

**Strategy Paper for
Future Direction of Soil, Vegetation and related Ecosystems Monitoring of EANET
(2009 - 2014)**

**Drafted by the Task Force on Soil and Vegetation Monitoring of EANET
Adopted by the Scientific Advisory Committee of EANET at its Eighth Session**

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I. Introduction

1. *The Strategy Paper for Future Direction of Soil and Vegetation Monitoring of EANET* was endorsed by the Scientific Advisory Committee at its 2nd Session (SAC2) in November 2002 in Bangkok, Thailand, with a few modifications to the final draft developed by the Task Force on Soil and Vegetation Monitoring. The Task Force has been promoting activities in line with the *Strategy Paper*, and the Network Center for EANET (NC) has been supporting their activities as the secretariat of the Task Force.
2. The previous *Strategy Paper* mostly covers important issues on ecological impacts of acid deposition. However, it was developed in 2002, and some information were out of date. Several activities described in the *Strategy Paper* have already been finished as milestones of the last five years. New milestones should be considered for the coming years.
3. Moreover, the “Strategy on EANET Development (2006-2010) (EANET/IG 8/7/1 rev)” was adopted by the Intergovernmental Meeting at its 8th Session in November 2006, as the overall strategy of EANET activities. The Strategy on EANET Development (2006-2010) included several activities related to ecological impacts. Description of the *Strategy Paper* should be modified in line with directions of the Strategy on EANET Development (2006-2010).
4. Taking the situation above into account, SAC decided to start the review and revision of the *Strategy Paper* at its 7th Session. As a benefit of the revision, more clear directions with wider vision can be shown in the *Strategy Paper* reflecting the current situation of EANET and the latest scientific information. Moreover, this revision will allow the *Strategy Paper* to show clear direction for implementation of activities described in the Strategy on EANET Development (2006-2010).
5. The revised Strategy Paper directly contributes to the “activity No. (6) *Review of Strategy Paper for future direction of soil and vegetation monitoring*” in the Strategy on EANET Development (2006-2010).

II. Objectives of soil and vegetation monitoring of EANET

II-1. Initial objectives of soil and vegetation monitoring

6. The initial objectives, “establishment of baseline data” and “early detection of

possible impacts” described in the Guidelines for Acid Deposition Monitoring in East Asia (2000) and Technical Manual for Soil and Vegetation Monitoring in East Asia (2nd ISAG, 2000) can be interpreted as follows.

7. Establishment of baseline data is to describe the present status on soil and forest vegetation by the basic survey, which was described in chapter 2 of the Technical Manual. As the baseline data, the following data should be accumulated:
 - Chemical properties of soil
 - Growth of trees (by description of trees)
 - Species composition of understory vegetation
 The basic survey should consider climatic zones in the participating countries.

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

II-2. The long-term objective of soil and vegetation monitoring

9. The long-term objective is “To assess impact of acid deposition on terrestrial ecosystem in a comprehensive and systematic manner through development and maintenance of a good quality database”.

10. The long-term objective of soil and vegetation monitoring can be achieved by evaluating spatially and temporally, the impacts of acid deposition on terrestrial ecosystem in the East Asian region with understanding the processes (mechanisms) in the ecosystems that are related to acid deposition.

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

III. Issues to be implemented to achieve the objectives

III-1. Issues for the initial objectives

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

Promotion of continuous monitoring:

12. Accumulation of the data on soil and forest vegetation is the first step for establishment of the baseline data, and the monitoring in the current sites should be carried out continuously at least every 3-5 years interval for soil chemical properties and general description of the forest. Protection/conservation of the monitoring site is important so that long-term data could be accumulated over several decades.
13. Financial and human resources in the respective countries are essential for continuous monitoring. Countries should make an effort to source funds from both national and international organizations. Networking and capacity building of relevant experts should also be promoted to accumulate human resources at both national and regional levels.

Improvement of monitoring system:

14. The number and location of monitoring sites should be reviewed considering climatic zones and the concept of the multi-stage sampling. Monitoring sites should be established systematically even though the numerous monitoring sites could not be established on small grids.
15. The East Asian region is a latitudinally wide area and consists of varied climatic zones. It can be recommended that one area at least should be selected for representative climatic zones in the respective countries. For each area, two types of soil are selected if possible, and plots and subplots are established according to the multi-stage sampling system on soil monitoring.
16. Support by experts on soil and forest vegetation is essential for the monitoring, and such experts should be involved continuously. In most participating countries of EANET, one expert may not be able to complete all work involved in soil, forest vegetation and ecosystems monitoring, and therefore needs cooperation with other experts. The continuous involvement of these experts in the monitoring activities, and establishment of an appropriate system for regular reporting to a national committee involving relevant agencies involved in EANET activities should be considered.

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

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

General information of tree decline symptoms in the participating countries:

18. Prior to discussion of acid deposition impacts, general information of tree decline symptoms should be accumulated; where, from when, which tree species, how decline, etc. A questionnaire survey with a standard reporting form should be carried out to draw a rough sketch of tree decline symptoms in the EANET participating countries.

Ozone concentration in forest area and its effects:

19. High concentrations of ozone have become one of the hot topics in the East Asian region due to increase in concentrations of its precursors, such as NO_x. Effects of ozone on vegetation should be discussed with those of acid substances, since ozone formation in the troposphere is closely related to other air pollutants. To evaluate effects of acid substances precisely, effects of ozone on vegetation should also be considered.
20. The data of ozone concentration in forest area is very limited in the East Asian countries. Ozone concentrations could be measured in forest area by using less-expensive methods, such as passive samplers. The passive samplers may be suitable for forest area since electric supply is not necessary for the measurement. The methods described in the Sub-Manual can be referred for use of the passive samplers.
21. Assessment of ozone visible injury by field observation or microscopic observation may be the next step. Information of possible visible injury should be accumulated. A case study or trial campaign for measurement of ozone concentrations using the passive samplers and assessment of ozone visible injury should be promoted. The areas where tree decline symptoms were reported may be likely candidates for the case study.

22. Further steps for assessment of ozone effects should be considered taking progress in other regions such as Europe and US into account. Effects on crops should also be discussed in future. Moreover, critical levels using AOT40 or ozone flux should be discussed with relevant EANET bodies, such as Task Force on Air Quality Monitoring and Dry Deposition and its Expert Group on Dry Deposition Flux Estimation.

Compilation of information on early detection:

23. Procedures to collect information on plant sensitivities and dose-response relationship should be discussed. Information on epiphytic plant species, such as mosses and lichens, should also be collected since they have been used as indicators of air pollution including acid deposition. The Sub-Manual can provide possible methodologies to collect the information on lichens. Practical solutions to utilize such methodologies should be discussed in coming years. It should be discussed to collect basic information on fauna (e.g. forest insects).
24. Use of high technologies for early detection should also be considered besides field observations. New instrumental analyses such as imaging of “delayed luminescence” may be useful to detect invisible influence on plants by environmental stresses. Such a technique may detect the influence before inhibition/reduction of plant growth.

III-2. Issues for the long-term objective

Promotion of case studies in reference catchment areas and establishment of the monitoring guideline/manual on ecosystem analysis:

25. The case studies started in several reference catchment areas by the NC in cooperation with some participating countries is the first step. Elemental budget and biogeochemical processes have been discussed in the study catchments to evaluate effects of acid deposition in the forest ecosystems. This kind of comprehensive studies should be promoted in the East Asian region by obtaining competitive research grants.
26. Experience and knowledge gained from the use of new techniques in these studies will be accumulated for the future monitoring. Development of the guideline for the catchment monitoring should be discussed based on the information above. With accumulation of experience in developing the guideline, a more practical technical manual for the catchment monitoring should be developed in future.

27. The case studies should be promoted taking regional variability of climate and ecosystems into account. Possibility of new case study sites should also be considered in other countries. Efforts should be made by the NC and the countries to source funds and manpower for the case studies.

Catchment analysis and simulation modeling on soil and inland water acidification:

28. Based on the elemental budget and biogeochemical process in the study catchments, possible impacts of acid loads resulting from atmospheric deposition should be evaluated. Disturbance of biogeochemical processes due to atmospheric deposition, including “nitrogen saturation”, is also one of issues to be evaluated.
29. Simulation model on soil and/or inland water acidification should be developed based on the catchment analysis above. Changes in chemical properties in the acidification process should be simulated in the model. Simulation modeling may help us evaluate the current situation of the ecosystems. A common simulation model applicable for the diverse ecosystems in the East Asian region is highly desired. Trends of soil and/or inland water acidification should also be predicted in future.
30. In the future simulation model, direct effects of acid deposition/air pollution on plants and effects on fauna should also be taken into account.
31. The quality of inland waters is being measured at several sites under the inland aquatic environment monitoring (IAEM) program of EANET. The technical manual for IAEM is being revised by the Expert Group on Revision of the Technical Manual for IAEM. In the revised technical manual, importance of rivers/streams and their catchments is expected to be further highlighted. Practical collaboration with the Expert Group may be important to promote the catchment monitoring.

Identification of “hot spots” areas susceptible to acid deposition

32. Areas or regions susceptible to acid deposition should be identified. To identify such areas/regions, several steps can be considered taking the issues above into account:
 - Literature studies on maps, such as soil maps, geological maps, and vegetation maps
 - Compilation of the data on soil chemical properties by the regular EANET basic survey
 - Compilation of information on tree decline symptoms
 - Assessment of ozone concentration levels in certain forest areas
 - Evaluation of elemental budgets and acid loads in the reference study

catchments

33. Regional assessment of possible impacts on ecosystems requires spatial data on atmospheric deposition. Emission inventory and numerical model on transport and chemical processes in the atmosphere are essential for this work. Further steps should be discussed in the EANET community according to the Strategy on EANET Development (2006-2010).

Up-scaling of the monitoring data and spatial evaluation

34. For spatial evaluation towards the long-term objective, up scaling of the monitoring data should be discussed as the next step. Use of the following methodologies should be discussed.
35. Based on the data in the basic survey and the catchment analysis, the condition of the region should be estimated by the appropriate spatial modeling, and then described on a map of the region. Regional data on atmospheric deposition may also be required for the evaluation.
36. Remote sensing technology may be helpful to describe the present condition on forest decline based on the data from the basic survey. The Sub-Manual can provide possible methodologies to utilize remote sensing technology. Practical solutions to utilize such methodologies should be discussed in coming years.

IV. Collaboration with relevant networks/organizations

37. The progress of other initiatives in the Asian region related to air pollution/acid deposition may be useful to EANET soil and vegetation monitoring such as Long-range Transboundary Air Pollution in Northeast Asia (LTP) Project, Male Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia, etc. As for LTP Project, an expert meeting is held annually to share the information on the monitoring and modeling activities of the countries concerned. As for the Male Declaration, monitoring activities based on the action plan and establishment of the databases are promoted in each country. In the relevant fields such as forest science, a network on teak forests has been established.
38. In Europe and the North America, much experience has been accumulated. In particular, the Working Group on Effects (WGE) and its International Co-operative Programmes (e.g. ICP Forests, ICP Vegetation, ICP Integrated Monitoring, etc.)

under the CLRTAP (Convention on Long-range Transboundary Air Pollution) in Europe can provide much useful information for the East Asian activities, including its existing monitoring manual for UNECE region.

39. In the research field, the International Union of Forest Research Organization (IUFRO) and International Long-Term Ecological Research Network (ILTER) may have the latest scientific information on forest ecosystems. As for IUFRO, Unit 7.01.00, “Impacts of air pollution and climate change on forest ecosystems” may have relevant information. As for ILTER, collaboration with their national networks, such as Japan LTER network (JaLTER), can also be considered.
40. Collaboration with these relevant networks/organizations should be promoted for future development of the EANET activities.

V. Overall strategy

41. The overall strategy to achieve the initial and long-term objective described above can be described as shown in Figure 1.
42. The initial objective is to describe the present status on soil and vegetation in the East Asian region, and it can also be one of steps toward the long-term objective.
43. For the long-term objective, another approach should also be promoted, especially for description of present status on ecosystem. To achieve these steps, some issues, such as promotion of catchment analysis and modeling, should be implemented.
44. Then, up scaling of these data should be discussed for spatial evaluation of impacts of acid deposition in the East Asian region.

VI. Roadmap and milestones

45. For the coming six years, from 2009 to 2014, the following is proposed as a roadmap with some milestones.
 - i. *Promotion of continuous monitoring*
46. Continuous efforts should be made for the long-term monitoring in each country. Measurement of soil chemical properties and general description of the forest should

be conducted periodically at least every 3 – 5 years. The Task Force and the NC will make efforts to support the countries on technical aspects.

ii. Improvement of monitoring system

47. Continuous efforts should be made for improvement of the monitoring system in each country. The number and locations of the monitoring sites should be reviewed taking the climatic zones into account. The Task Force and the NC will make efforts to support the countries on technical aspects.

iii. Compilation of the list of experts on ecological impacts in the respective countries

48. Involvement of experts on ecological impacts in the respective countries is essential for continuous monitoring and improvement of monitoring system. The NC will make effort to compile a list of the relevant experts in the participating countries and update the list annually. The list should be shared by the network for future regional collaboration.

iv. Promotion of capacity building activities

49. Capacity building of fieldwork/analytical staff is also essential for continuous monitoring. Continuous efforts should be made to promote the capacity building activities. Technical workshops on ecological impacts may be a good opportunity to share the information. Utilization of PhD programs or fellowship programs may also be effective to improve their research abilities.

v. Development of the guidelines and methods for the catchment monitoring

50. Scientists working for the catchment analysis in the EANET community are expected to acquire experience from the joint studies in reference catchment areas for development of monitoring guidelines and methods for catchment monitoring in the future based on their experience: The recommendations from the scientists are expected to be submitted to the Task Force to formulate the guideline: 2008/2009.
51. The Task Force will prepare the final draft: 2008/2009 – autumn 2010.
52. The guideline is expected to be endorsed by SAC at its 10th Session: autumn 2010.
53. This work contributes to the “activity No. (7) *Promotion of the future catchment*”

monitoring” in the Strategy on EANET Development (2006-2010).

vi. *Identification of the areas susceptible to acid deposition*

54. Literature studies will be carried out by members of the Task Force utilizing soil maps, geological maps, and vegetation maps in the East Asian region. The distribution of sensitive soils, acidic rocks, and sensitive tree species will be visualized on the regional map: 2008 -
55. The data on soil chemical properties by the regular EANET basic survey will be compiled and compared with the maps above: 2009 -
56. A standard reporting form for tree decline symptoms will be prepared by members of the Task Force. A questionnaire survey will be implemented to draw a rough sketch of tree decline symptoms in the EANET participating countries: 2009-2010.
57. The areas susceptible to acid deposition are expected to be visualized on the regional map(s). This map will be the initial map for further elaboration: 2010.
58. This work contributes to the “activity No. (8) *Evaluation of monitoring data with application of approach for assessment of impacts*” in the Strategy on EANET Development (2006-2010).
59. The map(s) above will be updated with other relevant information, such as ozone concentrations in certain forest areas, catchment analysis in several reference study catchments, regional modeling of atmospheric deposition, etc. The distribution of “hot spots” is expected to be identified.

vii. *Trial campaign for measurement of ozone concentration in forest area and its effects*

60. Detailed items and procedures on the trial campaign will be prepared by members of Task Force: 2010 -
61. The Task Force and the NC will make efforts to obtain competitive research grants for the campaign to purchase passive samplers and to hold necessary meetings: 2009 -
62. Trial campaign for measurement of ozone concentrations using the passive samplers and assessment of ozone visible injury will be implemented in certain forest areas on

voluntary basis by the EANET national centers: 2011 - 2014

63. Prior to the campaign, voluntary inputs from the EANET participating countries are highly welcomed for the information on ozone concentration in forest area and its effects.
64. The information obtained through the campaign is expected to be compiled for identification of “hot spots”, too: 2014.
65. This work may partly contribute to update of the “activity No. (4) *Consideration on possible application of less expensive methods of monitoring including passive samplers*” in the Strategy on EANET Development (2006-2010).
66. Implementation of this work depends on availability of the budget from some competitive research grants or donor agencies.
 - viii. *Promotion of catchment analysis and simulation modeling on soil and inland water*
67. Catchment analysis in existing study sites is expected to be promoted in the case study catchments utilizing the competitive research grants in cooperation with relevant organizations/agencies in the EANET participating countries: 2008 – 2010.
68. Simulation modeling on soil and inland water is also expected to be promoted in the case study catchments utilizing the competitive research grants: 2008 – 2010.
69. Efforts should be made to obtain competitive research grants for further promotion of the catchment analysis and simulation modeling on soil and inland water.
 - ix. *Evaluation of the ecological monitoring data for the next periodic report on the state of acid deposition in East Asia*
70. The regional monitoring data on soil, vegetation, and related ecosystems should be evaluated by the members of the Task Force as their contribution to the next periodic report. Prior to the regional assessment, the evaluation of the data on the national levels should be promoted. Practical collaboration with national centers is essential to draw clear pictures on ecological impacts in the region: 2008 - 2010

VII. Acknowledgements

71. This Strategy Paper is a product of the scientific discussions of the members of the Task Force on Soil and Vegetation Monitoring who met in Niigata City, Japan on August 6-7, 2008. The current members of the Task Force gratefully recognize the efforts of the members of the previous task force who formulated the First Strategy Paper for the Soil and Vegetation Monitoring. This Strategy Paper heavily drew ideas from this earlier Strategy Paper. Gratitude is also extended to the staff of the NC who provided guidance during the formulation of the Strategy Paper and the staff of ADORC for making the necessary arrangements for the meeting where this Strategy Paper was formed. The Secretariat of the Task Force is most certainly appreciated for their time and efforts which certainly made the task of the Task Force a pleasant one.

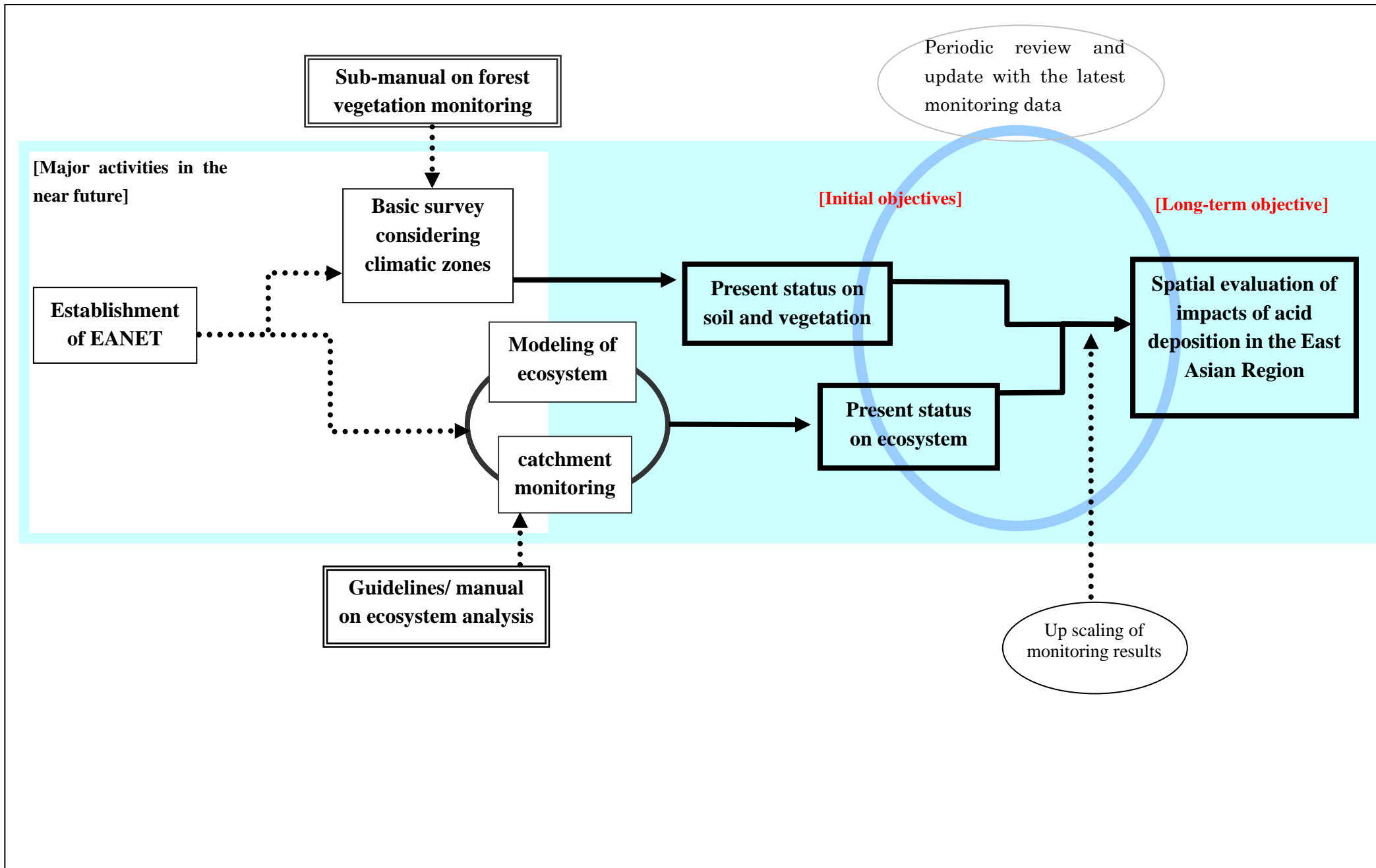


Figure 1. Overall strategy for Soil and Vegetation Monitoring of EANET

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