In Country Training Programme under "Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia"

Jointly organized by CEA-Sri Lanka, SEI, SACEP and UNEP RRC.AP, with the financial support from Sida

Report on Sri Lanka

Introduction

As a signatory to the Malé Declaration, Sri Lanka has agreed to participate in the monitoring of long range transport of air pollution and its likely impacts. Accordingly, Sri Lanka was recommended two monitoring stations by the United Nations Environment Programme (UNEP) for this programme. The Central Environmental Authority (CEA) is the National Implementing Agency (NIA). The sample monitoring and analysis will be done by CEA personnel.

Monitoring Site

Site location: The first monitoring site was chosen in a forest approximately 40 km east of Anuradhapura, in the north-central part of Sri Lanka.

Mr C K Amaratunga, Mr Jayawardane, Mr Sagar Dhara, Mr M Iyngararasan, Ms Karin Sjöberg, Ms. Naw Wah Wah Htoo and Dr Kevin Hicks visited the monitoring site during the training programme. A map of the monitoring site and its surroundings is provided in Fig 1.

The deposition-monitoring site is on a bald hillock on the edge of a forest. There was no human habitation close to the site except for a small Buddhist monastery. The monks from the monastery have taken the responsibility of providing security for the monitoring equipment. The approach road to the site is a little-used dirt track. The closest highway is about 15 km from the deposition monitoring site. A thick forest lies between the deposition monitoring site and the highway.

The ecological monitoring site is approximately 5-7 km away from the deposition monitoring site. It is located in another part of the forest. However, the road connecting the deposition and the ecological monitoring sites passes through human habitation. Water and aquatic ecology samples are proposed to be drawn from a man-made reservoir, over 5 sq km in area. Some fishing is done in the reservoir. Wild animals are known to use the reservoir as a water hole. Some contamination of this water body is bound to occur due to these activities. Since the water body is quite large, the contamination is likely to restricted to those parts of the reservoir, which are used by humans and animals.

Site type: The sites are remote deposition and ecological monitoring sites.
The site met the following siting criteria:

1. Both deposition and ecological monitoring sites were identified.
2. From available metrological data, the site receives winds from Southeast Asia as well as the eastern portion of South Asia (Bangladesh, Northeast India). The site is downwind of major sources in neighboring nations. Given the current situation in Sri Lanka, this is probably the best possible site in the northern part of the island-nation.
3. There is minimal human habitation close to the deposition monitoring site.
4. The terrain surrounding the site is flat land.
5. The site is as inland as is possible on this island nation.

6. There is a good forest, which can be, used for soil and vegetation surveys.
7. There are water bodies in the vicinity of the deposition monitoring site that can be used for water quality and aquatic ecology monitoring.
8. The deposition and ecological monitoring sites are secure and easily accessible.
7. The site is within 12 hours from the laboratory, which will analyze the samples.

The site did not meet the following criteria:

1. The closest working meteorological station is located in Anuradhapura, which is 40 km away.
2. The reservoir from which the water quality and aquatic ecology samples will be drawn may have some interference.

The site is a remote site.

Site characteristics: There may be some obstruction to free flow of wind by two small rock formations to the north and south of the location where the monitoring instruments are placed. The deposition and ecological sites are habitation for monkeys and other animals.

Monitoring and laboratory equipment

Equipment: The monitoring and laboratory equipment and glassware given in Annex 1 was handed over to CEA during the training programme held in June 2003.

Installation: From reports provided by the CEA, installation of the PM_{10} sampler, wet only collector, two bulk collectors and the diffusive samplers for SO_2 and NO_2 were installed at the deposition monitoring site in August 2003. A list of equipment provided is given in Annex 1. A small building was constructed for housing the equipment. To prevent monkeys from tampering with the diffusive samplers, cages have been provided for the samplers.

Training programme

An In Country Training Programme under "Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia" was held in the Central Environment Authority office in Colombo between 23-28 June 2003. The training programme was organized by CEA in collaboration with UNEP RRC.AP, SEI, SACEP.

The training programme's objective was to build national capacity to provide hands on experience on sampling and analysis of transboundary pollutants.

The welcome address of the training programme was given by Dr. Pethiyagoda, Member of the Board, CEA, followed by remarks by Mr. W.R.M.S. Wickremasinghe, Addl. Secretary, Ministry of Environment & Natural Resources, Mr P K Kotta, SACEP, Dr Kevin Hicks SEI and Mr M. Iyngararsan, UNEP RRC.AP. The opening session ended with a vote of thanks from Mr K G D Bandaratilake, Deputy Director, CEA. The training programme was facilitated by Mr Sagar Dhara.

The technical sessions in the training programme were handled by Mr M. Iyngararasan, Mr Sagar Dhara, Dr Karin Sjöberg, Dr R.H. Siddiqi and Dr Kevin Hicks. The training programme content is provided in Annex 2.

Participants: The trainees were from different departments of CEA. Resource persons were from IVL and Envirotech and from the collaborating centres UNEP RRC.AP and SEI. A list of participants is enclosed in Annex 3.

The trainees had an adequate educational background and the experience of handling field and laboratory equipment. Many of the trainees were chemists working in various CEA laboratories. The team was inherently very competent to do this work.

Equipment: Training was provided to handle the following equipment:

Envirotech International: High Volume Sampler– Envirotech APM 460NL—for TSPM, PM_{10}, gaseous sampling.
IVL: Passive Samplers for SO_2 and NO_2
MISU: Wet only collector, Bulk collector

The thermometer of the oven was broken in shipment and the door of the oven was slightly out of position, though still closed. Envirotech was to replace the thermometer. No damage was noticed to any other equipment or glassware when they were opened in the CEA offices.

Evaluation: A test paper (annex 4) was circulated amongst the trainees to assess how successful the training programme was in imparting knowledge and skills to the trainees. The answers were not marked but the answers were discussed collectively.

A participant evaluation of the programme was also done. The response questionnaire and the tabulated results of the responses are provided in Annexes 5.

Training programme experience: As a major portion of the training was handson, the trainees were enthusiastic and quick learners. Several dust gaseous samples were collected and analyzed by the trainees during the training programme. Knowing the results of their monitoring boosted the confidence of the trainees.

Recommendations

1. If the reservoir is found to be contaminated, another water body must be identified.

2. A manual anemometer should be placed at the monitoring site for 6 weeks each season (hot, wet, cool). If the wind direction data from the site does not correspond with that of Anuradhapura, a dedicated meteorological station must be installed at the site. The parameters that require to be monitored are: wind direction and velocity, relative humidity and rainfall. Sensors for other parameters, eg, solar insolation, may be added later.

3. If requested for, a follow-up visit may be done by a technician-level person in the first year after equipment installation.

4. A follow-up visit by a UNEP representative (MoC-level or equivalent) may be done in the first year after monitoring has begun to sort out problems related to data management and reporting, QA/QC, further capacity building, site change, etc.

5. Theoretical aspects of the subject, eg, basic chemistry and statistics need to re-covered in future refsher courses.

Annex 1

List of Equipments and Consumables

1 Site Equipment

No.	Description	No. of Unit	Remark
1.1	PM10 air sampler	1	Envirotech model APM 460(NL)
1.2	pH meter	1	Hand held WTW model pH 300i (pH meter)
1.3	EC meter	1	Electrical conductivity meter, hand held WTW model COND 330i
1.4	Thermometer	1	Best Indian Make (-20 to 15degree C, least count 0.1 degree)
1.5	Diffusive samplers	2	For measurements at 1 site on a monthly basis during one year
1.6	Bulk sampler	2	
1.7	Wet only Collector	1	Included solar panels, solar shunt regulator

2 Laboratory - Equipment

2.1	Spectrophotometer	1	U/V and Visible Best Indian Make, Elico SL 171
2.2	Oven	1	Best Indian Make (50 to 250 degree range, 220-240V, 0.5KW)
2.3	Balance	1	Electronic Balance, Sartorius Make. Model BL210S Capacity 210g. Readability 0.1 mg
2.4	pH meter	1	Hand held WTW model pH 300i (pH meter)
2.5	Electrical conductivity meter	1	Electrical conductivity meter, hand held WTW model COND 330i
2.6	Desiccator	1	Mark 'Duran' Size 300mm
2.7	Distallation Unit	1	
2.8	Magnetic stirrer 1 L	1	Though listed as being reqd for soil qlty analysis, would be preparing for preparing solutions for DD/WD sample analysis
2.9	pH electrode for low ion concentration	1	
2.10	Calibrators		
	a) Soap Bubble Meter (manual type) (Calibrator for Rotameter)	1	
	b) Top loading Flow Calibrator	1	

3 Laboratory Consumables

A	***Glassware and other consumables***		
3.1	Washing bottle with ground glass stopper 500 ml	2	
3.2	Measuring cylinder 100 ml, 50ml, 25 ml. 10 ml	8	100 ml x 2 nos, 50ml x 2 nos, 25ml x 2 nos, 10ml x 2 nos
3.3	Glass tubes with ground-in stopper (Nessler's tubes)	12	
3.4	Volumetric flask 1000ml, 500 ml, 250 ml, 100 ml	7	1000ml x 2nos, 500 ml x 1 nos, 250 ml x 2 nos, 100 ml x 2 nos
3.5	Pipette 10 ml, 25 ml	4	10 ml x 2 nos, 25 ml x 2 nos

3.6	Filter paper Whatman 41, dia 47 mm	3	1 box = 100 nos
3.7	Bottle polypropylene 1 L, 500 ml	14	1 L x 6 nos, 500 ml x 8 nos
3.8	Beaker 100 ml, 250 ml	16	250 ml x 2 nos, 100ml x 12 nos
3.9	Regaent bottles 100ml	6	100ml x 6nos
3.10	Regaent bottles 250ml	6	250ml x 6 nos,
	Chemicals and other consumables		
3.11	2 monitoring kits		

4 Site Consumables

4.1	Filter paper Whatmans GF/A	2	Size 8"x10", in sealed pkt. Of 100 sheet
4.2	Impingers	4	35ml capacity, 4 will be supplied with hvs, 4 more are reqd as spare
4.3	Syringe 100 ml	2	5.00 each packet, in pkt. Of 10
4.4	Glass/inert plastic tubing	3	per meter, Silicon tube
4.5	Silicon grease	2	for 100 gm packet
4.6	Measuring cylinder 100 ml	2	each
4.7	Pipette 20 ml	3	10 ml x 2 nos, 20 ml x 1 nos
4.8	Polyethylene containers 20 ml	100	each - 60ml
4.90	Funnel	6	50 mm x 3 nos, 75 mm x 3 nos
4.10	Capped bottles 1 L	3	each (Tarson)
4.11	Ice box	2	each (medium size)
4.12	Power Cord 5 meter long	2	
4.13	Junction Box (Extension Board)	1	1 set
4.14	Burette (50 ml)	1	
4.15	Burette Stand	1	
4.16	Cleaning Brush for Glassware	2	
4.17	Printed paper envelopes to keep filters	1pkt	1 pkt. of 12 Nos.
4.18	Graph Pad	1 Pad.	
4.19	Iodine flask (250ml)	2	
4.20	Membrane Filtration Assembly	2	
4.21	Petridish	1	
4.22	Pipette (1 ml)	1	
4.23	Pipette (2 ml)	1	
4.24	Pipette stand	1	
4.25	Plier	1	
4.26	Pipetting Pump	1	
4.27	Silica gel (500 gm)	1	
4.28	Torch	1	
4.29	Tissue Roll	1	
4.30	Tweezer	1	
4.31	Sampling Bag	1	

Annex II

Training Program

Day	Contents	Class/lab	Instructor
June 23 Morning (1100-1215)	Introduction to the Malé Declaration and Scope of present program (15min) Impacts of air pollution (15 min) Basics concepts of meteorology (30) Long range transport of air pollution (15)	C C C C	MI KH RHS SD
June 23 Afternoon	Units and materials and energy balance (30) HVS: features, and setting it up	C C/L	RHS RP
June 24 Morning	Basic chemistry (45 m) Passive sampling: theory and practice Bulk collector: theory and practice	C C/L C/L	RHS KS KS/SD
June 24 Afternoon	Spectrophotometer analysis (30) EC meter (30) PH meter (30) Spectrophotometer analysis, EC meter and PH meter	C C C L	RHS RP RHS RP
June 25 morning	Basic statistics (30 min) QA/QC (30 m) Wet only collector: theory and practice	C C C/L	RHS RHS KS/SD
May 25 Afternoon	Spectrophotometer analysis EC & pH meter HVS	L L L	RP RP RP
June 26	Monitoring protocol Data reporting Wet only collector and bulk collector One to one discussions	C C L	SD MI KS/SD
June 27	One to one discussions Evaluation and examination Discussion and conclusion	C C	SD MI/PK

KH: Kevin Hicks, SEI
MI: Mylvakanam Iyngararasan, UNEP/RRC.AP
RHS: R. H. Siddiqi, Envirotech
SD: Sagar Dhara, MoC
KS: Karin Sjoberg, IVL
PK: Pradyumna Kumar Kotta, SACEP
RP: Rajendra Prasad, Envirotech

Annex III

Participant List

1. H L Susiripala - Director (Laboratory Services) CEA
2. C K Amaratunga - Deputy Director (Lab. Services) CEA
3. K G Samaranatha Jayawardana - Senior Environmental Officer CEA
4. Sarath Wijesekara - Senior Environmental Officer CEA
5. Kamal Priyantha - Senior Environmental Officer CEA
6. R N R Jayaratna - Environmental Officer CEA
7. Saman Hapuarachchi - Environmental Officer CEA
8. T W A Wasantha Wijesinghe - Assistant Director (Lab. Services) CEA
9. R M Kulasena - Chemist CEA
10. S M S Samarakoon - Chemist CEA
11. Achala Lakmini - Laboratory Technician CEA

Resource Participants list

1)	Kevin William Hicks	SEI
2)	Rajendra Prasad,	Envirotech
3)	Karin Sjoberg,	IVL
4)	Mylvakanam Iyngararasan,	UNEP RRC.AP
5)	P K Kotta,	SACEP
6)	Rashid H Siddiqi,	Envirotech
7)	Sagar Dhara,	MoC
8)	S K Gupta,	Envirotech
9)	Naw Wah Wah Htoo	UNEP RRC.AP

Annex IV

(TEST PAPER)

1. Which are the participating countries of Malé Declaration?
……

2. Name the National Focal Point for Malé Declaration in Sri Lanka?
……

3. Name the three main pollutants the Male' Declaration wishes to measure?
……

4. Why are the Malé Declaration monitoring site located in remote areas?
……

5. What effects do air pollutants have on human health?
……
……

6. Air pollution can potentially result in fish kills in lakes.
True or False

7. Air pollution can have both good & bad effects on plants.
True or False

8. Air pollution can cause the corrosion of statues and man made materials such as paints.
True or False

9. Indicate if true or false:

a)	Concentration of air pollutants is measured in ppm by volume.	True	False
b)	5 mg/L is the same as $5g/m^3$.	True	False
c)	High volume sampler is used to measure dry deposition rate.	True	False
d)	Wet only collector is used to measure rainfall.	True	False
e)	EC meter can be used to indicate dissolved solids concentration.	True	False
f)	Impingers are here used to collect SPM in air.	True	False
g)	Unfiltered air is bubbled through Envirotechs impingers.	True	False
h)	Water in the manometer in high volume sampler should be replaced every 6 months.	True	False

10. Indicate the most appropriate or correct answer:

(a) With increase in altitude
(i) pressure decreases (ii) temperature remains constant (iii) density of air increases (iv) wind speed decreases

(b) which of the following is a secondary pollutant
(i) NO (ii) SO_2 (iii) O_3 (iv) Pb

(c) Wind rose diagram is a representation of
(i) Wind temperature (ii) Wind direction and speed
(ii) Wind humidity (iv) Wind pressure

(d) Which of the following instruments measures hydrogen ion concentration
(i) EC meter (ii) Spectrophotometer (iii) Bulk collector (iv) pH meter

(e) The cyclone in Hi-vol sampler

(i) collects respirable dust (ii) protects filter paper from moisture (iii) collects particles less than 10 μm size (iv) collects particles greater than 10 μm size

(f) If 1 mL of a 10 mg/L standard NO_2 solution is added to 9 mL of reagents the concentration will be

(i) 10 μg/L (ii) 1 μg/10 mL (iii) 1 g/m3 (iv) 1 ng/mL

(g) If 10 g S is burnt SO_2 production will be

(i) 10 g (ii) 20 g (iii) 32 g (iv) 64 g

(h) For gaseous sampling using impinger? the air flow rate is usually kept at

(i) 1-3 m^3/h (ii) 1-4 m^3/min (iii) 1-5L/min (iv) 1-4 mL/min

11. Calculate the dust concentration in air in μg/m^3 if 2 g dust is suspended in 1000 m^3 of air.

12. What is the total amount of air in m^3 which is filtered if a Hi-Vol sampler sucks air at an average rate of 0.5 m^3/min for 8 h.

13. What will be the volume of 273 m^3 of air which is at 0°C, if heated to 27°C.

14. What is wet deposition

…….

…….

15. What is dry deposition

…….

…….

16. How can you estimate dry deposition

…….

…….

17. What is the approximate average time a sulfur compound (as SO_2 or sulphate particle) spends in the atmosphere

a) 6hrs b) 1 day c) 4 days d)10 days e) 1 month f) 6 month g) 1 year

18. Can transboundary transport in the atmosphere be a problem for Sri Lanka? ……..
Why? ……

19. Deposition of pollutants from the atmosphere can be a problem. Give some examples?
…….
…….

20. Can diffusive (passive) sampler be used for measuring the SO_2 concentration in air?
…….

21. Do you need a pump for diffusive (passive) sampling?
…….

22. Can you analyse the diffusive (passive) samplers yourself ?
…….

23. How should the diffusive (passive) sampler be mounted?
…….

24. What should you do with the sample if you find bird dropping in the funnel of bulk collector?
…….

25. Why do you need gloves when handling the bulk sampling equipment?
…….

26. Why should you shake the sample a little before taking out a fraction of it from a bulk sampling equipment?
…….

27. When do you take out samples from the wet only collector?
……

28. Suppose that it is raining a lot and the bottle is more than 80% full already after 3 days. What do you do?
……
…….

29. Suppose that after installation of a collection bottle it become fill already the same afternoon. What do you do?
…….
…….

30. What do you do
    (a) If the lid becomes damaged?
    (b) If the wet only collector does not work properly or not at all and there is no obvious error?

31. Are you aware of the health and safety issues associated with analyzing the samples in the laboratory? Yes and no. Give example.
……
……

Annex V

Summary of evaluation

Question	Not at all (%)	A little (%)	Somewhat (%)	Mostly (%)	Completely (%)
Overall objectives and content					
1. Were the objectives clear and precise				30	70
2. Were the objectives attained?				60	40
3. Was the content linked to the objectives?				40	60
4. Was the content well structured?			10	40	50
5. Was the content presented clearly?				40	60
To what extend did these sections of the training workshop meet your expectations?					
6. Basics of air pollution monitoring			22.2	22.2	55.5
7. Sampling PM10 using HVS				44.4	55.5
8. Gaseous Sampling using HVS				44.4	55.5
9. Sampling with bulk collector			11.1	44.4	44.4
10. Sampling with wet only collector				55.5	44.4
11. Sampling using passive samplers			11.1	55.5	33.3
<u>Methodology</u>					
12. Was the methodology used appropriate for the training program and you as a professional?			10	50	40
13. Did the methodology help you to share your own knowledge and experience?			10	60	30
How useful did you find the following elements of the training program?					
14. Lab session (Spectrophotometer)				50	50
15. Lab session (pH and EC Meters)				50	50
16. Facilitated discussions			10	70	20
17. One to one discussions			10	90	-
<u>Logistics</u>					
18. Was the meeting venue adequate?				66.6	33.3
19. Was the timing of the agenda comfortable?			10	40	50
20. Was the length of the sessions appropriate?			10	50	40
	Excellent (%)	Good (%)	Average (%)	Unsatisfactory Poor (%)	
21. Overall, how would you rate the training? Please circle one.	60	40			

Learning rainwater sampling

Installation of passive sampler at the site

Learning rainwater air sampling

Site for the monitoring station

SOUTH- WEST

NORTH-EAST

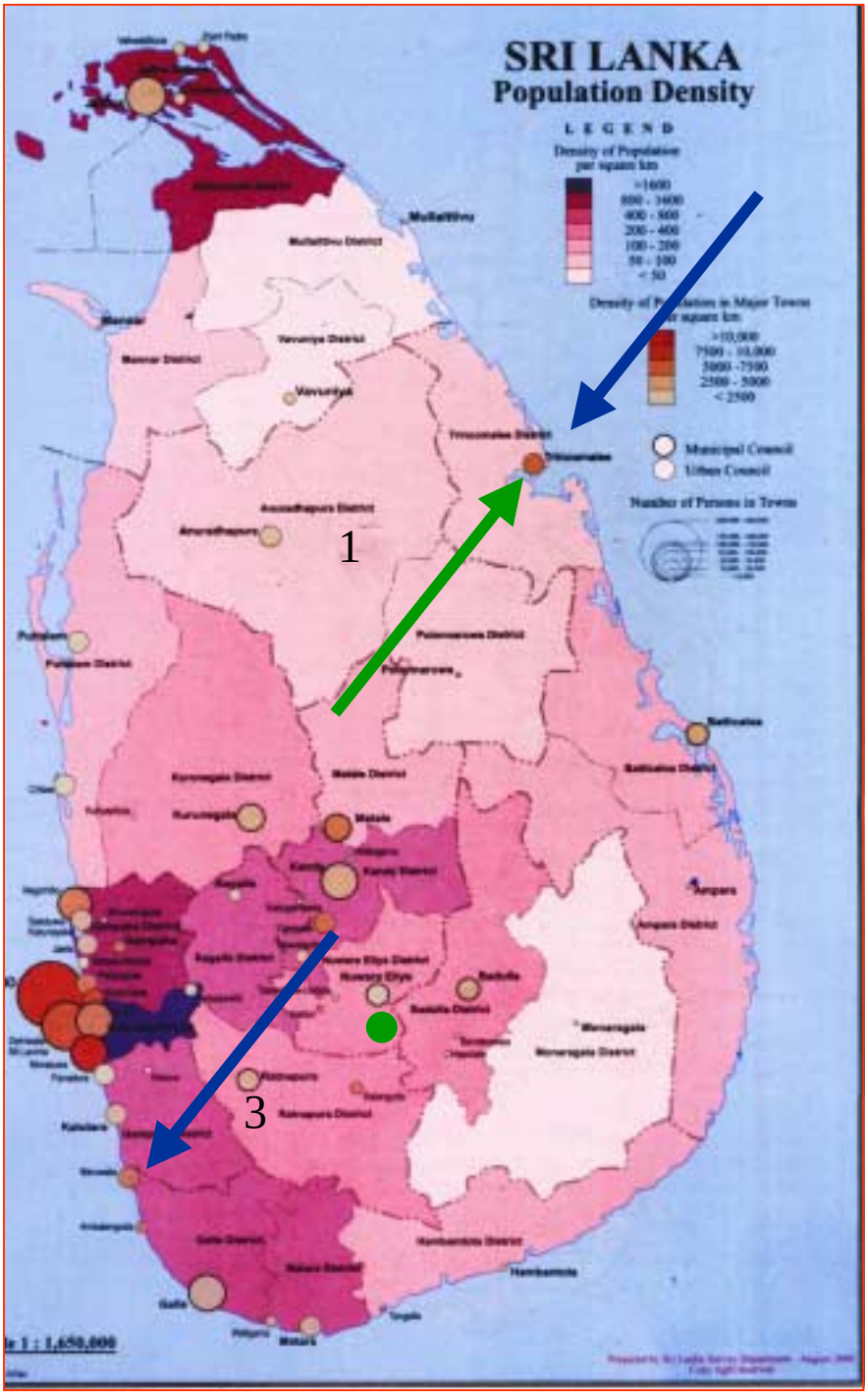

Figure 1: Monitoring site of Dutuwewa