



Malé Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia



Proceedings of the Annual Network Meeting 2003

6-7 October 2003
Dhaka, Bangladesh



PROCEEDINGS
ANNUAL NETWORK MEETING ON MALÉ DECLARATION
6-7 October 2003, Dhaka, Bangladesh

C O N T E N T S

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Proceedings

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LIST OF ACRONYMS

EANET	East Asia Network on Acid Deposition
DoE	Department of Environment
MoEF	Ministry of Environment and Forest
MoC	Monitoring Committee
NFP	National Focal Point
NIA	National Implementing Agency
RAPIDC	Regional Air Pollution in Developing Countries
SACEP	South Asia Co-operative Environment Programme
SEI	Stockholm Environment Institute
Sida	Swedish International Cooperative Development Agency
UNEP/RRC.AP	United Nations Environment Programme / Regional Resource Center for Asia and the Pacific
UNEP/ ROAP	UNEP Regional Office for Asia and the Pacific

PROCEEDINGS

The network meeting 2003 on the Malé Declaration on 'Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia' was held in Dhaka on 6-7 October 2003. The meeting follows a continuation of the process, which began in Bangkok in March 1998 where a policy dialogue concerning regional air pollution in South Asia was initiated. The first network meeting after the adoption of Malé Declaration was held in Kathmandu during 22-23 February, 1999 and the network meeting 2001 was held in Colombo on 29 June. The network meeting for the year 2002 was held in Kathmandu during 18-19 July. Each participating country in South Asia nominated the National Implementing Agency (NIA) and National Focal Points (NFP) to follow-up activities and implementation of the Malé Declaration. Phase I activities on baseline studies and national action plans to monitor air pollution and its transboundary effects were successfully completed with active participation of countries. Phase II activities were initiated in March 2002 aimed at building capacity in each participating country for generating dry and wet deposition data in order to carry out the assessment of transboundary air pollution. The network meeting 2003 was organised in order to review the progress made since the last network meeting, and to chart out the future plan of action.

The meeting was attended by the Ministries of Environment and National Implementing Agencies (NIA) of the participating countries, members of Monitoring Committee (MoC), SACEP, SEI, UNEP, some experts and an independent facilitator. A list of the participants is enclosed in Attachment 1.

The meeting was organized by UNEP/RRC.AP, in collaboration with DoE, Bangladesh, SACEP and SEI. The meeting was funded by Sida as a part of the Programme on Regional Air Pollution in Developing Countries (RAPIDC).

1. Opening session

The network meeting 2003 for Malé Declaration was inaugurated on 06 October 2003. The inaugural session was addressed by H.E. Shajahan Siraj, Hon. Minister of Environment and Forest (MoEF), Sabihuddin Ahmed, Secretary of MoEF, Omar Faruque Khan, Director General, DoE, Mahboob Elahi, Director General, SACEP, Johan Kuylenstierna, Director, SEI-Y and Surendra Shrestha, Regional Director, UNEP ROAP / RRC.AP.

Dr. Omar welcomed the participants and outlined the accomplishments of phase I implementation of Malé Declaration in Bangladesh. He informed that the monitoring station under the Malé declaration will be soon established in Bangladesh for monitoring the transboundary air pollution as part of the phase II activities.

Mr. Shrestha called for a proactive approach and briefly elaborated the achievements of the Malé Declaration. He informed that the current phase (phase II) is focusing on capacity building for monitoring transboundary air pollution and in the future there is a need to provide our policy makers with mitigation options. He also provided an update on the similar initiatives in East Asia (EANET) and ASEAN countries (ASEAN Protocol on Transboundary Haze). Lastly, he thanked all the participating countries and agencies for

their commitments and active cooperation with regard to the implementation of Malé Declaration and Sida for its financial support.

Mr. Elahi in his opening remark emphasized the significance of transboundary air pollution and said that the Malé Declaration provides a framework to allow countries to work together on transboundary air pollution.

Dr. Johan Kuylensstierna in his speech informed that SEI is providing technical support to the implementation of Malé Declaration and expressed satisfaction on the progress thus far. He explained that some of the scientific activities of the RAPIDC programme can be helpful to the Malé Declaration.

In an opening speech, H.E. Mr. Shajahan Siraj expressed that air pollution as an emerging environmental issue is becoming a matter of great concern for Asia. He informed that the Government of Bangladesh has taken various steps to control air pollution and these actions have resulted in significant improvement in the air quality of Dhaka. He mentioned that Bangladesh has been undertaking phase-wise activities toward implementation of the Malé Declaration.

Mr. Sabihuddin Ahmed touched on the national level implementation of the Malé declaration in Bangladesh. He also mentioned that holding the Malé declaration meeting in Dhaka will pave the way to undertaking further initiative in controlling air pollution at national level as well as undertaking studies to assess and combat transboundary impacts of air pollution at regional level. He thanked UNEP, SACEP and SEI for the initiative.

2. Review on progress made

Mr. R. Rajamani, former Secretary of Ministry of Environment and Forests, Government of India was invited to facilitate the proceedings. In his introductory remarks, Mr. Rajamani briefly elaborated the objectives of the meeting and requested participating countries to put forward issues of concerns that could be discussed in detail at the meeting.

Mr. M. Iyengararasan of UNEP-RRCAP presented the progress made since the last network meeting held in June 2002. The various activities carried out in the period included: Development of training manuals; formal contracts with equipment vendors; development of in-country training programmes; holding the in-country training programs and installation of equipments in 5 countries; organizing of a technical training program at regional level for wet deposition monitoring; a national level stakeholders meeting in India; and information exchange through a newsletter and news groups at www.rrcap.uneo.org/md/webboard for information exchange. He also outlined the proposed activities to be developed for phase III, which include: monitoring and science/capacity building; (ii) impact studies; (iii) policy setting (see Attachment II).

3. Country presentations

Bangladesh: Mr. Hashmi presented the progress in Bangladesh (Attachment IV). Summary of the presentation and major discussions include:

- Selection of monitoring station and land procurement are completed. The construction of monitoring site will start in one month time at Shamnagar in the Sathkhira district.
- Equipment has been received and the in-country training program will be held during 19 –23 October 2003.
- Linkages with relevant programs/institutions in Bangladesh have also been made.
- A ten member national advisory committee has been established.
- Sample analysis will be carried out at the laboratory at Kulna and the national database will be located at the DoE.
- DoE are finalizing an air quality index for Dhaka
- A National stakeholders meeting will be held during phase II

Bhutan: Mr. Nedup presented the current status of monitoring station in Bhutan (Attachment V). Summary of the presentation and major discussions include:

- The monitoring site is operational since mid-June.
- NEC is working to include the data to the national environment information system.
- Sample analysis will be conducted at RNR laboratory and the national level database will be located at NEC.
- Identified electricity, security and communications as the major obstacles in operating the site. It is expected a permanent power supply line will be established to minimize the power failure.
- Further training was requested for the improvement of data quality.

Iran: Dr. Saeed Motesadi presented the progress in setting up the monitoring station in Iran (Attachment VI). Summary of the presentation and major discussions include:

- 9 potential sites have been identified for the establishment of monitoring stations under the Malé Declaration.
- DoE have purchased the land for the establishment of 1st monitoring site at Chamsari and the constructions have also been initiated. The site will be operational by November 2003 and the first set of data will be available by mid-December.
- National database will be located at DoE in Tehran.
- Delays due to the war situation in the neighbouring countries are identified as a major constraint.
- More financial support, regional data bank through the internet and meteorological studies were suggested for the consideration.
- Iran expressed its interest to host the next network meeting in Tehran.

Nepal: Md. Bidya Banmaly Pradhan presented the progress in the implementation in Nepal (Attachment VII). Summary of the presentation and major discussions include:

- The site established at Rampur is operational and the technical staffs conducting the monitoring are confident with sampling and analysis.
- Monitoring results for the first 4 months together with the site's details were presented.
- The participants observed that the PM10 concentration was relatively high for a rural station like Rampur.
- Requested for an automatic met station and the site for the met station has also been allocated close to the air quality monitoring station.
- Wet deposition monitoring equipment to be installed at Rampur by end of 2003.

Sri Lanka: Mr. C. K. Amarathunga presented the progress in implementing the Malé Declaration in Sri Lanka (Attachment VIII). Summary of the presentation and major discussions include:

- Site selection completed and the passive samplers are already installed at the site.
- The site will be fully operational by the end of October 2003.
- A 7 member advisory committee has already been established which is to meet once every three months.
- The national level database will be located in the CEA.
- A limnology study will be set up in near future, depending on funding.

India: Dr. Sengupta presented the current status of air quality monitoring and the progress in implementing the Malé Declaration in India (Attachment IX). Summary of the presentation and major discussions include:

- Proposed to establish 9 sites for monitoring transboundary air pollution.
- The first site has already been established at Port Caning and it will be further strengthened with the equipments from Malé Declaration.
- Presented preliminary results from the site at Port Caning. The results are currently being reviewed by the national advisory committee and will be submitted to UNEP as soon as it is cleared by the national advisory committee.
- A nine member advisory committee has already been established and will meet every 6 months.
- A terms of reference for the advisory committee has also been developed.
- Recommended inventory of sources; validated air quality models; scientific studies for site selection; study of emissions from neighboring (non participating) countries; and road map for improvement of fuel quality.

4. Further improvement of monitoring network

A discussion on further improvement of monitoring network was held with the aim of strengthening the monitoring network under the Malé Declaration. Major discussion includes:

- Quality of the data needs to be improved through the implementation of QA/QC programs.
- Characteristics of particulate matter could be useful for source characterization.
- The type of analysis (parameters) is important and the ideal is to have fewer high quality sites rather than a larger number of poor sites. The optimum number of monitoring sites required depends on what the data will be used for. Monitoring and modeling need to be closely linked. The monitoring at the first sites established needs to be of the highest quality possible before the establishment of further sites. Some countries requested for more sites to get an idea of transboundary air pollution and in the future this should be considered using advice from modeling approaches.
- Study of local situation is important for the site selection. Although it is difficult to select regional representative site, optimal site should be selected. Site selection criteria have recently been relaxed by MoC.
- Facilities for monitoring meteorological parameters need to be included; if there are no met stations nearby.

- It was informed that the technical details including manuals are already available under the Malé Declaration for monitoring the impacts like soil, aquatic environment and vegetation monitoring. NIAs are encouraged to initiate the impact monitoring, after getting data on work already done by networked agencies in fields like agriculture, health etc.

5. Further improvement of technical manual

The technical manual has been updated with the comments made in the network meeting 2002 and the experiences in conducting the monitoring thus far. Mr. Sagar Dhara of the MoC presented the technical manuals. Major discussions on technical manual included:

- Guidelines for HVS roof design need to be included in the manual.
- If flow rate of HVS becomes low during sampling period and is not adjusted then sample should be disregarded.
- Installations of wire mesh cover was recommended to protect the samplers from wild animals. For HVS and passive sampler the cage will not affect the sampling.
- In order to minimize the moisture differences, filter papers should be kept in the same condition (desiccator at room temperature) and timing before and after the sampling.
- In order to avoid overflow of wet only collector a bigger collection bottle (10 l) was suggested. MISU now have a recommended design for modification to increase capacity to 10 litres or more.
- The technical manual should provide alternative methods for sample analysis.
- Preservation of filter papers for further analysis could be included in the manual.
- To improve sensitivity of active SO₂ and NO₂ sampling can have two impingers in parallel.

The manual will be updated based on the comments and suggestions from the meeting.

6. Parallel activities on emission inventory and integrated modeling

Mr. Mylvakanam Iyngararasan and Mr. Rohana of UNEP RRC.AP and Dr. Johan Kuylensstierna and Mr. Harry Vallack of Stockholm Environment Institute (SEI) presented (Attachment X) the parallel activities on emission inventory and integrated assessment modelling (IAM) that has been initiated under Malé Declaration for assessment of transboundary air pollution. In addition to the emission inventory, a preliminary version of IAM was also demonstrated. Major discussions include:

- The main objective is to have an IAM tailored to regional needs and all decisions on structure etc to include consultations with NIAs (e.g. similar to the process of deriving emission regions)
- Local emission factors should be used wherever possible.
- Emission factors for small industries should also be considered in the inventory.
- PM_{2.5} could be included in the inventory in the future.
- The IAM, which is a graphical tool to link emissions with mitigation options, includes an atmospheric transfer model (MATCH) which takes the best internationally available emissions inventory and calculates deposition values that can then be compared to some indicator of impacts. The MATCH atmospheric

transfer model was developed for European conditions but has now been adapted for Asian conditions and includes all major topography (on 40 by 40km grid so not so accurate for complex terrain). SMHI has reasonable confidence in the model performance but this needs to be backed up by validation with Malé monitoring results and the results can only be considered to be preliminary until countries have produced their own emission inventories and have satisfied themselves with the performance of the MATCH model in South Asian conditions.

- A main menu with well-defined input and output facilities should be developed for running the model.

7. Other issues

Means of data sharing was discussed during this session. Major discussions include:

- NIAs will maintain the data at their national database.
- NIAs will send the data to UNEP on a monthly basis and UNEP will verify the data with the expert team before inputting into the regional database. The National Advisory Committee will give their advice on the data in parallel.
- Regional database will be made available for the network through the Intranet.
- E-mails and web based discussion forums will be utilised as much as possible for the information exchange among the network members.
- The network will always be consulted regarding analysis and publication of monitoring data.

8. Closing session

Mr. Rajamani, facilitator, summed up. In his summary, he expressed that the presentations and discussions were in high standard and it shows the development of the network with the establishment of the monitoring network. He expressed the hope that study of impacts and mitigation options will be worked out by NIA's. The involvement of all stakeholders was important. Requested the NIAs to try and get national support for more efforts, do not wait for external support. The meeting ended with the representatives from SACEP, SEI and UNEP thanking the facilitator, participants and organizers.

**Attachment 1: Malé Declaration on Control and Prevention of Air Pollution and its Likely
Transboundary Effects for South Asia
Annual Network Meeting 2003**

6-7 October 2003

Participant List

<p>Bangladesh</p> <p>1. Mr. Md. Mizanur Rahman Assistant Chief Ministry of Environment and Forest Room# 1330 Building 3 Building#06 Bangladesh Secretariat, Dhaka Bangladesh Fax: 8802 8619210 Tel: 8802 9570661 Email: mazanforest@yahoo.com</p>	<p>2. Quazi Sarwar Imtiaz Hashmi Deputy Director (Dev. & Planning) Department of Environment Paribesh Bhaban, Room No. 101 E-16, Agargaon, Sher-E-Bangla Nagar Dhaka-1207, Bangladesh. Fax: 880-2-9118682/ 9113328 (Telefax) Email: hashmi@doe-bd.org</p>
<p>3. Mr. Md Saifullah Talukder Research Officer Department of Environment Paribesh Bhaban, Room No. 101 E-16, Agargaon, Sher-E-Bangla Nagar Dhaka-1207, Bangladesh Tel:8802-9118682/ Fax: 9113328 (Telefax) Email: saifullah@doe-bd.org</p>	
<p>Bhutan</p> <p>4. Nedup Tshering Program Coordinator National Environment Commission (NEC) Royal Government of Bhutan P.O. Box 466, Thimpu, Bhutan Tel (O): 975-2-323384/ 325856 Fax (O): 975-2-323385 Email: nedup@nec.gov.bt</p>	<p>5. Mr. Jigme National Environment Commission P.O. Box 466, Thimphu, Bhutan Fax: 975-2-323385 Tel: 975-2-323384/ 325856 Email: jigme@nec.gov.bt</p>
<p>India</p> <p>6. Dr. B. Sengupta Member Secretary, CPCB, Ministry of Environment & Forests, Parivesh Bhawan, East Arjun Nagar,, Delhi 110032, India Fax: 91-11- 22307078 Tel: 91-11- 22303655, 00-91-9810043771 Email :bsg1951@yahoo.com</p>	<p>7. Prof Dilip Biswas, Ex-Chairman, CPCB 40/14, CR Park, Kalkaji, New Delhi - 110019 Tel.: 91-11-26463991/ 26287063, 9810043774 (mobile) E-mail: biswasmala@hotmail.com.</p>

<p>8. Dr. A.L. Aggarwal, President, Indian Association for Air Pollution Control, Delhi Chapter 241A, Pocket-I, Mayur Vihar, Phase-I, Delhi-91 Tel: 91-11-31074668, 011-31074668 (mobile) Fax: 91-11-6811833 Email : al_aggarwal@hotmail.com & dralal@vsnl.net</p>	
<p>Iran</p> <p>9. Dr. Saeed Motesaddi Zarandi Director General for Air Pollution Research Bureau-DOE Environmental Research Center Hemmat Highway Pardisan Park Tehran, Islamic Republic of Iran Tel (O): 98-21-8267996 Fax (O): 98-21-8269920 Email: motesaddi@yahoo.com & motesadi@irandoe.org</p>	<p>10. Mr. Sadredin Ali pour Project Expert Air Pollution Research Office Environmental Research Center Hemmat Highway Pardisan Park Tehran, Islamic Republic of Iran Tel (O): 98-21-8267996 Fax (O): 98-21-8269920 Email: sadreddin1975@yahoo.com</p>
<p>Nepal</p> <p>11. Mr. Narendra Prasad Pokhrel, Senior Divisional Chemist, MOPE. Tel: 977-1-4245367(O); 977-1-4273395 (R) Fax: 977-1-4242138(O); 977-1-4260110 (R) Email: pokhreln@hotmail.com</p>	<p>12. Ms. Bidya Banmali Pradhan Environment Officer, MENRIS International Centre for Integrated Mountain Development (ICIMOD) P.O. Box 3226, Kathmandu, Nepal Tel (O): 977-1-525313 ext. 566; (R): 977-1-253044 Fax: 977-1-524509/536747 Email: bbanmali@icimod.org.np</p>
<p>Sri Lanka</p> <p>13. Mr. Anura Jayathilake Deputy Director Ministry of Environment & Natural Resources 'Sampathpaya', No 82, Rajamalwatta Road, Battaramulla, Sri Lanka Tel: 94-1-2887453, 94-74-412285 Fax: 94-74-412285 Email: coordinator@wow.lk or lasith@slt.lk</p>	<p>14. Mr. C. K. Amaratunga Deputy Director (Environmental Pollution Control) Central Environmental Authority 104, Robert Gunawardana Mawatha Battaramulla, Sri Lanka Tel: 94-1-2873452/3 Fax : 94-1-2872605 Email: ck@cea.lk</p>
<p>15. Prof. O.A.Ileperuma Department of Chemistry University of Peradeniya Peradeniya, Sri Lanka. Tel: 94 8 2388693, 2389152 (official) 94 8 2388848 (home) Fax: 94 8 2388018 or 2389026 E-mail: oliveri@pdn.ac.lk</p>	

<p>Regional Facilitator</p> <p>16. Raghunathan Rajamani Ex-Secretary, Ministry of Environment & Forestry Government of India 8-2-585/A/1, Road No.9, Banjara Hills Hyderabad-500034, India Fax: 91-40-2335 5480 Tel1: 91-40-2335 8320 E Mail: rraja9@vsnl.net</p>	<p>Monitoring Committee (MoC)</p> <p>17. Sagar Dhara E-303 Highrise Apts, Lower Tank Bund Rd Hyderabad 500 080, India Tel: 40 2753 6593, (40) 55137296 Fax: 40 2780 8808 E mail: sagdhara@hd1.vsnl.net.in</p>
<p>SACEP</p> <p>18. Mehboob Elahi Director General, South Asia Cooperative Environment Programme (SACEP) #10 Anderson Road, Colombo 5, Sri Lanka Fax: 94-1-2589369 Tel1: 94-1-2589787 Tel2: 94-1-2589376 Email: melahi@eureka.lk</p>	<p>19. Pradyumna Kumar Kotta Project Coordinator, South Asia Cooperative Environment Programme (SACEP) #10 Anderson Road, Colombo 5 Sri Lanka Fax: 94-1-2589369 Tel1: 94-1-2589787 Tel2: 94-1-2596443 E-Mail: pk_sacep@eureka.lk</p>
<p>SEI</p> <p>20. Dr. Johan Kuylenstierna Director, Stockholm Environment Institute - York (SEI-Y) University of York York YO10 5DD, UK Tel: +44 1904 432897 (general), 432892 (direct) Fax: +44 1904 432898 Email: jck1@york.ac.uk</p>	<p>21. Harry Vallack Research Associate Stockholm Environment Institute - York (SEI-Y) University of York York YO10 5DD, UK Tel: +44 1904 432897 (general), 432894 (direct) Fax: +44 1904 432898 Email: hvv1@york.ac.uk</p>
<p>22. Dr Kevin Hicks Research Associate Stockholm Environment Institute - York University of York York ,YO10 5DD ,UK Tel +44 (0) 1904 432 896 Fax +44 (0) 1904 432898 Email: khicks@york.ac.uk</p>	

<p>SMHI</p> <p>23. Dr Magnuz Engardt Swedish Meteorological and Hydrological Institute (SMHI) S-601 76 Norrköping ,Sweden Tel +46 11 495 85 82 Fax +46 11 495 80 01 Email: Magnuz.Engardt@smhi.se</p>	
<p>UNEP RRC.AP</p> <p>24. Surendra Shrestha Director UNEP RRC.AP Asian Institute of Technology P.O. Box 4, Klong Luang, Pathumthani 12120 Thailand Fax: 662 516 2125 Tel: 662 516 2124 E Mail: Surendra@rrcap.unep.org</p>	<p>25. Mylvakanam Iyngararasan Senior Programme Officer UNEP RRC.AP, Asian Institute of Technology P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand Fax: 662 516 2125, Tel: 662 524 6239 E Mail: iyngara@rrcap.unep.org</p>
<p>26. Naw Wah Wah Htoo Programme Officer UNEP RRC.AP, Asian Institute of Technology P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand Fax: 662 516 2125 Tel: 662 524 6234 E Mail: wahwah@rrcap.unep.org</p>	<p>27. Rohana Deshapriya Rezel Research Assistant UNEP RRC.AP, Asian Institute of Technology P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand Fax: 662 516 2125 Tel: 662 524 6492 E Mail: rohana.rezel@rrcap.unep.org</p>

Attachment II
Presentation on Progress science network meeting 2002

MALÉ DECLARATION



CONTENTS

Progress

Technical Details
Capacity building
Stakeholders participation

About Phase III

Monitoring
Science
Mitigation



Progress since Network meeting 2002



Last Network meeting was held in July 2002 at Kathmandu reiterated the need for Capacity building through training and equipments

Progress: Equipment Details

Completed technical details for the equipments

Technical Manual

Training materials

Equipments (site and lab)

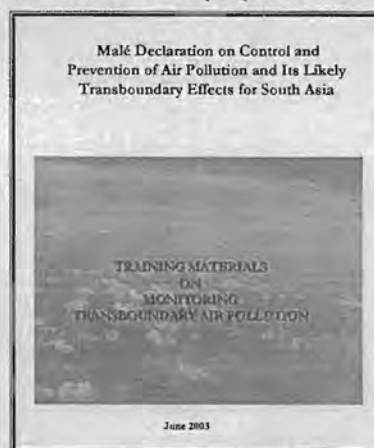
Consumables (site and lab)

Vendors:(formal contract)

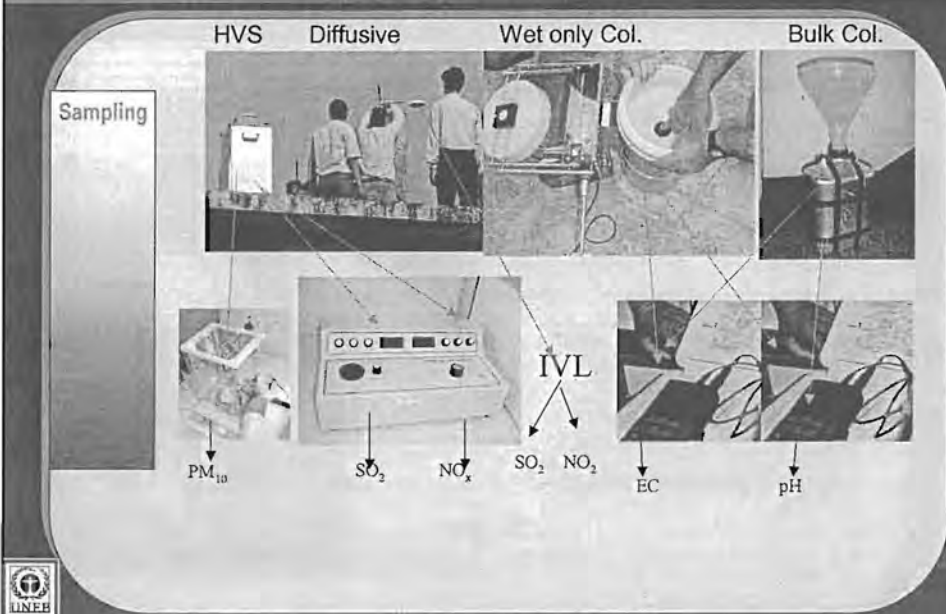
Envirotech, India

IVL, Sweden

MISU, Sweden



Progress: Equipment Details



Progress: In-country training program

Monitoring air concentration using HVS

- Sampling
- Analysis

Monitoring air concentration using Passive sampler

- Sampling
- Sample handling

Monitoring wet deposition

- Sampling by wet only collector
- Analysis of rainwater for pH and EC

QA/QC and Data management

OBJECTIVES: to familiarize the participants with the handling of air monitoring instruments and laboratory equipment.

Capacity building in Nepal

Monitoring station established in Chitwan, Nepal in March 2003. Trained over 15 technical personals.

MONITORING STATION AT RAMPUR, CHITWAN - ON LOCAL SCALE (10 Kms. circles of 500 m. interval)



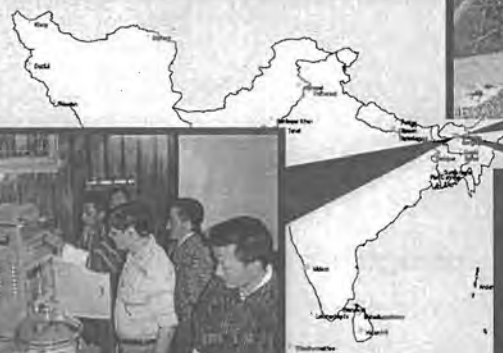
x To be established by Dec 2003
(8 sites)

. Locations identified for further expansion
(30 sites)



Capacity building in Bhutan

Trained 8 technical personals during May 28 – Jun 1 in Bhutan



Learning rainwater sampling



Learning air sampling



Analyzing the sample



Capacity building in Sri Lanka



Trained technical personals
during Jun 23 - 28 in
Colombo



Learning rainwater sampling



Air sampling



Capacity building in Maldives



x Trained technical personals
during Jul 28 - Aug 1 in
Hanimadho



Learning rainwater sampling



Air sampling



Capacity building in Maldives



Existing Met station



Fixing the passive sampler



Capacity building in Iran



X Trained technical personals
during Sep 13 – 17 in
*Tehran



Laboratory at Illam



Studying the passive samplers



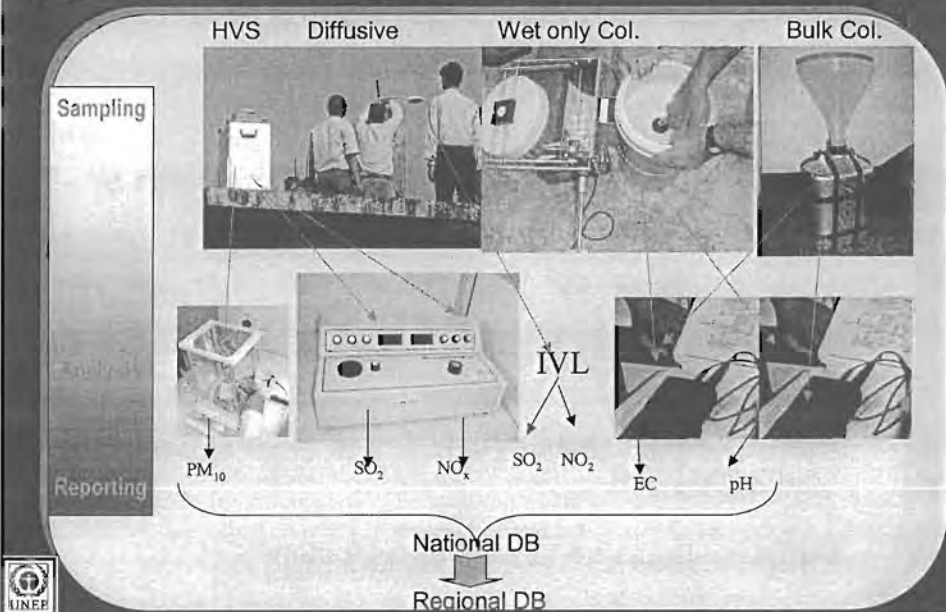
National Monitoring: Data reporting

objectives to provide useful inputs for decision-making at local, national and regional levels.

Reporting frequency: monthly basis



Malé Declaration: Data Reporting



National Reporting: Frequency

Wet deposition monitoring

- Weekly composite samples using wet only collector.
- Weekly composite samples using bulk collector. (Collector must be cleaned thoroughly at the beginning of each week to ensure that there is no dry deposition in the collector from the previous week)



National Reporting: Frequency

Air Concentration Monitoring

Gaseous samples: 24 hr samples [9 am – 9 am];
Sampling to be done for 10 days/month between 5th – 25th of each month.

Dust samples: 24 hr samples [9 am – 9 am next day]. Sampling to be done 10 days/month between 5th – 25th of each month.

(Valid sample: when machine up time is >60% of sampling time)

Diffusive (passive) samplers: Monthly



National Reporting: Meteorological measurements

wind direction/speed, temperature, humidity,
precipitation amount and solar radiation

(in accordance with the measurement frequency
of the meteorological monitoring system of
each country)



National Reporting: Site Details

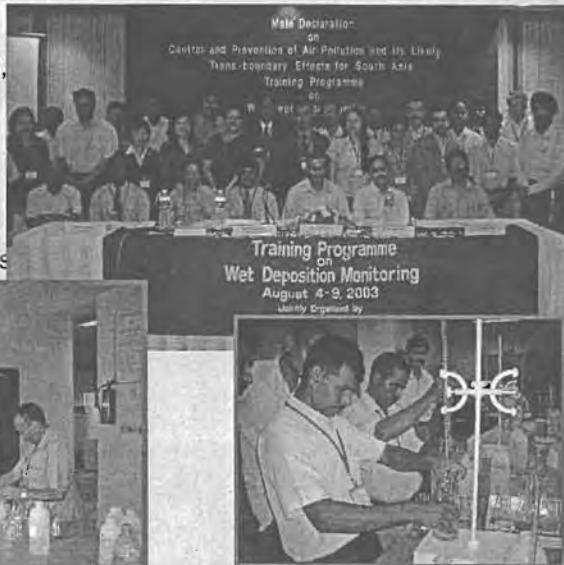
**Site details such as land use, potential contamination
sources, geographical description, climate need
to be documented using the reporting form S1,
S2, and S3.**

**If the information submitted changes, the up-to-date
information should be reported as soon as
possible**



Regional Training: Wet deposition monitoring

- 4-9 Aug 2003, CPCB, Delhi
- To familiarize the participants on analyzing rainwater for anions and cations



Parallel Studies

Emission Inventories

Integrated Assessment Model



2003 9 48

Stakeholder's participation

National Stakeholder meeting was held in Delhi on 24 September 2002.

Dissemination

Recommendations:

- clear scientific findings;
- Locate the source of concern and manner in which it can be addressed;
- Capability building should receive priority;
- Information sharing;
- Review action plans;
- Need financial support and countries to step up their investments, especially in kind



Information Exchange

Publication of Newsletters

A discussion group for the Male' Declaration network is developed

<http://www.rrcap.unep.org/malewebboard>



About Phase III

Objectives

- * Capacity building activities initiated during the phase II implementation has made significant impacts at the national and regional level.
- * The general objective of Phase III is to continue the capacity building activities in terms of monitoring, training, quality assurance and quality control and initiate the load up of information to the policy making process.
- * This objective could be achieved through three major components namely monitoring and science, analysis and impact studies, and policy studies.



About Phase III

Monitoring and Science

- * Continue monitoring initiated during phase II
- * Establish / strengthen additional monitoring sites for monitoring air concentration and rainwater
- * Introduce Ozone monitoring in all the Malé sites
- * Training and refresher courses
- * Implementation of QA/QC program
- * Review of technical manual



About Phase III

Analysis and Impact Study

- * Emission inventory and modeling
- * Study the impacts of air pollution on health
- * Study the impacts of air pollution on agriculture
- * Promotion of research and data analysis at NIAs and participating institutions; staff exchange programs
- * Establishment and maintenance of monitoring data base



About Phase III

Policy Setting

- * Network activities
- * Strategy paper on future scenario of Malé declaration
- * Mitigation options



Attachment III
Preparation of national implementation plan by Bangladesh

Annual Network Meeting: 2003
Male Declaration of on Control and Prevention of Air
Pollution and Its Likely Transboundary Effects for South Asia

Presentation on the National Monitoring Plan of Bangladesh

By
Quazi Sarwar Imtiaz Hashmi
Deputy Director (Dev & Planning)
Department of Environment
Ministry of Environment and Forest

Background Information

Phase I: Preparation of National Action Plan for
Bangladesh on Control and Prevention of Air
Pollution and its Likely Transboundary Effects

- National Action Plan
- National Database
- Proposed Monitoring Stations

Background Information

Phase II: Implementation of Measure on Control and Prevention of Air Pollution and its Likely Transboundary Effects

- Expanding Network
- Capacity Building
 - Training
 - Supply and Installation of Equipments
 - Establishment of Monitoring Stations
- Studying the Transboundary Effects of Air Pollution

Project Activity Status

- **Expanding Network**
 - Setup National Advisory Committee - Completed
 - Joint Secretary, MOEF
 - Representative from BMD
 - Representative from DoI
 - Representative from BAEC
 - Representative from Departmental Science, KU
 - Representative from Department of Chemistry, DU
 - Representative from Department of Microbiology, DU
 - Representative from IMED
 - Representative from ET&I, wing of Planning Commission
 - Representative from CEN
 - Representative from FBCCI
 - Representative from BARC
 - Representative from SRDI
 - Project Director

This advisory committee will provide advisory services to the Department of Environment and other organizations involved in monitoring exercise. It will also act as an information clearing house.

1

INDIA

Project Activity Status

■ Monitoring and Capacity Building

- Local arrangement to install the monitoring station – on going
- Recruitment of Technical Staff is in the final stage
- In-country training programme will be organized during 19-23 October, 2003
- In-country training report will be submitted after the completion of training workshop

Project Activity Status

■ Monitoring and Reporting

- Monitoring and reporting will be carried out as per UNEP guideline and manual
- Data will be stored according to the specified format
- Digital data will be sent to RRC.AP for the centralized database
- Regular Reporting as per schedule

Project Activity Status

- Organize National Stakeholders Meeting
 - End of November 2003
 - Report will be submitted in December 2003
- Linkage to other Projects/Organizations
 - It has been accomplished through expanding national network

Thank You

Attachment IV
Preparation of national implementation plan by Bhutan









Attachment V
Preparation of national implementation plan by India

**MALE' DECLARATION ON CONTROL AND
PREVENTION OF AIR POLLUTION AND ITS
LIKELY TRANSBOUNDARY EFFECTS FOR
SOUTH ASIA**

COUNTRY PAPER - INDIA

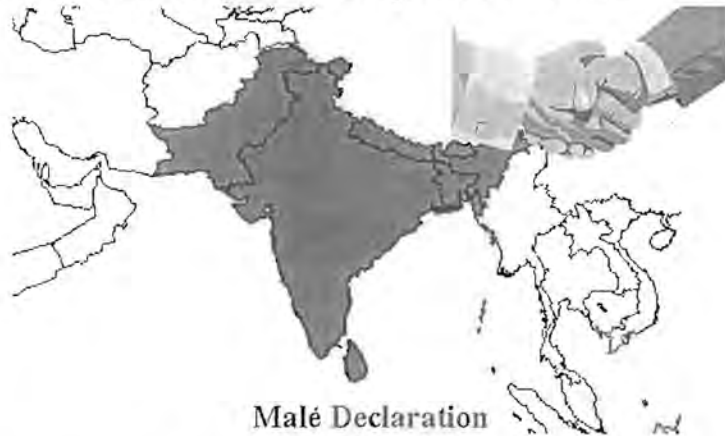


Dr. B. Sengupta
Member Secretary
Central Pollution Control Board
Ministry of Environment & Forests
New Delhi

Email: bsg1951@yahoo.com
Website: <http://cpcb.delhi.nic.in>

Paper presented at Male' declaration Network Meeting to be held at Dhaka during
6 – 8 October, 2003

Malé: Sub-Regional Response in South Asia



Malé Declaration
On
Control and Prevention of Air Pollution and Its
Likely Transboundary Effects
for
South Asia

MAJOR ENVIRONMENTAL ACTS IN INDIA

- The Water (Prevention & Control of Pollution) Act, 1974
- The Water (Prevention & Control of Pollution) Cess, Act, 1974 as amended in 1991.
- The Air (Prevention & Control of Pollution) Act, 1981
- The Environment (Protection) Act, 1986
- The Public Liability Insurance Act, 1991
- The National Environmental Tribunal Act, 1995
- The National Environment Appellate Authority Act, 1997



CENTRAL POLLUTION CONTROL BOARD

- APEX BODY IN INDIA FOR PREVENTION AND CONTROL OF ENVIRONMENTAL (AIR, WATER, NOISE, SOLID WASTE) POLLUTION.
- TECHNICAL AND SCIENTIFIC WING OF MOEF
- SET UP UNDER PARLIAMENT ACT (WATER ACT 1974, AIR ACT 1981)
- SUPREME COURT/HIGH COURT EXPECTATIONS
- RESPONSIBLE FOR SETTING ALL STANDARD AND POLICIES FOR CONTROL OF ENVIRONMENTAL POLLUTION BASED ON SCIENTIFIC STUDY.
- ENVIRONMENT PROTECTION ACT, 1986 (SECTION 5, DELEGATED BY MOEF)
- NEW RESPONSIBILITIES GIVEN UNDER VARIOUS RULES / ACTS
 - NOISE POLLUTION CONTROL
 - BIOMEDICAL RULES
 - HAZARDOUS WASTE MANAGEMENT
 - MUNICIPAL SOLID WASTE MANAGEMENT
 - EIA - NOTIFICATION
 - FLY ASH MANAGEMENT
 - COAL BENEFICIATION
 - VEHICULAR POLLUTION CONTROL



MAJOR AIR POLLUTION ISSUES IN INDIA

1. Major Cities (Vehicular Air Pollution)
2. 24 – Critically polluted area (Industrial Air Pollution)
3. Indoor Air Pollution (Rural Area)



AIR POLLUTION PROBLEM IN INDIA

I. MAJOR CITIES


(DELHI, KOLKATA, MUMBAI, CHENNAI, AHMEDABAD, BANGALORE, HYDERABAD, PUNE, KANPUR).-----VEHICLES, SMALL/MEDIUM SCALE INDUSTRIES

II. PROBLEM AREA


<u>AREA</u>	<u>TYPE OF POLLUTING INDUSTRIES</u>
SINGRAULI	- POWER PLANTS, MINING, ALUMINIUM INDUSTRY.
KORBA	- POWER PLANTS, ALUMINIUM INDUSTRY, MINING.
VAPI / ANKALESHWAR	- CHEMICAL INDUSTRIES.
GREATER COCHIN	- OIL REFINERIES, CHEMICAL, METALLURGICAL INDUSTRIES
VISAKHAPATNAM	- OIL REFINERY, CHEMICAL, STEEL PLANTS.
HOWRAH	- FOUNDRY, REROLLING MILLS, VEHICLES.
DURGAPUR	- CHEMICAL INDUSTRIES, POWER PLANTS, STEEL PLANTS.



AREAS	TYPE OF INDUSTRY
MANALI TAMIL NADU	- OIL REFINERIES, CHEMICAL INDUSTRY, FERTILIZER INDUSTRY
CHEMBUR	- REFINERIES, POWER PLANT, FERTILIZER INDUSTRY.
MANDI GOBINDGARH	- SECONDARY STEEL INDUSTRY
DHANBAD	- MINING, COKE OVEN.
PALI	- COTTON TEXTILE, DYEING.
NAGAFGARH DRAIN BASIN	- POWER PLANTS, VEHICLES.
ANGUL-TALCHER	- MINING, ALUMINIUM PLANTS, THERMAL POWER PLANTS.



AREAS	TYPE OF INDUSTRY
BHADRAVATI KARNATAKA	- IRON & STEEL, PAPER INDUSTRY
DIGBOI	- OIL REFINERY
JODHPUR	- COTTON TEXTILE, DYE
KALA-AMB	- PAPER, ELECTROPLATING
NAGDA-RATLAM	- VISCOSE RAYON, CAUSTIC, DYES DISTILLERY
NORTH ARCOT	- TANNERIES
PARWANOO	- FOOD PROCESSING UNIT ELECTROPLATING
PATANCHERU- BOLLARAM	- ORGANIC CHEMICAL, PAINTS, PETROCHEMICAL INDUSTRY
TARAPUR	- CHEMICAL INDUSTRY



PROBLEM AREAS IN INDIA



REASONS FOR AIR POLLUTION IN INDIA

- POOR QUALITY OF FUEL (COAL, DIESEL, PETROL, FUEL OIL)
- OLD PROCESS TECHNOLOGY (SPECIALLY IN S.S.I.)
- WRONG SITING OF INDUSTRIES
- NO POLLUTION PREVENTIVE STEP TAKEN (EARLY STAGE OF INDUSTRIALISATION)
- POOR VEHICLE DESIGN (2-STROKE)
- UNCONTROLLED GROWTH OF VEHICLE POPULATION IN ALL MAJOR CITIES / TOWNS.
- NO POLLUTION PREVENTION AND CONTROL SYSTEM IN SMALL/ MEDIUM SCALE INDUSTRY (S.M.S)



POOR COMPLIANCE OF STANDARD IN S.M.S

MAJOR ENVIRONMENTAL ISSUES IN INDIA

1. Air Quality Problem in Major Cities (45) and Metro Cities (7) with respect to RSPM/PM₁₀ and NO_x.
2. Toxic Pollutants (VOC, Benzene, PAH) level in Seven Cities generally exceeding the guidelines.
3. Industrial Air Pollution Control - Major Issues:
 - Thermal Power Plants (fly ash management, emission of SO₂/PM)
 - Iron & Steel Industry (coke oven plants emissions, waste utilization, BOD plant performance)
 - Aluminium Industry (pot room secondary emission)



Contd..

- Paper & Pulp Industry (Emission from Chemical Recovery Plant, Odour issues)
- Oil Refinery (SO₂ emission, VOC emission, Fugitive emission).
- Cu / Zn (SO₂ emission, Sludge disposal)
- 5. Pollution Control from Small Scale Industry (3 million).
 - Stone Crusher
 - Lime Kiln
 - Foundries
 - Electroplating
 - Rerolling Mills
 - Brick Kiln



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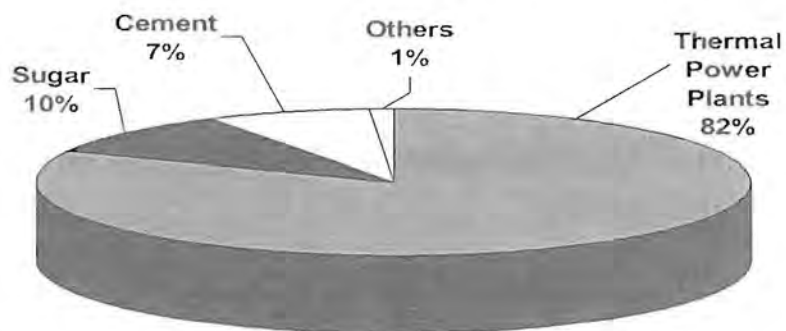
6. Coal Quality (Clean Coal Technology, High Ash)
7. Fuel Quality (Benzene, Sulphur)
8. Pollution control from in-use Vehicles improvement of (I/M System)
9. Fly Ash Management (100 million tonne generation)



INVENTORY OF INDUSTRIAL EMISSIONS IN THE COUNTRY



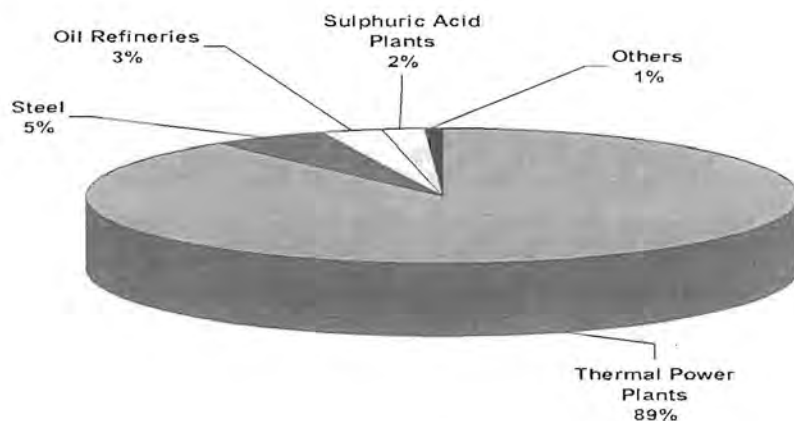
EMISSION ESTIMATES



Share of Suspended Particulate Matter Load (tonnes/day) by Different Categories of Industries (With Control Device), Total Load = 5365 tonnes/day



Share of Sulphur Dioxide Load (tonnes/day) by Different Categories of Industries (Total Load = 3715 tonnes/day)



VEHICULAR POLLUTION PROBLEMS IN INDIA

- High vehicle density in Indian urban centers
- Older vehicles predominant in vehicle vintage
- Inadequate inspection & maintenance facilities
- Predominance of two stroke two wheelers
- Adulteration of fuel & fuel products
- Improper traffic management system & road conditions
- High levels of pollution at traffic intersections
- Absence of effective mass rapid transport system & intra-city railway networks
- High population exodus to the urban centers



INVENTORY OF VEHICULAR EMISSIONS IN THE COUNTRY



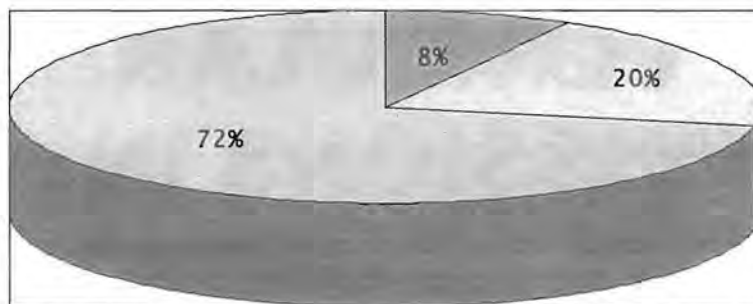
ESTIMATED AIR POLLUTION LOAD IN MAJOR CITIES

CITY	POLLUTION LOAD (TONNES/DAY)	NUMBER OF ON- ROAD VEHICLES (LAKHS)
Delhi	2686	34.25
Mumbai	885	8.4
Bangalore	971	12.4
Kolkata	449	6.6
Chennai	786	11.5
Ahmedabad	638	7.8
Hyderabad - Secunderabad	1123	10.99



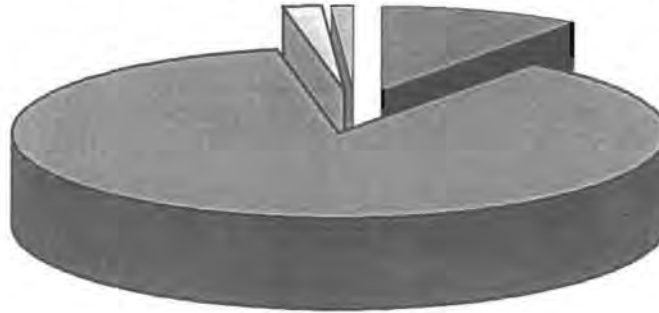
CONTRIBUTION OF VARIOUS SECTORS TO AMBIENT AIR QUALITY IN MAJOR CITIES

■ Domestic ■ Industrial ■ Vehicular



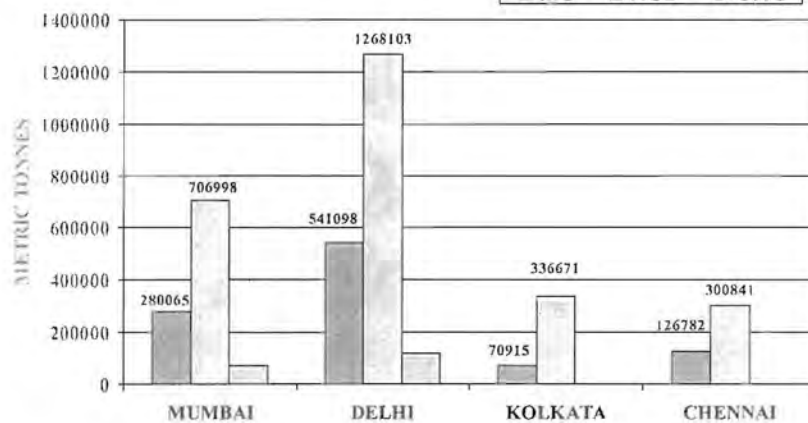
FUEL SHARE IN INDIA

■ GASOLINE ■ DIESEL □ CNG ■ LPG/ELEC

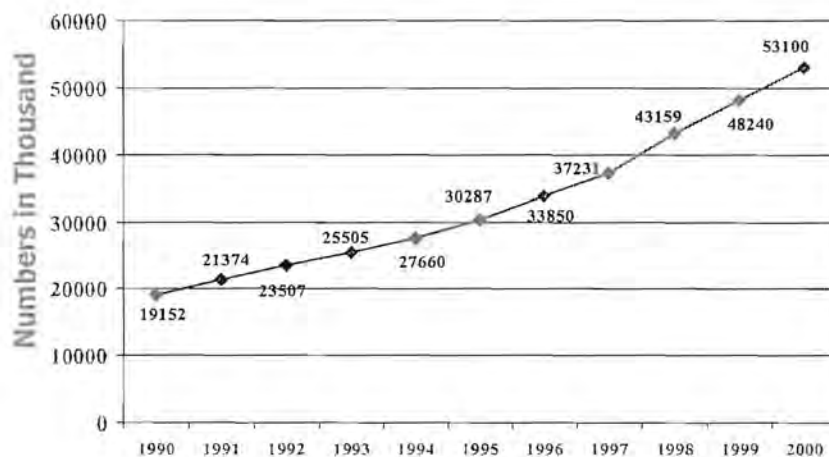


FUEL CONSUMPTION IN METRO CITIES(1999-2000)

■ MS □ HSD □ CNG



GROWTH OF MOTOR VEHICLES IN INDIA



AIR QUALITY MONITORING IN INDIA



NATIONAL AIR QUALITY MONITORING

- ▶ Started in 1984 - 7 Station (Manual Station)
 - ▶ By 2000 - Increased to 295 Stations (Operated and Maintained by SPCB/CPCB/ Universities, etc. and funded by CPCB)
 - ▶ Monitoring in Delhi
 - 2 Continuous AQMS (set up under GTZ assistance)
 - 1 Continuous AQMS (CPCB)
 - 2 Mobile Vans (with GTZ assistance)
 - 6 Manual AQMS
 - ▶ Monitoring by Industry/Universities/ Other Institutes
- 200 Stations (approx.)



Air Quality Monitoring

Parameters Monitored

- Criteria Pollutants** - SPM, SO₂, RSPM/PM₁₀, NO_x, CO, Pb
- Specific Pollutants** - Poly aromatic Hydrocarbons
Benzene / Xylene / Toluene
Ground level ozone
(24 hourly, 8 hourly, 1 hourly)



CALIBRATION FOR ACCURACY OF DATA



CALIBRATION

- Calibration of a system in its original meaning is to check up of any any scale, reading or value, digital or analog by comparison with an absolute standard.
- The calibration of any measuring system is very important to get meaningful results.
- The response of most of the analyser has a tendency to change somewhat with time (drift), the calibration must be updated (or the analyser response must be adjusted) periodically to maintain a high degree of accuracy.

CALIBRATION STANDARD

- **PRIMARY STANDARD**

Primary standard is certified to traceable to the NBS or SRM.

Ex.: Static Injection System, Soap bubble meters, volumetric burettes etc.

- **TRANSFER STANDARD**

A transfer standard is a device that is certified against a primary standard. These standards usually travel to the monitoring stations.

ZERO AND SPAN GAS

- **ZERO GAS**

Zero gas is defined that the gas which does not contain any type of impurities or external material. The concentration of zero gas must be zero in respect of pollutant being calibrated.

- **SPAN GAS.**

The span gas must be capable of providing an accurate, stable and reliable concentration of measured gas for at least five concentration , equally spaced between zero and full scale.

FREQUENCY OF CALIBRATION

An analyser should be calibrated (or re calibrated):

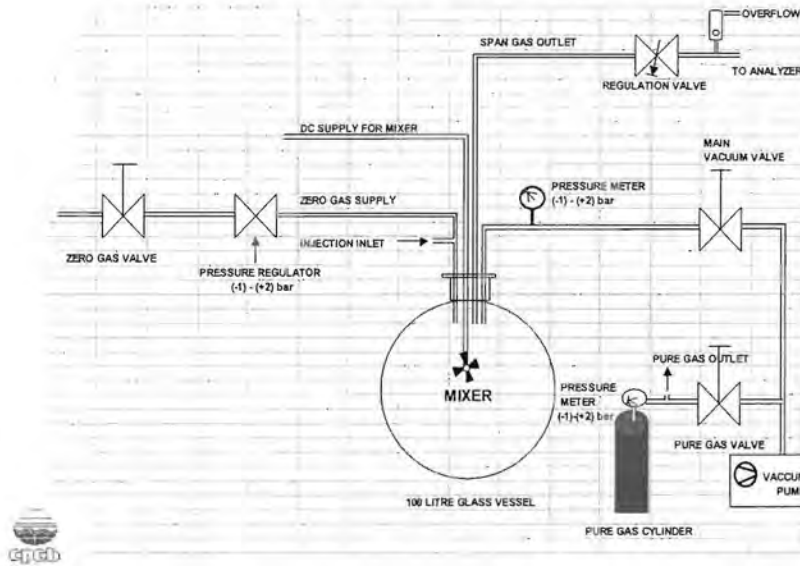
- a) **Upon initial installation;**
- b) **Following physical relocation;**
- c) **After any repairs or service that might affect its calibration;**
- d) **Following an interruption in operation of more than a few days; and**
- e) **Upon any identification of analyser malfunction.**

CALIBRATION OF AUTOMATIC ANALYSER

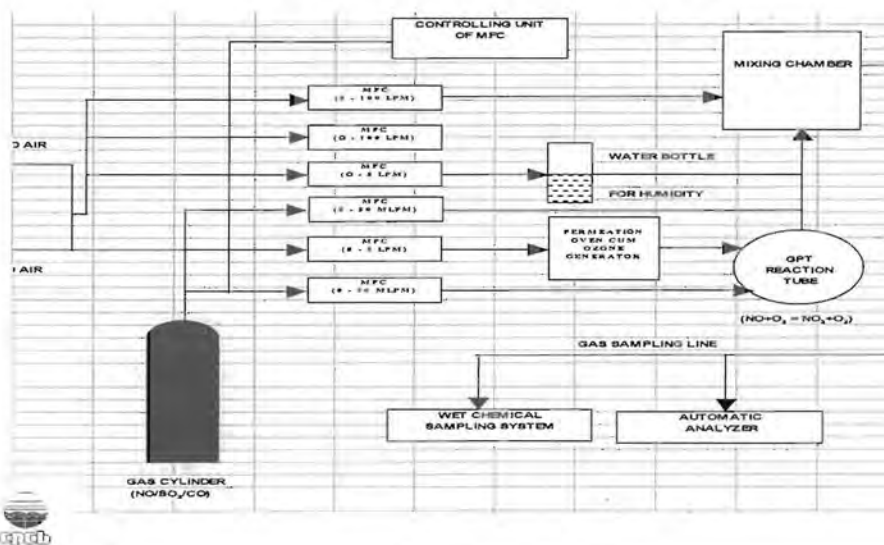
- 1) **Static Injection System;**
- 2) **Dynamic Dilution System; and**
- 3) **Permeation System.**

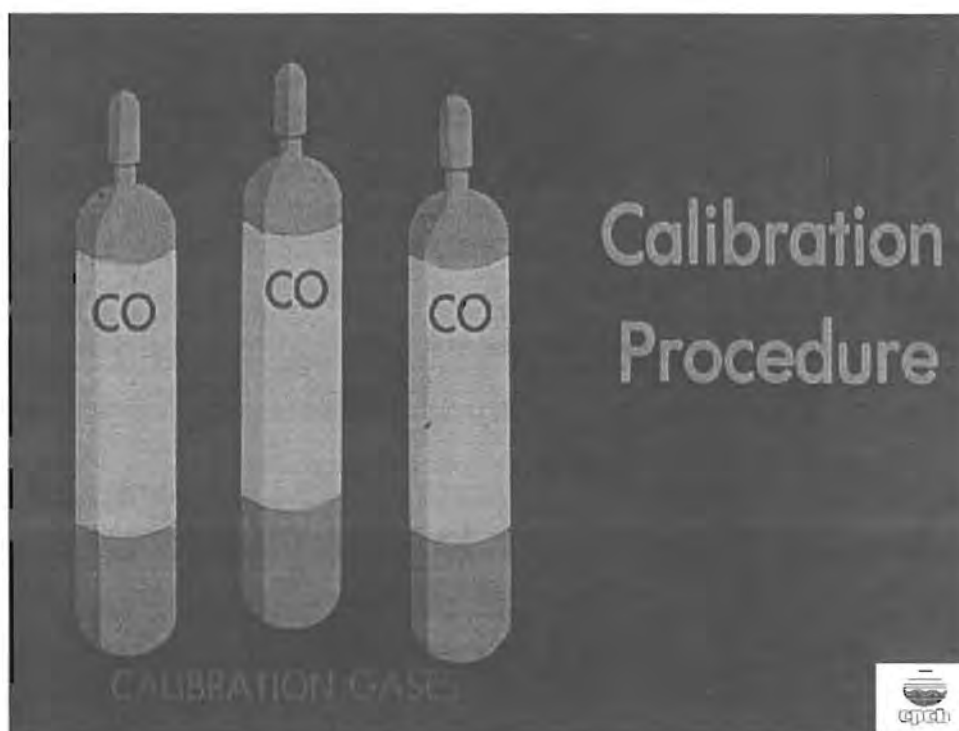
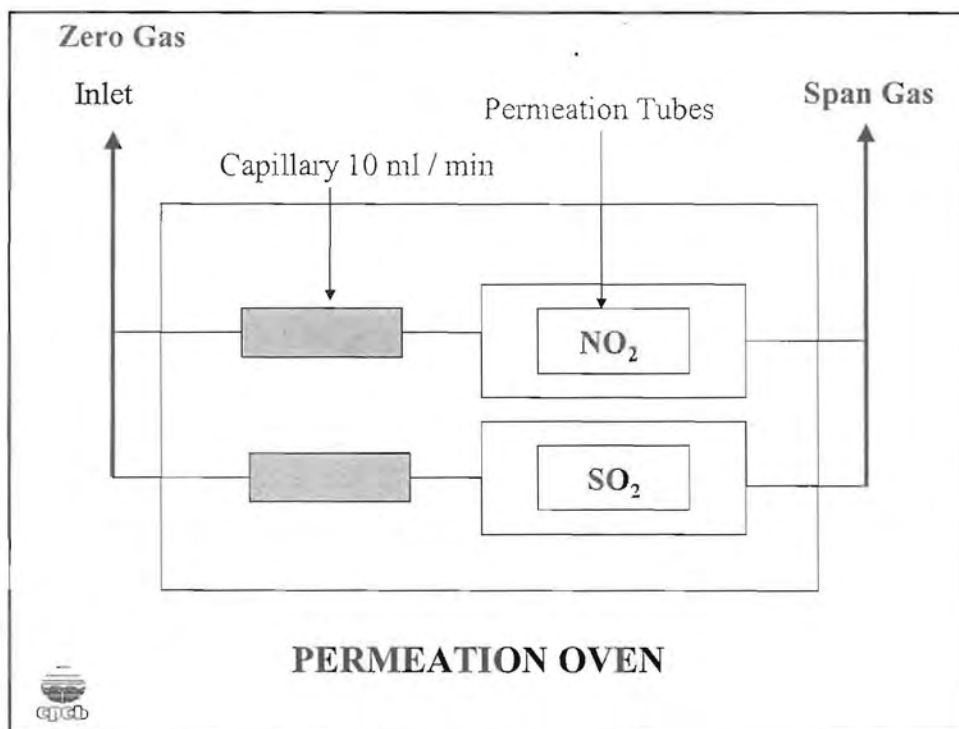


STATIC INJECTION SYSTEM



DYNAMIC DILUTION SYSTEM (RING TEST FACILITY)



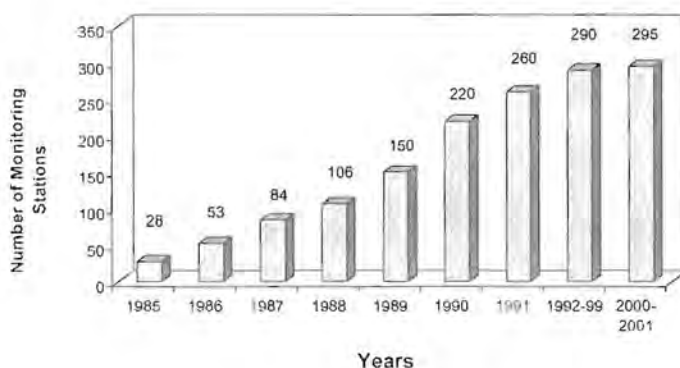


Sensitive areas – sensitive area may include the following:



- 1) 10 kms all around the periphery of health resorts so notified by State Pollution Control Boards in consultation with department of public health of the concerned state.
- 2) 10 kms all around the periphery of biosphere reserves, sanctities and national parks, so notified by Ministry of Environment and Forest or concerned states.
- 3) 5 kms all around the periphery of an archeological monument declared to be of national importance or otherwise so notified A.S.I. in consultation with State Pollution Control Boards.
- 4) Areas where some delicate or sensitive to air pollution crops/important to the agriculture/horticulture of that area are grown so notified by State Pollution Control Boards in consultation with department of agriculture/horticulture of concerned state.
- 5) 5 kms around the periphery of centers of tourism and/or pilgrim due to their religious, historical, scenic or other attractions, so notified by department of tourism of the concerned state with State Pollution Control Boards.

**Growth of Ambient Air Quality
Monitoring Stations under N.A.M.P.**



NON-ATTAINMENT AREAS

Observed Annual Mean Concentration of
a Criterion Pollutant

$$\text{Exceedence Factor} = \frac{\text{Observed Annual Mean Concentration of a Criterion Pollutant}}{\text{Annual Standard for the Respective Pollutant and Area Class}}$$

The Four Air Quality Categories are:

- **Critical Pollution (C):** When EF is more than 1.5;
- **High Pollution (H):** When EF is between 1.0 - 1.5;
- **Moderate Pollution (M):** When EF is between 0.5 - 1.0;
- **Low Pollution (L):** When the EF is less than 0.5.



AIR QUALITY CATEGORY IN SOME CITIES

Pollutants → Area Class → State / City ↓	SO ₂		NO ₂		SPM	
	I	R	I	R	I	R
• Andhra Pradesh						
Hyderabad	L	L	M	L	M	M
Visakhapatnam	L	L	L	L	L	M
• Assam						
Guwahati	-	L	-	M	-	H
• Bihar						
Dhanbad	L	L	L	L	M	C
Jharia	L	-	L	-	H	-
Jamshedpur	M	M	M	M	M	C
Patna	-	L	-	L	-	C
• Delhi						
Delhi	L	L	M	H	M	C

Contd..

Pollutants →	SO ₂		NO ₂		SPM	
	I	R	I	R	I	R
Area Class →						
State / City ↓						
• Gujarat						
Ahmedabad	L	L	L	M	-	-
• Goa						
Ponda	-	L	-	L	-	M
Vasco	L	-	L	-	L	-
• Himachal Pradesh						
Damtal	-	L	-	L	-	C
Parwanoo	L	L	L	L	M	C
Paonta Sahib	L	-	L	-	L	-
Shimla	-	L	-	L	-	L
• Haryana						
Yamuna Nagar	L	-	L	-	M	-

Contd..

Pollutants →	SO ₂		NO ₂		SPM	
	I	R	I	R	I	R
Area Class →						
State / City ↓						
• Karnataka						
Banglore	L	L	L	M	L	C
Mysore	L	-	L	-	L	-
• Kerala						
Cochin	M	L	L	M	L	-
Kottayam	L	-	L	-	L	-
Kozhikode	L	L	L	L	L	L
Palakkad	L	-	M	-	L	-
Thiruvanthapuram	L	L	L	L	L	L
• Maharashtra						
Mumbai	L	L	L	M	-	-
Chandrapur	L	L	M	M	L	H

Pollution Level	Annual Mean Concentration Range ($\mu\text{g} / \text{m}^3$)	
	RSPM Levels	
	Industrial (I)	Residential (R)
Low (L)	$0 - 60$	$0 - 30$
Moderate (M)	$60 - 120$	$30 - 60$
High (H)	$120 - 180$	$60 - 90$
Critical (C)	>180	> 90
Area Class \longrightarrow State / City \downarrow	I	R
• Andhra Pradesh		
Hyderabad	M	H
Visakhapatnam	M	C
• Assam		
Guwahati	-	C
• Delhi		
Delhi	C	C
• Gujarat		
Ahmedabad	C	C

Pollution Level	Annual Mean Concentration Range ($\mu\text{g} / \text{m}^3$)	
	RSPM Levels	
	Industrial (I)	Residential (R)
Low (L)	$0 - 60$	$0 - 30$
Moderate (M)	$60 - 120$	$30 - 60$
High (H)	$120 - 180$	$60 - 90$
Critical (C)	>180	> 90
Area Class \longrightarrow State / City \downarrow	I	R
• Himachal Pradesh		
Parwanoo	-	H
• Karnataka		
Banglore	L	H
Mysore	M	-
• Kerala		
Kochi	H	C
Kottayam	L	H

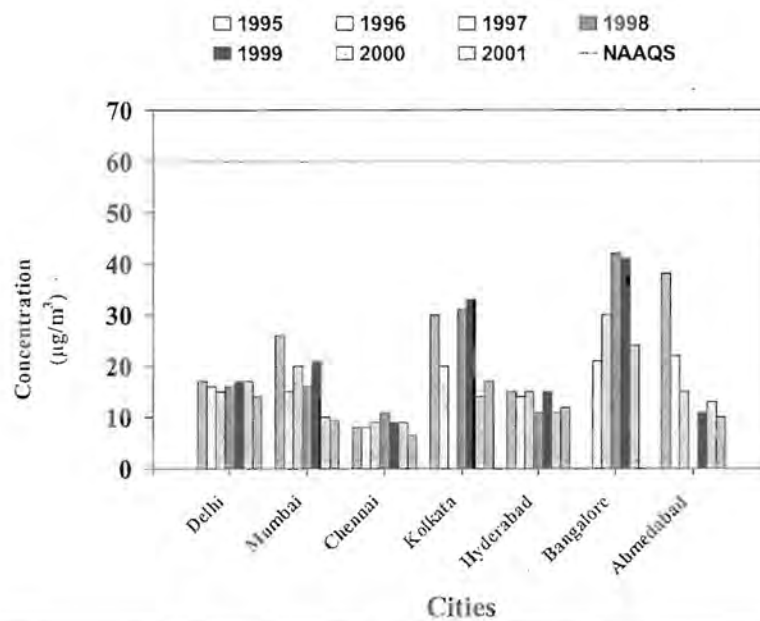
Pollution Level	Annual Mean Concentration Range ($\mu\text{g} / \text{m}^3$)	
	RSPM Levels	
	Industrial (I)	Residential (R)
Low (L)	0 – 60	0 – 30
Moderate (M)	60 – 120	30 – 60
High (H)	120 – 180	60 – 90
Critical (C)	>180	> 90
Area Class →	I	R
State / City ↓		
Kozhikode	L	M
Thiruvanthapuram	C	C
Palakkad	L	-
• Madhya Pradesh		
Bhopal	C	C
Indore	C	C
Jabalpur	-	H
Nagda	M	C

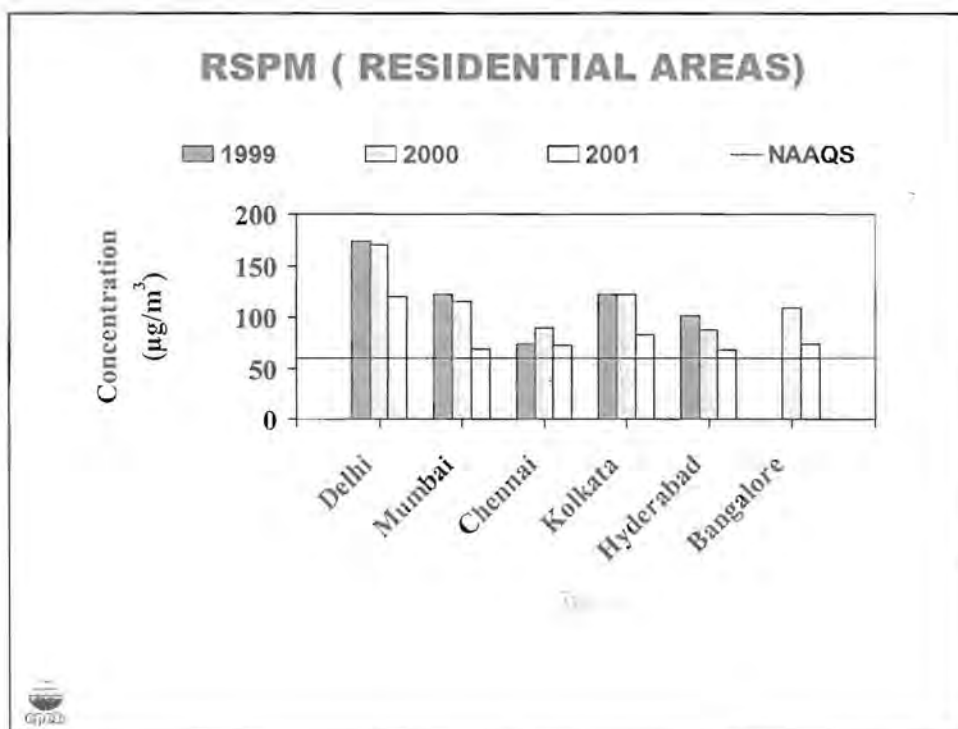
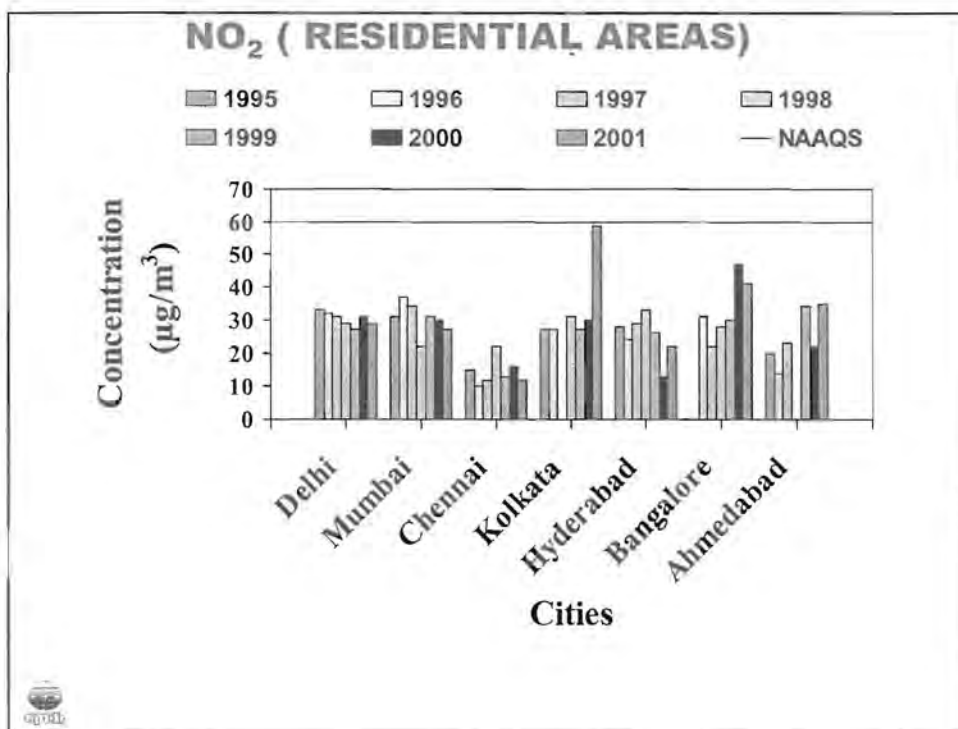
Pollution Level	Annual Mean Concentration Range ($\mu\text{g} / \text{m}^3$)	
	RSPM Levels	
	Industrial (I)	Residential (R)
Low (L)	0 – 60	0 – 30
Moderate (M)	60 – 120	30 – 60
High (H)	120 – 180	60 – 90
Critical (C)	>180	> 90
Area Class →	I	R
State / City ↓		
Satna	H	C
• Maharashtra		
Mumbai	M	H
Nagpur	M	C
Nashik	M	C
Pune	-	C
Solapur	C	C

TRENDS IN MEGA CITIES

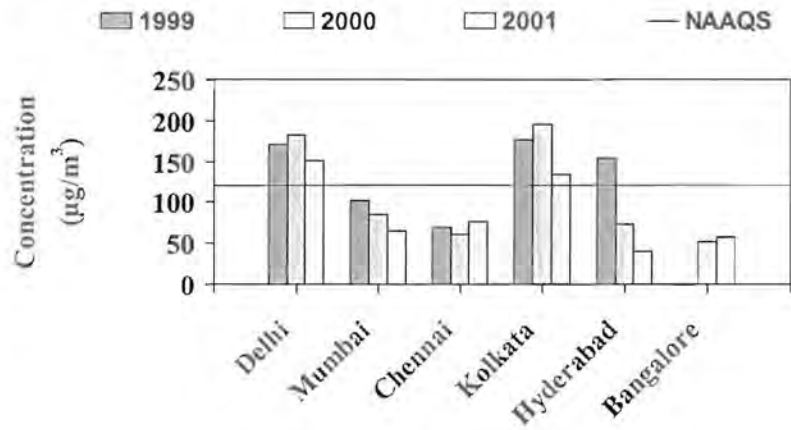


SO₂ (RESIDENTIAL AREAS)

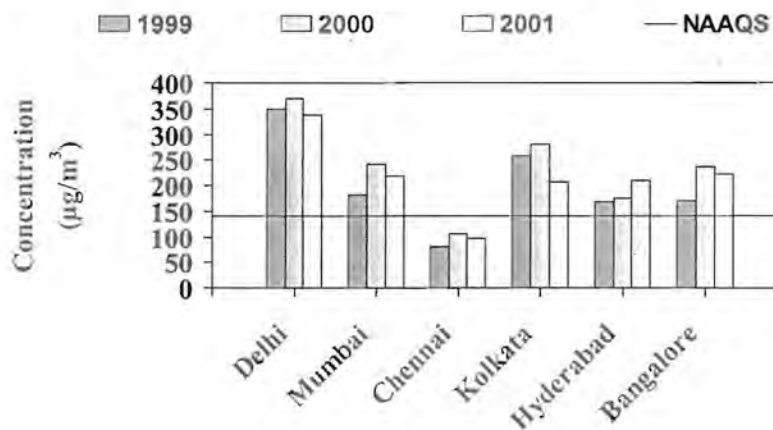


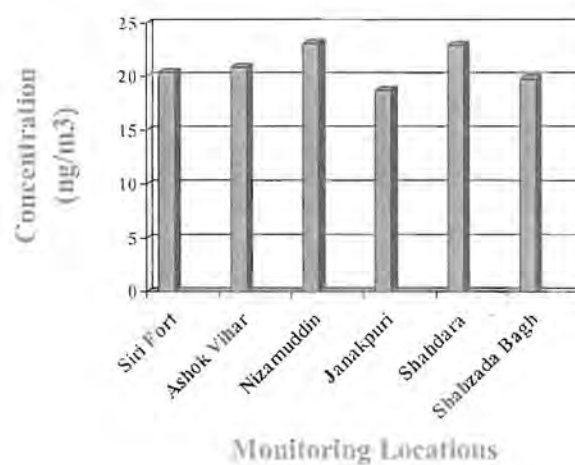
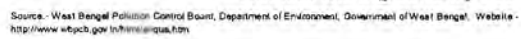


RSPM (INDUSTRIAL AREAS)



SPM (RESIDENTIAL AREAS)

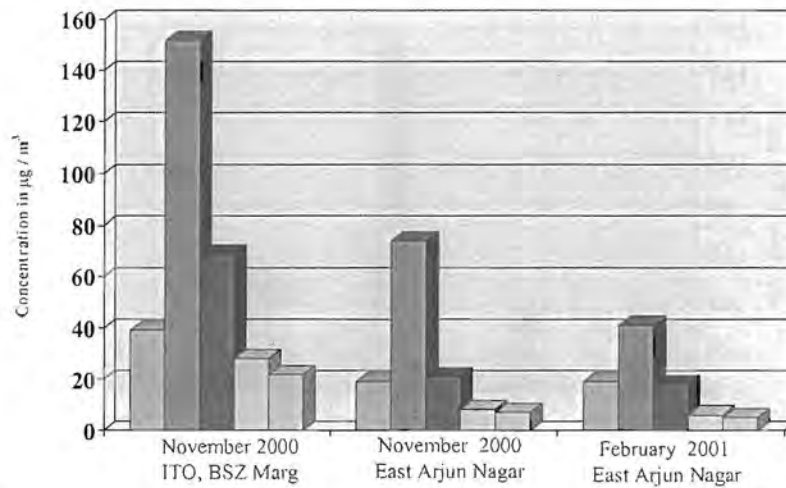




Monitoring Locations

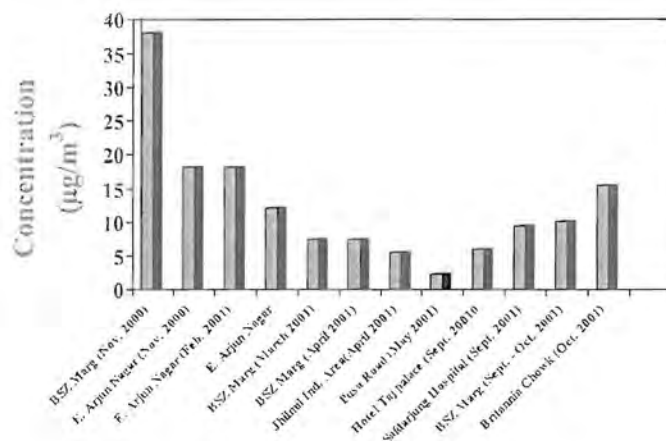
BTX Profile During Winter in Delhi

Benzene
 Toluene
 m,p - Xylene
 o - Xylene
 Ethyl - Benzene



Source: CPCB Newsletter

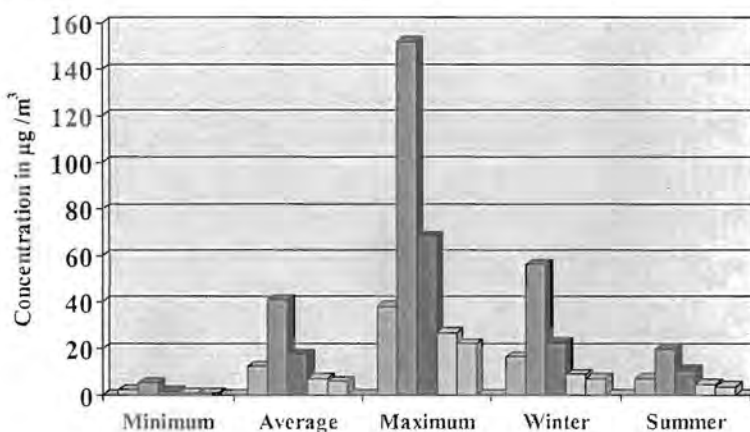
BENZENE LEVELS IN DELHI



Monitoring Locations

Average Benzene, Toluene levels observed in Delhi During the year 2000 to 2001

■ Benzene ■ Toluene ■ m,p - Xylene □ o - Xylene □ Ethyl - Benzene



Source: CPCB Newsletter

CONCLUSION OF AIR QUALITY MONITORING (LAST TEN YEARS)

Critical Pollutants (exceeded the standard)

- RSPM (PM₁₀)
- Carbon Monoxide
- Benzene (Major Cities)
- Ozone (some places)
- Polyaromatic Hydrocarbon (Benzo - a- Pyrene)
- Oxides of Nitrogen (Some places)

Within Limit

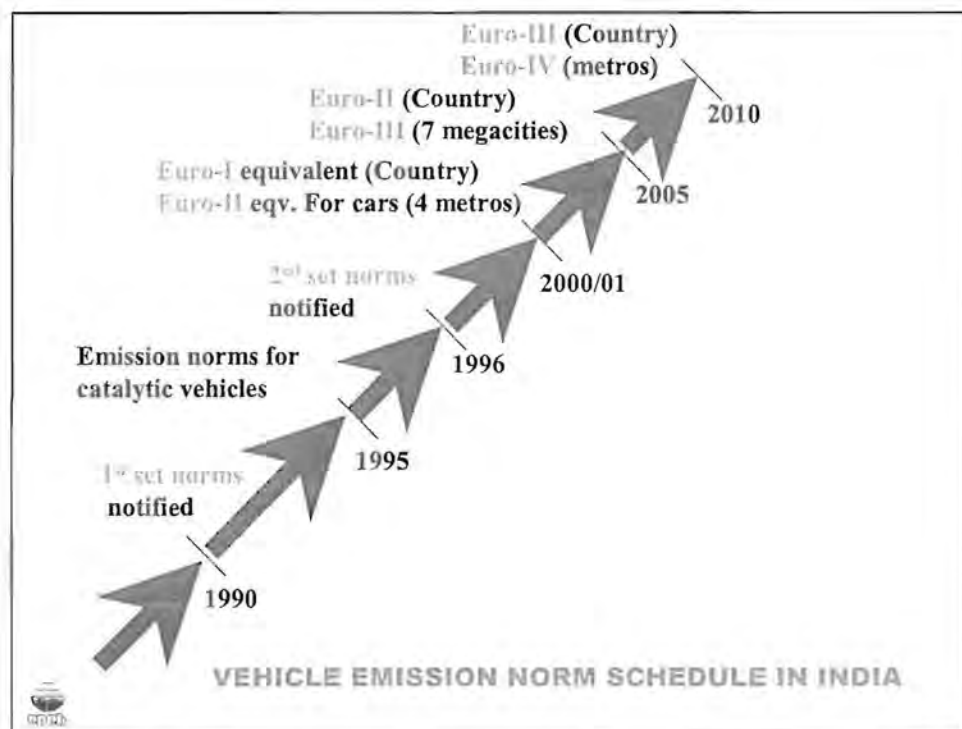
- Sulphur Dioxide
- Lead

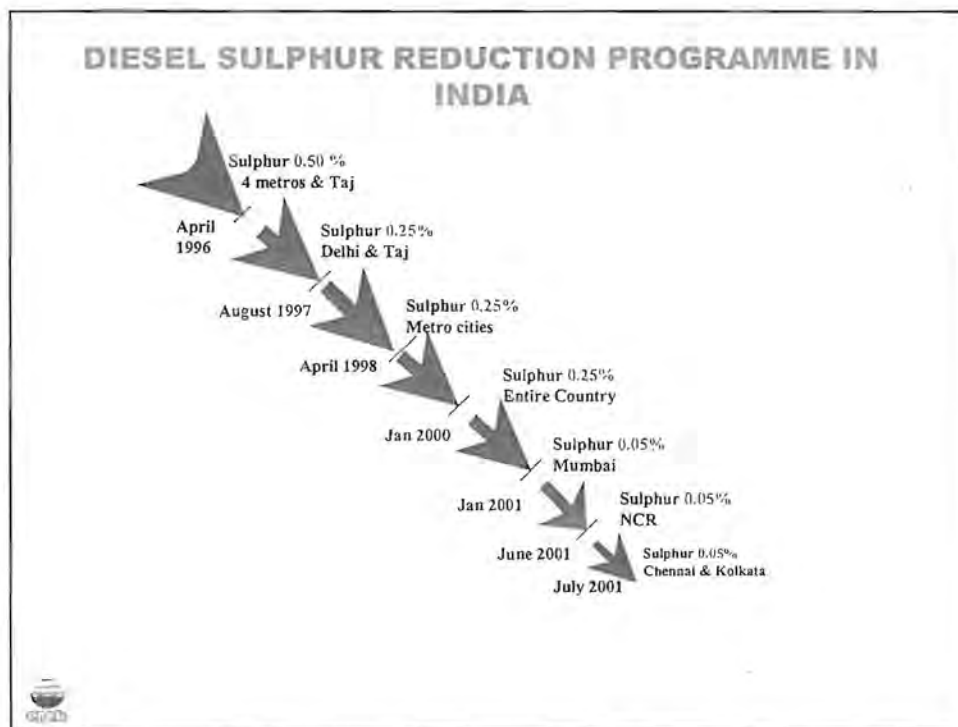
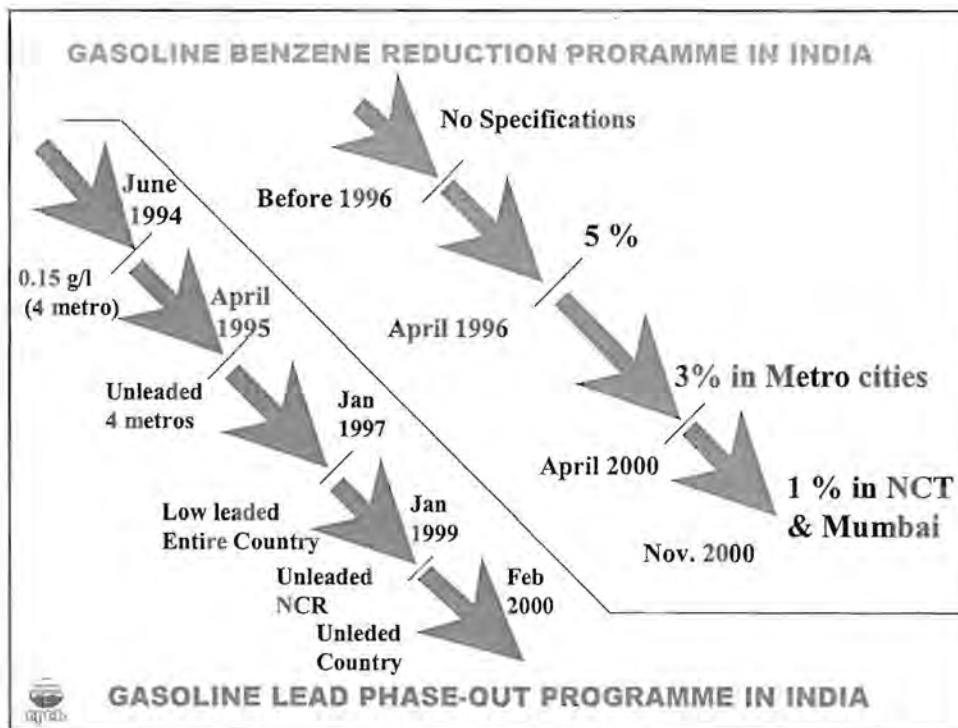


STEP TAKEN SO FAR FOR CONTROLLING VEHICULAR POLLUTION

Vehicle Emission Standards

- 1991 Norms: First time introduced, very relaxed norms
- 1996 Norms: Norms made slightly tighter
- 1998 Norms: Passenger car with cat converter
- 2000 Norms: India Stage 2000 (EURO – I)
- 2005 Norms: Bharat Stage – II (EURO – II)
- 2010 Norms: Bharat Stage – III (EURO – III)





ALTERNATE FUEL

- **CNG** – Norms notified more than 80,000 CNG vehicles in Delhi
- **LPG** – Norms notified, LPG kits approved
- **Gasoline** with 5% ethanol from 2003 in sugar producing states & UT to be extended to other states and Union Territories. 10% to be introduced by 2007
- **Bio – diesel** (5%) by 2005 & **Bio – diesel** (10%) by 2011

STEP TAKEN TO CONTROL INDUSTRIAL AIR POLLUTION IN INDIA

- **Enforcement of Standard** in 17 categories of highly polluting industries.
- **Use of Beneficiated Coal** (34% Ash) in Power Plants.
- **Pollution Prevention and Control Technology** adoption in S.S.I. (stone crusher, brick kiln. etc.)
- **Use of approved fuel** in major cities.
- **Adoption of clean process technology** in major industries in India.
- **Formulation and Implementation of Corporate Responsibility in Environmental Protection (CREP) Programme.**

RESTRICTION ON GROSSLY POLLUTED VEHICLES

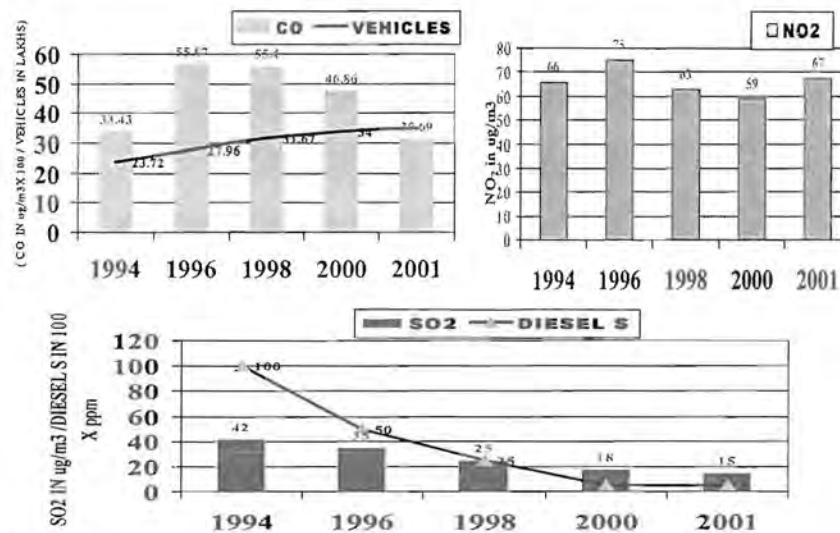
- 15 YEARS OLD COMMERCIAL VEHICLES PHASED OUT IN DELHI
- CITY DIESEL BUSES PHASED OUT IN DELHI

AGENCIES INVOLVED

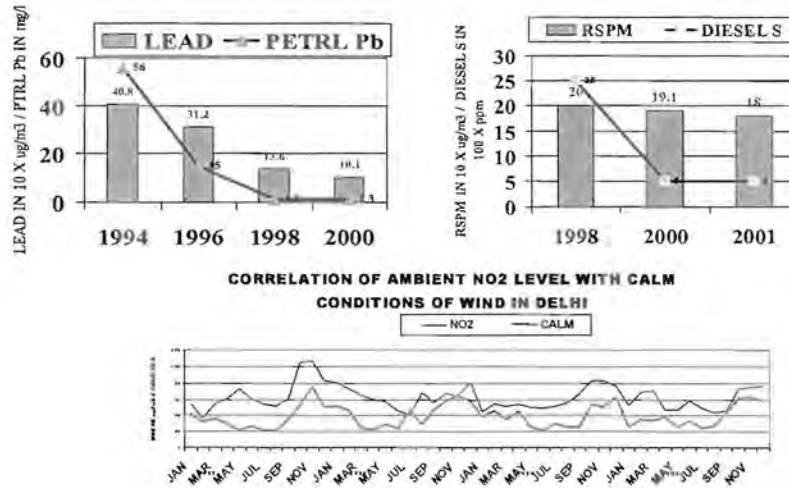
- Central Pollution Control Board
- Ministry of Environment & Forests
- Environmental Pollution Control Authority
- Ministry of Petroleum & Natural Gas
- Ministry of Road Transport & Highways
- Ministry of Industries

IMPACT OF STEPS TAKEN TO CONTROL AIR POLLUTION IN DELHI – NATIONAL CAPITAL OF INDIA

AMBIENT POLLUTANT LEVELS IN TRAFFIC INTERSECTION IN DELHI



AMBIENT POLLUTANT LEVELS IN TRAFFIC INTERSECTION IN DELHI



**PROGRESS MADE
TO IMPLEMENT
MALE' DECLARATION
IN INDIA**

PROPOSED MONITORING SITES - INDIA

<i>BANGLADESH BORDER</i>	:	- Port Canning (Sunder bans) - Dumki
<i>BHUTAN BORDER</i>	:	Bongaigaon
<i>MALDIVES BORDER</i>	:	Lakshadweep Islands
<i>NEPAL BORDER</i>	:	Narkatiaganj
<i>PAKISTAN BORDER</i>	:	- Tanot - Pathankot
<i>SRILANKA BORDER</i>	:	Thirunelveli
<i>SOUTH EAST ASIA BORDER</i>	:	Andaman Islands
<i>NORTH EAST ASIA BORDER</i>	:	Changele
<i>ECOLOGICAL SITE</i>	:	Molem

Proposed Monitoring Stations



Proposed site for first station



Port
Caning

Climate of the region

- Tropical monsoon type climate
- Average annual rainfall 1750 – 1800 mm
- 80% rainfall between June and September
- Maximum and minimum temperature during summer 18 – 39°C during winter 13 – 32°C
- Humidity between 60 and 88 %
- Dominant wind direction N to NE during winter and S to SW in summer

Sundarbans

Industrial Activities

- No large or medium industry located in Sundarbans
- Small scale manufacturing of cutlery and agricultural implements (Jayanagar and Mathurapur)
- Candle manufacturing, cock briquettes, small printing press, leather, wooden furniture, plastic, rubber electrical and other miscellaneous

Sources of Air pollution

- Use of Generator sets (Limited power supply)
- Burning of coal, briquettes, cow dung cake, wood, kerosene, dry leaf in household
- Water based transport by mechanised boats and launches

Port Canning

Industrial Activities

- Agriculture
- Fishing (mechanical boats and launches)
- Tourist movement in Sundarbans (mechanical boats and launches)

Sources of Air Pollution

- Burning of fire wood, coal, briquettes and kerosene
- Running of generator sets
- Plying of vehicles

Air Quality at Port Canning

Parameters	Station I	Station II
RSPM	123	144
SPM	131	229
NO ₂	14	24
SO ₂	BDL	5

Unit : $\mu\text{g} / \text{m}^3$, 24 hrs. average values

Strengthening of the Network

- In addition to the proposed station at Sundarbans additional stations will be incorporated in the Male' Network by relocating of existing stations under the National monitoring programme or establishing new stations



FUTURE PLAN IN INDIA TO STRENGTHENING AIR QUALITY MONITORING

1. Increase number of air quality monitoring station from 295 to 1000 in phased manner.
2. Inclusion of Toxic and Hazardous air pollutants monitoring (Benzene, Poly Aromatic Hydrocarbon, Ozone, Metals etc.) in selected station in phased manner.
3. Strengthening monitoring of fine particulate matter (PM_{10} & $PM_{2.5}$).
4. Periodically calibration of air quality monitoring analysers.
5. Setting of Regional air quality monitoring calibration centres (Vadodara, Bangalore, Kanpur and Kolkata)
6. Setting of few stations which will monitor background air quality.
7. Location of air quality monitoring station based on proper scientific study.

Condt..

8. Analytical Quality Control and Ring Test facilities for all air quality monitoring.
9. Certain specific pollutants to be monitor continuously in back ground and maximum impacts zones.
10. Proper ventilation coefficient and micro meteorological condition to be considered for locating new air quality station.
11. Periodic training to personnel who are doing air quality monitoring in SPCBs / other agencies.
12. Encouraging private participation in air quality monitoring.

**ADVISORY COMMITTEE
TO IMPLEMENT
MALE' DECLARATION
RECOMMENDATION
IN INDIA**

Advisory Committee

Nine member committee comprising members from

- Central Pollution Control Board
- State Pollution Control Boards
- Research Organizations
- NGOs
- Experts in the field of Air pollution

Terms of Reference of Advisory Committee

- To review the data, generated from the Air quality monitoring stations, established to monitor the transboundary air pollution before releasing it to UNEP or any other organisation.
- To identify the emission sources within the country which may contribute to transboundary movement of air pollutants.
- To prepare a list of major emission sources across the border which may affect the air quality within the country.

- To develop a model for assessing the movement of air pollutants from major emission sources within the country.
- To assess the need for strengthening / developing an Air quality monitoring network for assessing the transboundary movement of air pollutants from the neighbouring countries.
- To identify the parameters, necessary for monitoring the transboundary movement of air pollutants (in addition to the parameters, identified under Male' Declaration).

RECOMMENDATION OF CPCB ON CONTROL AND PREVENTION OF AIR POLLUTION AND ITS LIKELY TRANSBOUNDARY EFFECTS FOR SOUTH ASIA

1. Proper Inventory of air polluting sources (point, area and line source) to be made in this region using own country specific emission factors.
2. Prediction of air quality using appropriate and validated air quality models.
3. Location of air quality stations to see the impacts of transboundary air pollution should be selected based on proper scientific study.
4. Likely impacts of air pollution from neighbouring countries (not included in the network) to be studied also where coal and oil consumption for industrial and transportation purpose is very high.
5. Road map to be developed for improvement of fuel quality (both solid and liquid fuel) and to be implemented.

Condt..

6. Major thrust to be given to pollution prevention and control option for small scale air polluting industries in this region (brick kiln, lime kiln, rerolling mills, arc furnaces, foundries etc.).
7. Emission from Diesel Buses / Trucks and 2 stroke two and three wheelers to be controlled further and if required using clean fuel like CNG / LPG etc.
8. Proper source apportionment study to identified the sources of various pollutants like FPM, NO_x, SO₂ to be conducted in time bound manner.

THANK YOU

Attachment VI
Preparation of national implementation plan by Iran



*Department of the environment
Islamic republic of Iran*



**Male Declaration on Control and Prevention of Air Pollution
and its Likely Transboundary Effects for South Asia**

National monitoring plan In Iran

*Presented by :Dr. saeed motesaddi
Director general for APRB, project manager*

1-Introduction

*2-Male declaration implementations plan
phase one*

phase two

3-Establishment of advisory committee

4-Obstacle to the project

5-Suggestion

Introduction

✓ *Bilateral, Regional and international cooperation*

✓ *Performance of monitoring programs
(urban and industrial)*

Implementation of Male declaration

phase one :

Signing and confirming the project agreement on February 19, 1999

Providing a databank on air pollution specialists and NGO's

Conducting baseline studies

Collecting information about the current situation of air pollution

*Identification of pollutants and dissemination sources as well as their
assessment and studying*

*National solutions for problems stemming from pollution
preparation of action plan*

phase two :

1-Conducting preliminary meteorological studies

2-Implementing a study tour across the country

1)Ilam province (west of Iran)

2)Khoozestan province (South west of Iran)

3)Khorasan province (North east of Iran)

4)Mazandaran province (North of Iran)

5)Hormozgan province (South of Iran)

6)Khorasan province (North east of Iran)

7)Khoozestan province (South west of Iran)

8)West Azarbaijan province (North west of Iran)

9)Sistan and Baloochestan province (South east of Iran)

3-considering the first location

Name:

chamsari

Area:

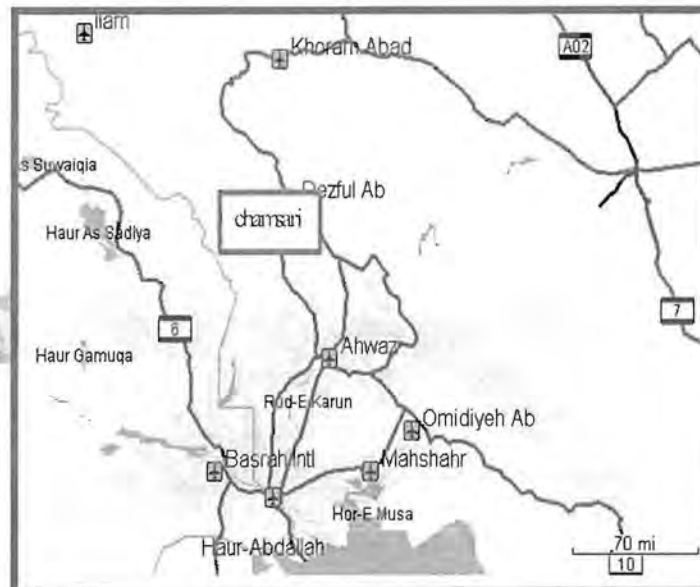
one hectare

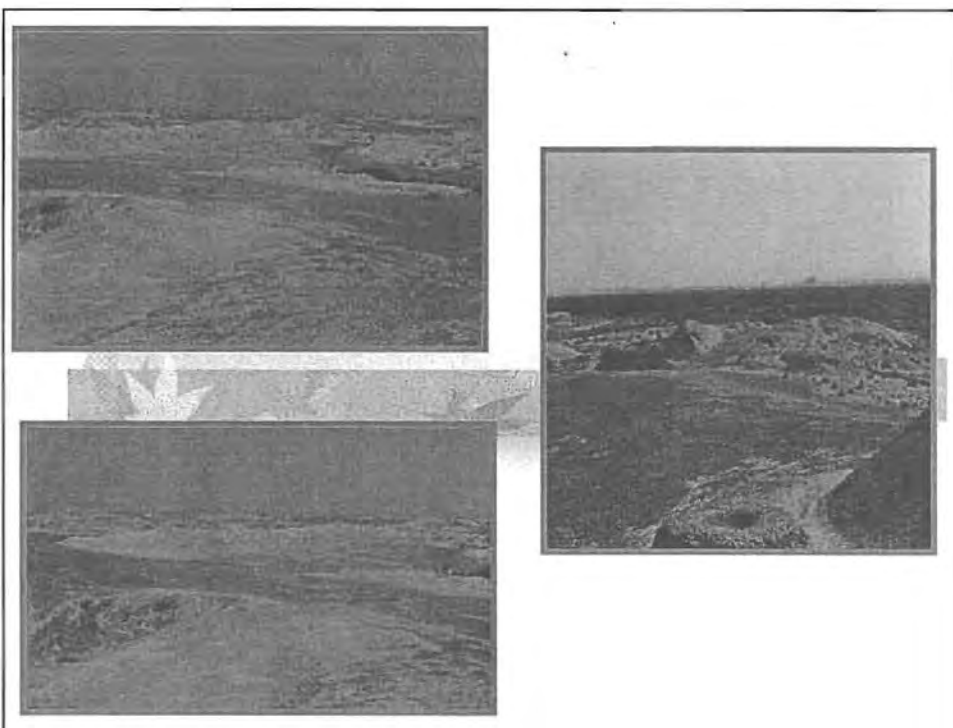
Location:

*40 kilometer at the south of ilam near
the border of Iran - Iraq*

graphical situation:

*32 23' north latitude and 47 30' of east
longitude*





4-Holding a training workshop

for five days from September 13 through September 18 at the Environment Research Center of Iran's Department of the Environment in Tehran



Establishment of advisory committee

No		Name	Designation
1	Dr	Saeed moesaddi (Chairman)	Director General for air pollution research bureau and assistant prof. DOE
2	Prof.	Mansour ghiasaldin (Member)	University professor in the field of air pollution
3	Prof	Mahmoud shariat (Member)	University professor in the field of EIA and water quality and pollution
4	Dr	Volaid isfahani (Member)	Associate prof. In the field of meteorology
5	Dr	Masoud monavari (Member)	Assistant prof. In the field of EIA and rep. of NGO's
6	Dr	Abdolfali zedagat kerdar	Head of meteorological institute
7	Dr	Amiri ranjbar (Member)	Director General for sustainable development bureau -ministry of agriculture
8	Eng	Mashafak tohid (Coordinator)	Expert in the field of meteorology- DOE
9	Eng	Sadrudin aliqour (Secretary)	Expert in the field of environment- DOE

Obstacles to the Project

1- Budget:

*Allocating one hectare land to the establishment and development of
the First station*

*Constructing the station and a subsidiary building to accommodate
the resident expert of the station*

2-Problems related to America-Iraq war

Suggestions

- 1- Increasing budget*
- 2- Establish a data bank through internet*
- 3- Evaluating the effects of some meteorological and climatic parameters on shifting pollutants*
- 4- Drawing up the related protocol*

*the Islamic Republic of Iran would be happy to
host the next year's meeting of Male declaration
in Tehran*



Thank you very much for your patient and attention



Attachment VII
Preparation of national implementation plan by Nepal

Phase II

Malé Declaration on control and prevention of transboundary air pollution and its likely transboundary effects for South Asia

Nepal

Ministry of Population and Environment

International Centre for Integrated Mountain Development



Site Information

Site Classification	: Rural
Latitude	: 27° 38'52.88"
Longitude	: 84° 20'47.73"
Altitude	: 164.5m
Height of Sampling	: 1.5m

Outline of Monitoring Plan

Current Monitoring site		Parameters Measured
Air Concentration	1	SO ₂ , NO ₂ , PM ₁₀ , TSP
Wet Deposition	1	pH, EC, NH ₄ ⁺ , Na ⁺ , K ⁺ , Ca ²⁺ , Mg ²⁺ , SO ₄ ²⁻ , NO ₃ ⁻ , Cl ⁻

Measurement Method

PM10, TSP

High Volume Sampler

Envirotech model APM 460NL

Gaseous Sampling

Envirotech model APM 460NL with Gaseous Sampling

IVL Passive Samplers



Laboratory Responsible for Monitoring Wet and Dry Deposition

Institute : Institute of Agriculture and Animal Science
(IAAS)

Department : Soil Science

In Charge : Dr. Shri Chandra Jha

Address : Institute of Agriculture and Animal
Science, Tribhuvan University, Rampur,
Chitwan.

Sample Collection

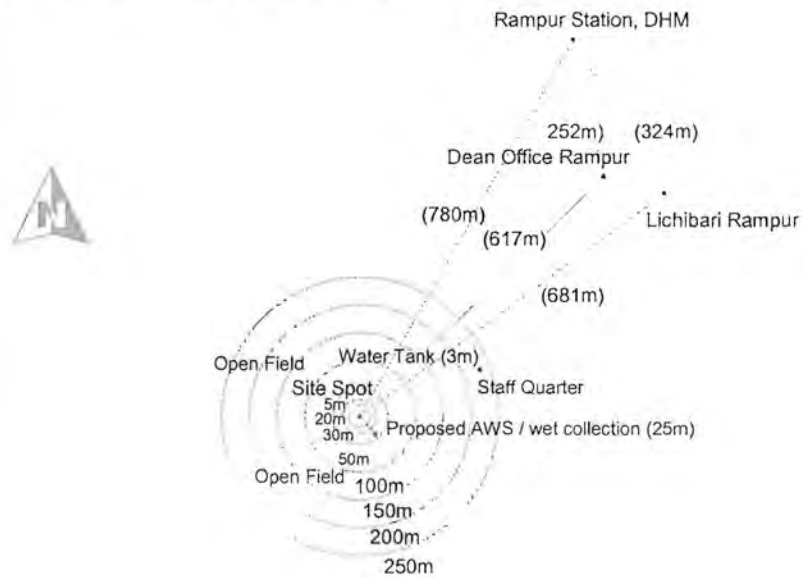
10 Days each month

Meteorological Observation

~ 780m

- Rainfall
- Temperature
- Humidity
- Sunshine
- Wind Velocity

On Site Scale (5m-250m)



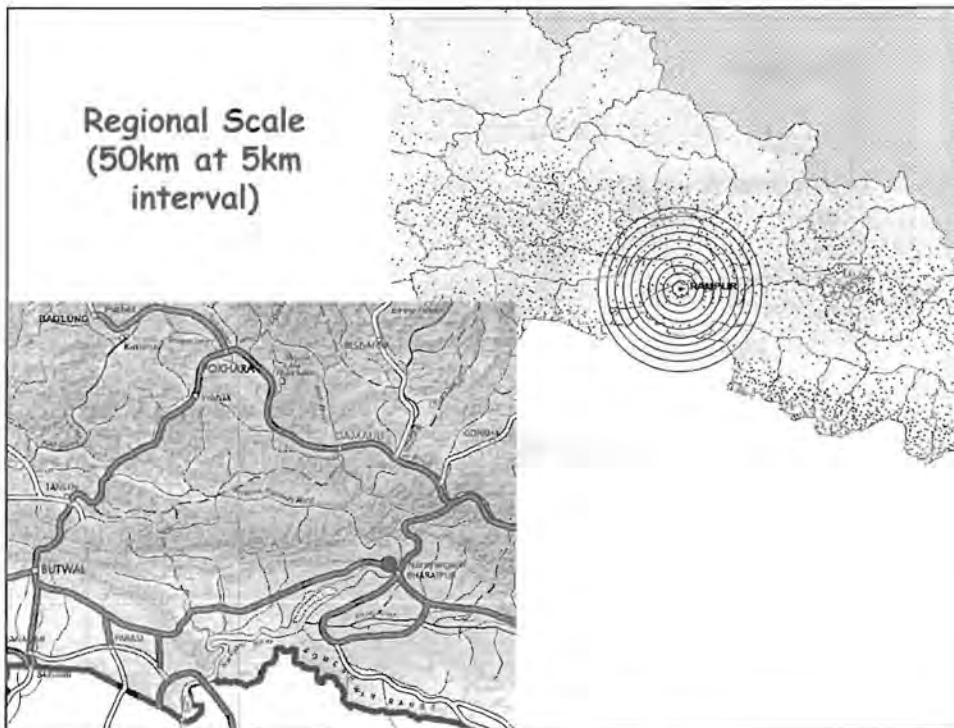
On Site Scale (within 250m)

Items	north direction (NW-NE)	east direction (NE-SE)	south direction (SE-SW)	west direction (SW-NW)
Existence of trees, poles and buildings, and the heights of those.	Few planted trees avg. 4m, Cultivated land Buildings avg. 5m	Few planted trees avg. 4m, Cultivated land, Buildings avg. 5m	Few trees, Cultivated land, No building	
Existence of emission sources, cooking energy domestic heating, waste and agricultural products, dairy farm, and many livestock.	Refuse burning, Agriculture field, Cooking energy - gas	Cooking energy - gas, Agriculture waste		
Ground Slope degree of the site. (+ for upwards)	0°	0°	0°	0°
Surface condition of the site. % surface covered by rock, concrete trees, home sheds building, etc.	10%	10%	0%	0%
Existence of a forest, river, lake, marsh, farm or fields.	Field	Field	Field	Field
Existence of roads, and their traffic densities.	Few only	No	No	No

Local Scale (150m - 10km)

Items	North direction (NW-NE)	East direction (NE-SE)	South direction (SE-SW)	West direction (SW-NW)
Information on trunk roads, expressways, and their traffic densities (with more than >1,000 vehicles/day).	Side road nearly touching the main road Traffic density >1000	Side roads Traffic density <200	Side roads Traffic density <150	Side roads Traffic density <100
Lakes, rivers, streams Marshes, forests, etc.	Narayani river Cultivated land	Cultivated land	Cultivated land Rapti river	Narayani river Cultivated land
Information on major emission sources such as industries, and power plants and their fuel consumptions and so on.	Brikuti Paper Mill (10Km) Small food industries			
Information on houses/ settlements with more than 100 persons, and their population.	Settlement approx. 6000 people	Settlement approx. 3000	Settlement approx. 3000	Settlement approx. 2000
Descriptive information around the site such as Topography, Soils, land use, meteorological condition	Area is plain, low elevated, river bed, mostly cultivated land with fertile soil. Narayani river – one of the major river, Tropical zone.			

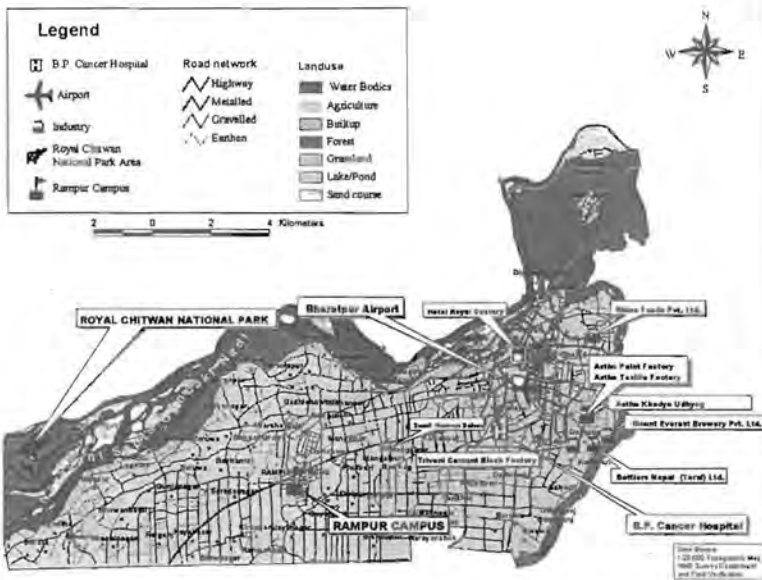
Regional Scale
(50km at 5km
interval)



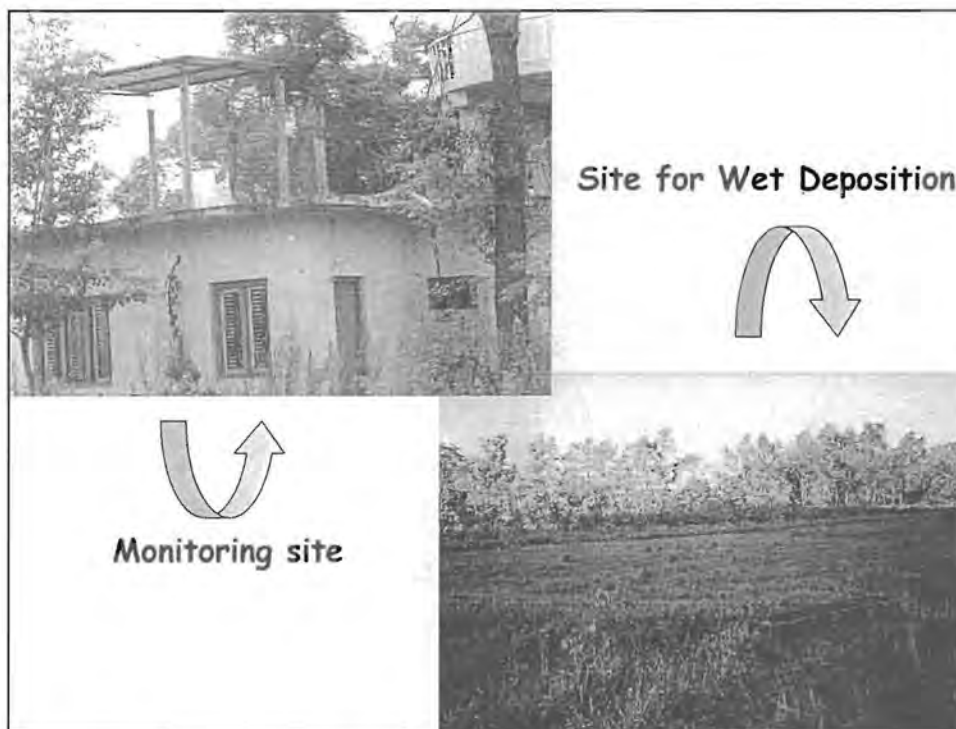
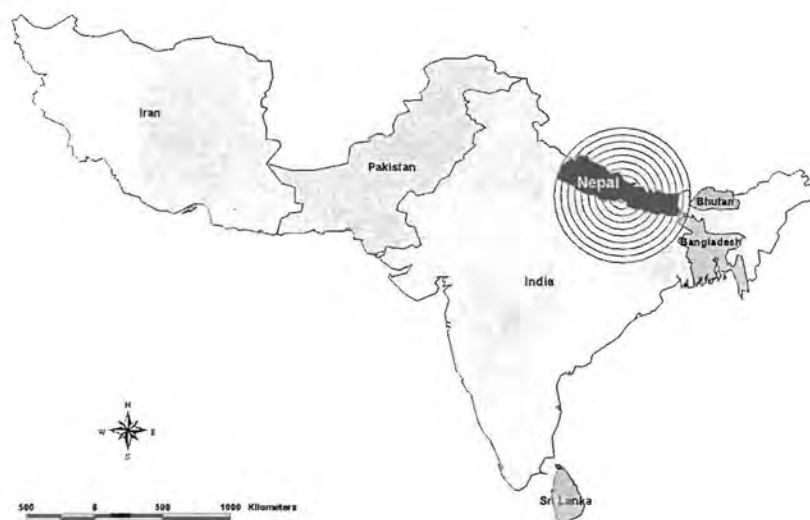
Regional Scale (up to ~ 50km)

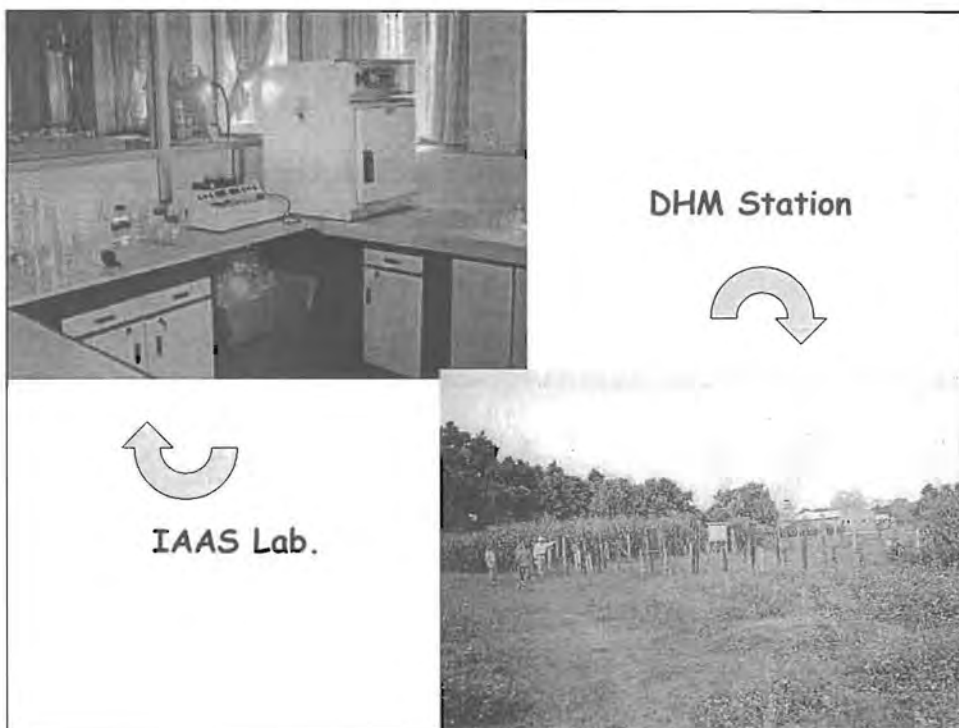
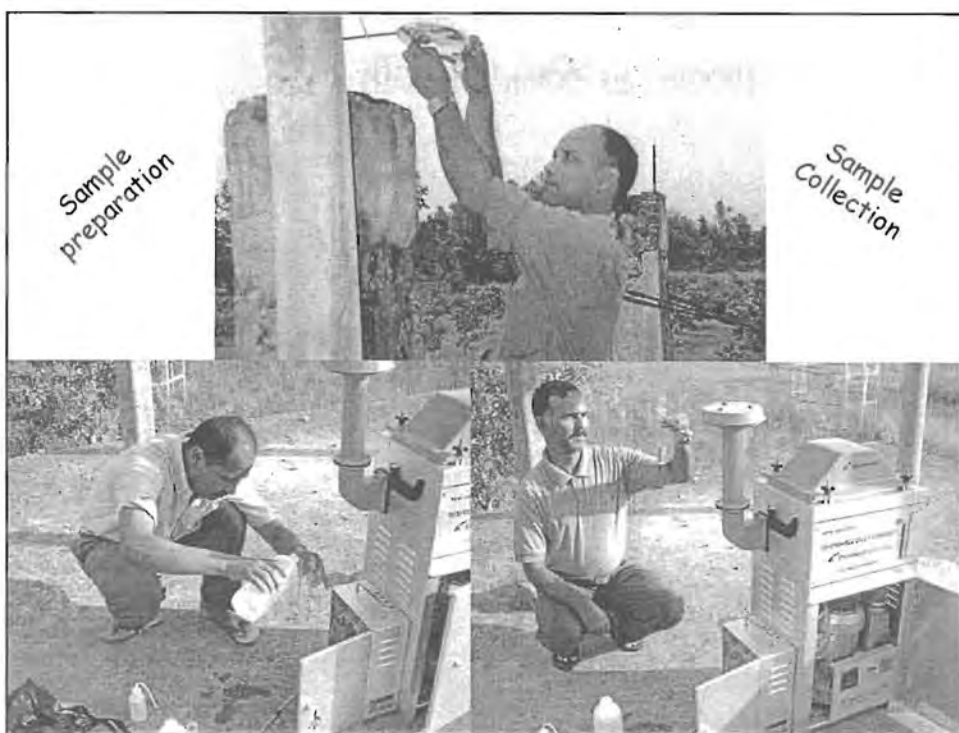
Issues	North direction (NW-NE)	East direction (NE-SE)	South direction (SE-SW)	West direction (SW-NW)
Existence of major air pollution sources* - Industries (dist from Monitoring site and Sources strength in kg/day of SO ₂ , NO ₂ , SPM)	Brikuti Paper Mill and other small industries	Small Industries	Rice Mill, Saw Mill etc	Rice Mill, Saw Mill etc
Existence of roads with more than 5000 vehicles/day, and their traffic densities.	East West Highway <5000 vehicles	East West Highway <5000 vehicles	Side Roads <500 vehicles	Highway / Side Road <4000
Existence of settlements with the population more than 1500 persons	Population density <20,000	Population density <12000	Population density <10000	Population density <12000

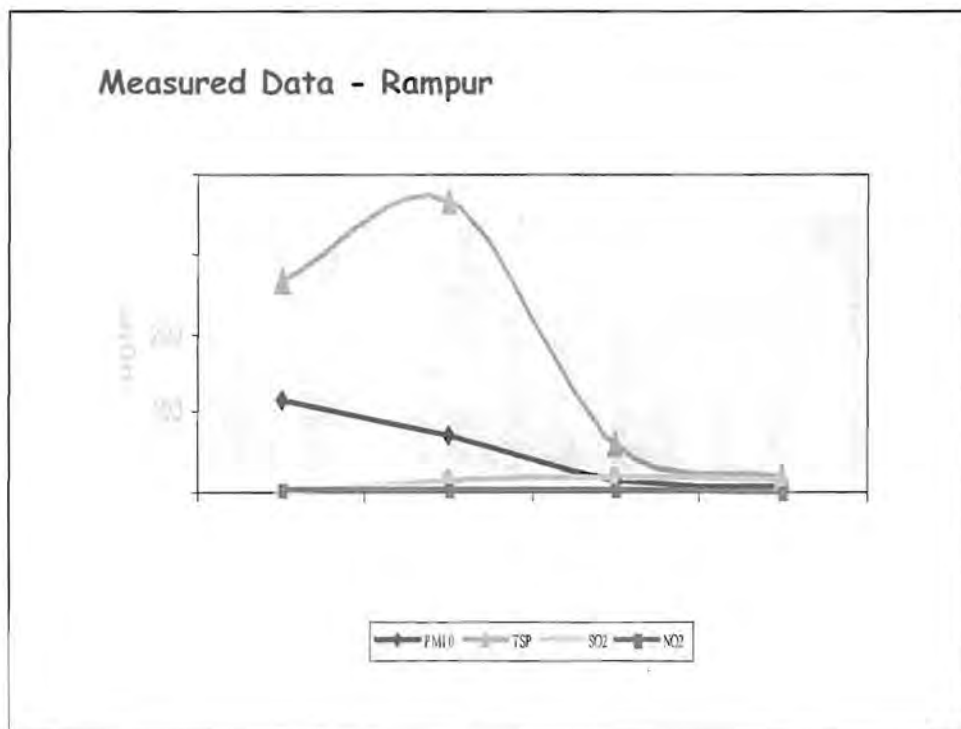
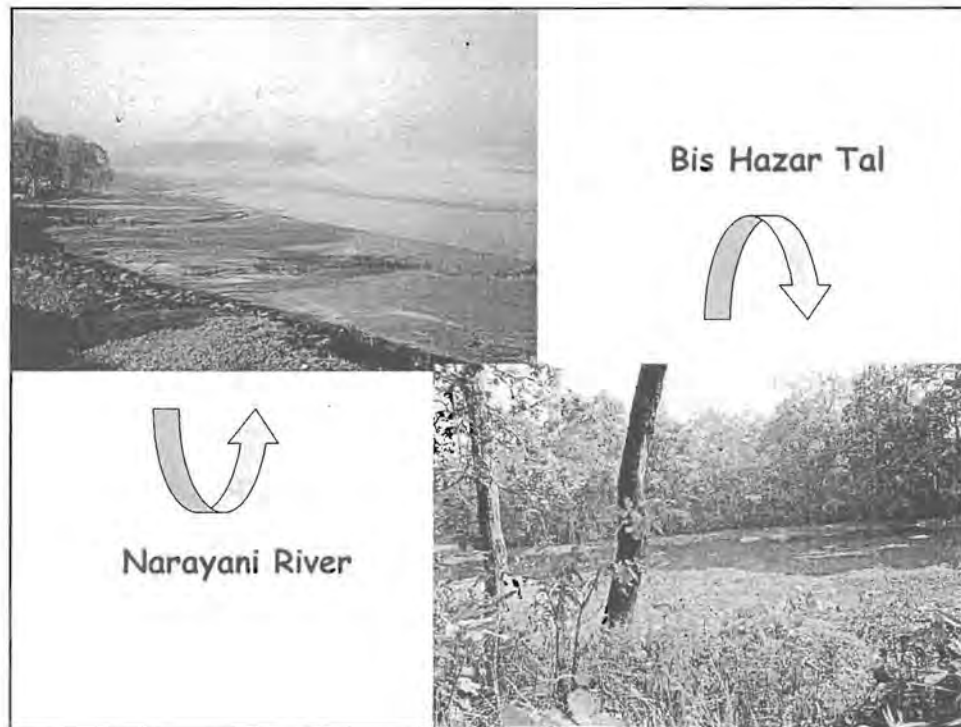
Chitwan

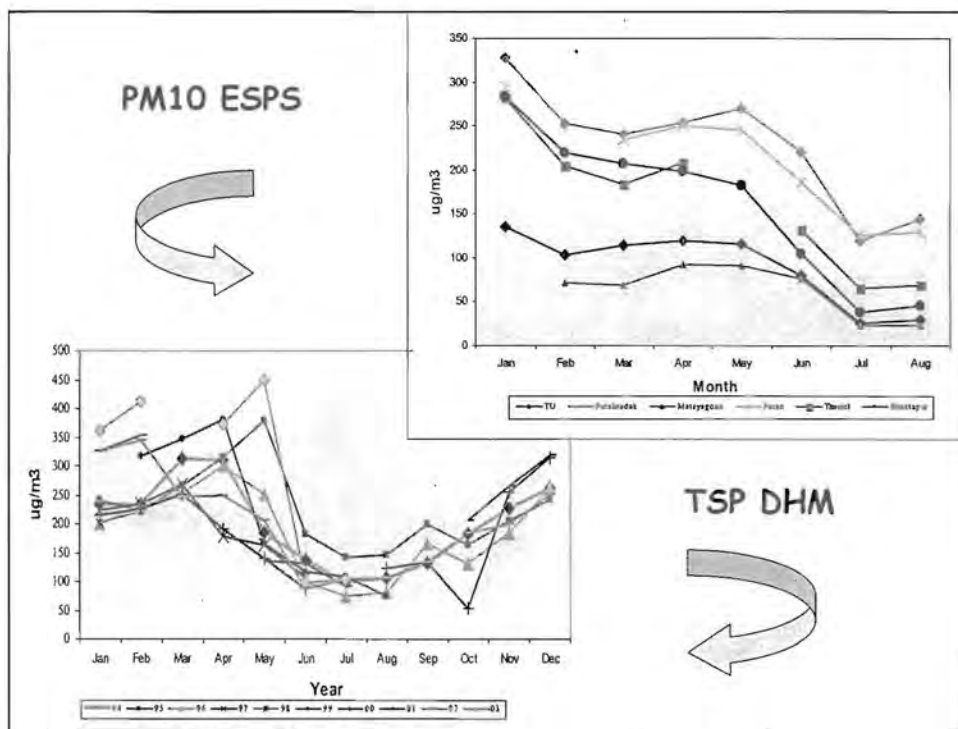


Meo Scale (500km at 50km interval)









Thank You

Attachment VIII
Preparation of national implementation plan by Sri Lanka

OUTLINE OF THE NATIONAL MONITORING PLAN FOR THE PHASE II OF
MALE DECLARATION
SRI LANKA



by
Anura Jayathilake
&
C.K.Amaratunga

1

↗ SOUTH- WEST (MAY-SEP)
↖ NORTH-EAST (DEC- FEB)

MONITORING SITE
DUTUWEWA



SITE FOR THE MONITORING STATION



3

TOWARDS *NORTH*



4

TOWARDS *WEST*



5

TOWARDS *EAST*



6

TOWARDS NE DIRECTION



7

ACCESS ROAD



8

MONITORING PARAMETERS

- PASSIVE SAMPLING FOR SO₂ & NO₂
- WET DEPOSITION
- PM₁₀, SO₂ & NO₂
- LYMNOCYTOLOGY & SOIL CHARACTERISTICS DEPENDING ON THE AVAILABILITY OF FUNDS

9

ANALYSIS

PASSIVE SAMPLING

WE HAVE STARTED PASSIVE SAMPLING ON AUGUST 15, 2003 AT THE SITE. THE PROBLEM THAT WE FACED WAS TO PROTECT SAMPLERS FROM MONKEYS.

WET & DRY DEPOSITION

WE INTEND TO START THIS ACTIVITY IN OCTOBER, 2003. ANALYSIS WILL BE CARRIED OUT AT CEA LABORATORY. CEA INTENDS TO PROCURE AN ION CHROMATOGRAPH BEFORE THE END OF THE YEAR. AAS AVAILABLE AT THE CEA WILL BE USED FOR THE DETERMINATION OF CATIONS.

PM₁₀, SO₂ & NO₂

WE INTEND TO START THIS ACTIVITY ALSO IN OCTOBER, 2003. ANALYSIS WILL BE CARRIED OUT AT THE SITE ITSELF.

10

LOCATION OF PASSIVE SAMPLERS



11

INSTALLING PASSIVE SAMPLERS



12

LYMNOLOGY

CEA INTENDS TO CARRY OUT THIS ACTIVITY IN COLLABORATION WITH PROF. Mrs.SVARNA PIYASIRI, DEPT OF ZOOLOGY, SRI JAYAWARDANEPURA UNIVERSITY DEPENDING ON THE AVAILABILITY OF FUNDS.

SOIL

CEA INTENDS TO CARRY OUT THIS ACTIVITY IN COLLABORATION WITH A SUITABLE LABORATORY SUCH AS RUBBER RESEACH INSTITUTE LAB, INDUSTRIAL TECHNOLOGY INSTITUTE LAB ETC. DEPENDING ON THE AVAILABILITY OF FUNDS.

HOWEVER, IT IS INTENDED TO DO THE SAMPLING ONLY ONE TIME TO BE KEPT AS BASELINE DATA COLLECTION.

13

ADVISORY COMMITTEE

NAME	POSITIO N	E-MAIL
Dr. P.K.Kotta	SENRIC Coordinator	pk_sacep@eureka.lk
Prf. O.A.Illeperuma	Snr. Lecturer	oliveri@pdn.ac.lk
Prf.(Mrs.) Swarna Piyasiri	Snr. Lecturer	piyasiri@slt.lk
Dr. Anura Dissanayake	Soil Chemist	dimri@tradene.lk
Dr. B.R.S.S.Basnaya ke	Meteorologist	
Mr. H.D. Ratnayake	Dy. Director Dept. of Wild Life	hdr@dwlc.lk

14

Dr. B.M.S.Batagoda	Director(Globe Aff.), My. Of Env't.	
Mr. Hemantha Withanage	NGO	hemantha@ef.is.lk

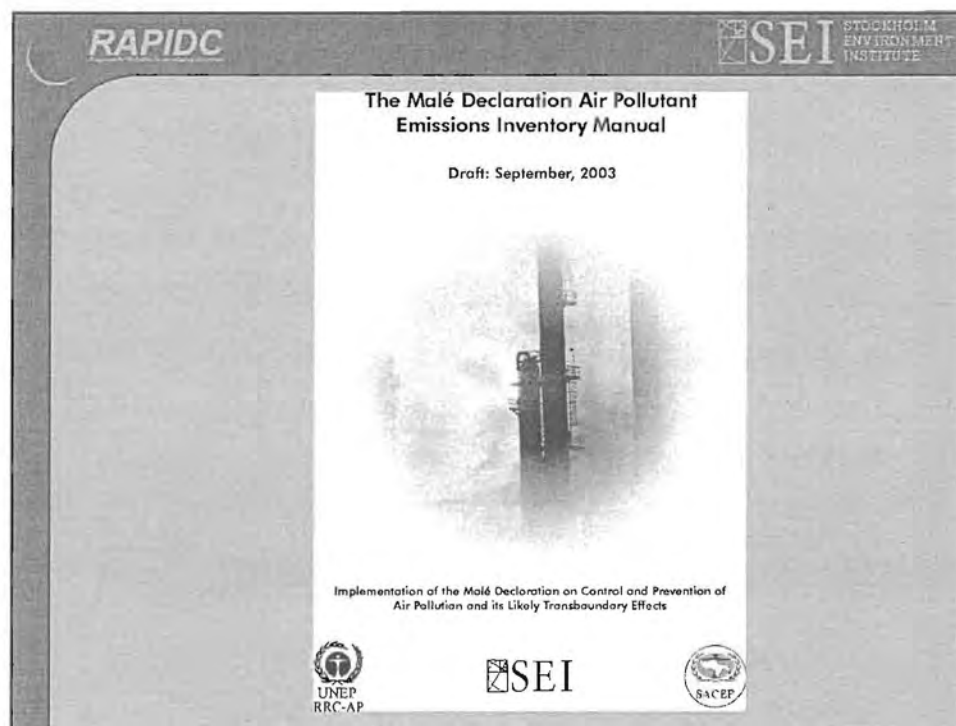
15

THANK YOU

16

Attachment IX

Presentation on parallel activities on emission inventory and modeling



RAPIDC

SEI STOCKHOLM ENVIRONMENT INSTITUTE

Aim and objective of the parallel activity on emissions inventories

Aim:

each Malé Declaration country to compile (during Phase III) air pollutant emission inventories which are compatible with each-other and with the Integrated Assessment Model (IAM)

Aim and objective of the parallel activity on emissions inventories

Aim:

each Malé Declaration country to compile (during Phase III) air pollutant emission inventories which are compatible with each-other and with the Integrated Assessment Model (IAM)

Objective:

to produce, in consultation with the NIAs and S. Asian experts, a manual and associated software (Excel-based workbook) for use by the Malé Declaration countries in compiling these emission inventories

Process for developing the manual and workbook

- At end of Phase I, development of an IAM (including an emission inventory) **identified by NIAs as a priority** - to be carried out in parallel to the monitoring efforts.

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- This activity **builds on earlier work** carried out during Phase I - especially the *Baseline Studies*
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- This activity **builds on earlier work** carried out during Phase I - especially the *Baseline Studies*.
- The manual and workbook has been developed in **consultation with the NIAs** (questionnaire circulated last year) and regional experts
- Malé Declaration countries will then use the manual to develop emission inventories and run scenario projections in Phase III

Pollutants included in manual

- Sulphur dioxide (SO_2)
- Nitrogen oxides (NO_x)
- Particulate matter (PM_{10} and Total Suspended Particulate (TSP))
- Ammonia (NH_3)

Summary of emission source categories used in the manual

Energy sources:

- 1 Combustion in the Energy Industries
- 2 Combustion in Manufacturing Industries and Construction
- 3 Transport
- 4 Combustion in Other Sectors

Summary of emission source categories used in the manual

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- 4 Combustion in Other Sectors

Other source sectors:

- 5 Fugitive emission from fuels
- 6 Industrial Processes
- 7 Agriculture
- 8 Vegetation Fires & Forestry
- 9 Waste
- 10 Natural sources

Breakdown of energy source sectors

Sector	Sub-sector	Sub-sub sector
1. Combustion in Energy Industries	Public Electricity and Heat Production	
	Petroleum Refining	
	Manufacture of Solid Fuels and Other Energy:	Coke ovens
		Patent fuel, BKB
Gas works		
		Charcoal production
2. Combustion in Manufacturing Industries and Construction	Iron and steel	
	Non-ferrous metals	
	Chemicals	
	Pulp, paper and print	
	Food, beverages and tobacco	
	Textiles and leather	
	Other	
3. Transport	Civil Aviation	
	Road transport	
	Railways	
	Navigation	
	Pipeline transport	
	Other	
4 Combustion in other sectors	Commercial/Institutional	
	Residential	
	Agriculture/Forestry/Fishing	

Fuel combustion sectors – Fuel categories

Coal	Gas	Oil	Combustible Renewables / wastes
Coking Coal	Gas Works Gas (GWG)	Crude Oil	Solid Biomass and Animal Products:
Other Bituminous Coal & Anthracite	Natural Gas	Natural Gas Liquids (NGL)	Wood
Sub-Bituminous Coal		Refinery Gas	Vegetal materials and wastes
Lignite		Liquefied Petroleum Gases (LPG)	Other (e.g. Animal products/wastes)
Patent Fuel		Motor Gasoline	Gas/Liquids from Biomass + wastes
Coke Oven Coke		Aviation Gasoline	Municipal Waste
Gas Coke		Gasoline type Jet Fuel	Industrial Waste
BKB (Brown coal briquettes)		Kerosene type Jet Fuel	Charcoal
Coke Oven Gas (COG)		Kerosene	
Blast Furnace Gas (BFG)		Gas/Diesel Oil	
		Residual Fuel Oil (RFO)	
		Petroleum Coke	
		Other Petroleum Products	

General approach for calculation of emissions

Unless measured directly, emissions are generally estimated using emission factors:

$$\text{Emission} = (\text{emission factor}) \times (\text{activity rate})$$

Emission Factors (EFs)

EFs are the rate of emission of a pollutant per unit of activity (e.g. kg NO_x per kt of coal burnt; kg SO₂ per tonne copper smelted)

The manual and associated workbook contains suggested default EFs

Default EFs mostly derived from European or North American source documents (e.g. EMEP/Corinair; USEPA AP-42; IPCC Guidelines)

Emission Factors (EFs)

Where possible, EFs appropriate for the region have been used in the manual (and workbook) after consultation with NIAs, local experts and a literature search e.g. :

- Road vehicle EFs - mostly from Indian Central Pollution Control Board (CPCB), New Delhi.
- Biomass fuel and biomass residue burning – Centre for Environmental Science and Engineering, Mumbai, India.

Activity rates

Examples:

- For ***fuel combustion***, the “activity rate” is the annual rate of consumption of a fuel (e.g. kilotonnes oil equivalent (ktoe) burnt per year)
- For ***industrial process emissions*** the “activity rate” is the annual rate of production of the commodity (e.g. tonnes copper per year)

Activity rates

Sources of activity data:

- National statistical yearbooks

Activity rates

Sources of activity data:

- National statistical yearbooks
- International sources:

*International Energy Agency (IEA) Energy Statistics and Balances
of non-OECD Countries (on CD ROM)*

United Nations, Industrial Commodity Statistics Yearbooks

*UN Food and Agricultural Organization's on-line database
FAOSTAT*

Top-down or bottom up approach?

- Depends on data availability – flexibility crucial

Top-down or bottom up approach?

- Depends on data availability – flexibility crucial
- If national data only – then top-down

Top-down or bottom up approach?

- Depends on data availability – flexibility crucial
- If national data only – then top-down
- If large point source (LPS) data – bottom-up

Top-down or bottom up approach?

- Depends on data availability – flexibility crucial
- If national data only – then top-down
- If large point source (LPS) data – bottom-up
- National and LPS sources can be inventoried together–
the workbook will automatically adjust national activity data
to avoid 'double-counting'.












The emission inventory Excel workbook: main menu

User must enter inventory details here:

Inventory year:	2000
Region:	S. Asia
Country:	Someland
Province:	SomeCounty

The emission inventory Excel workbook: main menu

MENU OVERVIEW

	Menu1	Sectors 1. to 4. Fuel combustion activities
	Menu2	Sector 5. Fugitive emissions (non-combustion) for fuels
	Menu3	Sector 3. Fuel combustion activities. Sub-sector: Transport (Detailed method)
	Menu4	Sector 6. Industrial processes (non-combustion) emissions
	Menu5	Sector 7. Agriculture
	Menu6	Sector 8. Vegetation fires and Forestry.
	Menu7	Sector 9. Waste
	Menu8	Sector 10. Natural sources
	Menu9	Sector 11. Large Point sources
	Sheet 8	Summary sheet - Annual emissions of each pollutant by source sector
	References	

The emission inventory Excel workbook: Menu 3

Sector 3. Fuel combustion activities. Sub-sector: Transport (Detailed method)

[Back to
Main Menu](#)

- [GO](#) Sheet 1.7.1 Emissions for LTO* and cruise activities of domestic aircraft.
- [GO](#) Sheet 1.7.2 Emissions for LTO* and cruise activities of international aviation.
- [GO](#) Sheet 1.7.3 Mobile emissions of NO_x and PM (detailed) for on-road vehicles.
- [GO](#) Sheet 1.7.4 Age of vehicle deterioration factors for exhaust emissions.

Road transport emissions – detailed or simple method?

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- Workbook will permit either method.

Mobile emissions of (detailed) for on-road vehicles

Sheet 1.7.3 Mobile emissions of NO_x, PM₁₀ and TSP (detailed) for on-road vehicles.

Sector: Transport (Detailed method)

Sub-sector: Road transportation

[BACK TO MENU](#)

Fuel	Vehicle class	Year of manufacture	A	B	C	D
			Number of vehicles in use	Average distance travelled per vehicle (km/yr)	Total distance travelled (km/yr) C = A x B	Distance travelled on unpaved roads as a percent of total (%)
Gasoline	2-wheeler, 2-stroke	Pre 1986			0	
		1986-1990			0	
		1991-1995			0	
		1996-2000			0	
		2001-2005			0	
		2006-2010			0	
Gasoline	2-wheeler, 4-stroke	Pre 1986			0	
		1986-1990			0	
		1991-1995			0	
		1996-2000			0	
		2001-2005			0	
		2006-2010			0	
Gasoline	3-wheeler, 2-stroke	Pre 1986			0	

Mobile emissions of NO_x (detailed) for on-road vehicles

Fuel	Vehicle class	Year of manufacture	E		F	G
			NO _x emission factor (g/km)		NO _x deterioration factor	NO _x emissions (Tonnes)
				Default ^b		G = C x F x E/1000000
Gasoline	2-wheeler, 2-stroke	Pre 1986		0.03	1.4	0
		1986-1990		0.03	1.4	0
		1991-1995		0.03	1.3	0
		1996-2000		0.06	1.2	0
		2001-2005		0.07	Newer than year 2000!	#VALUE!
		2006-2010		0.08	Newer than year 2000!	#VALUE!
Gasoline	2-wheeler, 4-stroke	Pre 1986		0.31	1.4	0
		1986-1990		0.31	1.4	0
		1991-1995		0.31	1.3	0
		1996-2000		0.3	1.2	0
		2001-2005		0.3	Newer than year 2000!	#VALUE!
		2006-2010		0.3	Newer than year 2000!	#VALUE!
Gasoline	3-wheeler, 2-stroke	Pre 1986		0.05	1.7	0

Mobile emissions of PM₁₀ (detailed) for on-road vehicles

Year of manufacture	H		I	J	M		N	Q		R
	Exhaust PM10 emission factor (g/km) (Assume = TSP emission factors)		PM deterioration factor	Exhaust PM ₁₀ emissions (Tonnes)	Paved road resuspended dust (PM ₁₀) emission factor (g/km)		Paved road resuspended dust (PM ₁₀) emissions (Tonnes)	Unpaved road resuspended dust (PM ₁₀) emission factor (g/km)		Unpaved road resuspended dust (PM ₁₀) emissions (Tonnes)
		Default		J = I x C x G/1000000		Default ¹	N = C x (100-D)/100 x M/1000000		Default ¹	R = C x (D/100) x Q/1000000
Pre 1986		0.23	1.4	0		0.02	0		64	0
1986-1990		0.23	1.4	0		0.02	0		64	0
1991-1995		0.23	1.3	0		0.02	0		64	0
1996-2000		0.1	1.2	0		0.02	0		64	0
2001-2005		0.05				0.02	0		64	0
2006-2010		0.05				0.02	0		64	0
Pre 1986		0.07	1.4	0		0.02	0		64	0
1986-1990		0.07	1.4	0		0.02	0		64	0
1991-1995		0.07	1.3	0		0.02	0		64	0
1996-2000		0.06	1.2	0		0.02	0		64	0
2001-2005		0.05				0.02	0		64	0
2006-2010		0.05				0.02	0		64	0
Pre 1986		0.35	1.7	0		0.04	0		128	0
1986-1990		0.35	1.7	0		0.04	0		128	0

Details of user-entered emission factors

[illegible]

Reference source for activity rate(s)

[illegible]

Step-by-step guide to using workbook

Sheet 1.7.3 Mobile emissions of NO_x, PM₁₀ and TSP (detailed) for on-road vehicles.

- Step 1 Enter in column A the average number of vehicles in use, for each vehicle class, during the inventory year.
- Step 2 Enter in column B the average distance travelled (kilometres per year) for each vehicle class.
- Step 3 Enter in column D the % of total distance which was travelled on unpaved roads.
- Step 4 Enter in column E the NO_x emission factor (grammes NO_x per kilometre) for each vehicle class.
- Step 5 Enter in column H the PM₁₀ exhaust emission factor (grammes per kilometre) for each vehicle class.
- Step 6 Enter in column K the TSP exhaust emission factor (grammes per kilometre) for each vehicle class.
- Step 7 Enter in column M the paved road emission factors (grammes per kilometre) for resuspended dust (PM₁₀).
- Step 8 Enter in column O the paved road emission factors (grammes per kilometre) for resuspended dust (TSP).
- Step 9 Enter in column Q the unpaved road emission factors (grammes per kilometre) for resuspended dust (PM₁₀).
- Step 10 Enter in column S the unpaved road emission factors (grammes per kilometre) for resuspended dust (TSP).
- Output: Worksheet 1.7.3 calculates NO_x emissions (in column G), exhaust emissions of PM₁₀ and TSP (in columns J and L), paved road emissions of PM₁₀ and TSP (in columns N and P) and unpaved road emissions of PM₁₀ and TSP (in columns R and T). Totals then carried forward to summary sheet (Worksheet 8).

The Malé Declaration Air Pollutant Emissions Inventory Manual

Draft: September, 2003



Implementation of the Malé Declaration on Control and Prevention of
Air Pollution and its Likely Transboundary Effects

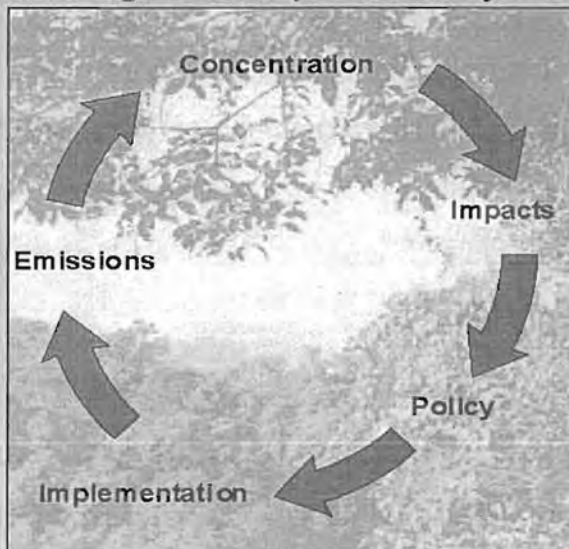


Developing an Integrated Assessment Model for South Asia

IAMs have proved useful in Europe for developing regional agreements on air pollution control. How can they help South Asia?

- What can it be used for?
- What questions can it answer?
- What is the structure?
- What are the different stages in the development?

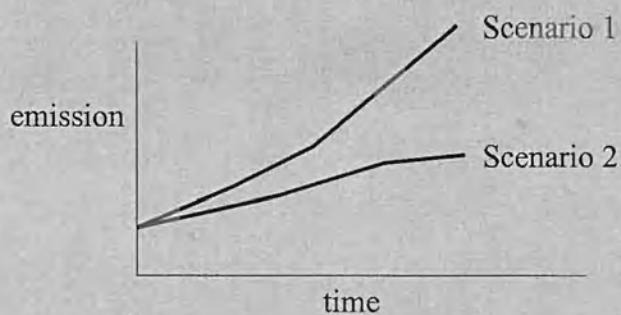
Knowledge to underpin the Policy Process



Developing an Integrated Assessment Model for South Asia

What can it be used for?

a. Investigating emission trends



Developing an Integrated Assessment Model for South Asia

What can it be used for?

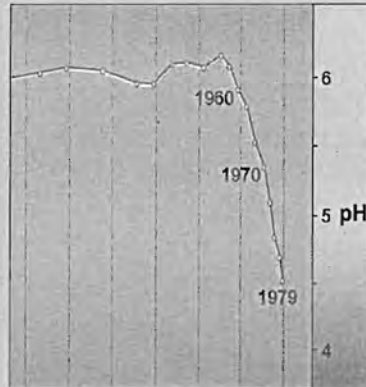
b. Investigating regional movement of pollutants

region	emission	Deposition in region			
		a.	b.	c.
a.	150	100	30	20	
b.	80	20	50	10	
c.	10	2	3	5	
Total deposition		122	83	35	

Developing an Integrated Assessment Model for South Asia

What can it be used for?

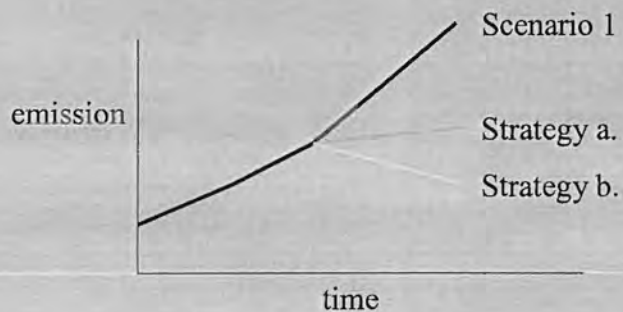
c. Assessing risks of impacts



Developing an Integrated Assessment Model for South Asia

What can it be used for?

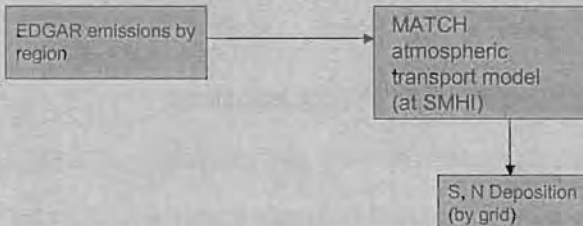
d. Developing cost-effective strategies to limit air pollution



Developing an Integrated Assessment Model for South Asia

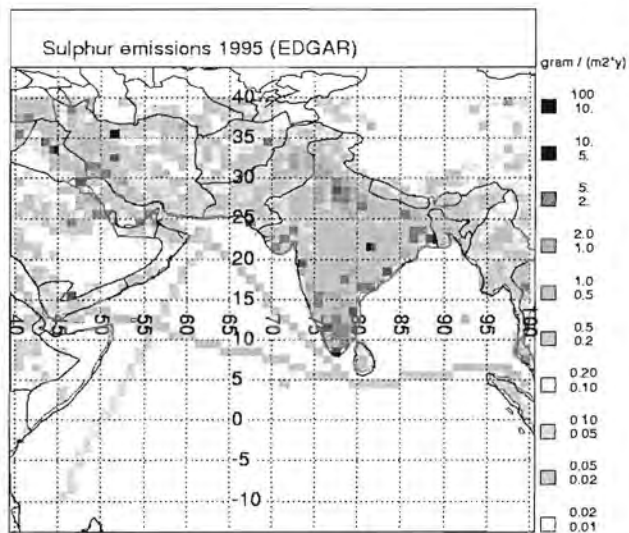
Phases in Model Development

- Phase I: develop model structure using internationally available data – allow NIA familiarity with model (2003)
- Phase II: develop national emission inventories and ecosystem impact data for use in the model and complete the transfer of MATCH model to Asia (2004-2006)
- Phase III: further develop the model to include other pollutants such as ozone, PM_{10} and $PM_{2.5}$, and impacts such as crop yield losses, corrosion, visibility and health (2006-)



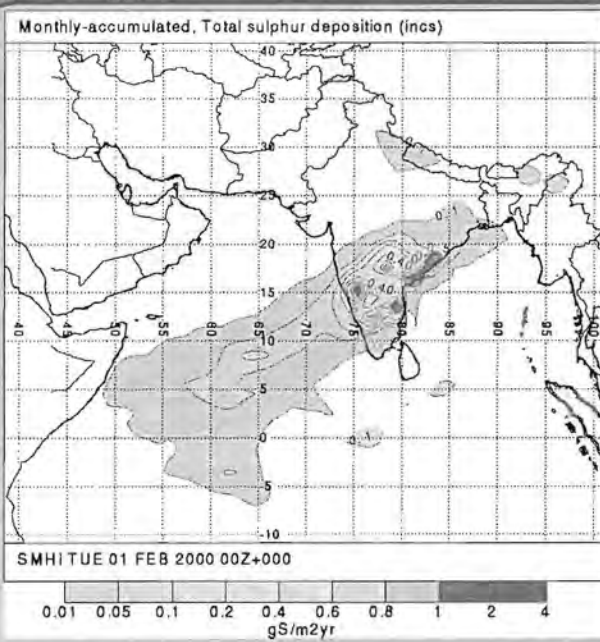
PHASE I: linking international emissions to deposition

RAPIDC
Regional Air Pollution Data Center

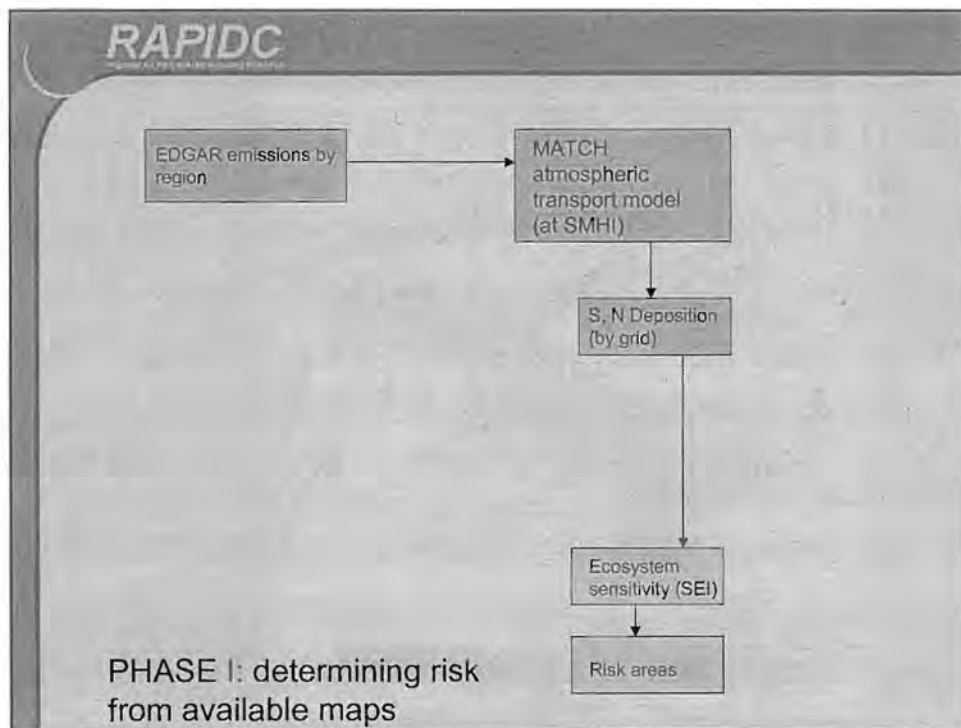
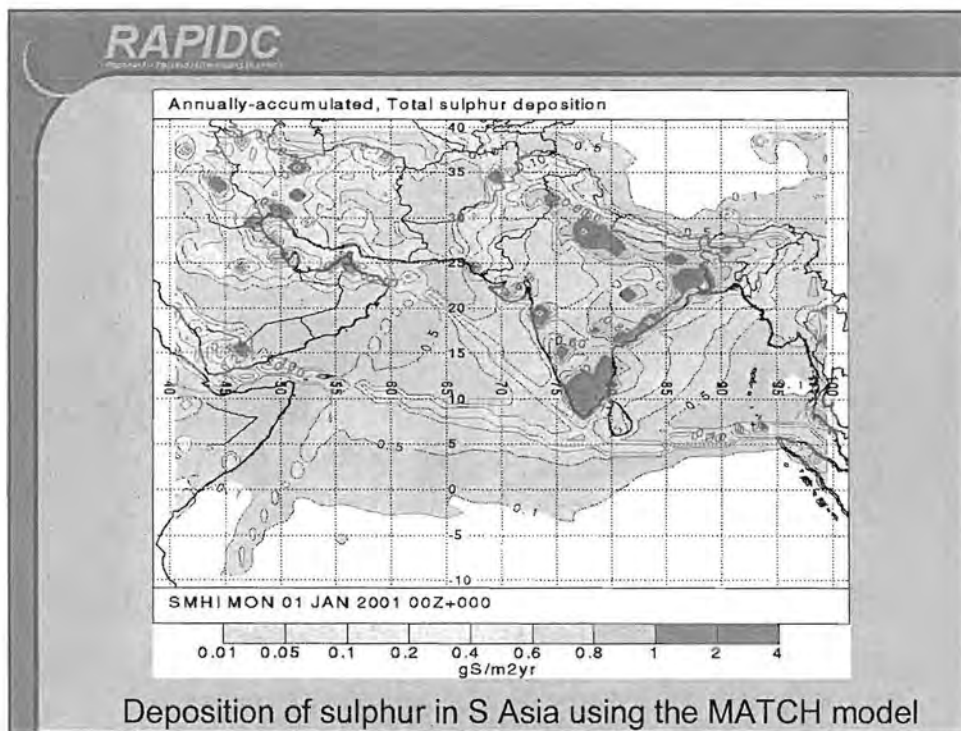


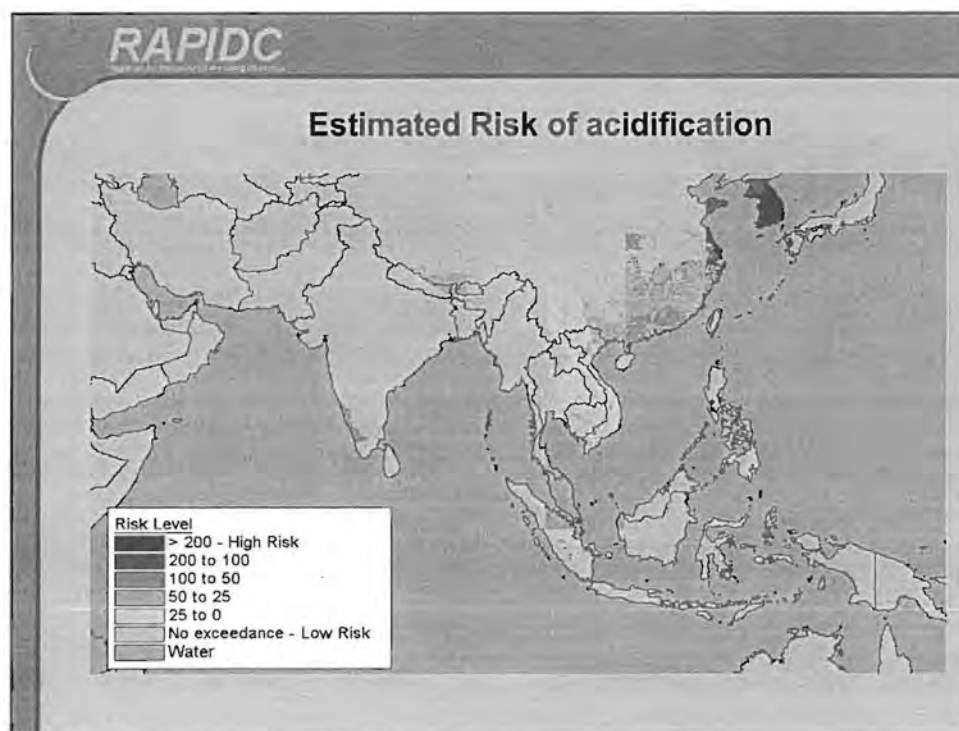
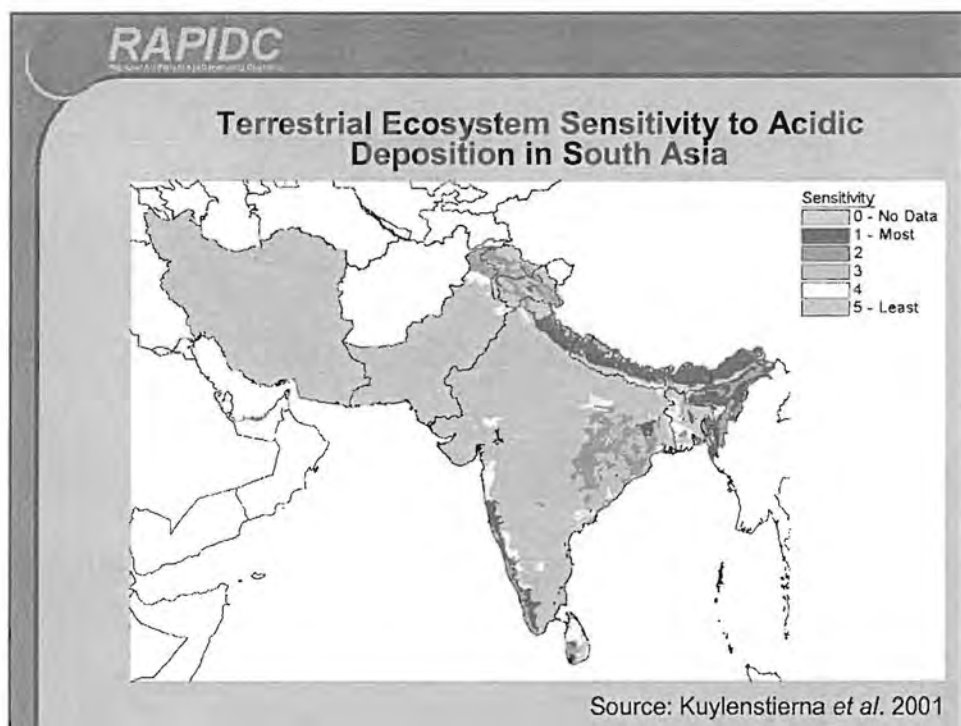
EDGAR emissions of sulphur in S Asia

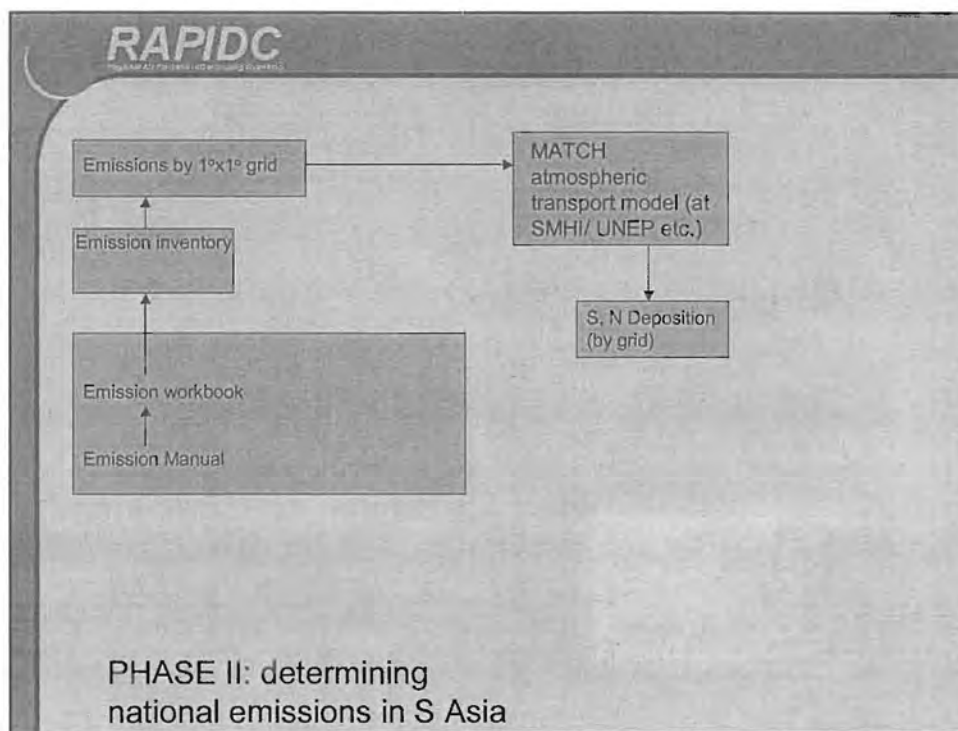
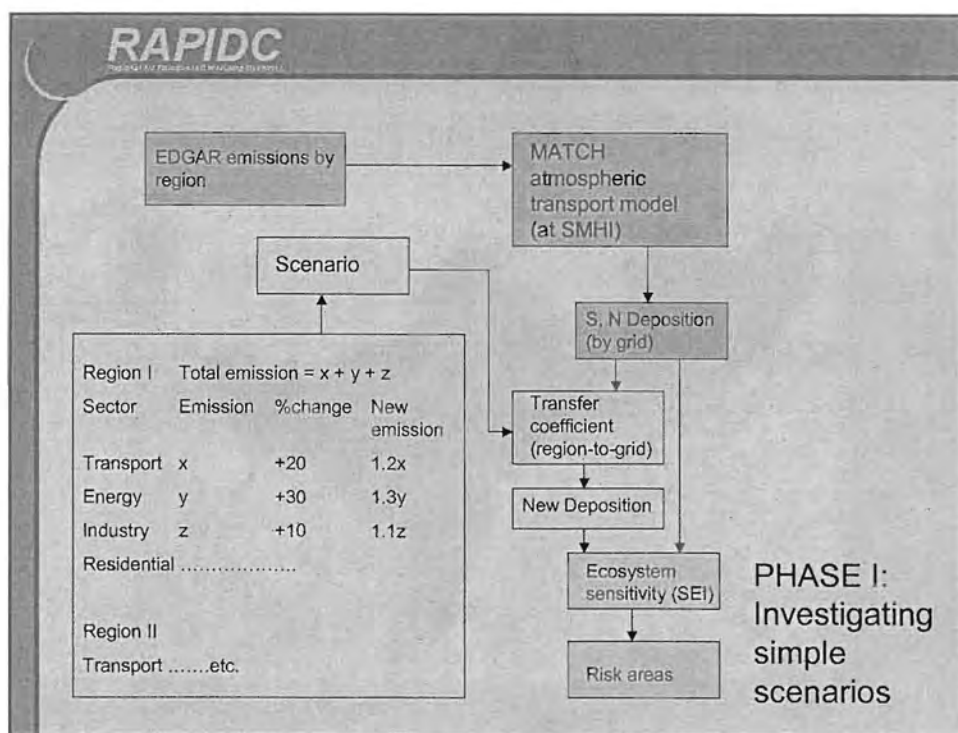
RAPIDC
Regional Air Pollution Data Center

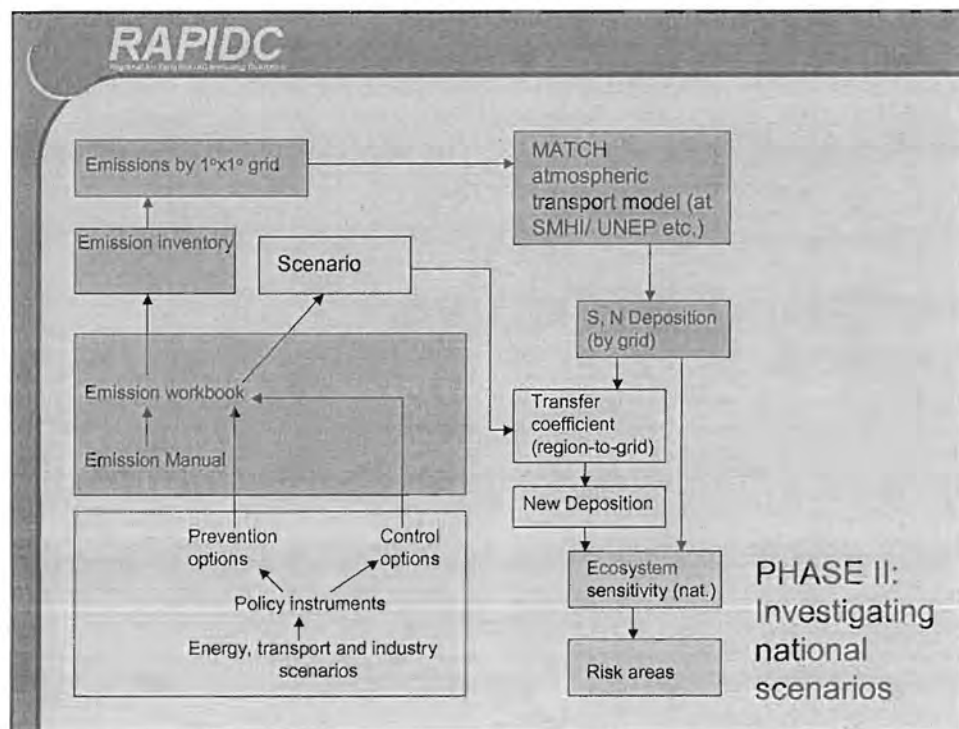
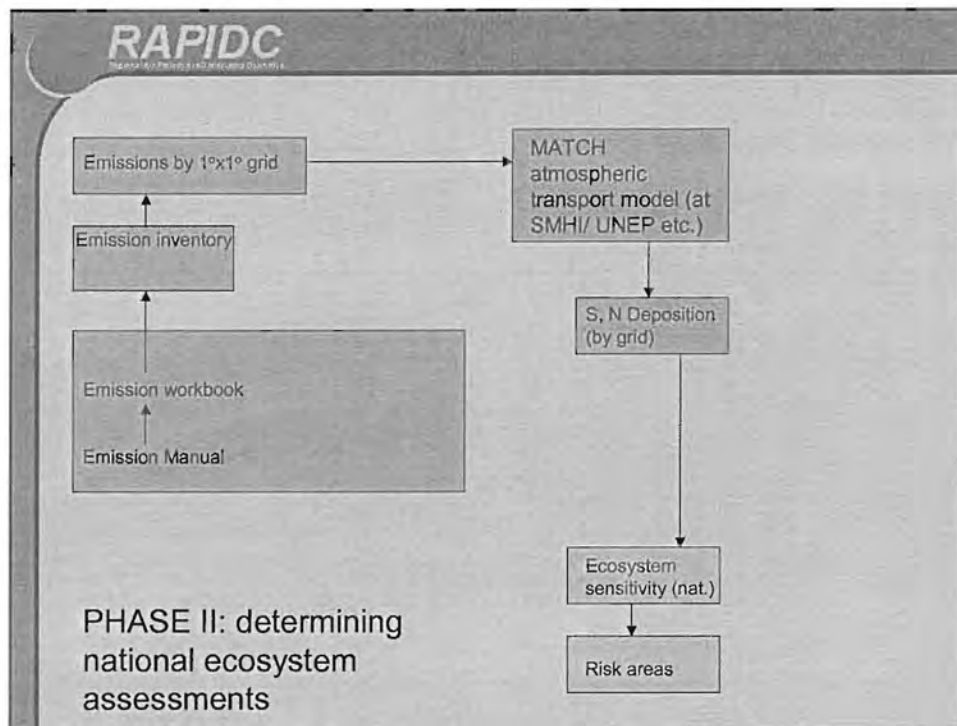


MATCH model
run for emission
region 'India
south-central'
(Andhra
Pradesh +
Karnataka +
Goa)









RAPIDC

Regional Air Pollution Impact and Control

