

The Seventh Senior Technical Managers' Meeting
of the Acid Deposition Monitoring Network
in East Asia
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Activities in line with “The Strategy Paper for Future Direction of Soil and Vegetation Monitoring of EANET”

Network Center for EANET

1. Strategy Paper for Future Direction of Soil and Vegetation Monitoring of EANET

The Strategy Paper for Future Direction of Soil and Vegetation Monitoring of EANET was endorsed by the Scientific Advisory Committee at its Second Session (SAC2) in November 2002 in Bangkok, Thailand, with a few modifications for the final draft developed by the Task Force on Soil and Vegetation Monitoring.

The Strategy Paper describes that the following four items would be implemented as the milestones, which are reflected to the specific work plan for coming five years:

- Joint Workshop by ICP Forests and EANET: 2002
- Implementation of the next monitoring: 2002-2005
- Start of case studies in selected reference catchments: 2006
- Preparation of sub-manual on forest monitoring: 2005

Task Force has been promoting some of the above 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. Clarification of sampling plan/schedule for soil and forest monitoring

Soil and vegetation monitoring is carried out at 3-5 years interval. For surely implementation of the next monitoring in the respective monitoring sites, detailed next sampling plan/schedule should be clarified based on the National Monitoring Plans. The following items should be described in the detailed plan:

- a) Monitoring sites: locations, soil types, and vegetation types
- b) Monitoring items: soil and/or forest
- c) Parameters: pH, exchangeable cations, exchangeable acidity, etc. for soil; general description of forests, survey of tree decline, etc.
- d) Monitoring year: 2003, 2004, 2005, 2006, and/or 2007

- e) Monitoring seasons and/or months: spring, summer, autumn, and/or winter; rainy season or dry season; month
- f) Organizations in charge of the sampling and analysis:

Consequently, Network Center (NC), as the secretariat of the Task Force, prepared a document “Sampling Plan/Schedule for Soil and Vegetation Monitoring of EANET 2003-2007”, and the document has been updated based on the latest information several times. The document might be effective for implementation of the survey as well as informative for data compilation. The document was updated as “Sampling Plan/Schedule for Soil and Vegetation Monitoring of EANET 2006-2009” (Attachment 1) for coming years.

Sufficient efforts should be made in the participating countries to implement the described plan for promotion of continuous monitoring. The document will be updated based on the latest information.

3. Promotion of studies for catchment analysis

NC promoted studies on catchment analysis in Japan and Thailand. A study plot was established in a small catchment area in Shibata City, Niigata Prefecture, in Japan. In the area, monitoring on input (deposition) and output (stream water) fluxes in/from the catchment area, and analyses on other biogeochemical aspects have been carried out continuously, and nutrient dynamics and acid deposition impacts in the area were discussed. Based on this experience, NC started the joint research project on catchment analysis in Thailand with Royal Forest Department (RFD) and Environmental Research and Training Center (ERTC), as introduced in the ongoing joint research activities. Scientific and technical information obtained by these studies will be shared in the EANET region for future monitoring.

4. Discussion on sub-manual for forest monitoring in East Asia

EANET - ICP Forests Joint Workshop was held in Seremban, Malaysia in 2002 as one of the milestones described in the strategy paper, and some technical subjects for forest monitoring were clarified based on discussions at the workshop. Task Force and NC developed the document “Procedures and schedule for preparing sub-manual on forest monitoring in East Asia (EANET/SAC3/8/2/Annex3)” taking these technical subjects into account. Task Force and NC are preparing the sub-manual according to the procedures and schedule.

Contents and the leading authors of the sub-manual were decided in March 2004, and the manuscripts are under preparation by the leading authors. Most of manuscripts have been prepared and now being edited for the reviewing. The manuscripts were reviewed by Task Force Members as well as SAC Members from October 2005 to January 2006. NC is editing and compiling the manuscripts as the draft sub-manual in cooperation with TF members. The introduction of the sub-manual is attached

in Attachment 2.

The sub-manual is expected to be endorsed at SAC6 in 2006.

Sampling Plan/Schedule for Soil and Vegetation Monitoring of EANET 2006 - 2009 (As of July 2006)

Network Center for EANET

1. Introduction

The Strategy Paper for Future Direction of Soil and Vegetation Monitoring of EANET was prepared by the Task Force on Soil and Vegetation Monitoring to promote activities toward the initial and ultimate objectives. The Strategy Paper describes issues to be implemented for the objectives and specific work plans for coming years. The Strategy Paper was endorsed by the Second Session of Scientific Advisory Committee (SAC2) in Thailand in November 2002, and activities in line with the Strategy Paper are being promoted.

Continuous monitoring in accordance with the Technical Manual is one of the issues to be implemented for achievement of the initial objective, “establishment of baseline data”, which was described in the Strategy Paper. As the first step on continuous monitoring, sampling/observation activities should surely be carried out as scheduled. In most monitoring sites, the sampling would be carried out from 2003 to 2007 because the previous samplings were done at least once from 1999 to 2002 meanwhile the monitoring interval was adopted as 3-5 years. Therefore, in the Strategy Paper, implementation of the next sampling was described as one of the milestones for coming five years (2003-2007), and clarification of detailed next sampling plan was proposed among the specific work plans.

Network Center (NC) as the secretariat of TF prepared the document, “Sampling Plan/Schedule for Soil and Vegetation Monitoring of EANET 2003 – 2007” for this purpose. The document was effective for sure implementation of the survey in the respective monitoring sites as well as informative for data compilation in Network Center. The document is updated annually based on the latest information. Sufficient effort should be made in the respective monitoring sites for implementation of the survey as scheduled.

2. Description of the sampling plan

The detailed plan for the respective monitoring sites should be clarified based on the National Monitoring Plans. The following items should be described in the detailed plan:

- a) **Monitoring sites:** locations, soil types, and vegetation types
- b) **Monitoring items:** soil and/or forest

- c) **Parameters:** pH, exchangeable cations, exchangeable acidity, etc. for soil; general description of forests, survey of tree decline, etc.
- d) **Monitoring year:** 2003, 2004, 2005, 2006, and/or 2007
- e) **Monitoring seasons and/or months:** spring, summer, autumn, and/or winter; rainy season or dry season; month
- f) **Organizations in charge of the sampling and analysis**

3. Sampling Plan/Schedule for Soil and Vegetation Monitoring of EANET 2006 - 2009

The latest information from 2006 to 2009 was summarized in the Table 1.

Table 1. Summary of sampling plan/schedule in the individual monitoring sites 2006-2009

Country	Organization	Area (Name of nearest deposition monitoring)	Name of individual monitoring site	Soil type by FAO/Unesco or ISRIC	Forest type (major species)	Monitoring records	Next sampling schedule and items	Interval
China	S, F) Chongqing Institute of Environmental Science	Jiayunshan (Chongqing)	Jiayunshan	(Acidic-Udic Argosols) ^{*2}	<i>Castanopsis carlesii</i> var. <i>spinulosa</i> , <i>Symplocos setchuenensis</i> , etc.	2000 (S) 2003 (S, F)	2006 (S, F)	3 years
	S, F) Xi'an Environmental Science	Jiwozi (Xi'an)	Dabagou	(Brown soil) ^{*2}	<i>Pinus armandi</i> , <i>Larix gmelini</i> , etc.	2001 (S) 2003 (S, F)	2006 (S, F)	
	S, F) Xiamen Environmental Monitoring Central Station	Xiaoping (Xiamen)	Xiaoping	(Red soil) ^{*2}	Man-made forest (<i>Michelia macclurei dandyar</i> , <i>Fokienia hodginsii</i> , <i>Pinus massoniana</i>)	2000, 2003 (S, F)	2006 (S, F)	
	S, F) Zhuhai Environmental Monitoring Station	Zhuxiandong (Zhuhai)	Zhuxiandong	(Ochric Udic Ferrosols) ^{*2}	<i>Acacia auriculiformis</i> , <i>A. confusa</i> , <i>Pinus</i>	2000 (S, F) 2001 (S) 2003 (S, F)	2006 (S, F)	
Indonesia	S) Soil and Agro Climate Research Development Center (Puslitanak) Environmental Management Center (EMC) F)	EMC	Bogor Research Forest (Dramaga Experimental Forest)	(Typic Dystrudepts) ^{*2}	Man-made forest (<i>Hopea mengarawan</i> , <i>Khaya anthotheca</i> etc.)	2001 (S)	-	3 years
Japan	S) Gifu Prefectural Research Institute of Health and Environmental Science F) Forest Science Research Institute, Gifu Prefecture	Ijira	Ijira	Dystric Cambisols	Man-made forest (<i>Cryptomeria japonica</i> , <i>Chamaecyparis obtuse</i> etc.)	2000 (S, F) 2003, 2004 (F) 2005 (F) ^{*6}	2006 summer (S, F)	5 years ^{*8}
			Yamato	Andosols	Man-made forest (<i>Chamaecyparis obtuse</i>)	2003, 2004 (F) 2005 (F)	2006 summer (S, F)	
	S) Agricultural Experimental Station, Shimane Prefecture F) Forestry Technology Center, Shimane Prefecture	Banryu	Banryu-2 ^{*3}	Cambisols	Secondary forest (<i>Symplocos lucida</i> , etc.)	2000 (F) 2001 (S, F) 2003, 2004 (F) 2005 (F)	2006 summer (S, F)	
			Iwami "rinku" Factory Park ^{*3}	(Acrisols) ^{*4}	Secondary forest (<i>Castanopsis cuspidate</i> , etc.)	2001 (S, F) 2003, 2004 (F) 2005 (F)	2006 summer (S, F)	

Malaysia	S) Universiti Putra Malaysia F)	-	Pasoh Reserve Forest	Dystric Nitosols/ Rhodic Ferralsols	Natural forest	2000 (S)	2007 August (S) 2007	3 years
		Petaling Jaya	Sungai Lalang Reserve Forest	Dystric Nitosols/ Rhodic Ferralsols	Secondary forest		2007 August (S) 2007	
Mongolia	S) Central Laboratory for Environmental Monitoring F) National University of Mongolia (NUM).	Ulaanbaatar	Bogdkhan Mountain ^{*1}	Not reported	Natural forest (<i>Larix sibirica</i>)	2005 August (S, F)		3-5 years
Philippines	S) University of the Philippine Los Banos (UPLB), Environmental Management Bureau F) UPLB	Los Banos	Mt. Makiling	Eutric Cambisols	Secondary forest (<i>Celtis luzonica, etc.</i>)	2000 (F) 2002 (S) 2001, 2005 ^{*7} (S, F)	2007 (S, F)	3 years
			UP Quezon, Land Grant	Dystric Nitosols	Secondary forest	(2000(s)) 2001, 2005 ^{*7} (S, F)	2007 (S, F)	
Republic of Korea	S, F) National Institute of Environmental Research	Imsil	Mt. Naejang	Not reported	Secondary forest (<i>Pinus densiflora, Pinus rigida, Styrax japonica, Prunus maximowiczii</i>)	2001, 2004 (S, F)	2007 (S, F)	3 years
Russia	S) Laboratory of Hydrochemistry and Atmospheric Chemistry, Limnological Institute of RAS/SD (Irkutsk) F) Siberian Institute of Plant Physiology and Biochemistry, RAS/SD (Irkutsk)	Irkutsk	Irkutsk	Eutric Regosols/ Calcaric Luvisols	Man-made forest (<i>Pinus sylvestris, Betula pendula</i>)	2001 (S, (F)) 2003 (F)	-	3-5 years
		Listvyanka	Bolshie Koty	Mollic Leptosols/ Umbric Leptosols	Natural forest (<i>Pinus sylvestris, Populus tremula, etc.</i>)	2000 (S) 2002 (F)	-	
			Pereemnaya river catchment	Gelic Podzols/ Dystric Leptosols	Natural forest (<i>Betula pendula, Picea obovata, etc.</i>)	2005 (S, F)	-	
		Mondy	Ilchir Lake	Gelic Podzols/ Gelic Gleysols	Not reported	1999 (S)	-	
			Okinskoe Lake	Gelic Podzols	Not reported	1999 (S)	-	
			Solar Observatory	Calcic Gleysols	Natural forest (<i>Larix sibirica</i>)	1999 (S) 2004 (F)	-	
		Primorskaya	Primorskaya	Mollic Leptosols/ Umbric Leptosols	Natural forest (<i>Quercus mongolica, Betula daurica, etc.</i>)	-	2006 (S, F)	

Thailand	S) Department of Agriculture, King Mongkut's University of Technology Thonburi F) Royal Forest Department	Vachiralongkorn Dam (old name: Kao Lam Dam) *5	Vachiralongkorn Dam	Ferric Acrisols	Secondary forest (<i>Xylia xylocarpa, etc.</i>)	2000 (S, F) 2001, 2002 (S) 2003 (S, F)	2006 April and August (S, F)	3 years
			Vachiralongkorn Puyea	Luvisols	Secondary forest (<i>Dipterocarpus turbinatus</i>)	2002, 2003 (S, F)	2006 April and August (S, F)	
Viet Nam	S) Institute of Meteorology and Hydrology (IMH), and National University of Hanoi	Hoa Binh	Cave of Heaven	Ferric Acrisols	Man-made forest (<i>Pinus sp.</i>)	1999 (S, F)	-	3-5 years
			Thang Ranh	Ferric Acrisols	Man-made forest (<i>Acacia auriculiformis</i>)	1999 (S, F)	-	

Note: S, Soil monitoring; F, Forest monitoring; *1. New sites, Serpong, Medan, Manado and Palangkaraya in Indonesia, and Bogdkhan Mountain in Mongolia, will be established in the near future; *2. Classification by FAO/UNESCO has not been reported; *3. The sites around Banryu deposition site were relocated in 2001; *4. Further analysis should be carried out for correspondence to accurate FAO/UNESCO classification; *5. Kao Lam Dam was renamed to Vachiralongkorn Dam; *6. Underlined data will be published in Data Report 2005; *7. The surveys were carried out in February 2005 due to postponement of surveys in autumn 2004 in the Philippines. The data is included in the Data Report 2004; *8. Tree decline will be surveyed every year in Japan.

Annex**Reporting Form for Sampling Plan/Schedule of Soil and Vegetation Monitoring**

Items	Examples for description	Sampling Plan/Schedules
a) Monitoring sites	Locations (Area (the nearest deposition monitoring site), Name of individual sites)	
	Soil type (by FAO/UNESCO)	
	Vegetation (forest) type: Natural forest, Secondary forest, or Man-Made forest	
b) Monitoring items	Soil and/or forest	
c) Parameters	Mandatory Parameters for soil: Moisture content, pH, exchangeable base cations, exchangeable acidity, etc.	
	General description of forests, and/or survey of tree decline	
d) Monitoring year	2003, 2004, 2005, 2006, and/or 2007	
e) Monitoring seasons and/or months	Spring, summer, autumn, and/or winter; rainy season or dry season; month	
f) Organizations in charge of the sampling and analysis	Name of organization, Department, etc.	
g) Others	Monitoring interval (if it changed), etc.	

The form would be prepared for the respective monitoring sites. Information on a), c) and f) above has already been described in the National Monitoring Plan, and the same descriptions would be filled in the form if they were not changed.

The introduction of the sub-manual on forest vegetation monitoring

1. Introduction

1.1. History

Development/improvement of methodologies for forest vegetation monitoring was described in the Strategy Paper on Future Direction of Soil and Vegetation Monitoring of Acid Deposition Monitoring Network in East Asia (EANET) as one of the issues to be implemented for early detection of possible impacts by acid deposition. It was expected that the Task Force on Soil and Vegetation Monitoring (TF) would prepare the sub-manual on forest vegetation monitoring.

EANET and International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) jointly held “Workshop on Elaboration and Development of Forest Monitoring in East Asia” in Seremban, Malaysia on 16 - 19 December 2002. The Joint Workshop was expected as a milestone and a basis for discussion on development of the sub-manual in the Strategy Paper.

Some important technical subjects were pointed out based on the Chairperson’s Summary of the Joint Workshop as “Technical subjects to be discussed for sub-manual on forest monitoring in East Asia”, and then, “Procedures and schedule for preparing sub-manual on forest monitoring in East Asia” was prepared in 2003.

Possible contents and authors were discussed by TF and Network of Soil and Vegetation Monitoring Specialists (Network of Specialists) based on the technical subjects and the latest scientific information, and the document “Contents and authors for the sub-manual on forest monitoring in East Asia” was developed in March 2004. Members of TF or the Network of Specialists were mainly designated as the leading authors. Additionally experts outside TF and the Network of Specialists were also designated as the leading or contributing authors for some contents, especially for advanced techniques. The leading authors prepared manuscripts of the respective (sub-) chapters by early 2005.

The manuscripts were uploaded on the web site in October 2005 and reviewed by members of TF and Scientific Advisory Committee (SAC) and experts of ICP Forests. Several comments or suggestions were made for manuscripts or a structure of the sub-manual itself. The manuscripts were revised and edited based on comments and suggestions as this sub-manual.

The final draft of the sub-manual is expected to be presented and adopted in the sixth session of SAC in

autumn 2006.

1.2. Characteristics and structure of this sub-manual

Forest monitoring in the basic survey of EANET consists of two items, namely, general description of forest, and survey of tree decline, as shown in Table 1.1. General description of forest is carried out mainly for establishment of baseline data, one of the initial objectives of soil and vegetation monitoring in EANET. The Technical Manual for Soil and Vegetation Monitoring in East Asia (2000) should be referred for implementation of the survey. On the other hand, survey of tree decline is carried out mainly for early detection of possible impacts, which is another initial objective. The survey will detect tree declining symptoms or phenomena. This sub-manual was developed for implementation of this survey.

Table 1.1. Monitoring items and methods in forest monitoring of EANET

Item	Detailed survey items	Classification	Purpose	Methods to be referred
General description of forest	Description of trees (species name, DBH, and height)	Mandatory	Mainly for baseline data	Technical Manual for Soil and Vegetation Monitoring (2000)
	Understory vegetation	Mandatory		
Survey of tree decline	Observation of tree decline	Mandatory	Mainly for early detection	Technical Manual, and <u>Sub-manual on forest monitoring</u> (this issue)
	Photographic record of tree decline	Optional		
	Estimation of decline causes	Optional		

This sub-manual consists of two parts, namely, the main text, and informative references for the future monitoring. The structure of the sub-manual and positions in the EANET documents are shown in Table 1.2. Contents of the main text had already been suggested in the Guidelines for Acid Deposition Monitoring in East Asia (2000) and/or Technical Manual. The respective methods were elaborated for practical use based on recent experiences in the EAENT participating countries. These methods are applicable for the survey of tree decline, as described in the section 1.3.

Table 1.2. Structure of the sub-manual and positions in the EANET documents

		Content	Positions in the EANET documents
1		Introduction	History, structure of the sub-manual, etc.
2		Additional methods for “survey of tree decline” of basic survey	Improved method based on the Guidelines and the Technical Manual
3	3.1	Estimation of concentrations and depositions of air pollutants in forest area	Detailed methods based on suggestions in the Guidelines and the Technical Manual

	3.2	Chemical analysis of needles and leaves	Modified method based on the Technical Manual
4		QA/QC on forest vegetation monitoring	Additional descriptions for the QA/QC program
Annex 4.1		Image analysis for assessment of tree crown condition	Modified method based on the Technical Manual
Annex 4.2		Hemispherical photography for assessment of canopy gaps and light penetration	Detailed methods based on suggestions in the Technical Manual
5	5.1	Monitoring of lichens as bio-indicator for air pollution/acid deposition	Informative reference
	5.2	Remote-sensing technologies including satellite, airborne and smaller scale devices	Informative reference
App.		Information on research methodologies for plant sensitivities	Informative reference

Contents of the informative references describe the methodologies, which are new topics in EANET, while the methodologies were suggested based on experience in Europe and/or several EANET participating countries. Applicability of these methodologies to the EANET monitoring will be discussed in future, while the methodologies are informative for research activities in the participating countries.

1.3. Practical use of the sub-manual

The methods described in the main text should be used for the survey of tree decline in forest monitoring. As shown in Table 1.1, three detailed items, namely, observation of tree decline, photographic record of tree decline, and estimation of decline cause, should be carried out for the survey of tree decline. Applicable methods for each item are shown in Table 1.3.

As for observation of tree decline (mandatory item), the additional methods for “survey of tree decline” of basic survey in the Chapter 2 are applicable. Specific information for temperate/sub-arctic and (sub-) tropical zones was also included in the sections 2.2 and 2.3, respectively. These improved methods should be used for observation of tree decline.

Table 1.3. Applicable methods for each item

Items	Chapter and content (method) to be referred	
Observation of tree decline (Mandatory)	2	Additional methods for “survey of tree decline” of basic survey
Photographic record of tree decline (Optional)	The current Technical Manual can be used for recording the canopy condition.	
Estimation of decline cause (Optional)	3	3.1 Estimation of concentrations and depositions of air pollutants in forest area
		3.2 Chemical analysis of needles and leaves
QA/QC program	4	QA/QC on forest vegetation monitoring
QA/QC of observation	Annex	Image analysis for assessment of tree crown condition
Photographic record of tree decline (Optional), especially for numerical analysis	4.1	
	Annex	Hemispherical photography for assessment of canopy gaps and light penetration
	4.2	

As for photographic record of tree decline (optional item), the current Technical Manual can be used just for recording the canopy condition. However, it was difficult to evaluate the photograph quantitatively. For numerical analysis of photographic record, the image analysis for assessment of tree crown condition in Annex 4.1 and the hemispherical photography for assessment of canopy gaps and light penetration in Annex 4.2 are applicable. These methods can be recommended as alternative methods for photographic record. Moreover, these image analyses should be utilized as helpful tools for QA/QC. Observation of tree decline may be fluctuated due to experience of surveyors and uncertainty of observation standard, and therefore it is recommended to promote calibration of the standard and check the observation by using other quantitative methods in order to assure quality of the data. The image analyses by computer may be useful for crosschecking. In fact, a photographic image analysis system for tree crown condition, “CROCO”, which was described in Annex 4.1, has been applied for the data of ICP Forests for QA/QC. Therefore, the methods were included as annexes of the QA/QC part.

As for estimation of decline cause (optional item), implication with acid deposition should be discussed when the cause is unknown. For this purpose, intensive surveys were suggested in the Guidelines and the Technical Manual. However, in practical, information on deposition and leaf chemistry should be accumulated in the regular monitoring of the basic survey if effects of acid deposition are expected. Therefore, the methods described in the Chapter 3 can be utilized for the optional item. The methods may be informative also for more intensive surveys of ecosystems.

The QA/QC program for Soil and Vegetation Monitoring in East Asia was mainly focused on soil monitoring. Therefore, a supplementary document for the QA/QC of forest monitoring was prepared as the Chapter 4. Fundamental philosophy of the document is same as the current QA/QC program, while

supplementary descriptions for the respective methods were added. The Chapter 4 should be utilized with the current QA/QC program.

1.4. Update of the methods

The methods described in the sub-manual should be updated based on the latest scientific information and experience of the EANET participating countries. Applicability of the new methodologies, which were included as informative references, will be discussed with revision of the Guidelines and fundamental description of the Technical Manual in future.