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 Department of Environment, Ministry of Environment and Forest , SEI, SACEP and UNEP RRC.AP, with the financial support from Sida

Report on Bangladesh

Introduction

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

Monitoring Site

Site location: The first station was to locate at a site close to the town Khulna, Satkhira District. The site is close to the Indian border across Kolkata, in West Bengal. Data on the site and surroundings, as required in the formats provided by UNEP, are yet to be received.

Details of the site a long with the site visit are provided in the annex 6.

Monitoring and laboratory equipment

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

Installation: DoE will complete the installation before April 2004.

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 Dhaka between 19 and 23 October 2003. The DoE organized the training programme in collaboration with UNEP RRC.AP, SACEP and SEI.

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

The training programme was started with the welcome address by Dr K R Huq, Director General, DoE, followed by opening remarks from Dr Quazi Sarwar Imtiaz Hashmi, Deputy Director (Dev. & Planning) & Project Director for Phase II Implementation of Malé Declaration Project, DOE. Mr M. Iyngararsan (UNEP RRC.AP). Mr Sagar Dhara facilitated the training programme.

The technical sessions in the training programme were handled by Dr G D Agarwal, Dr R H Siddiqi, Dr Martin Ferm, Mr M Iyngararasan and Mr Sagar Dhara. The training programme content is provided in Annex 2.

Participants: The trainees were from various offices and laboratories of the DoE, the Departments of Meteorology and Atomic Energy. The resource persons were from IVL, Envirotech and UNEP RRC.AP. A list of participants is enclosed in Annex 3.

The senior members of the team being trained had masters level degrees in various science disciplines. 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, PM10, gaseous sampling.
IVL: Passive Samplers for SO_2 and NO_2
MISU: Wet only collector, Bulk collector

No damage was noticed to the equipment or glassware when they were opened at the DoE.

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 hands-on, the trainees were enthusiastic and quick learners. Several dust samples and gaseous samples were collected at the DoE building and analyzed by the trainees. Knowing the results of their monitoring boosted the confidence of the trainees.

Recommendations

1. A follow-up visit should be done by a technician-level person in the first year after equipment installation to help sort out any problems that may exist with, sample collection and analysis, and equipment handling.

2. 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.

3. Theoretical aspects of the subject, eg, basic chemistry and statistics, QA/QC need to re-covered in future refresher 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 2

(**COURSE CONTENT AND SCHEDULE**)

Day	**Contents**	**Class/lab**	**Instructor**
Oct 19 Starting at 09:30 Tea break 10:30-10:45 Lunch 12:30-13:30	Introduction to the Malé Declaration and scope of present program (30min) Malé monitoring network (30) Units and materials and energy balance (30) Basics concepts of meteorology (30) Basic chemistry (30)	 C C C C C	 MI SD RHS GDA RHS
Afternoon Tea break Upto 17:00	HVS: features and setting it up (45 min) Features &operation of desiccator, balance & distillation unit Setting up the HVS for monitoring (60 min) Prep. for HVS operation like filter weighing, solution prep. Passive sampling: theory and practice (45 min)	C L L L L	GDA AG/SH AG/SH SH MF
Oct 20 Starting at 09:30	Dispersion of pollutants (30min) Spectrophotometer analysis (30 min) Calibration curve preparation NO_2	C C L	GDA RHS SH
Afternoon Upto 17:30	pH meter (30) Practical on PH meter (30 min) EC meter (30) Practical on EC meter (30 min) Wet only & bulk collector: theory (30 min) Setting up wet only collector Setting up bulk collector Removal /setting up HVS for new sample	C L C L C L L L	RHS SH RHS SH MF MF MF SH
Oct 21 Starting at 09:30	QA/QC (45 min) Basic Statistics (30) Calibration curve preparation SO_2	C L L	SD/RHS RHS SH
Afternoon Upto 17:30	Analyzing previous day's samples for HVs, WC, BC & computing results. Preventive maintenance for HVS Setting up HVS, WC and BC	L C	SH AG/GDA SH/MF
Oct 22 Starting at 09:30	Troubleshooting of WC, BC Analyzing previous day's samples for HVs, WC, BC & computing results.	C	MF/SD SH
Afternoon Upto 17:00	HVS Calibration One to one discussion Setting up HVS, WC and BC		GDA SH/MF
Oct 23 Starting at 09:30	Good laboratory practices Analyzing previous day's samples for HVs, WC, BC & computing results by participants.	C L	RHS
Afternoon Upto 16:30	Monitoring protocol (20 min) Data reporting (20 min) Evaluation and examination (1hr) Discussion, conclusion and issue of certificates		SD/MI MI MI/SD/MF/GDA

Note :

GDA	G. D. Agrawal, Env .	RHS:	R. H. Siddiqui Env.
MF:	Martin Firm, IVL	AG:	Anuj Goel Env.
MI:	Mylvakanam Iyngararasan, UNEP/RRC.AP	SH:	Shiv Shanker Env.
SD:	Sagar Dhara, MoC		

Annex 3

List of Participant

SL. No.	Name	Designation	Organization
1.	B.U.H. Mst. Akhtaruzzahan	Senior Chemist	DOE, Dhaka
2.	Md. Abdul Mannan	Junior Chemist	- Do -
3.	Md. Murshadul Islam	Junior Technician	- *Do* -
4.	Md. Mokbul Hossain	Senior Chemist	DOE, Khulna
5.	Md. Mizanur Rahman	Lab. Assistant	- Do -
6.	Md. Mustafizur Rahman Akand	Senior Chemist	DOE, Chittagong
7.	Md. Ashadul Haque	Junior Chemist	- Do -
8.	Md. Shah Alam	Junior Technician	- Do -
9.	Md. Saiful Islam	Lab. Assistant	DOE, Rajshahi,
10.	Md. Saifullah Talukder	Research officer	DOE, Hade Office, Dhaka
11.	Md. Abdul Azim	Draftsman	- Do -
12.	Abul Monsur Showkot Hossain	Sr. Scientific Officer	AQMP, DOE, Dhaka
13.	Mohammad Forhad Hossain	Lab.Technitian	AQMP, DOE, Dhaka
14.	Ms.Mosammet Jasmine Akter	Lab.Technitian	AQMP, DOE, Dhaka
15.	Qazi Kamrul Hassan	Officer-in-charge	Meteorological Office, Shathkhira
16.	Dr. Swapan Kumar Biswas	Principal Scientific Officer	Bangladesh Atomic Energy Commission, Dhaka

Resource Participants list

1)	Martin Ferm,	IVL
2)	Sagar Dhara,	MoC
3)	G. D. Agrawal	Envirotech
4)	Mylvakanam Iyngararasan,	UNEP RRC.AP
5)	R. H. Siddiqui,	Envirotech
6)	Shri. Shiv Shankar Singh,	Envirotech

Annex 4

TEST PAPER

1. Which are the participating countries of Malé Declaration?

……

2. Name the National Focal Point for Malé Declaration in Bangladesh?

……

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

……

4. Name the three main pollutants the Malé Declaration wishes to measure in AAQ monitoring?

……

5. What effects do air pollutants of immediate concern to us in the Malé Declaration have on human health?

……
……

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

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

8. Indicate if true or false:

   a) Concentrations of particulate air pollutants are measured in ppm by volume. True False
   b) 5 mg/L is the same as 5g/m^3. True False
   c) High Volume Sampler can be used to measure dust fall True False
   d) 1PPM is equal to 1000PPb 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 impingers for collection of gaseous pollutants – SO_2 and NOx. True False
   h) Water in the manometer in High Volume Sampler should be replaced every 6 months. True False

9. 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) 0.2-1L/min (iv) 1-4 mL/min

(i) 26μg/m^3 is equal to

(i) 1 PPM (ii) 0.1 PPM (iii) 0.01PPM (iv) 1 PPB

(j) Calculate the amount of $NaNO_2$ need to be dissolved in 1000ml of distilled water to obtain NO_2 concentration as 1000μg/m^3. Assay of $NaNO_2$ is 97%.

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

11. 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.

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

13. What is wet deposition

…….

…….

14. What is dry deposition

…….
…….

15. 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

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

…….
…….

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

…….

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

…….

19. What is the current plan to analyse the diffusive (passive) samplers?

…….

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

…….

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

…….

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

…….

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

…….

24. Why do we need to measure the volume of the precipitation?

……
…….

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

……
…….

26. Why are two different equipments used for rain collection?

…….
…….

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

28. Are you aware of the health and safety issues associated with analyzing the samples in the laboratory? Give example.

……
……

Annex 5

Summary of the final program evaluation Result

Question	Not at all (%)	A little (%)	Somewhat (%)	Mostly (%)	Completely (%)
Overall objectives and content					
1. Were the objectives clear and precise			18.18	72.72	9.09
2. Were the objectives attained?			9.09	63.64	27.27
3. Was the content linked to the objectives?			9.09	54.54	36.36
4. Was the content well structured?			9.09	63.63	27.27
5. Was the content presented clearly?			9.09	54.54	36.36
To what extend did these sections of the training workshop meet your expectations?					
6. Basics of air pollution monitoring			9.09	63.63	18.18
7. Sampling PM10 using HVS		9.09	9.09	45.45	27.27
8. Gaseous Sampling using HVS		9.09	18.18	54.54	18.18
9. Sampling with bulk collector		27.27	9.09	45.45	9.09
10. Sampling with wet only collector	27.27	9.09	9.09	36.36	9.09
11. Sampling using passive samplers	27.27	18.18	18.18	18.18	9.09
Methodology					
12. Was the methodology used appropriate for the training program and you as a professional?		9.09	27.27	36.36	27.27
13. Did the methodology help you to share your own knowledge and experience?	9.09		18.18	45.45	27.27
How useful did you find the following elements of the training program?					
14. Lab session (Spectrophotometer)				54.54	36.36
15. Lab session (pH and EC Meters)			9.09	36.36	45.45
16. Facilitated discussions		9.09	9.09	54.54	27.27
17. One to one discussions		18.18		54.54	27.27
Logistics					
18. Was the meeting venue adequate?		9.09	9.09	45.45	36.36
19. Was the timing of the agenda comfortable?		9.09	27.27	36.36	27.27
20. Was the length of the sessions appropriate?	9.09	9.09	18.18	54.54	9.09
	Excellent (%)	Good (%)	Average (%)	Unsatisfactory Poor (%)	
21. Overall, how would you rate the training? Please circle one.	27.27	72.72			

Annex 6

REPORT ON VISIT TO THE BANGLADESH MONITORING SITE

1. Team

Mr QSI Hashmi, Dy Dir, DoE, Govt of Bangladesh, Mr Mylvakanam Iyngararasan, Programme Specialist, UNEP, RRC.AP, Bangkok, Mr PK Kotta, Project Coordinator, SENRIC, SACEP, Sri Lanka and Mr Sagar Dhara, Member, MoC, UNEP, visited the proposed Bangladesh monitoring site on 26-27 February 2004. The team was accompanied by district and village authorities.

2. Area visited

The proposed area for the site was chosen by DoE, Bangladesh. The site is in southwestern tip of Bangaladesh in Nurnagar union, Shayamnagar Upazilla, Shatkhira District, Khulna Division, bordering the southeastern tip of West Bengal state of India.

The team was shown two sites, approximately 45-50 km from Shatkhira. Both sites are less than 5 km distance from the Indian border. The exact location for these sites has yet to be fixed.

The soil of the area was fine clay, typical of the Indo-gangetic plains. The area had lush vegetation, but which did not completely suppress re-entrained PM (particulate matter).

3. Site 1: Ramjibanpur

Location: N 22^{o} 20.038; E 89^{o} 03.022

This site is about 8 km from Shyamnagar. It is surrounded by aquafarms. There is road within 200-300 m from the proposed site. There is a power line along the road, which can be tapped to provide power to the site.

There are several emission sources in the vicinity of the site.

1. Several water pump (diesel) sets were visible in the immediate proximity of the site. The local government officials estimated that there were 30-50 water pumps in a one kilometer radius around the site. The water pimp sets were 8-12 HP and ran for about 8 hrs every 4-5 days. These pumps do not run during the monsoon months—May-July and run regularly during the months—January-March. During the other months, their use is a little more sparing.

2. The road close to the proposed site had 2-wheeler, 3-wheer and 4-wheeler vehicles plying on it. While the team was at the site approximately one 4-wheeler and 2-3 two and three wheelers plied on the road every 5 minutes.

3. While there are no major industries in the vicinity, there are about 40-50 brick kilns within a 50 km radius of the site.

4. There are about 16 villages in a 10 km radius around the site, with an approximate population of 15,000 persons (3,000 families). Biomass burning is considerable in these villages. The primary cooking energy used is wood. Each family used about 8 kg of wood per day. Rice husk was also used for making par-boiled rice. Approximately 100-200 kg of rice husk (emits considerable PM) was burnt by each village per year. Rice husk ash was added to the aqua ponds (more PM emissions).

5. Some edaphic source dust would be emitted from football and such other games played in the vicinity of the sites.

6. Agricultural activity across the border were basically one-season paddy cultivation.

4. Site 2: Haripur

Location: 22^{o} 18.975; E89^{o} 02.607

This site was about 3 km inland from Site 1 and was surrounded by paddy fields. There was a small hamlet close to the site.

The conditions of this site were similar to that of Site 1, except in two respects. There were no water pump sets to be seen in the site surroundings and the number of vehicles plying on the interior road close to the site were very few. The hamlet close to the village had a power line from which a power line could be extended to the site.

The additional emission sources in this area were:

1. The use of power tillers once a year to plough the land. Each acre requires the use of a power tiller for about 3 hrs.

2. Some rice husk straw and cow dung is burnt.

3. There is some use of pumps for supplying irrigation water to the fields.

5. Forest Departments area

Location: N 22^{o} 12.055; E 89^{o} 04.403

The team also traveled upto the edge of the Sundarbans forest, about 30-40 km south of Sites 1 and 2, and took a small boat ride into the mangrove forests in the Forest Department's boat. There were some human settlements close to the Forest Department office located at the edge of the Sundarbans Forest. Livelihood of the local people seemed to be divided between fishing in the creeks and agriculture.

6. Site selection criteria

Site selection criteria that were met are:

1. All three sites were representative of their areas.
2. Both types of sites—deposition monitoring and ecological monitoring sites were available.
3. The sites were sufficiently close to the international border, with the intervening terrain being flat and without any major point or area emission sources between the emission sources across the border and the monitoring station.
4. The sites are downwind of the emission sources across the border.

5. The sites are accessible.
6. The sites are within 12 hr travel time from Khulna, where the samples will be analyzed.
7. The site is probably in an ecologically sensitive area. However, this requires verification.

The site selection criteria that were not met are:

1. Except for the Sundarbans Forest Department office, the sites were not in low population density areas. However, it is impossible to find a low population density site in Bangladesh, except probably inside the Sundarbans Forest. Hence, these sites are as good as they can be for the purpose of the deposition and ecological monitoring.
2. The sites are not remote sites but rural sites.

7. Site classification

All three sites may be classified as rural, with the Forest Department office land coming the closest to being a remote site.

8. Recommendations

Between Site 1 and 2, it was felt that Site 2 was a better site. The local government officials indicated that there is no problem shifting the location of site in this area.

Between the two sites and the Forest Department area, the best site is the Forest Department. It is more remote, with fewer local interferences, than the other two sites, and meets the MoC criteria better. However, it has no power line, which is a disadvantage for refrigerating the samples before analysis and for the running the HVS.

- The first choice would be set up the monitoring station in the Forest Department office land, provided a power line can be obtained there in the near future.

- The second choice would be to choose an appropriate location at Site 2 and also place additional samplers and a bulk collector at the Forest Department site. This would provide an understanding of the extent of local interference at Site 2.

Some Photographs from the Training Programme