work in national monitoring systems.

A major benefit of the program was its contribution to application-oriented learning. Participants expressed clear intentions to apply the acquired knowledge and skills in their daily work.

For example, trainees planned to improve the operation and maintenance of monitoring equipment, enhance data quality assurance processes, and strengthen analytical capabilities within their organizations. This demonstrates that the program successfully bridged the gap between theoretical knowledge and practical implementation.

- Institutional Strengthening and Knowledge Dissemination

The program also had a strong impact on institutional capacity building and knowledge dissemination. Many participants indicated plans to share their learning outcomes through internal seminars, training sessions, and knowledge-sharing platforms within their organizations.

In some cases, participants aimed to integrate new methodologies into standard operating procedures (SOPs) or to support national-level training programs for local authorities. These initiatives are expected to multiply the impact of the program by extending its benefits beyond the individual participants.

- Strategic Understanding, Technology, and Regional Cooperation

Another key benefit was the enhancement of understanding of integrated air quality management systems. Participants gained insights into how emission inventories, monitoring data, satellite observations, and policy frameworks are interconnected.

This holistic perspective enables them to contribute more effectively to evidence-based policymaking and environmental management in their respective countries.

The program also strengthened regional cooperation and networking among participants. By bringing together trainees from multiple countries, the program facilitated the exchange of

experiences and best practices related to air pollution challenges.

Participants recognized the value of platforms such as EANET for fostering collaboration, harmonizing methodologies, and addressing transboundary pollution issues.

In addition, exposure to advanced technologies—such as satellite monitoring and real-time data systems—provided participants with new perspectives on how to modernize and expand their national monitoring networks.

This is particularly important for countries seeking to improve spatial coverage and data integration in air quality assessment.

Challenges and management actions:

While the TNT & Capacity Building Program 2025 was largely successful, several challenges were identified through participant feedback. These challenges primarily relate to time constraints, technical depth, and practical implementation, and provide valuable insights for future program improvement.

In response to these challenges, several implicit and potential management actions can be identified based on participant feedback:

- Enhanced time allocation and modularization: Future programs could allocate additional time to complex topics or divide them into modular sessions, allowing participants to engage more deeply with technical content.
- Expansion of hands-on training: Increasing the number of practical sessions and live demonstrations, particularly for advanced monitoring and analytical techniques, would improve knowledge retention and practical applicability.
- Targeted curriculum adjustments: Tailoring the level of technical depth to participants' backgrounds and providing preparatory materials in advance could help address differences in prior knowledge and learning needs.
- Strengthening interactive learning: Incorporating more group discussions, case studies, and problem-solving exercises would facilitate peer learning and enhance understanding of real-world applications.

- Post-training support and networking: Establishing follow-up mechanisms, such as online platforms or alumni networks, could support continued learning and collaboration among participants, as suggested in the feedback.

Despite these challenges, it is important to note that they were generally incremental and improvement-oriented, rather than fundamental issues. The program's overall effectiveness was not compromised, and the feedback provides constructive guidance for refining future capacity-building initiatives.

Budget Expenditure:

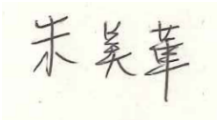
Name of Activities	**Budget (financial and in-kind)**	**Expenditure**	**Balance**
1) Travel costs			
Travel costs from the participant's country to Korea	7,000	7,000	0
Expense occurring in Korea (Lodging and meals, Visa issuance fee, Business trip expenses, and others)	15,100	15,100	0
Consumables at lab in Korea	9,000	9,000	0
Travel costs from Korea to Japan	2,600	2,600	0
Expense occurring in Japan (Lodging and meals, Visa issuance fee, Insurance fee (inc. Trip to R. of Korea), Business trip expenses, and others)	8,000	8,000	0
Consumables at lab in Japan	5,000	3,811	1,189
Travel costs from Korea to participant's country	7,000	7,000	0
2) Personnel costs			
Personnel cost of NIER	37,000	37,000	0
Personnel cost of NC	24,000	24,000	0
Total	**114,700**	**113,512**	1,189

Signatures:

Name and title of the responsible person:
Dr. Meihua ZHU,
Department Head, Planning and Training Department,
Asia Center for Air Pollution Research

_____

Name of Project Lead (PL) Dr. Meihua ZHU
organization: Planning and Training Department, Asia Center for Air Pollution Research

Signature  Date 30 March 2026

Name and title of the Secretariat for the EANET: Ms. Yujeong Kim, Senior Programme Management Officer, UNEP, and Ad Interim Coordinator, Secretariat for the EANET

Signature Yujeong Kim Date 30 March 2026

PROJECT COMPLETION REPORT 2025-07

General Information

Project Title	Seminar on utilizing Satellite Monitoring including access to Dust and Sand Storm
Agreement start/end date	January – December, 2025
Reporting period	From August 2025 … To December 2025
Location of Activities (Cities, Countries)	Niigata, Japan (ACAP)
Project Lead (PL)	Network Center for the EANET, Asia Center for Air Pollution Research (ACAP)
Project Lead Contact Details (including address, telephone, and email address)	Dr. Ken Yamashita Senior Research Fellow Network Center for the EANET, Asia Center for Air Pollution Research (ACAP) kyamashita@acap.asia 1182 Sowa, Nishi-ku, Niigata City, 950-2144, Japan

Background Information:

Project summary:

The project was implemented to enhance the understanding and capacity of EANET Participating Countries regarding the use of satellite monitoring technologies for air quality management. The activity focused on recent developments in satellite-based observations of air pollutants and greenhouse gases, including their applications to transboundary air pollution phenomena such as Dust and Sand Storms (DSS).

The project provided a platform for government officials, scientists, and experts to exchange information on the capabilities and limitations of satellite monitoring, discuss its relationship with ground-based monitoring networks, and explore opportunities for future cooperation. Through expert presentations and discussions, the project promoted a more comprehensive understanding of air quality monitoring approaches under EANET.

Main objectives:

The objectives of the project were:

- To discuss, and make recommendations where appropriate, on the possibility of future collaboration with organizations related to satellite monitoring;
- To discuss the applications of satellite monitoring for regional air quality issues, including Dust and Sand Storms (DSS);

- To obtain scientific knowledge on the relationships between satellite monitoring and ground-based air quality monitoring; and
- To enhance the capacity of EANET stakeholders through information sharing and exchange on emerging monitoring technologies.

Expected results:

The project was expected to:

- Improve the understanding of EANET National Focal Points (NFPs), Scientific Advisory Committee (SAC) members, and other network stakeholders regarding the use of satellite monitoring technologies for air quality observations;
- Facilitate the sharing of scientific knowledge and experiences through expert presentations and discussions;
- Introduce the concept of more comprehensive air quality monitoring through the integration of satellite observations and ground-based monitoring networks;
- Promote information exchange and cooperation among EANET Participating Countries and relevant organizations; and
- Contribute to improved air quality management in the EANET region through enhanced understanding of air pollution sources and monitoring approaches.

Activity/deliverable summary:

An online seminar entitled *"EANET Seminar on Utilizing Satellite Monitoring including Access to Dust and Sand Storms"* was held on 12 December 2025 as EANET Project Activity 7 in 2025. The seminar aimed to enhance the understanding of satellite-based air quality monitoring technologies, discuss their applications to Dust and Sand Storms (DSS) and other transboundary air pollution issues, and exchange information on the relationship between satellite observations and ground-based monitoring.

A total of 66 participants attended the seminar, representing government agencies, research institutions, universities, international organizations, and EANET-related bodies from 14 countries and territories. The seminar consisted of expert presentations from Japan, China, and the Republic of Korea, followed by question-and-answer sessions and a general discussion.

The programme of the seminar is shown below.

Table 1 Program

Time	Topics/title of a presentation	Speaker	Note
13:00 UTC+7 (15:00 JST)	Opening the workshop Group Photo	Prof. Meng Fan, Deputy Director General, NC Ms. Yujeong Kim, Ad Interim coordinator, EANET Secretariat	MC: Dr. Ken Yamashita, NC
13:10 (15:10)	Presentation 1: (30 minutes: The GOSAT-GW observations of greenhouse gases and air pollutants from the urban to global scales)	Dr. Tanimoto Hiroshi, NIES	
13:40 (15:40)	Q&A (10 Minutes)		
13:50 (15:50)	Presentation 2: (30 minutes: Dust sand storm in Mongolian Plateau)	Prof. Dr. Wang Tao, Northwest Institute of Eco-Environment and Resources, Chinese Academy of Science	
14:20 (16:20)	Q & A (10 minutes)		
14:30 (16:30)	Presentation 3: (30 minutes: GEMS applications: Current status and way forward	Dr. Hye Jung Shin, ESC, NIER	
15:00 (17:00)	Q & A (10 minutes)		
15:10 (17:10)	Discussion, summary of the seminar	Prof. Meng Fan, Deputy Director General, NC	
15:30 (17:30)	Closing		

Performance remarks and highlights:

The project was successfully implemented through an online seminar held on 12 December 2025, with the participation of 66 participants from 14 countries and territories, including government officials, researchers, technical experts, and representatives of EANET-related organizations. The seminar provided an important platform for information exchange and capacity building on emerging satellite monitoring technologies and their applications to regional air quality management.

One of the major highlights of the seminar was the introduction of the newly launched GOSAT-GW satellite by experts from the National Institute for Environmental Studies (NIES), Japan. Participants gained updated knowledge on the capabilities of the satellite to observe greenhouse gases and air pollutants from urban to global scales, as well as its potential applications for emission inventory verification and atmospheric assessment. Strong interest was expressed regarding data availability, data accuracy, and the potential use of near-real-time information for policy-relevant applications and early warning purposes.

The seminar also provided participants with a comprehensive overview of Dust and Sand Storm (DSS) issues in the Mongolian Plateau. Scientific evidence presented during the seminar demonstrated the increasing severity of DSS events in recent years and highlighted the combined influence of climate change, desertification, and human activities. The discussion emphasized the importance of integrating satellite observations with field observations and long-term land management efforts to improve understanding and mitigation of DSS.

Another important highlight was the presentation on the Geostationary Environment Monitoring Spectrometer (GEMS) operated by the Republic of Korea. Participants learned about the wide range of satellite products currently available, including NO_2, O_3, SO_2, aerosols, and other air quality parameters. The presentation demonstrated the practical value of satellite data for monitoring transboundary air pollution, supporting air quality forecasting, and improving emission estimation. Participants also expressed strong interest in the accessibility and potential use of GEMS data within EANET activities.

Throughout the seminar, discussions highlighted both the advantages and limitations of satellite monitoring technologies. While satellite observations provide broad spatial coverage and valuable information on regional and transboundary air pollution, participants also recognized the importance of validation and interpretation using ground-based monitoring data. A common understanding emerged that satellite monitoring should be regarded as a complementary tool that enhances, rather than replaces, existing monitoring networks. This balanced perspective was considered particularly important for supporting future discussions on the use of satellite monitoring within EANET.

The seminar successfully contributed to the objectives of enhancing knowledge and awareness of satellite monitoring technologies among EANET stakeholders. It also introduced the concept of more comprehensive air quality monitoring through the integration of satellite observations, ground-based monitoring, and other emerging technologies. The discussions highlighted the importance of continued cooperation among participating countries and relevant organizations to maximize the benefits of satellite monitoring for regional air quality assessment and management.

Overall, the project strengthened the scientific basis for future discussions on the use of satellite monitoring within EANET and provided a valuable opportunity to share experiences and knowledge among participating countries. The seminar demonstrated that satellite monitoring can serve as an important complementary tool to support regional efforts to address

transboundary air pollution challenges, including Dust and Sand Storms, while reinforcing the continued importance of ground-based monitoring activities.

The seminar also provided an opportunity to discuss future cooperation among organizations involved in satellite monitoring and atmospheric observation. Discussions highlighted the importance of strengthening scientific collaboration, data sharing, and joint validation activities among EANET participating countries and relevant institutions. Participants recognized that effective utilization of satellite monitoring requires not only technological advancement but also continued regional cooperation and capacity building.

Impacts / Benefits Achieved:
Feedback from participants indicated a high level of satisfaction with the seminar and strong interest in future activities related to satellite monitoring. According to the post-seminar questionnaire (n = 13), the average score for overall satisfaction was 4.15 out of 5, while the average score for willingness to learn more about the topic in the future reached 4.54 out of 5. In addition, 92% of respondents rated the seminar as either “Excellent” or “Good”. These results suggest that the seminar successfully enhanced awareness and interest in satellite monitoring technologies among EANET stakeholders.

Table 1. Summary of Participant Feedback Questionnaire (n = 13)

Evaluation Item	**Average Score (5-point scale:5=highest)**
The seminar met my expectations	4.08
The knowledge gained will be useful for my work/research	4.23
I would like to learn more about this topic in the future	4.54
Overall satisfaction with the seminar	4.15

Participants’ comments further indicated strong interest in the newly launched GOSAT-GW satellite and the operational applications of GEMS. Several respondents highlighted the usefulness of satellite observations for air quality assessment, forecasting, and environmental management. Participants also emphasized the importance of integrating satellite observations with ground-based monitoring networks to improve the reliability and practical application of monitoring data.

The project contributed to strengthening the knowledge base and technical awareness of EANET stakeholders regarding the use of satellite monitoring technologies for air quality assessment and management. Through expert presentations and discussions, participants gained updated information on recent developments in satellite observations, including GOSAT-GW and GEMS, as well as their potential applications for monitoring transboundary air pollution phenomena such as Dust and Sand Storms (DSS).

One of the key benefits of the project was the promotion of a more comprehensive understanding of air quality monitoring approaches. Participants recognized that satellite observations can provide valuable information on the spatial distribution, transport, and

regional characteristics of air pollution, while ground-based monitoring remains essential for validation, detailed assessment, and long-term trend analysis. The seminar therefore contributed to a balanced understanding of the complementary roles of satellite and ground-based monitoring systems.

The project also facilitated information exchange among experts and stakeholders from multiple countries and organizations. By bringing together specialists working on satellite observations, atmospheric monitoring, and air quality assessment, the seminar strengthened regional networks and provided opportunities for future scientific cooperation and knowledge sharing.

In addition, the project introduced participants to emerging opportunities for integrating satellite observations into existing air quality monitoring frameworks. The knowledge shared during the seminar is expected to support future discussions on the utilization of satellite data within EANET activities, including regional assessments, monitoring enhancement, and capacity-building initiatives.

Overall, the project enhanced awareness of advanced monitoring technologies and reinforced the importance of combining multiple monitoring approaches to address regional and transboundary air pollution issues. The seminar provided a useful foundation for future consideration of satellite monitoring as a complementary component of EANET's long-term air quality monitoring activities.

The seminar also increased participants' awareness of practical opportunities for applying satellite data to air quality assessment and management. Discussions on near-real-time observations, emission inventory verification, DSS monitoring, and publicly available GEMS products provided participants with concrete examples of how satellite information may support future monitoring and assessment activities within the EANET region.

Challenges and management actions:

One of the challenges identified during the implementation of the project was the varying levels of familiarity and experience among participating countries regarding the use of satellite monitoring technologies for air quality management. While satellite observations are increasingly used for regional and global assessments, many countries continue to rely primarily on ground-based monitoring data for regulatory and assessment purposes.

In addition, participants recognized that satellite observations have inherent limitations, including uncertainties associated with meteorological conditions, retrieval algorithms, and the interpretation of column measurements. These issues highlight the importance of validation and complementary use of ground-based monitoring data.

To address these challenges, the seminar was designed to provide balanced perspectives on both the advantages and limitations of satellite monitoring technologies. Presentations and discussions emphasized the complementary relationship between satellite observations and

ground-based monitoring networks, rather than promoting satellite monitoring as a replacement for existing monitoring systems. Particular attention was given to the importance of data validation, integration of multiple monitoring approaches, and cooperation among countries and institutions.

The project also provided an opportunity for participants to exchange experiences and raise practical questions regarding data accessibility, usability, and potential applications. These discussions helped improve understanding of current capabilities and challenges, while contributing to a more realistic and informed perspective on the future use of satellite monitoring within EANET activities.

The seminar confirmed that future discussions within EANET should focus not only on satellite monitoring itself, but also on approaches for integrating satellite observations with existing ground-based monitoring networks.

Budget Performance:

Provide an overview of budget performance (including balance remaining for each activity) and the amount of additional resources leveraged due to the project (financial and in-kind).

Name of Activities	Budget (Financial and in-kind)	Expenditure	balance
Preparation for seminar (discussion with internal and external experts, draft of concept note and scenario, issue of invitations, advertisement using website and Mailchimp, checking and uploading the presentation files)	Personnel cost 2,000	2,000	0
Holding seminar (set-up the Zoom webinar system, rehearsal, connection test and discussion on program arrangement with participants/moderator)	Personnel cost 2,000	2,000	0
Follow-up of seminar (making the complete report, compiling and uploading the presentation files and summary report on EANET website)	Personnel cost 500	500	0
Project Fund Holder Fee	3,000	3,000	0
Total	7,500	7,500	0

Signatures:

Name and title of responsible person:
Dr. Ken Yamashita, Senior Research Fellow

Name of Project Lead (PL)

organization: Network Center for the EANET, Asia Center for Air Pollution Research (ACAP)

Signature Ken Yamashita Date 31 March 2026

Name and title of the Secretariat of the EANET: Ms. Yujeong Kim, Senior Programme Management Officer, UNEP, and Ad Interim Coordinator, Secretariat for the EANET

Signature Yujeong Kim Date 31 March 2026

PROJECT COMPLETION REPORT 2025-09

General Information

Project Title	Sharing information on early warning for local and regional air pollution for the Mekong sub-region
Agreement start/end date	January – December, 2025
Reporting period	From August 2025 … To December 2025
Location of Activities (Cities, Countries)	Vientiane Capital, Lao PDR
Project Lead (PL)	Biotechnology and Ecology Institute, Ministry of Agriculture and Environment, Lao PDR
Project Lead Contact Details (including address, telephone, and email address)	Mr. Sitthideth Nonthaxay, Acting Director of Environmental Laboratory, Contact person of the EANET Network- Natural Resource and Environment Research Institute, Ministry of Natural Resources and Environment, Lao PDR Email: s_nonthaxay@yahoo.com Tel: +856-2052220202

Background Information

Project summary:

The Mekong sub-region continues to face recurrent air pollution episodes associated with biomass burning, agricultural residue burning, forest fires, and transboundary haze. In response, the Second ASEAN Haze-Free Roadmap (2023–2030) emphasizes the importance of strengthening science-based approaches, including monitoring, forecasting, and early warning systems.

To support these efforts, EANET implemented the project "Sharing Information on Early Warning for Local and Regional Air Pollution for the Mekong Sub-region." The project aimed to strengthen the science–policy–action interface by facilitating information sharing and dialogue among scientists, policymakers, and regional organizations.

The project was implemented through the EANET Seminar on Early Warning for Local and Regional Air Pollution in the Mekong Sub-region, held on 23 October 2025 in Vientiane, Lao PDR.

The seminar provided a platform for sharing scientific knowledge and experiences on early warning systems and exploring opportunities for future regional cooperation.

Main objectives:

To strengthen the science–policy–action interface in support of the implementation of the Second ASEAN Haze-Free Roadmap (2023–2030).

• To share scientific and technical knowledge related to early warning systems for haze and PM2.5, including monitoring, satellite observations, emission inventories, air quality modeling, source apportionment, and emerging AI-based approaches.

• To facilitate dialogue and cooperation among EANET Participating Countries, ASEAN-related initiatives, and relevant international organizations.

• To improve understanding of opportunities and challenges for developing and applying early warning systems for local and regional air pollution in the Mekong sub-region.

Expected results:

• Improved understanding among participants of scientific approaches and tools supporting early warning systems for haze and PM2.5 pollution.

• Enhanced exchange of information and experiences among scientists, policymakers, and regional organizations.

• Strengthened regional dialogue and cooperation relevant to the implementation of the ASEAN Haze-Free Roadmap.

• Identification of potential areas for future collaboration on early warning systems and air quality management in the Mekong sub-region.

Activity/deliverable summary

The project was implemented through the EANET Seminar for Sharing Information on Early Warning for Local and Regional Air Pollution for the Mekong Sub-region, held on 23 October 2025 in Vientiane, Lao PDR, in a hybrid format. The seminar was jointly organized by the Network Center for EANET (ACAP) and the Biotechnology and Ecology Institute (BEI), Ministry of Agriculture and Environment of Lao PDR, with support from the EANET Secretariat. Approximately 40 participants from around 10 countries attended the seminar, including government officials, scientists, representatives of international organizations, and regional initiatives.

The seminar was conducted according to the programme shown in Table 1. The programme included presentations on early warning technologies, PM2.5 source apportionment, regional initiatives (CASA and SEACAI), and the air quality situation in Lao PDR, followed by discussions among participants.

Table 1

Time	Topics/title of a presentation	Speaker
8:30 UTC+7 (10:30 JST)	Opening the workshop Group Photo MC: Dr. Ken Yamashita, NC	Mr. Khamsene OUNEKHAM, DG of BEI, Dr. Toshimasa Ohara, Director General of NC, Ms. Maria Katherina Patdu, Ad Interim coordinator, EANET Secretariat
8:40 (10:40)	Presentation 1: (25 minutes: Air Quality Modeling: Models and Emissions, and Application Examples)	Dr. Yusuke Kiriyama, NC
9:05 (10:05)	Q&A (5 Minutes)	
9:10 (11:10)	Presentation 2: (25 minutes: PM2.5 source apportionment in major cities in EANET)	Dr. Keiichi Sato, NC
9:35 (11:35)	Q & A (5 minutes)	
9:40 (11:40)	Presentation 3: (25 minutes: Clean Air for Sustainable ASEAN project)	Mr. Gaston Melo-Felgueres, ESCAP
10:05 (12:05)	Q & A (5 minutes)	
10:10 (12:10)	Presentation 4: (25 minutes: Monitoring, Source Apportionment and Modelling within the SEACAI Framework)	Mr. Xavier Mari, IRD
10:35 (12:35)	Q & A (5 minutes)	
10:40 (12:40)	Presentation 5: (25 minutes: Air Quality Situation and PM2.5 Source Attribution in Lao PDR)	Mr. Khamhou Tounalom and Mr. Sitthideth Nonthaxay, Lao PDR
11:05 (13:05)	Q & A (5 minutes)	
11:10 (12:10)	Discussion, summary of the workshop and closing	Prof. Meng Fan, Deputy Director General, NC
11:30 (13:30)	Coffee break	

Performance remarks and highlights:

The seminar successfully brought together scientists, policymakers, and representatives of regional initiatives to exchange views on scientific and operational approaches for strengthening early warning systems for haze and PM2.5 pollution in the Mekong sub-region. The presentations and discussions highlighted several important scientific and policy-relevant messages.

One of the key highlights was the recognition that effective early warning systems require the integration of multiple scientific approaches rather than reliance on a single tool. Presentations demonstrated how satellite observations, emission inventories, ground-based

monitoring, and chemical transport models (CTMs) can complement one another to improve the understanding, forecasting, and management of haze pollution. Participants noted that advances in satellite observations and modeling technologies provide increasing opportunities to strengthen early warning capabilities in the region.

Another important topic was PM2.5 source apportionment. Case studies from East and Southeast Asia demonstrated the value of source apportionment techniques for identifying major pollution sources and supporting evidence-based policy development. The presentations highlighted the significant contributions of biomass burning, waste burning, transportation, and secondary aerosol formation in different urban environments, emphasizing that effective mitigation measures require location-specific scientific information.

The seminar also introduced emerging approaches that combine environmental monitoring, modeling, and digital technologies. Presentations from the CASA and SEACAI initiatives demonstrated ongoing efforts to strengthen regional monitoring networks, data-sharing platforms, and analytical capabilities. In particular, participants expressed interest in the growing application of artificial intelligence (AI), data fusion techniques, and digital platforms to support air quality assessment and early warning activities.

The discussions further highlighted the importance of addressing uncertainties associated with biomass burning emissions, fuel-load estimates, emission factors, and model performance. Participants emphasized that improvements in these areas would contribute to more reliable forecasting and more effective policy responses. The need for continued collaboration between observational and modeling communities was also recognized.

A recurring theme throughout the seminar was the importance of strengthening the science–policy–action interface. Participants shared the view that scientific information generated through monitoring, modeling, source apportionment, and forecasting should be translated into practical information that can support decision-making, preparedness, and response actions. In this regard, the seminar contributed to promoting dialogue between scientific experts, policymakers, and regional organizations.

The seminar also highlighted opportunities for enhanced cooperation among EANET, ASEAN-related initiatives, and international organizations. The discussions demonstrated that regional platforms such as EANET, CASA, and SEACAI possess complementary strengths and could contribute collectively to the implementation of the Second ASEAN Haze-Free Roadmap (2023–2030). Participants recognized the value of continued information exchange and collaboration to strengthen early warning systems and air quality management in the Mekong sub-region.

Impacts / Benefits Achieved

The seminar contributed to improving participants' understanding of scientific and technical approaches that support early warning systems for haze and PM2.5 pollution. Through presentations and discussions covering satellite observations, emission inventories, air quality modeling, source apportionment, and emerging digital technologies, participants gained a broader understanding of the strengths, limitations, and complementary roles of different approaches for air quality assessment and forecasting.

The seminar also strengthened the science–policy–action interface by providing a platform

for dialogue among scientists, policymakers, and representatives of regional and international initiatives. Discussions highlighted the importance of translating scientific information into practical tools and actionable information that can support preparedness, response, and long-term air quality management. The exchange of experiences helped promote a common understanding of the challenges and opportunities associated with developing and applying early warning systems in the Mekong sub-region.

Another important benefit of the seminar was the promotion of regional cooperation. Participants were introduced to ongoing initiatives, including CASA and SEACAI, and discussed their relevance to regional air quality management and the implementation of the Second ASEAN Haze-Free Roadmap (2023–2030). The seminar provided an opportunity to exchange information on complementary activities and to identify potential areas for future collaboration among EANET Participating Countries, ASEAN-related initiatives, and other international partners.

The seminar further highlighted the importance of integrating monitoring, modeling, source apportionment, and emerging AI-based approaches to strengthen future early warning systems. Participants recognized that no single method can adequately address the complexity of haze pollution and that a combination of scientific approaches is needed to improve both understanding and decision-making.

The discussions also identified several areas requiring further attention, including improvements in biomass burning emission inventories, emission factors, monitoring networks, and modeling capabilities. These issues were recognized as important technical foundations for enhancing the reliability and effectiveness of future early warning systems.

Overall, the seminar contributed to establishing a shared understanding of scientific and policy priorities related to haze early warning and supported continued dialogue toward strengthened regional cooperation under EANET and ASEAN frameworks. The outcomes of the seminar are expected to provide useful inputs for future capacity-building activities, technical cooperation, and the further development of science-based approaches for air quality management in the Mekong sub-region.

Challenges and management actions

One of the challenges encountered during the implementation of the project was the limited time available for discussion within the seminar programme. Given the broad range of topics covered, including satellite observations, emission inventories, air quality modeling, source apportionment, and emerging AI-based approaches, the time available for in-depth discussion on each topic was necessarily limited.

In addition, the seminar was conducted in a hybrid format, which required coordination between on-site and online participants. While the hybrid format enabled broader participation from different countries and organizations, opportunities for direct interaction among participants were more limited than in a fully face-to-face meeting.

Another challenge relates to the complexity of developing and applying early warning systems for air pollution in the Mekong sub-region. Discussions highlighted technical challenges associated with emission inventories, biomass burning emission factors, monitoring coverage, and model uncertainties. These issues require continued scientific research, capacity building, and regional cooperation beyond the scope of a single seminar.

To address these challenges, the organizers facilitated exchanges among scientists, policymakers, and representatives of regional initiatives and encouraged continued information sharing and collaboration through EANET and related regional frameworks. The seminar also helped identify priority areas for future technical cooperation and capacity-building activities related to early warning systems and haze management in the Mekong sub-region.

Budget Performance

Provide an overview of budget performance (including balance remaining for each activity) and the amount of additional resources leveraged due to the project (financial and in-kind).

Name of Activities	Budget (Financial and in-kind)	Expenditure	balance
Regional workshop (RWS) on local and regional air pollution: WS venue	3,000	1,635	1,365
RWS: Travel cost	2,000	516	1,484
Preparation for seminar (discussion with internal and external experts, draft of concept note and scenario, issue of invitations, advertisement using website and mail Chimp, checking and uploading the presentation files) Holding seminar (set-up the Zoom webinar system, rehearsal, connection test and discussion on program arrangement with participants/moderator) Follow-up of seminar (making the complete report, compiling and uploading the presentation files and summary report on EANET website) :Personnel cost	PF(5,000) and cofinance from ESCAP(6,000)	11,000	0
RWS: research	Cofinance from ESCAP(10,000)	10,000	0
Project Fund Holder Fee	3,000	3,000	0
Total	29,000	26,151	2,849

Signatures:

Name and title of responsible person:
Mr. Sitthideth Nonthaxay, Acting Director of Environmental Laboratory

Name of Project Lead (PL)
organization: Natural Resource and Environment Research Institute, Ministry of Natural Resources and Environment, Lao PDR

Signature _____ Date 30 March 2026

Name and title of the Secretariat of the EANET: Ms. Yujeong Kim, Senior Programme Management Officer, UNEP, and Ad Interim Coordinator, Secretariat for the EANET

Signature Yujeong Kim Date 30 March 2026

PROJECT COMPLETION REPORT 2025-10

General Information

Project Title	Studies on the effects of atmospheric deposition on ecosystems, from a catchment scale to a regional scale as a methodological study
Agreement start/end date	1st January 2023 – 31st December 2025 (3 years)
Reporting period	1st January 2025 – 31st December 2025
Location of Activities (Cities, Countries)	● Niigata City and Shibata City, Niigata, Japan ● Yamagata City, Gifu, Japan ● Moscow City, Russia ● Metro Manila, Philippines
Project Lead （PL）	Asia Center for Air Pollution Research Co-Project Lead: ● Institute of Global Climate and Ecology (IGCE), Russia (in 2025) ● Environmental Management Bureau (EMB), Philippines (in 2025)
Project Lead Contact Details (including address, telephone, and email address)	Dr. Hiroyuki Sase, Head of Ecological Impact Research Department, Asia Center for Air Pollution Research Sowa 1182, Nishi-ku, Niigata 950-2144, Japan +81-25-263-0560 sase@acap.asia

Background Information:

Background:

- Forest ecosystems provide various ecological services, such as provision of nature resources, groundwater recharge, carbon sequestration, and prevention of disasters. Long-term atmospheric deposition of acidifying species and related chemical substances may have disturbed the functions and resilience of forest ecosystems.
- According to the experience in Europe and North America, a recovery of forest ecosystems from acidification did not progress as expected and problems remained even after a reduction of SO_2 and NOx emissions. Remaining problems, such as O_3 and PM, and excess nitrogen deposition, still exist.
- Meteorological variabilities and extreme weather, such as changing precipitation patterns, high temperature and sudden heavy rains, may also affect the recovery process.
- Responses of forest ecosystems to a changing atmospheric environment have not been enough clarified, yet. This is important not only to create a common understanding of ecological impacts but also to verify the effectiveness of relevant policy measures to date.

Rationale:

- A field observation on a catchment scale is a useful approach to evaluate effects of atmospheric deposition on forest ecosystems, quantitatively and qualitatively.
- Regional assessments of ecological impacts by atmospheric deposition have been contributing to reduction of the emissions historically, as shown in the experience in Europe (adoption of relevant protocols under the Convention on Long-Range Transboundary Air Pollution, UNECE).
- It is suggested that impact assessments be promoted in EANET to create common understanding of the current ecological impacts and provide useful inputs for policy makers.

Main objectives:

- To understand responses of ecosystems to declining atmospheric deposition and other environmental factors, such as extreme weather events, in forest catchments
- To promote methodological research on impact assessments applicable to Japanese sites, such as the Kajikawa catchment site (KJK) and Lake Ijira site (IJR)
- To provide scientific knowledge for future policy measures

Activity/deliverable summary:

The major activities in the project include:

- Field surveys at KJK for atmospheric deposition and stream water chemistry
- Intensive field survey at KJK and IJR during rainfall events to discuss possible mobilization of air-pollution legacy pools in forest ecosystems (under the project supported by an external grant)
- Analysis of relevant EANET data (in particular, in Russia and the Philippines)
- Publication and presentation of scientific findings in journals and scientific meetings
- Promotion of regional assessment as a methodological study in the seminar (2023-07)
- Progress report for EANET meetings, such as SAC24, STM26, and SAC25

Deliverables obtained from the project include:

1. Long-term datasets from KJK for a period of more than 23 years

   At KJK, field surveys were conducted as non-core budget activities from 2002 to 2021 and as EANET Project Fund activities from 2022 to 2025. As a result, long-term datasets on atmospheric deposition and stream water chemistry have been obtained for a period of more than 23 years. The long-term datasets reveal that atmospheric deposition in the forest at KJK has declined, reflecting improvements in the atmospheric environment of the region. The stream water chemistry also appears to have responded rapidly to changes in atmospheric deposition.

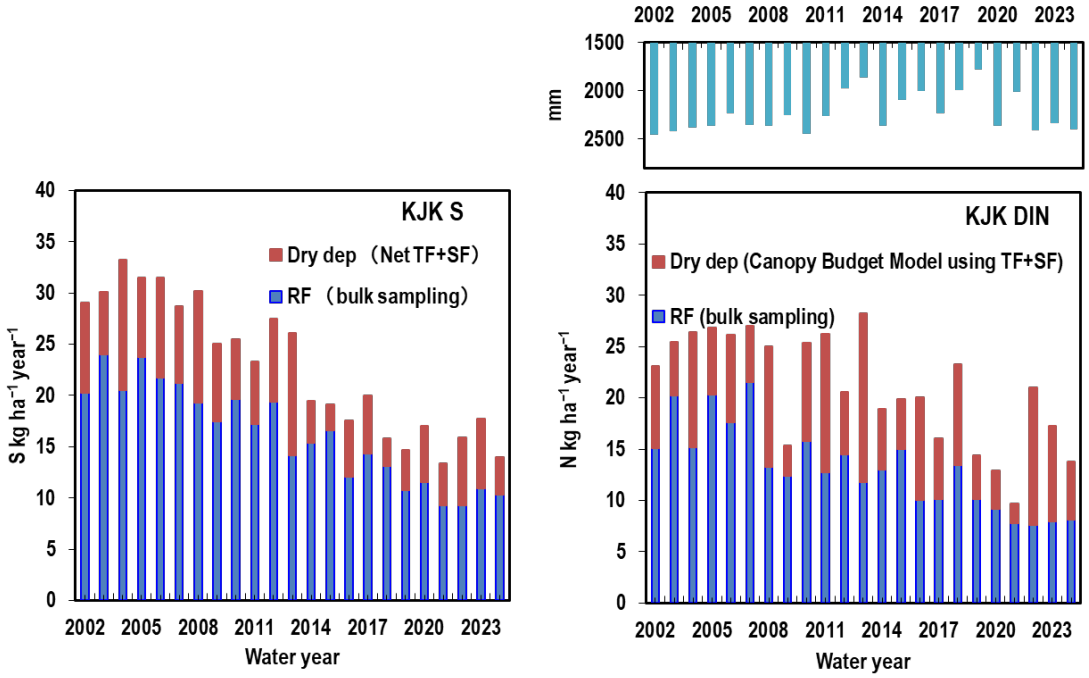


Fig. 1. Long-term changes in atmospheric sulfur (S) deposition and dissolved inorganic nitrogen (DIN) deposition. The water year is defined as June of one year through May of the following year. Dry deposition was estimated as the net throughfall and stemflow (TF + SF) for sulfur and using a canopy budget model (Staelens et al., 2008, Water, Air and Soil Pollution) for DIN. Modified from Sase et al. (2021).

Atmospheric deposition of sulfur and dissolved inorganic nitrogen (DIN) has recently shown a decreasing trend (Fig. 1), and the clear decline in sulfur deposition may reflect the SO_2 emission trend in Northeast Asia (Sase et al. 2021, *Atmospheric Environment*). With decreasing atmospheric deposition, the alkalinity of stream water increased and SO_4^{2-}

concentrations decreased, suggesting recovery from the acidification of forest ecosystems (Fig. 2). However, the decrease in SO_4^{2-} concentrations in stream water was disproportionately small compared to that in sulfur deposition. In addition, NO_3^- concentrations continued to increase despite the decline in DIN deposition. As a result, stream water pH remained relatively stable.

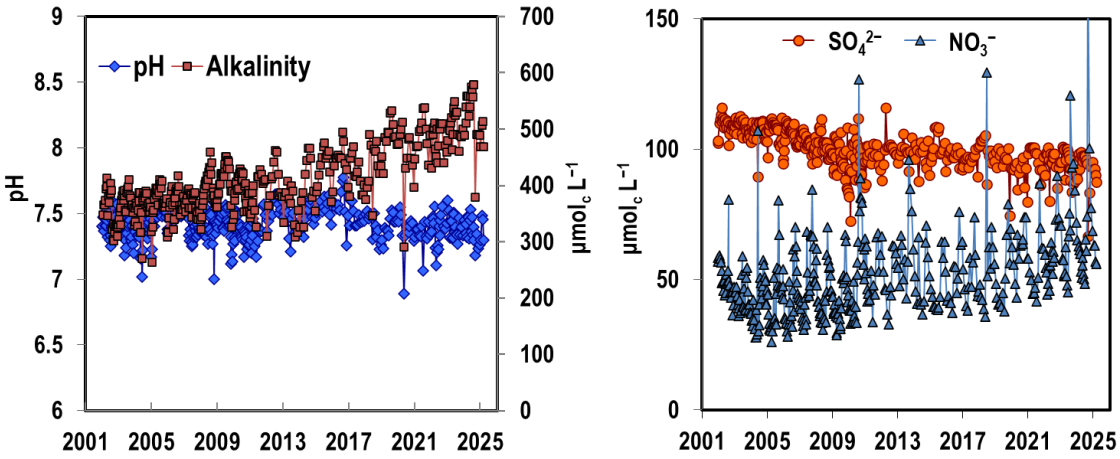


Fig. 2. Long-term changes in pH and alkalinity (left) and concentrations of SO_4^{2-} and NO_3^- (right). Modified from Sase et al. (2021).

2. Preliminary analytical results from relevant EANET catchment sites in Russia and Philippines

In Project Fund Activity 2025-01, the Institute of Global Change and Ecology (IGCE) in Russia and the Environmental Management Bureau (EMB) in the Philippines officially participated in the project as Co-Project Leads to promote the assessment of existing catchment-scale data in their respective countries. Accordingly, in addition to KJK and IJR, assessments of EANET monitoring data have been promoted for the Komarovka River catchment (KMR) and the Pereemnaya River catchment (PRN) in Russia, as well as the La Mesa Watershed (LMW) in the Philippines. Prior to STM26, the NC held two technical meetings with IGCE and EMB, respectively. The SAC member from the University of the Philippines Los Baños also contributed to the scientific discussions with EMB. Based on the discussions at the technical meetings, preliminary analytical results from these sites were presented at STM26 (Annex 1).

- Technical Meeting with IGCE for KMR and PRN: July 1 and August 19
- Technical Meeting with EMB: July 7 and August 18

3. Scientific insights from related studies at KJK and IJR

At KJK and IJR, related studies supported by external research grants, such as those from the Japan Society for the Promotion of Science (JSPS), have also been implemented in cooperation with the EANET Project Fund activities. The following scientific findings were obtained from these related studies.

1) Buffering system of seasonal acid deposition

Atmospheric sulfur deposition at KJK increases markedly during winter due to westerly seasonal winds. To clarify the buffering system that mitigates this seasonal acid load, vertical variations in the sulfur isotopic ratio ($\delta^{34}S$) of waters within the KJK forest catchment were examined. The $\delta^{34}S$ values of rainwater also increased during winter, indicating the presence of seasonally different sulfur sources. Although $\delta^{34}S$ values in rainwater—including rainfall (RF), throughfall (TF), and stemflow (SF)—showed pronounced seasonality, those in soil solutions and stream water were well homogenized (Fig. 3). This suggests that the large sulfur inputs during winter were rapidly buffered within the forest ecosystem. Because no clear evidence of biological fractionation was observed, the adsorption–desorption processes of SO_4^{2-} in soils were considered the primary buffering mechanism (Saito et al. 2023).

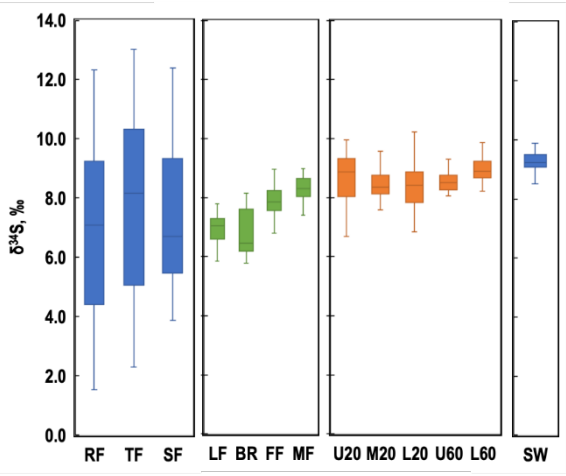


Fig. 3. Vertical changes in the sulfur isotopic ratio ($\delta^{34}S$) of rainfall outside forest canopy (RF), throughfall (TF), stemflow (SF), litterfall (leaf (LF), branch (BR), female flower (FF), and male flower (MF)), soil solutions (U20, M20, L20, U60, and L60), and stream water (SW) at the Kajikawa catchment (KJK). For soil solution, U, M, L indicate upper, middle, and lower slope positions, respectively and 20 and 60 indicate depths in cm. Modified from Saito et al. (2023).

Scientific paper containing the above findings:

Saito T, Nakata M, Yamashita N, Inomata Y, Uchiyama, S, Ohizumi, T, Sase, H. 2023. Vertical changes in sulfur isotopic ratio of water flowing through a forested catchment along the coast of the Sea of Japan in central Japan–a buffer against seasonal transboundary air pollution. *Journal*

of Forest Research 28:4, 240-250. https://doi.org/10.1080/13416979.2023.2198113

2) Possible mobilization of air-pollution legacy pools due to extreme weather events

Changes in stream concentrations of ionic constituents during rainfall events have been investigated at KJK and IJR to examine mobilization of air-pollution legacy pools from forest ecosystems. Isotopic analysis was applied to sulfur, water hydrogen and oxygen, and nitrate nitrogen and oxygen. At KJK, the fact that sulfur isotope ratios ($\delta^{34}S$) of river water remained stable during the events (Fig. 4) suggests that homogenized sulfur in soil solutions was primarily transported into the river water (Yotsuyanagi et al. 2024). At IJR, groundwater strongly influenced by rock-derived sulfur, with markedly lower $\delta^{34}S$ values (< −13‰), appears to contribute predominantly to river water. In contrast, most atmospheric-derived sulfur with higher $\delta^{34}S$ values (3–4‰) is retained and cycled within the soil–plant system (Sase et al. 2019). During rainfall events, the $\delta^{34}S$ values of SO_4^{2-} in river water increased significantly, suggesting the mobilization of air-pollution legacy sulfur. Such sudden discharges of SO_4^{2-} into river water may delay the recovery of forest ecosystems from acidification. These findings suggest that the effects of extreme weather events should be considered when evaluating recovery from acidification, particularly in historically high-deposition areas such as IJR. A scientific paper reporting these findings is currently being prepared for submission to an international journal.

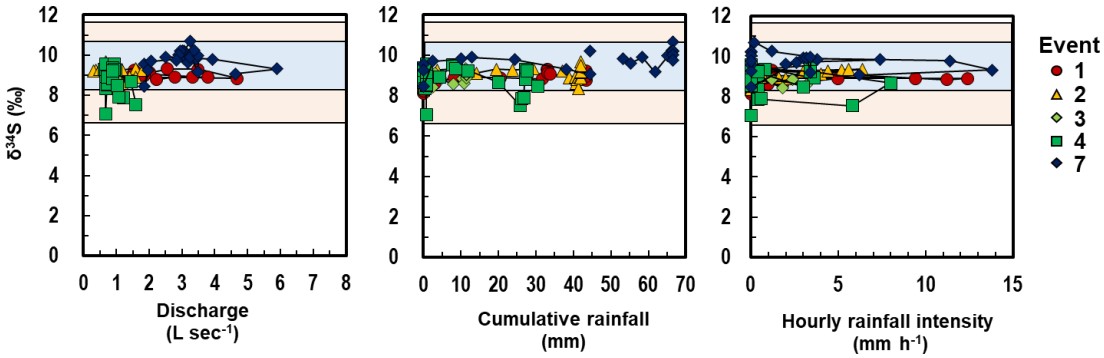


Fig. 4. Changes in $\delta^{34}S$ values of stream water with (a) discharge, (b) cumulative rainfall, and (c) hourly rainfall intensity. The shaded area shows the range of $\delta^{34}S$ values from August 2012 to November 2020 for stream water (SW: light blue) measured during the routine observations (Ministry of the Environment, 2019), and the range of the soil solution samples (SS: light orange) collected from 2012 to 2016 (Saito et al., 2023). Modified from Yotsuyanagi et al. (2024).

Scientific paper containing the above findings:

Yotsuyanagi, H., Morohashi, M., Takahashi, M., Ohizumi, T., Inomata, Y., Yabusaki, S., Tayasu, I., Okochi, H., Sase, H. 2024. Sulfate runoff processes during rainfall events in a small forested catchment on the Sea of Japan side recovering from acidification under climate change. *Hydrological Processes* 38(7), e15221. https://doi.org/10.1002/hyp.15221

3) Changes in concentrations of trace elements in rainwater at KJK

In addition to sulfur and nitrogen compounds, trace elements released into the atmosphere by human activities, such as fossil fuel combustion, enter forest ecosystems through wet and dry deposition and may subsequently be discharged via mountainous stream water. To obtain additional evidence of changes in regional air pollution, we investigated the concentrations of trace elements dissolved in precipitation and stream water at KJK. At the beginning of the observation period, Pb concentrations in rainwater showed distinct peaks mainly in winter or spring, and those in stream water were relatively high. However, these concentrations have rapidly decreased over the past eight years (Fig. 5). This study revealed that trace elements are transported to the Sea of Japan side in central Japan, particularly in winter, but that their quantity and composition change in response to variations in both local and transboundary air pollution (Morohashi et al. 2024).

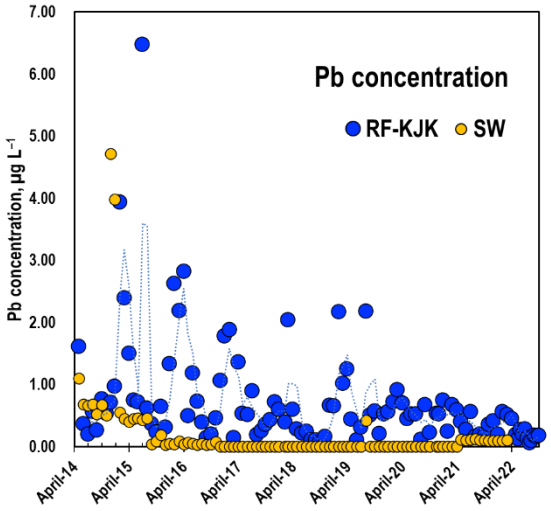


Fig. 5. Changes in monthly Pb concentration in rainwater (RF-KJK) and stream water (SW) at the Kajikawa catchment site. The dotted blue line shows a 3-month moving average. Modified from Morohashi et al. (2024).

Scientific paper containing the above findings:

Morohashi, M., Saito, T., Takahashi, M., Inomata, Y., Nakata, M., Ohno, M., Kose, T., Ohizumi, T., Shin, K-C., Tayasu, I., Sase, H. 2024. Variations of dissolved trace elements in precipitation and stream water in Japanese forest area: additional evidence of changing air pollution in the region. *Asian Journal of Atmospheric Environment* 18, 18. https://doi.org/10.1007/s44273-024-00040-1

4. Additional publications

Atmospheric nitrogen deposition data from EANET sites were analyzed together with the data collected by the research group of Institute of Applied Ecology, Chinese Academy of Sciences. A scientific paper on nitrogen deposition in Northeast Asia has been published in an international journal.

Mgelwa, AS, Zhu, F, Huang, D, Song, L, Wang, Y, Gurmesa, GA, Wang, A, Liu, M, Huang, S, Qiu Q, Sase, H, Zhu, W, Fang, Y 2024. Patterns and drivers of atmospheric inorganic nitrogen deposition in Northeast Asia. Journal of Environmental Management 349, 119343. https://doi.org/10.1016/j.jenvman.2023.119343

5. Presentation of scientific findings in scientific meetings

Several scientific outputs relevant to the project activity have been presented at the 10th International Conference on Acid Deposition, ACID RAIN 2020 – The Future Environment and Role of Multiple Air Pollutants, which was held in April 2023 in Niigata, Japan, after 3-year postponement due to COVID-19. The outputs presented there include:

Sase H et al. 2023. Reactions of forested catchments to changing sulfur deposition in different climatic zones in East Asia, ACID RAIN 2020 Proceedings, S6B-5 (oral), p. 71.

Yamashita N et al. 2023. Mapping critical loads and exceedances in the Southeast Asian tropics, ACID RAIN 2020 Proceedings, 39A-2 (oral), p. 180.

Morohashi M et al. 2023. Seasonal variations and trends of dissolved elements in rainfall and stream water in a small forest catchment area of central Japan, ACID RAIN 2020 Proceedings, P-45 (poster), p. 245.

Yotsuyanagi H et al. 2023. Characterization of sulfate runoff during rainfall events using isotope ratio analysis in a small catchment on the Sea of Japan side, ACID RAIN 2020 Proceedings, P-53 (poster), p. 253.

Saito T et al. 2023. Estimation of sulfur dynamics in a small forest catchment by isotopic ratio analysis in the Sea of Japan coastal area, ACID RAIN 2020 Proceedings, P-55 (poster), p. 255.

6. European experience of the regional assessment shared in the webinar (2023-07)

   A scientist from ICP Modelling and Mapping under CLRTAP was invited to introduce European experience of the regional assessment. The presentation topic was selected taking account of activities of the Project 2023-01.

7. Progress reported to SAC24

   Activities/findings were presented at SAC24 and SAC25.

Performance remarks and highlights:

1. Long-term datasets from KJK revealing improvements in the atmospheric environment of the region

   Both atmospheric sulfur deposition and nitrogen deposition in the forest area have been declining throughout the 2010s. Sulfur deposition appears to reflect regional SO_2 emissions, as non-sea-salt sulfur deposition shows two peaks around 2006 and 2012/2013 (Fig. 6). These patterns provide evidence of improvements in the atmospheric environment of the region.

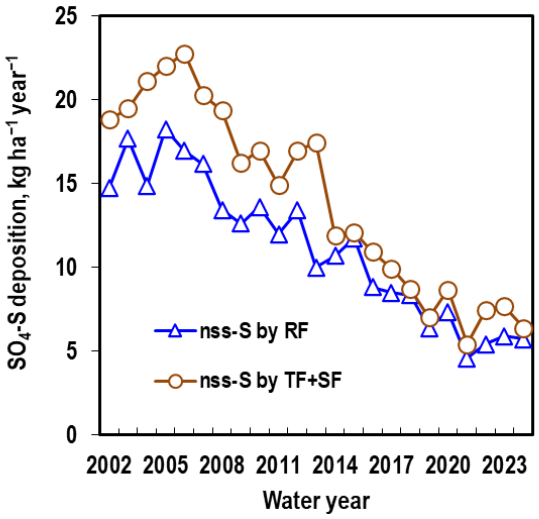


Fig. 6. Long-term changes in non-sea-salt (nss) sulfur deposition by rainfall outside forest canopy (RF) and throughfall and stemflow (TF + SF) at KJK. The water year is defined as June of one year through May of the following year. Modified from Sase et al. (2021).

2. Activated discussion on catchment-scale analysis in Russia and the Philippines
   Catchment-scale analysis is a useful approach for quantitatively and qualitatively examining the effects of atmospheric deposition on forest ecosystems. In Russia and the Philippines, relevant data have been accumulated through EANET monitoring. To accelerate the analysis of these data, the NC held two technical meetings with IGCE and EMB, respectively. These efforts were reported at STM26 along with preliminary assessment results. In addition, experts from IGCE and EMB were assigned as co-authors for the catchment-monitoring section of the periodic report, "*The 5th Periodic Report on the State of Atmospheric Environment in East Asia (PRSAE5)"*, which will be published in 2026. Consequently, scientific discussion on this topic has become highly active within the EANET community.

3. Scientific insights into ecosystem responses to changing atmospheric deposition
   The long-term monitoring data were assessed together with additional research data, providing scientific insights into ecosystem responses to changing atmospheric deposition. The key findings are as follows:
   - Stream water chemistry responded rapidly to declining atmospheric deposition, particularly with respect to SO_4^{2-} concentrations and alkalinity. However, the decrease in SO_4^{2-} concentrations in stream water was disproportionately small compared to that in sulfur deposition.
   - Isotope analysis suggests that atmospheric-derived sulfur is first retained or cycled within soil–plant systems and then gradually leaches into stream water. This process appears to cause time lags and weaken the correspondence between atmospheric inputs and ecosystem outputs.
   - During rainfall events, rainwater SO_4^{2-} does not directly flow into the stream. Instead, SO_4^{2-} retained or cycled within soil–plant systems appears to leach into stream water. In forest areas where sulfur has accumulated in soil, such as at IJR, this accumulated sulfur appears to be mobilized during rainfall events.
   - The research on trace elements also suggests improvements in regional air pollution. However, reductions in nitrogen deposition remain unclear in the region, as indicated

by assessments of other EANET data. Nitrogen deposition and its cycle in forest ecosystems should be monitored continuously.

Impacts/benefits achieved (for the final report, only):

1. Understanding of atmospheric deposition in forest area
   Emissions of SO_2 and NOx have already peaked and begun to decline in the region (Kurokawa and Ohara 2020). In fact, relevant wet-deposition and air-concentration data from many EANET sites indicate decreasing trends over the past decade. However, the actual conditions in forest areas could not be confirmed based solely on the regular monitoring data. The project has contributed to improving the understanding of atmospheric deposition in forest areas and the responses of forest ecosystems to changing atmospheric deposition.

2. Establishment and dissemination of monitoring methodologies
   KJK was originally established as a case study site for conducting methodological studies on catchment-scale analysis. Experience gained at KJK contributed to the preparation of the technical document "*Guideline for Catchment-scale Monitoring in East Asia*," which was adopted at SAC10. Based on this guideline, catchment-scale analysis has been promoted in Japan, Russia, and the Philippines, either as part of regular EANET monitoring or through project-based research. KJK data has played a key role as a reference for these efforts. Even after KJK was closed, regular catchment-scale monitoring at IJR and LMW, as well as catchment-scale analysis of EANET inland water data at sites such as KMR and PRN, is expected to continue in order to better understand the effects of atmospheric deposition on forest ecosystems.

3. Identification of future directions
   The EANET was established as a monitoring network for acid deposition. Data from KJK has contributed to understanding acid deposition in forest areas and its effects on ecosystems, particularly the dynamics of sulfur derived from atmospheric deposition. However, as shown in Figs. 1 and 2, the reduction in DIN deposition has been relatively slow, and NO_3^- concentrations in stream water are still increasing. This fact suggests that nitrogen deposition and its biogeochemical cycles should be considered an important

scientific focus for the next phase. A shift from sulfur to nitrogen as the key issue is underway. The Medium-Term Plan (2026–2030) recommends strengthening nitrogen management by expanding monitoring and assessment of NOx, NH_3, and their ionic species, with particular emphasis on their atmospheric concentrations, deposition, and ecological impacts.

Challenges and management actions:

- The full 23-year monitoring dataset has been accumulated at KJK since 2002. However, regular field surveys at KJK were completed in 2025 June, and continuation of the regular surveys thereafter was not possible due to the budget constraints.
- All samplers installed within the forest at KJK were successfully removed. The cost of removing the samplers was borne by the NC.

Budget Expenditure:

Name of Activities	Budget (Financial and in-kind)	Expenditure	Balance
Field surveys at KJK (sampling and maintenance of the instruments)	25,000 (for 2023)/ 26,909 (for 2024)/ 28,000 (for 2025) 79,909 (for three years)	25,000 (for 2023)/ 26,909 (for 2024)/ 61,356 (for 2025): 113,265 (for three years)	−33,356
Laboratory analysis of KJK samples	10,000 (for 2023)/ 6,291 (for 2024)/ 6,200 (for 2025) 22,491 (for three years)	10,000 (for 2023)/ 6,291 (for 2024)/ 6,200 (for 2025) 22,491 (for three years)	0
(Intensive surveys, conference fees, and travel costs) In-kind: JSPS grants	38,000 (for JFY2023)/ 30,000 (for JFY2024)/ 24,000 (for JFY2025) 92,000 (for three years)	38,000 (for JFY2023)/ 30,000 (for JFY2024)/ 24,000 (for JFY2025) 92,000 (for three years)	0
Data analysis for KJK, IJR and other Japanese national sites	10,000 (for 2023)/ 6,000 (for 2024)/ 3,000 (for 2025) 19,000 (for three years)	10,000 (for 2023)/ 6,000 (for 2024)/ 3,000 (for 2025) 19,000 (for three years)	0
Data analysis for EANET sites	In-kind from Co-Project Lead, human resources for data assessment	In-kind from Co-Project Lead, human resources for data assessment	
Discussion on regional impact assessments as a methodological study	10,000(for 2023)/ 6,000 (for 2024)/ 2,000 (for 2025) 18,000 (for three years)	10,000(for 2023)/ 6,000 (for 2024)/ 2,000 (for 2025) 18,000 (for three years)	0
Publication and conference presentation	5,000 (for 2023)/ 2,100 (for 2024)/ 2,100 (for 2025) 9,200 (for three years)	5,000 (for 2023)/ 2,100 (for 2024)/ 2,100 (for 2025) 9,200 (for three years)	0
Removing the samplers from the forest at KJK (additional contribution from the NC)	*33,356*		*33,356*
Total	98,000 USD (for 2023) 77,300 USD (for 2024) 65,300 USD (for 2025 approved) *33,356USD (for 2025, additional contribution from the NC)* 273,956 (for three years)	98,000 USD (for 2023) 77,300 USD (for 2024) 98,656 USD (for 2025) 273,956 (for three years)	0

Signatures:

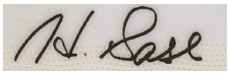
Name and title of the responsible person:

Dr. Hiroyuki Sase, Head of the Ecological Impact Research Department, Asia Center for Air Pollution Research (ACAP)

_____

Name of Project Lead (PL)

organization: Network Center for the EANET, Asia Center for Air Pollution Research

Signature  Date 30 March 2026

Name and title of the Secretariat for the EANET: Ms. Yujeong Kim, Senior Programme Management Officer, UNEP, and Ad Interim Coordinator, Secretariat for the EANET

Yujeong Kim

Signature_____ Date 30 March 2026

PROJECT COMPLETION REPORT 2025-12

General Information

Project Title	Fellowship for building leadership in Atmospheric Environment and Air Quality Management in East Asia
Agreement start/end date	January 2024 – December 2025
Reporting period	January 2024 – December 2025
Location of Activities (Cities, Countries)	Niigata (Japan), Shanghai (China)
Project Lead (PL)	Network Center for EANET, Fudan University, China
Partner organizations (POs)	Clean Air Asia, China
Project Lead Contact Details (including address, telephone, and email address)	Dr. Meihua ZHU Department Head, Planning and Training Department, Asia Center for Air Pollution Research, Postal address: Sowa 1182, Nishi-ku, Niigata City, Japan Telephone: +81-25-263-0556 Email address: mhzhu@acap.asia] Prof. Xu TANG Executive Director, IRDR International Center of Excellence on Risk Interconnectivity and Governance on Weather/Climate Extremes, Atmospheric Environment Impact and Public Health (FDU-IRDR ICoE-RIGWCEIPH) Jiangwan Campus, Fudan University, Office Phone Number: +86-21-31248855 5028-2, Environment Science Building, 2005 Songhu Road, Yangpu District Shanghai 200438, China

Background Information (maximum one page):

Since 200, the EANET Research Fellowship Program has successfully enhanced the individual technical competencies of 30 researchers. However, a strategic evaluation identified a critical need to transition from isolated technical training toward a focus on "generational change." By fostering a community of leaders rather than just skilled technicians, EANET mitigates the risk of institutional memory loss as senior members retire and ensures the long-term sustainability of the network. This shift toward leadership development allows for the translation of scientific data into strategic organizational achievements across national borders.

Core Objectives

- Capacity Enhancement: Strengthening the research and management capabilities of young officers and researchers in EANET participating countries.
- Science-Based Policy: Promoting the interlinkage between rigorous atmospheric science and effective environmental policy-making.
- Leadership Potential: Cultivating the ability of participants to take active leadership roles and initiatives within the future EANET framework.
- Interdisciplinary Cooperation: Enhancing collaboration between academia and government sectors to address comprehensive regional problems.
- Integrated Platform: Providing a collaborative space for the next generation to engage in diversified discussions and reflection beyond their national borders.These objectives were operationalized through a hybrid mechanism: five months of remote, supervised research followed by a two-week intensive on-site residency at Fudan University and ACAP, ensuring deep mentorship while maintaining cost-efficiency.

Activity/deliverable summary (maximum two pages):

The project's "Hybrid Approach" was a strategic choice designed to maximize limited budgets while ensuring deep expert mentorship. This model allowed for sustained engagement between the fellows and their supervisors in China and Japan, transcending the limitations of traditional short-term training.

Implementation Milestones

- Selection & Kick-off (Q1-Q2 2024): Rigorous selection based on nominations from National Focal Points and demonstrated leadership potential.
- Hybrid Mentorship (May – Sept): Monthly online progress meetings between fellows and supervisors at Fudan University and ACAP.
- Intensive On-site Guidance (Oct): Concentrated technical residency in Shanghai and Niigata to finalize research themes and modeling.
- Final Reporting (Nov 2025): Completion of comprehensive research dossiers and policy recommendation papers.

Thematic Alignment of Research

The research topics were meticulously mapped to the five "Thinkable Themes" established in the project proposal to ensure alignment with EANET's strategic scope.

Research Fellows Summary Table in 2024

Fellow	Country	Research Topic	Primary EANET Theme
Prawira Yudha Kombara	Indonesia	Effect of anabatic and katabatic winds on $PM_{2.5}$ dispersion and concentration in the Bandung Basin using the WRF-Chem model. 1	Methodology development on simulation and modeling / Air quality modeling 1
Norazura Binti Zakaria	Malaysia	Long-term trends of wet and dry acid deposition in Malaysia and assessment of the impacts of forest-fire haze using ground observations and satellite data. 1	Acid deposition monitoring and assessment 1
Ei Ei Htwe	Myanmar	Overview and assessment of air quality in Yangon City using AQI and $PM_{2.5}$ monitoring data to improve public awareness and air pollution management. 1	Air quality monitoring and data analysis 1
Wyona Kay Castillo Rativo	Philippines	Identification of potential EANET monitoring sites based on ground-level SO_2 concentrations from solid fuel-fired boiler emissions using GIS and air-dispersion modeling. 1	Air quality management and monitoring network development 1
Ekaterina Zhigacheva	Russia	Estimation of acidifying compound runoff in the Pereemnaya River catchment and evaluation of acidification processes using EANET monitoring data. 1	Acid deposition and ecosystem impact assessment 1

Research Fellows Summary Table in 2025

Fellow	Country	Research Topic	Primary EANET Theme
Annisa Zahara	Indonesia	Temporal behavior of $PM_{2.5}$ and external source contributions in Jakarta using WRF-Chem.	Data analysis
Tran Minh Son	Viet Nam	Development of a Smart City Air Quality Management Score (AQMS) via AHP/DPSIR.	Policy and management
Bounmany Soulideth	Lao PDR	Source analysis using EANET observational data and NOAA-20 satellite fire hotspot imagery.	Air quality monitoring
Barkhasracghaa Baldorj	Mongolia	Economic burden of air pollution-related mortality using GAINS-Asia and VSL metrics.	Methodology development on simulation and modeling, emission inventory, health impact and others
Noor Azam Bin Shaari	Malaysia	Validation of the Copernicus Atmosphere Monitoring Service (CAMS) with Ground Observation and Satellite Data for the Malaysian Region	Air quality monitoring

Performance remarks and highlights (maximum two pages):

The EANET Fellowship Program in 2024 and 2025 strengthened scientific and technical capacity among member countries through research on air quality, acid deposition, atmospheric modeling, monitoring technologies, and policy assessment. The fellowship projects generated practical knowledge and innovative approaches to support evidence-based environmental management and regional cooperation in East Asia.

<u>Summary of 2024 Fellows</u>

Indonesia – Prawira Yudha Kombara

Investigated the influence of local mountain–valley winds on $PM_{2.5}$ dispersion in the Bandung Basin using the WRF-Chem model.

- ✧ Evaluated seasonal pollutant transport under complex terrain conditions.
- ✧ Improved understanding of local circulation effects on air quality and monitoring strategies.

Malaysia – Norazura Binti Zakaria

Analyzed long-term trends in wet and dry acid deposition and the impacts of transboundary haze.

- ✧ Combined ground monitoring and satellite observations.
- ✧ Supported national acid deposition assessment and policy development.

Myanmar – Ei Ei Htwe

Assessed air quality conditions in Yangon using $PM_{2.5}$ and AQI data.

- ✧ Identified key urban pollution sources.
- ✧ Promoted public awareness and air quality management capacity.

Philippines – Wyona Kay Castillo Rativo

Evaluated potential EANET monitoring sites using SO_2 concentration analysis and dispersion modeling.

- ✧ Applied GIS and air quality modeling techniques.
- ✧ Provided baseline information for future monitoring network expansion.

Russia – Ekaterina Zhigacheva

Studied acidifying compound runoff in the Pereemnaya River catchment.

- ✧ Applied a catchment-scale approach linking atmospheric deposition and ecosystem impacts.
- ✧ Strengthened inland aquatic monitoring and acidification assessment.





Summary of 2025 Fellows

Indonesia – Annisa Zahara

Examined temporal $PM_{2.5}$ behavior in Jakarta using monitoring and atmospheric models.

- ✧ Validated low-cost sensors for air quality assessment.
- ✧ Identified significant contributions from external pollution sources, highlighting the need for regional mitigation efforts.

Vietnam – Tran Minh Son

Developed a Smart City Air Quality Management Score for Ho Chi Minh City.

- ✧ Applied AHP and DPSIR frameworks to create a management indicator system.
- ✧ Proposed a replicable governance model for other EANET cities.

Lao PDR – Bounmany Soulideth

Analyzed $PM_{2.5}$ source contributions using EANET and satellite hotspot data.

- ✧ Confirmed the influence of biomass burning on pollution episodes.
- ✧ Proposed expansion of the approach to the Mekong sub-region.

Mongolia – Barkhasracghaa Baldorj

Estimated the economic burden of air pollution in Ulaanbaatar.

- ✧ Applied mortality and economic valuation methodologies.
- ✧ Demonstrated potential economic benefits of stricter air quality policies.

Malaysia – Noor Azam Bin Shaari

Validated CAMS $PM_{2.5}$ forecasts using ground observations and machine learning.

- ✧ Improved forecast accuracy through bias correction techniques.
- ✧ Demonstrated strong potential for operational air quality forecasting in Southeast Asia.





Impacts/benefits achieved (for the final report, only) (maximum two pages):

The 2024–2025 Fellowship Programs demonstrated a clear progression in both scientific scope and technical sophistication across EANET member countries. While the 2024 fellows primarily focused on strengthening fundamental capacities in air quality assessment, acid deposition monitoring, atmospheric modeling, and ecosystem studies, the 2025 fellows advanced these efforts through the application of high-resolution modeling, machine learning, economic valuation, source apportionment, and policy-oriented analytical frameworks.

Key achievements include improved understanding of $PM_{2.5}$ transport and dispersion processes, enhanced assessment of acid deposition and ecosystem impacts, development of innovative monitoring and forecasting approaches, and the introduction of practical tools for air quality governance and policy evaluation. Several projects also highlighted the growing importance of integrating satellite observations, ground-based monitoring, and advanced analytical methods to address transboundary air pollution challenges in East Asia.

Collectively, the fellowship projects strengthened the scientific use of EANET data, fostered regional collaboration, and provided evidence-based knowledge to support air quality management, environmental policy development, and sustainable atmospheric environmental protection across the region. The outcomes demonstrate the Fellowship Program's continuing role as an effective platform for developing future leaders and promoting innovative solutions to regional air pollution issues.

Challenges and management actions (maximum one page):

The project's resilience was tested by technical and methodological hurdles, which were resolved through proactive management:

- Data Gaps and Resource Constraints: In Lao PDR, limited computational resources and local emission inventories for non-biomass sources were identified.
- Management Action: The project prioritized the "Laos model" utilizing accessible satellite data while establishing a phased roadmap for future modeling as local inventories mature.

- Methodological Complexity and Rigor: In Viet Nam, the initial scope involving 13 countries was found to be incompatible with the rigorous mathematical requirements of the AHP methodology.
- Management Action (Success Story): To preserve scientific integrity, a "Methodological Recalibration" was executed, downscaling the focus to a high-resolution study of Ho Chi Minh City. This recalibration ensured a mathematically acceptable Consistency Ratio (CR) and turned a potential scoping failure into a risk-mitigation success story.
- Data Scalability and Computational Constraints in Model Development: In Malaysia, the integration of high-resolution CAMS datasets with machine learning models generated extremely large data volumes, posing challenges for processing efficiency and model training. To address this, the project adopted a phased and focused approach by limiting the initial scope to $PM_{2.5}$ and a three-month training period, while prioritizing ground-based validation for operational relevance. This ensured manageable computation, maintained methodological rigor, and established a scalable foundation for future expansion to longer timeframes and multiple pollutants.

Budget Expenditure (maximum two pages):

Budget and Expenditure in 2024

Name of Activities		**Budget (financial and in-kind)**	**Expenditure**	**In-balance**
Direct Expenses	Travel cost/person	8,000	8,000	0
	Accommodation, Transportation, Daily Subsistence Allowance (DSA), and others	18,000 in Japan	18,000	0
		18,000 Fudan Univ in China 6,000 Clean Air Asia in China	24,000	0
Personnel cost/person	the NC for the EANET	24,000 (4man/month)	24,000	0
	Fudan University, China	24,000 (4man/month)	24,000	0
Project Fund Holder Fee		3,000	3,000	0
Total		101,000	101,000	0

Budget and Expenditure in 2025

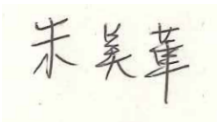
Name of Activities	**Budget (financial and in-kind)**	**Expenditure**	**Balance**
3) Direct Expenses			
Travel cost	7,000	7,000	0
For the program in Japan: Accommodation, Transportation, Daily Subsistence Allowance (DSA), and others	16,000	11,827	4,173
For the program in China: Accommodation, Transportation, Daily Subsistence Allowance (DSA), and others	16,000	16,000	
4) Personnel costs			
The NC for the EANET	21,000	21,000	0
Fudan University, China	23,000	23,000	0
Project Fund Holder Fee	3,000	3,000	0
Total	**86,000**	**81,827**	**4,173**

Signatures:

Name and title of the responsible person:
Dr. Meihua ZHU,
Department Head, Planning and Training Department,
Asia Center for Air Pollution Research

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Name of Project Lead (PL) Dr. Meihua ZHU
organization: Planning and Training Department, Asia Center for Air Pollution Research

Signature  Date 30 March 2026

Name and title of the Secretariat for the EANET: Ms. Yujeong Kim, Senior Programme Management Officer, UNEP, and Ad Interim Coordinator, Secretariat for the EANET

Signature Yujeong Kim Date 30 March 2026