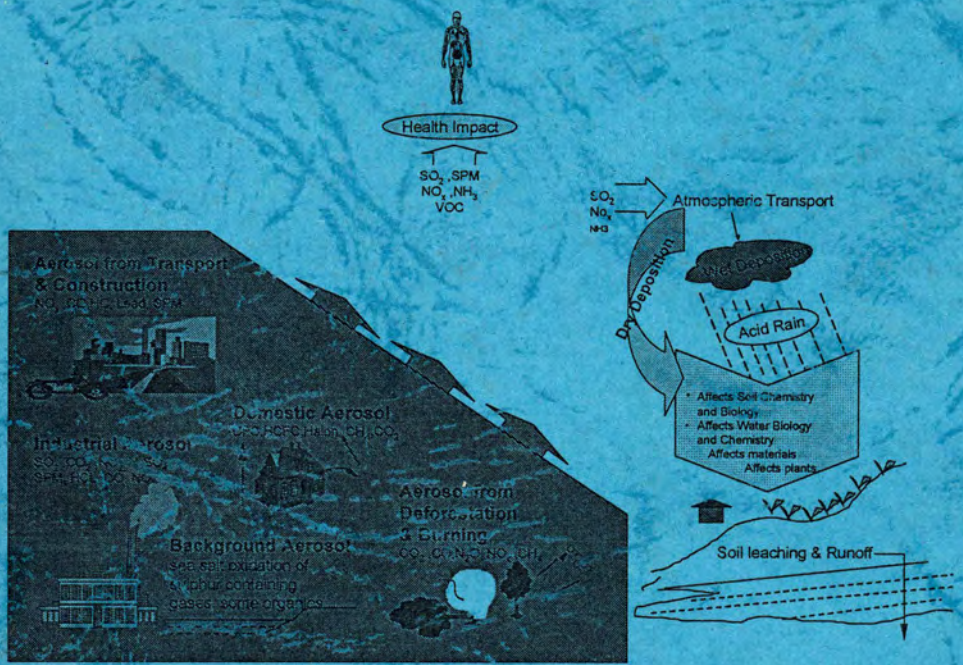
Atmospheric Environment Issues in Developing Countries

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

Phase I



FEBRUARY 1999

UNEP

SEI STOCKHOLM ENVIRONMENT INSTITUTE

Sida

SACEP

Impacts of Air Pollution

Air pollution can be defined as presence in the atmosphere of one or more contaminants which may be harmful to the environment, causing impacts on human health, crops, forests, fisheries, semi-natural ecosystems and materials (e.g. corrosion) etc. Air pollution from sulphur and nitrogen emissions can give rise to impacts close to sources in urban areas or in the vicinity of major industries. Pollutants can also cause impacts far from the source, through transfer in the atmosphere by winds, and may also cause impacts across national boundaries. Impacts of air pollution may therefore be both localised and/or transboundary in nature. Pollutants are emitted as gases, such as sulphur dioxide and nitrogen dioxide, and these can have direct impacts on the environment. Furthermore, the nitrogen oxides may react with volatile organic compounds to give rise to ozone gas, which is also damaging to health and vegetation. During transport in the atmosphere the sulphur dioxide is transformed into sulphuric acid and nitrogen oxides into nitric acid, which give rise to acidic deposition, causing potential acidifying effects on ecosystems.

There are a number of 'regional' air pollutants including sulphur oxides, nitrogen oxides, ammonia, tropospheric ozone, heavy metals and persistent organic pollutants (POPS). As it is used here 'regional' refers to that part of the issue that is not solely local (e.g. urban areas) or global (e.g. global climate change). In that emissions often give rise to local impacts and also regional effects after long-range transport, local impacts are considered part of the regional air pollution problem. Although there are a number of regional air pollutants, which are important in developing countries, the Malé Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects is concerned with impacts of sulphur and nitrogen compounds and tropospheric ozone.

Air Pollution in South Asia

In South Asia, air pollution as a local issue has been partially addressed by legislation in most countries. Further action has not been taken because the knowledge base concerning linkages between observed pollution levels and established health effects in South Asia is weak. As a result, there is some degree of complacency, which does nothing to discourage the development of polluting activities in the interest of

promoting industrial and social development in South Asia. It is not inevitable that the promotion of economic development entails increased pollution. The "precautionary principle" has not come into play as yet in this field due to the imperatives of "growth" and lack of conclusive evidence to establish the existence of effects. By taking such concepts and impacts into account development paths may be chosen that both promote development and minimise the impact on the environment.

Malé Declaration

In view of the above, governments in South Asia have agreed that initiatives are required such that risks from air pollution may be understood and emissions prevented as required. The Malé Declaration was formulated and approved at the seventh meeting of the Governing Council of SACEP held on 22 April 1998 in Malé, Republic of Maldives. This followed a policy dialogue held at AIT, Bangkok, in March 1998 where a draft declaration was developed by the participants. The development of the policy process rests on a thorough understanding of the issues relating to air pollution.

Baseline Studies and Action Plans

The signatories to the Malé Declaration stated the need for countries to carry forward or initiate studies and programmes on regional air pollution in each country of South Asia. The first stage in this process is to document current knowledge and structures in each nation relevant to air pollution issues. To this end it has been agreed that baseline studies will be developed. There will be a number of gaps in the current status of knowledge and infrastructure which will become apparent from the information gathered by the baseline studies. These gaps will need to be filled to aid the policy process and, for this reason, action plans need to be developed in each country which, when implemented, will create a solid scientific basis for the policy process. There is a need for integration of national efforts and data on a sub-regional basis. The format for this will be discussed amongst SACEP, NIAs and Environmental Ministries, together with advice from UNEP/EAP-AP and SEI.

Accompanying this document are two further documents, the purpose of which is to assist the National Implementing Agencies (NIAs) in preparing the baseline studies and

Malé Declaration action plans (national) to support the implementation of the Malé Declaration. The additional documents are designed to help in the production of the baseline report and Malé Declaration action plan (national) report. These are:

Part I: **Guidelines for the Preparation of Baseline Studies**

Part II: **Guidelines for the Preparation of Malé Declaration Action Plans (National)**

Note: The national reports should be produced both in hardcopy and digital format (in MS Word)

These guideline documents have been produced by Mylvakanam Iyngararasan and Surendra Shrestha of UNEP/EAP-AP (Environmental Assessment Programme for Asia and Pacific) and Johan Kuylenstierna and Kevin Hicks of SEI (Stockholm Environment Institute). These guideline documents have also been reviewed and adopted by the National Implementing Agencies. Sida, the Swedish International Cooperation Development Agency, has funded this part of the implementation of the Malé Declaration.

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

Phase I

Part I: Guidelines for the Preparation of Baseline Studies

FEBRUARY 1999

Contents

OBJECTIVE OF THE BASELINE STUDY

The objective is to gather national information on air pollution to facilitate the implementation of the Malé Declaration in South Asian countries in order to achieve significant environmental and public health benefits through reductions in emissions of air pollutants. Deposition reductions are unlikely to be met solely through national policies and measures because of the transboundary nature of air pollution transfer. Therefore, there is a need for inter-governmental cooperation and the development of sub-regional air quality assessment procedures and appropriate action plans. The information collected from baseline studies will be used to develop national and sub-regional action plans and to establish a consistent air quality assessment procedure for each nation (Figure 1).

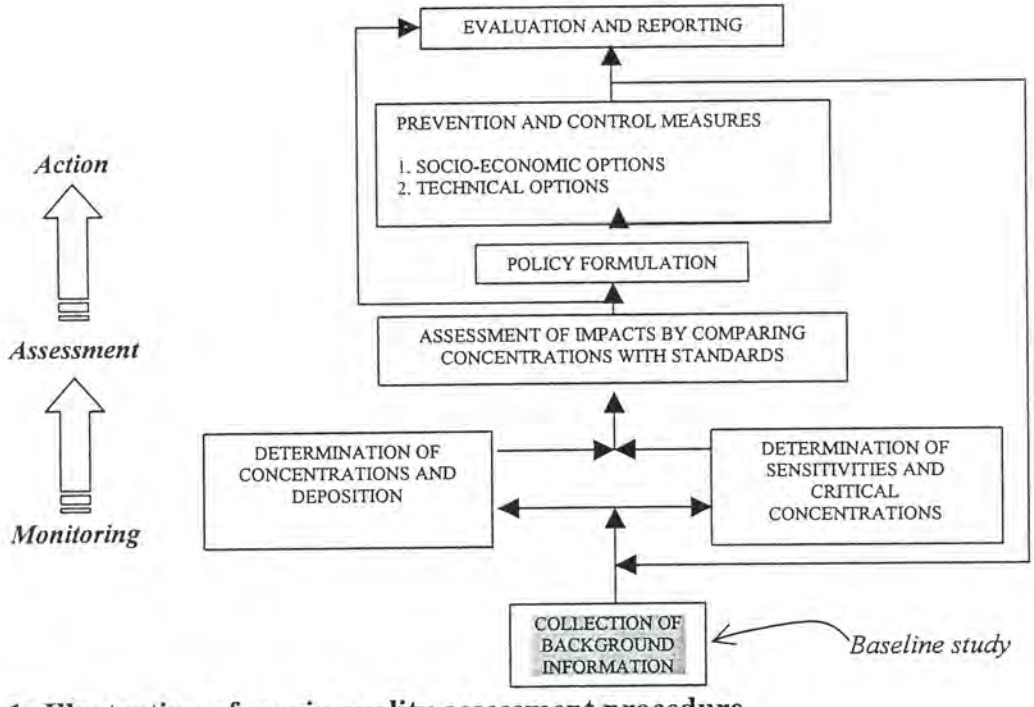


Figure 1: Illustration of an air quality assessment procedure

The assessment procedure has to begin with the collection of detailed knowledge describing the existing situation. The aim is to know which air pollutants are present and in what quantities, their origin, their dispersal patterns, the potential that they will impact on sensitive receptors, and what response measures should be taken to ameliorate the situation.

STRUCTURE OF THE REPORT

The baseline report for each country should be a detailed account of national background information on air pollution related to sulphur and nitrogen emissions. Therefore, it should be able to provide background information on air pollution in general and emissions of sulphur and nitrogen and their regional effects in particular. The following is the proposed structure of the report:

Title: Baseline Study for Air Pollution in *name of the country*

	Section	Approximate number of pages
1	National Views on Air Pollution	5
2.	Air Pollution Monitoring	10
3.	Emission Sources and Estimates	10
4.	Research Studies into Air Pollution	10
5.	National Responses to Air Pollution Problems	5

Attachment I List of available publications (see attached template-attachment 1)

Attachment II Database on national institutions, equipment experts and skills (see attached template-attachment 2)

Attachment III National database on air pollution: this will not form part of the document but should be completed in electronic format as part of the baseline studies (The standardised database format is provided in the attachment 3)

Note: Sub-sections could be included and/or other sections omitted to reflect the situation in individual countries more accurately.

CONTENTS OF THE REPORT

The following part of the guidelines describes the main sections outlined above in more detail, explaining the type of detail that may be included. The individual sections will require specialist knowledge of the different areas of research. It may be necessary for

the National Implementing Agency (NIA) to access the specialist knowledge from other institutions and experts for the individual sections, as appropriate.

SECTION 1. THE NATIONAL VIEW OF AIR POLLUTION

This section should give a national overview of the state of the environment with regard to air pollution using the following guidelines:

- What are the major concerns with regard to air pollution in the country?
- What is the importance of air pollution in relation to other environmental issues?
- Where in the country is air pollution considered a problem?
- What types of impacts have been reported?
- General environmental conditions in the country can be briefly explained to place air pollution issues in contexts.

SECTION 1. THE NATIONAL VIEW OF AIR POLLUTION

This section should give a national overview of the state of the environment with regard to air pollution using the following guidelines:

- What are the major concerns with regard to air pollution in the country?
- What is the importance of air pollution in relation to other environmental issues?
- Where in the country is air pollution considered a problem?
- What types of impacts have been reported?
- General environmental conditions in the country can be briefly explained to place air pollution issues in contexts.

SECTION 2. AIR POLLUTION MONITORING

Monitoring is an essential part of any programme to understand the magnitude of potential or existing air pollution impacts. Many countries already have monitoring networks in place. Most of these have been set up to monitor urban air pollution problems and are therefore situated in cities.

Monitoring stations have been set up to monitor pollutant gas and particle concentrations and the deposition of various pollutants in rainwater. This section should show the status of monitoring in the nation for the deposition of sulphate, nitrate, ammonium, basic cations and any other important compounds that are actively monitored in the country. In addition, monitoring of gaseous concentrations of SO_2, NO_x, NH_3, SPM and O_3 should be reported.

Important considerations for a monitoring station within the network are:

i. location

ii. purpose of the monitoring station

iii. pollutants monitored

iv. quality and type of analysis

v. short-term future plans

vi. long-term future plans

2.1 Current Monitoring Network

The nature of any monitoring is related to the current national priorities. These priorities need to be stated and the current design of the network explained in terms of this need. The description of the current network should if possible include the following:

- a map showing the location of monitoring stations in the country;
- the status of the existing monitoring network: pollutants monitored and techniques used for the different pollutants;
- mode of dissemination of results;
- a description of the organisation responsible for the monitoring stations.

For those stations considered to produce high quality data and which are useful for illustrating trends in regional air pollution, information may be tabulated as shown in the following table:

Monitoring station	Parameters monitored	Monitoring technique	Organisation responsible	Mode of dissemination

Note: For each monitoring station the following information should be included: Latitude, Longitude and height above mean sea level; a description of the immediate surroundings (e.g. rural, forest, town etc); industries to the north, open sea to the south etc; a description of how the measurements were taken e.g. measurements were collected at x metres above the ground, which was covered with .....type vegetation etc. Photographs of monitoring stations are also useful to be included in the report.

2.2 Siting of Monitoring Stations

Most monitoring stations in South Asian countries have been set up in urban areas to determine the level of pollution in cities and its potential impact on human health. There are other functions of air pollution monitoring which give an indication of the air pollution load in larger areas within a country and show the development of long-range transport of air pollution. Sites valuable for these functions are likely to be fewer in number but they are important as they may be used to indicate general trends in air pollution across a large region, rather than the changes in local pollution sources. They may also be used to validate models of long-range atmospheric transport of air pollutants which can be important tools in the regional policy process. Monitoring in sub-urban areas is also important as it can give a value for the city in general and not just the city centre. It would be useful to include an analysis of the number of sites which may be classified as A) Urban, B) Sub-urban, C) Rural and to describe in more detail the sites which are more rural in nature.

The siting of monitoring stations is of primary importance since those situated too close to sources of pollution may dominate the results making the data difficult to interpret. There are international guidelines for siting criteria (e.g. from WMO (World

Meteorological Organization)), but it would be useful to outline national procedures and guidelines adopted for the siting of monitoring stations.

2.3 Examples of Monitoring Results

For those sites which are considered to be the best in each country, specimen results could be included to give an indication of the levels of deposition or concentrations that are being experienced annually.

2.4 Data Availability

The question of data availability is an important one and the following questions are relevant:

- How are the monitoring data made public or available to various parties?
- Is access to the data restricted in any way?

2.5 Data Quality Checks

It is important that the quality of monitoring data is maintained at a high level if the data are to be used to support the policy process. There are many standard checks as to the accuracy of monitoring equipment and simple tests of data quality (such as checking the ion balance of wet deposition data). The standard procedures adopted in each country to ensure the quality of monitoring should, if possible, be outlined, for example, calibrations between different laboratories in the country and comparisons with other (international) groups. Develop ideas for data quality checks in the action plan.

2.6 Future Developments of Monitoring Networks

In order to furnish the policy process with the necessary monitoring data it is necessary to identify shortfalls in the existing monitoring system for each country. It will then be necessary to design a network that can provide the necessary information required for the regional policy process. Ideally, existing equipment should be upgraded rather than

starting a new monitoring network from scratch, and the potential for this option should be discussed.

SECTION 3. EMISSION SOURCES AND ESTIMATES

This section is designed to compile existing information regarding pollution sources and estimates of emissions from those sources. The pollutants of interest are sulphur dioxide (SO_2), nitrogen oxides (NO_x), Suspended Particulate Matter (SPM) and ammonia (NH_3). This section should include a summary of all known information. Databases underlying this summarised information for the sources of pollution are to be included according to Attachment 3.

Note: This section covers the most common pollutants that give rise to both regional and local air pollution problems. Other pollutants identified in section 1 of the baseline study may also be regarded as nationally important (e.g. lead, and Volatile Organic Compounds (VOC)) and these could also be included in this Section, using the same format as for the major pollutants.

3.1 Energy Consumption Statistics

This section should, where possible, present summary tables for primary energy consumption associated with the various pollutants as follows:

Year	Consumption (Mtoe)	Coal (%)	Petroleum (%)	Gas (%)	Hydropower (%)	Biofuel (%)
1960						
1970						
1980						
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						

Mtoe: megatonnes of oil equivalent

Nitrogen Oxides

A. Stationary sources

Sector	Energy consumption (mtoe)
1 Industry	
3 Domestic	
4 Power generation	
5 Fuel conversion	

Note: See Table 1.1 in Attachment 3, note for sectoral definitions.

B. Mobile sources

Vehicle category	Energy consumption (Mtoe)
LPG vehicles	
Motor cycles - 2 stroke	
Motor cycles - 4 stroke	
Gasoline cars (<1.5l)	
Gasoline cars (1.5-2.0 l)	
Gasoline cars and light trucks (>2.0l)	
Heavy trucks – gasoline	
Buses (gasoline)	
Diesel cars (<1.5l)	
Diesel cars (1.5-2.0 l)	
Diesel cars and light trucks (>2.0 l)	
Heavy trucks (diesel)	
Buses (diesel)	
Trains (coal)	
Trains (diesel)	
Boats/ships (diesel)	
Boats/ships (fuel oil)	

3.2 Sulphur Dioxide

3.2.1 Sources

Sources of sulphur dioxide are mainly associated with the combustion of sulphur containing fossil fuels. Other activities giving rise to emissions include process emissions from: (i) non-ferrous metal smelting (copper, lead and zinc); (ii) oil refineries; (iii) paper and pulp industries; and (iv) sulphuric acid production. The major industrial processes contributing to sulphur dioxide emission, including sub-divisions if possible, should be presented as follows:

Process	Product Throughput (thousands tonnes)
Paper and pulp	
Copper smelting	
Lead smelting	
Zinc smelting	
Oil refineries	
Sulphuric acid production	

3.2.2 Emission Factors

A. Coal

The average sulphur contents of coal consumed should be added to tables as follows:

Sub-region of country (eg. State, province etc.)	Type of coal	Sulphur contents(%)	Reference
Sub-region 1	Coking coal Other bituminous coal and Anthracite Sub-Bituminous coal Lignite Derived coal (coke) Derived coal (patent fuel) Derived coal (brown coal briquettes)		

Note: Information on the sulphur retention rates in ash assumed for different sectors (e.g. power generation, industry, residential/commercial/public services) should be given where available.

B. Oil

The average sulphur contents in oil consumed can be included according to the following data table:

Sub-region of (eg. State, province	Type of oil	Sulphur contents(%)	Reference
	Crude Oil Gasoline (motor, aviation and jet) Kerosene Diesel Oil Heavy Fuel Oil		

C. Process emissions

Emission factors in use for estimating sulphur dioxide emissions from processes should, if possible, be included as follows:

Process	Emission factor (S per tonne product)	Reference
Paper and pulp		
Copper smelting		
Lead smelting		
Zinc smelting		
Oil refineries		
Sulphuric acid production		

3.2.3 Current sulphur emission estimates (most recent specified year)

A. Sectoral breakdown of emissions

This may be included as a table (see below). See Table 1.1 of Attachment 3 for detailed definitions of each sector:

Sector	Emission(tonnes S / yr)
1 Industry	
2 Transport	
3 Domestic	
4 Power generation	
5 Fuel conversion	

Table below refers to Source type

Source type	Emission(000 tonnes S/yr)
1 Point source	
2 Area source	

Note: In the 2nd table total emission could be broken down into point sources and area sources in addition to the sectoral breakdown.

B. Distribution of emissions

This should include a description of the location of the major sources of emission and a map of sulphur dioxide emissions within the nation. This should be based upon data according to area and point-source emissions (power stations, refineries, paper and pulp etc. -see Attachment 3/Table 1.3) together with an assessment of current pollution control on different sources. This could be presented as follows:

Region	Total emissions (tonnes S / yr)	Area Source	Point source

3.2.4 Trends in emissions

The national trends in total emissions of sulphur dioxide for the past decade should, if possible, be discussed and included according to following table:

Year	Emission (tonnes S/yr)
1960 1970 1980 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998	

3.3 Nitrogen Oxides

3.3.1 Sources

Sources of nitrogen oxides are mainly associated with fossil and biomass fuel combustion and biomass burning. The following sections give a summary of the basic data required for these sources.

A. Mobile sources

The number of vehicles in each vehicle category for a stated recent year should be given where possible:

Vehicle category	Number of vehicles (000)
LPG vehicles	
Motor cycles - 2 stroke	
Motor cycles - 4 stroke	
Gasoline cars (<1.5l)	
Gasoline cars (1.5-2.0 l)	
Gasoline cars and light trucks (>2.0l)	
Heavy trucks – gasoline	
Buses (gasoline)	
Diesel cars (<1.5l)	
Diesel cars (1.5-2.0 l)	
Diesel cars and light trucks (>2.0 l)	
Heavy trucks (diesel)	
Buses (diesel)	
Trains (coal)	
Trains (diesel)	
Boats/ships (diesel)	
Boats/ships (fuel oil)	

B. Industrial process emissions of NO_x

The important process emission source of nitrogen oxides is nitric acid production, which is predominantly used in fertiliser manufacture. The emission factor (in tonnes NO_2 equivalent per kilotonne nitric acid produced) and the total nitric acid production are therefore required in the following format:

Process	Production (thousands tonnes /yr)	Emission factor

C. Biomass burning

The area of forest burnt per year with a description of emission factors that may be used should, if possible, be reported.

3.3.2 Emission Factors

A. Stationary sources

These should be given in the following format:

Fuel Type	Emission Factors			
	Power Generation	Industry	Residential, Commercial and Public Services	Reference
Coking coal Other bituminous coal & Anthracite Sub-bituminous Coal Lignite Derived coal (brown coal) Derived coal (coke) Derived coal (patent fuel) Heavy Fuel Oil Diesel Oil Biomes Fuel: Fuelwood Vegetal materials and wastes Others e.g. forests smouldering and burning				

B. Mobile sources:

These should be given in the following format:

Vehicle category	Emission Factor (g NO_2/ Mtoe)
LPG vehicles	
Motor cycles - 2 stroke	
Motor cycles - 4 stroke	
Gasoline cars (<1.5l)	
Gasoline cars (1.5-2.0 l)	
Gasoline cars and light trucks (>2.0l)	
Heavy trucks – gasoline	
Buses (gasoline)	
Diesel cars (<1.5l)	
Diesel cars (1.5-2.0 l)	
Diesel cars and light trucks (>2.0 l)	
Heavy trucks (diesel)	
Buses (diesel)	
Trains (coal)	
Trains (diesel)	
Boats/ships (diesel)	
Boats/ships (fuel oil)	

3.3.3 Current NO_x emission estimates (most recent specified year)

A. Sectoral breakdown of emissions

The sectoral breakdown of emissions should be represented as follows:

Sector	Emission(tonnes NO_2 equivalent / yr)
1 Industry	
2 Transport	
3 Domestic	
4 Power generation	
5 Fuel conversion	

Source type	Emission(000 tonnes NO2 equivalent / yr)
1 Point source	
2 Area source	

B. Distribution of emissions

This should include a description of the location of the major sources of emission and a map of nitrogen oxide emissions within the nation. This should be based upon data according to area and point-source emissions (power stations, refineries, paper and pulp etc. -see Attachment 3) together with an assessment of current pollution control on different sources.

3.3.4 Trends in emissions

The trends in emissions of nitrogen oxides should be shown according to following table:

Year	Emission (tonnes NO_2 equivalent)
1960 1970 1980 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998	

Note: It would be useful if the main features of these trends were commented on.

3.4 Ammonia

3.4.1 Sources

Ammonia emissions are from the following sectors:

- Agriculture (i) from animal waste;
  (ii) from fertiliser application;
- Industry (i) from fertiliser production
- Vehicle transport
- Residential (i) human waste
  (ii) waste from pets

The most important national sources should be discussed.

3.4. 2 Emission estimates

Ammonia emission estimates are generally calculated from an inventory of animal numbers, fertiliser application and fertiliser production rates which are linked to appropriate emission factors. It would be useful to document the data used to calculate the emissions and to outline the emission factors used in the following format:

Year: for the latest available year

Source	Emissions (tonnes NH_3)
Livestock	
Fertiliser application	
Rice field	
Industry	
Transport	
Residential	

3.4.3 Trends in emissions

Trends in emissions of ammonia should be reported according to following table:

Year	Emission (tonnes NH_3)
1960	
1970	
1980	
1988	
1989	
1990	
1991 etc.	

It would be useful if the main features of these trends were commented on.

3.5 Suspended Particulate Matter

3.5.1 Sources

Sources of suspended particulate matter are associated with the natural as well as human activities which include industrial operations, power generation, biomass burning and vehicular traffic. The most important national sources should be discussed.

3.5. 2 Emission estimates

The sectoral emissions of SPM from different sources may be computed as follows:

Sector	Emissions (tonnes / year)	Percentage
Industry		
Power generation		
Biomass burning		
Vehicular traffic		
Natural Sources (eg. Soil dust)		

3.4.3 Trends in emissions

Trends in emissions of SPM should be reported according to following table:

Year	Emission (tonnes SPM)
1960	
1970	
1980	
1988	
1989	
1990	
1991	
1992	
1993	
1994	

1995 1996 1997 1998	

It would be useful if the main features of these trends were commented on.

SECTION 4. RESEARCH STUDIES INTO AIR POLLUTION

4.1 Atmospheric Transport of Air Pollutants

Any research on the atmospheric transport of air pollution carried out within the nation or sub-region should be explained in this section. A list of available published and/or on- going research work should be included as an attachment (Attachment I). This research can include trajectory analysis and air pollutant transfer modelling. Experts/institutions in meteorological aspects related to transport of air pollutants should also be described (Attachment II). A standardized format for data collection is provided in Appendix 1 and 2 of this document. Note that the number of pages (10) suggested for this section in the outline of the structure of the baseline studies report exclude the lists of publications/institutions/experts mentioned above.

4.2 National Air Quality Criteria and Standards

Air quality standards are used to indicate the seriousness of the air pollution situation. The criteria may refer to human health and also to crops, forests, freshwater ecosystems and semi-natural ecosystems. This section seeks to find out which type of air quality criteria and standards are used in each country for guidance. This could include:

- description of national criteria used for different receptors
- statistical tables to show the national standards
- status of use of national standards

4.3 Impacts of Air Pollution

This section should outline the knowledge of impacts that have been shown to be, or that are suspected of being, linked with air pollution. This could include a description of studies into impacts on (i) human health; (ii), livestock (iii) corrosion of materials, buildings and monuments; (iv) impacts of gases (mainly SO_2 and ozone) on crops; forests or natural vegetation; (v) acidification of soils and surface waters by acidic deposition; (vi) impacts due to the excessive build-up of nitrogen in ecosystems (eutrophication); (vii)Visibility and (viii) impacts on water quality (e.g. salinisation). These areas may be illustrated with analysis of areas where depositions or

concentrations of pollutant gases exceed national or international air quality guidelines or safe threshold levels.

4.4 Future Trends in Emitting Sources and Emissions

This part should be based on available studies and projections. These could project forward to see how the current problem will continue if a 'business as usual' or other scenario is followed. Important aspects include future trends in the development of the emitting sectors (description of planned plants, projections in energy consumption, vehicle fleet size, emission projections as far ahead as have been carried out nationally). All major air pollutants (e.g. sulphur dioxide, nitrogen oxides, ammonia and ozone) should be mentioned here.

SECTION 5. NATIONAL RESPONSES TO AIR POLLUTION PROBLEMS

National response to cope with the air pollution issues could be assessed according to the following breakdown:

i. regulation relevant to air pollution with references and mention of effectiveness/ implementation issues;

ii. preventive measures (efficiency drives/ efficiency standards/fuel switching);

iii. control options applied according to the following table:

Source	Control option applied	Abatement efficiency

iv. Fiscal instruments

v. Other policy initiatives

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

Phase I

Part II: Guidelines for the Preparation of the Malé Declaration Action Plan (National)

FEBRUARY 1999

Contents

1. Objective of the Malé Declaration Action Plan (National)

The aim of this booklet is to aid the development of national action plans for the implementation of the Malé Declaration in South Asian countries. During the preparation of the baseline studies it will become apparent that there are gaps in the knowledge or understanding of air pollution issues concerning some of the areas pertinent to the policy process. The objective of the national action plans is to carry out activities that fill these gaps. Eventual implementation of an action plan in each country should put in place expertise, equipment and information for quantitative monitoring, analysis and policy recommendations for eventual prevention/control of air pollution. National action plan reports will be based on information collected in the national baseline studies and the provisions of the Malé Declaration. The action plans should be built around an air quality assessment procedure, such as that which is outlined in Figure 1 of the accompanying document: Part 1: Guidelines for the Preparation of Baseline Studies. It is important that the development of an action plan in each country acknowledges the need for integration of national efforts and data on a sub-regional basis. SACEP, the National Implementing Agencies (NIAs) and Environmental Ministries, together with advice form UNEP/EAP-AP and SEI, will discuss the format for sub-regional integration.

2. Structure of the Malé Declaration Action Plan (National) Report

This report should propose a national level plan to achieve the objectives outlined in the above Section. The report should be approximately 60 pages in length and the proposed structure is shown in Table 1.

3. Content of the Malé Declaration Action Plan (National) Report

Chapter 1: Monitoring and Evaluation

The Malé Declaration will be the backbone of the national action plan. It is stated in the Malé Declaration that South Asian countries will "*cooperate in building up standardized methodologies to monitor phenomena like acid depositions and analyse their impacts without prejudice to the national activities in such fields*". This should be reflected throughout the action plan, particularly in this Chapter.

Table 1: Proposed Report Structure for the National Action Plan on Air Pollution in *name of the country*

Sections	Number of pages (for guidance)
Chapter 1: Monitoring and evaluation 1.1 National monitoring network 1.2 National emission inventories	20
Chapter 2: Assessment 2.1 Assessment tools 2.2 Assessing impact 2.3 Assessing prevention/abatement options 2.4 Reporting	20
Chapter 3: Actions 3.1 Socio-economic options 3.2 Technical options	15
Chapter 4: Implementation	3

1.1 National pollutant deposition/concentration monitoring network

Data and information compiled through monitoring networks are of crucial importance not only for fulfilling the objectives of monitoring air quality, but also for advancing knowledge on air pollution and the development of scientific tools to assist with air pollution issues. This Section should propose a methodology for an air quality assessment with consideration of the following:

- A thorough monitoring system should be proposed to keep authorities and the public informed about the short- and long-term changes in air quality and to assess the results of abatement options.
- The proposed monitoring network should complement any previously existing monitoring system.
- The long-term sustainability of the monitoring system should also be considered.
- The sub-regional coordination of monitoring activities (i.e. of all countries in South Asia) should be outlined with consideration of the methods to be used and the proposed scale of monitoring.
- Procedures for collating data and making it generally available in the South Asia sub-region should be described.

- The proposed system should have provision for validation of atmospheric transfer models with monitoring data.

1.2 National emission inventories

Preparing a national inventory should not be a one-time process and should be continually updated and improved. The following should be considered:

- Methods and procedures for emission inventory calculations for SO_x, NO_x, SPM and NH_3 need to be determined.
- Data required for the inventory need to be compiled.
- Plans for the building of the inventories need to be made clear especially linkages with other countries in the sub-region.

Chapter 2: Assessment

2.1 Assessment tools

Certain assessment tools can help significantly in the study of air pollution and its impacts. One important tool is atmospheric transfer modelling of air pollutants. Another is integrated assessment modelling which links emission scenarios, atmospheric transfer, impacts and abatement options. This Section of the report should consider the following:

- Sub-regional or regional specific atmospheric transfer and integrated assessment models need development, and/or refinement. The requirements for each country should be outlined in a regional context.
- The expectations of such models and the expected characteristics of the models (e.g. which questions and which abatement options) should also be outlined.
- How the national networks could help develop sub-regional or regional level tools should be outlined.

2.2 Assessing impacts

This Section should explain how the most common air pollution impacts including the transboundary effects will be assessed. Impacts may be divided into those on aquatic ecosystems, soils, groundwater and vegetation, materials (including historic and cultural monuments), human health, livestock and visibility. The stage of development and future

requirements for research, air quality standards and thresholds for pollution damage (e.g. critical loads) should be outlined.

2.3 Assessing prevention/abatement options

Existing and newly introduced abatement or pollution prevention options should be assessed (see Chapter 3) with special consideration of the most feasible options available to the South Asia sub-region. This section will only suggest an **assessment procedure** to assess the abatement and/or pollution prevention options. Suggestions for the **abatement and/or pollution prevention option** will be covered in the chapter 3 and not in this section.

2.4 Reporting

Periodically the nationally responsible body should present an assessment report on the comprehensive picture of atmospheric air pollution in each country which includes mention of air quality, impacts and abatement strategies.

Chapter 3: Actions

This Chapter should introduce responses to air quality issues. This could be sub-divided into the following two sub-sections:

3.1 Socio-economic options

3.2 Technical options - i.e. (i) demand-side options; (ii) supply side options

Air pollution, particularly acid deposition, is transboundary in nature and therefore some sub-regional agreements/protocols to deal with the transboundary issues based on the Malé Declaration should be outlined and discussed. Options could also be prioritised into short-term and long-term needs.

Chapter 4: Implementation

Monitoring, Assessment, and Action could be considered as three major components of the action plan. How these three components will be integrated in the implementation should be discussed. The Chapter should consider what the institutional set-up should

resemble and present a flowchart to show the integration of the three major elements. It is important to highlight the capacity building including training needed to implement the proposed system. Budget formulation to implement the proposed system should also be included in this chapter.

FRAMEWORK FOR THE DATABASE ON AIR POLLUTION

FEBRUARY, 1999

FRAMEWORK
FOR THE DATABASE
ON
AIR POLLUTION

FEBRUARY, 1999

TABLE OF CONTENTS

This document describes the framework for the air pollution database. The framework defines the types of data to be collected and the formats in which the collected data should be specified. This document divided into two sections.

Section I: Database Overview

This section provides an overview of the whole of the database.

Section II (Attachments): Data collection tables

This section presents tables for air pollution data to be collected. A sample table along with a detail explanation of the specific data required for each table is given.

- It must be emphasized that all sources of data should be recorded and reported along with the data collected for each table and the map
- Numeric data (data tables provided) should be prepared in digital format (in Excel)
- Spatial maps could be prepared either in digital format or hardcopy, depending on the availability

DATABASE OVERVIEW

The database contains the following groups of data

1. Literature on air pollution
2. Institutions and Experts
3. Pressure, State and Response variables
4. Spatial maps

Literature on air pollution

This is a list of available literature on air pollution issues. Available literature should be documented according to the template given in the attachment 1 of this document. The same template is also referred in the section 4 of the baseline studies guideline.

Institutions and Experts

This is a list of institutions and experts working on the air pollution issues. A template is given in the attachment 2 of this document. The same template is also referred in the section 4 of the baseline studies guideline.

Pressure, State and Response variables

Considering air pollution as the issue, a Pressure State Response model is utilized to organize the database. Classification of variables under sub-groups "pressure", "state" and "response" will aid both research and decision making. In order to facilitate the data collection, variables are given in a tabular format in attachment 3 of this document.

1. Pressure variables:

The pressure variables included are: energy consumption (1.1), industrial process activity rates (1.2), agricultural activities (1.4), natural sources (1.5) and socio-economic data (1.6). Included within the first two variables are further details on mobile/line sources of emissions (resulting from energy consumption in the transport

sector) and major point sources of emissions (resulting from energy consumption in the power sector and certain industrial processes).

1.1. Energy consumption

This section specifies total energy consumption by sector and fuel type at the national level. In addition to the national data, sub-national data should also be included for geographically bigger countries. The sectors included are Industry, Domestic (residential, commercial and agricultural), transportation, power generation, fuel conversion and non-energy use.

1.1.1 Emission factors for fuel combustion

This section specifies the fuel characteristics (such as sulfur content, calorific value, sulfur retention in ash (for coal combustion only), and emission control levels (e.g. installed FGD (Flue Gas Desulphurization) capacity on power stations) which are necessary for calculating the emission factors (the amount by which the fuel consumption rate must be multiplied in order to calculate the emissions).

1.1.2 Mobile/Line sources

Further details about fuel consumption in the transport sector will enable more precise emissions estimates. This section contains data on number of vehicles, the energy consumed and emission factors within the following vehicle categories:

1. LPG vehicles
2. Motor cycles - 2 stroke
3. Motor cycles - 4 stroke
4. gasoline cars (<1.5l)
5. gasoline cars (1.5-2.0 l)
6. gasoline cars and light trucks (>2.0l)
7. Heavy trucks - gasoline
8. Buses (gasoline)
9. Diesel cars (<1.5l)
10. Diesel cars (1.5-2.0 l)
11. Diesel cars and light trucks (>2.0 l)
12. Heavy trucks (diesel)
13. Buses (diesel)
14. Trains (coal)
15. Trains (diesel)
16. Boats/ships (diesel)
17. Boats/ships (residual fuel oil)

At the local or sub-national scale, it can be useful to collect information on the line sources like major highways, railways, inland waterways, coastal sea routes etc. the following information on the specified line source should be collected:
Type of traffic, traffic volume, traffic speed, and annual vehicle kilometres traveled.

1.2 Industrial processes

These tables specify the historic activity levels (defined as annual input or output for a given industrial process/power plant) of various industrial processes which contribute to SO2 and NOx emissions (in addition to any emissions resulting from the fuel consumed which is covered under "energy consumption"). The following industrial processes are considered:

1. Paper and pulp
2. Copper smelting
3. Lead smelting
4. Zinc smelting
5. Oil refineries
6. Sulphuric acid production
7. Nitric acid production
8. Nitrogen fertilizer production
9. Cement production
10. Agro-processing

1.2.1. Process emission factors

Levels of sulfur recovery and other emission controls will be required to calculate process emission factors.

1.3 Major Point Sources

This section contains information on the major point sources of emissions resulting from energy consumption (i.e. large power stations) and industrial processes (e.g. non-ferrous metal smelters).

The following types of data for point sources will be collected: location with latitude and longitude, capacity, emission controls (and their efficiency), annual emission estimates and emission factors.

1.4 Agricultural activities

The agricultural activities which contribute to emissions are included in this section. The following pressure variables are considered: animal population and production, and rice cultivation.

1.5 Natural sources

In this table any natural sources contributing to the major pollutants should be listed with the estimated contribution.

1.6 Socio-economic data

There are two general types of socio-economic data to be collected –population data and gross domestic product (GDP) data. Within these two categories, there are six specific types of socio-economic data to be collected. They are:

1. Total population,
2. Urban population,
3. Total GDP,
4. Agricultural GDP,
5. Commercial GDP, and
6. Industrial GDP.

1.7 Total emissions

The total national emission estimates should be collected on the primary pollutants.

2. State variables

The state subsystem contains measurements of ambient concentrations of air pollutants. The primary or criteria pollutants, for which data should be collected, are:

1. SO_2 (Sulfur dioxide),
2. NO_2 (Nitrogen dioxide),
3. PM10 (Particles with diameter < 10μm),
4. TSP (Total Suspended Particles),
5. NH_3,
6. VOCs, and
7. Wet deposition of SO_4^{2-} ,NO_3^- , NH_4^+, Ca_2^+, and
8. Dry deposition of SO_4^{2-},NO_3^- , NH_4^+, Ca_2^+

3. Response variables

The third component in the model, ***response***, is applied for air pollution to record the responses by Governments, Government agencies, and other responsible organizations in terms of policies and legislation enacted such as emission monitoring, environmental standards, ratification and participation in major global and/or regional conventions, etc. Environmental awareness campaigns, publicity and media use should also be reported.

Spatial maps

In addition to the numeric data, the following spatial maps should also be included in the database.

1. Spatial Allocation of Emissions

   The database may contain maps on three types of source: point, area or line.

   Point sources - emission estimates are provided on an individual plant or emission outlet (usually large) usually in conjunction with data on location, capacity or throughput, operating conditions etc. Maps to show the spatial distribution of point sources with these characteristics could be included.

   Area sources - smaller or more diffuse sources of pollution are provided on an area basis either for administrative areas, such as counties, department etc., or for regular grids. These emissions can be spatially allocated according to population density or some other surrogate statistic.

   Line sources - in some inventories, vehicle emissions from road transport, railways, inland navigation, shipping or aviation etc. are provided for sections along the line of the road, railway-track, sea-lane etc. Major highways for example, can be divided into sections (called links when used in traffic modelling) which are spatially defined (and may be allocated to a formal emission grid). These spatial maps, if available should be collected.

2. Spatial distribution of air quality monitoring stations
3. Geological map
4. Soil type
5. Land cover

6. Land use
7. Mean annual rainfall

The above mentioned spatial maps needs to be collected in digital format. Incase the data is not available in digital form, hardcopy maps could also be included with the database.

ATTACHMENT 1

DATABASE ON AIR POLLUTION
ITERATURE

Geographic coverage	Title	Year	First author	2nd author	Publisher	Publication	Volume	Edition	Pagenumbers	Location	Keywords	Subject	Language	Reviewed	Abstract	Downloadable	website	note

ATTACHMENT 2

DATABASE ON AIR POLLUTION
INSTITUTIONS

Name	Acronym	Year of establishment	Postal Address	Telephone	Fax	E-mail	Parent organization (if any) (If any)	Head of the organization	Organizational status	Functions	Level of functioning	Services offered	Facilities/ equipments	Medium of work	Funding agencies	Title of research projects on air pollution	Could this information be disseminated though Internet
									Eg: Governmental	Eg:	Eg:						
									Semi-autonomous	Regulatory/administrative	National						
									Non-governmental	Education/training	Sub-regional						
									Private	Information dissemination	Regional						
									International	Research	Continental						
									Research institutions	Consultancy	Global						
									Others (specify)	Other(specify)							

DATABASE ON AIR POLLUTION
EXPERTS

Name	Institution	Address	Telephone	fax	e-mail	Main specialty	Skills	Geographic region	Proficiency in Languages	Could this information be disseminated through Internet	Note

Notes:

1. Database should be in digital format (Excel-commonly used and compatible with DBF)
2. For each experts attach:
   a) list of publications
   b) Photo

ATTACHMENT 3

AIR POLLUTION DATABASE
PRESSURE VARIABLES

Table 1.1: Energy Consumption (megatonnes of oil equivalent(Mtoe))

Country/subregion of country:

Year[1]	Fuel Type	Industry[2]	Domestic[3]				Transportation[4]	Power Generation[5]	Fuel Conversion[6]	Non-Energy Use[7]	Total
			Residential	Commercial	Agricultural	Total					
1980	Coking coal										
	Other bituminous coal and Anthracite										
	Sub-bituminous coal										
	Lignite										
	Derived coal (coke)										
	Derived coal (Patent fuel)										
	Derived coal (Brown coal briquettes)										
	Crude oil										
	Gasoline (motor, aviation and jet)										
	Kerosene (jet, and other)										
	Diesel oil										
	Heavy fuel oil										
	LPG										
	Other non energy oils										
	Natural and other gases										
	Biomass fuel (wood)										
	Biomass fuel (vegetal materials and wastes)										
	Biomass fuel (other - including animal products/wastes)										
	Hydro										
	Geothermal, solar, wind, tide and wave										
	Nuclear										
	Electricity										
1985											

Data Source:

Notes:

1. Year: in the table above 1980 is given as an example. The table should be extended for the following years 1980,1985,1990,1991,9992,1993,1994,1995,1996,1997,and 1998
2. Industrial sector includes energy consumption by manufacturing industries
3. Domestic sector is divided into three sub-sectors. Whenever, it is not possible to separately estimate the share of these sub-sectors, the combined domestic energy consumption could be reported in the total column.
4. The consumption of gasoline and diesel oil by vehicles should be reported in the transportation sector no matter in which sector the consumption is accounted
5. Energy consumption for centralized public power plants and district heating plants. Aggregated energy consumption by all power sources including large point sources should be included.
6. Fuel conversion sector includes refineries, coke and briquette works, gasification plants, etc. It does not include energy conversion in central power plants or district heating plants. This is covered under power generation
7. Non-energy use includes the consumption of lubricants, heavy oil fractions like asphalt for road construction, and fuel used as chemical feedstock
8. In addition to the national energy consumption, separate tables should also be prepared for subregions of geographically bigger countries

AIR POLLUTION DATABASE
PRESSURE VARIABLES

Table 1.1.1 (a) Sulfur Content of Fuels (%)

Country/subregion of country:

Fuel Type	Fuel Conversion Sector	Power Generation Sector	Domestic Sector	Transport Sector	Industry Sector
Coking coal					
Other bituminous coal and Anthracite					
Sub-bituminous coal					
Lignite					
Derived coal (coke)					
Derived coal (Patent fuel)					
Derived coal (Brown coal briquettes)					
Crude oil					
Gasoline (motor, aviation and jet)					
Kerosene (jet, and other)					
Diesel oil					
Heavy fuel oil					
LPG					
Other non energy oils					
Natural and other gases					
Biomass fuel (wood)					
Biomass fuel (vegetal materials and wastes)					
Biomass fuel (other - including animal products/wastes)					

Source:

Notes:

1. Separate tables should also be prepared for subregions of geographically bigger countries

Table 1.1.1 (b) Net Calorific Value of Fuels (tonnes of oil equivalent per tonne)

Country/subregion of country:

Fuel Type	Fuel Conversion Sector	Power Generation Sector	Domestic Sector	Transport Sector	Industry Sector
Coking coal					
Other bituminous coal and Anthracite					
Sub-bituminous coal					
Lignite					
Derived coal (coke)					
Derived coal (Patent fuel)					
Derived coal (Brown coal briquettes)					
Crude oil					
Gasoline (motor, aviation and jet)					
Kerosene (jet, and other)					
Diesel oil					
Heavy fuel oil					
LPG					
Other non energy oils					
Natural and other gases					
Biomass fuel (wood)					
Biomass fuel (vegetal materials and wastes)					
Biomass fuel (other - including animal products/wastes)					

Source:

Notes:

1. Separate tables should also be prepared for subregions of geographically bigger countries

AIR POLLUTION DATABASE
PRESSURE VARIABLES

Table 1.1.1 (c) Sulfur Retention in Ash of Fuels (%)

Country/subregion of country:

Fuel Type	Fuel Conversion Sector	Power Generation Sector	Domestic Sector	Transport Sector	Industry Sector
Coking coal					
Other bituminous coal and Anthracite					
Sub-bituminous coal					
Lignite					
Derived coal (coke)					
Derived coal (Patent fuel)					
Derived coal (Brown coal briquettes)					
Biomass fuel (wood)					
Biomass fuel (vegetal materials and wastes)					
Biomass fuel (other - including animal products/wastes)					

Source:

Notes:

1. Separate tables should also be prepared for subregions of geographically bigger countries

Table 1.1.2 (a) Mobile Sources (number in millions)

Year	LPG vehicles	Motor cycles-2stk	Moto cycles-4stk	Gasoline car<1.5l	Gasoline car (1.5-2l)	Gasoline cars and light trucks(>2l)	Heavy trucks-gasoline	Buses (gasoline)	Diesel cars(<1.5l)	Diesel cars (1.5-2 l)	Diesel cars & light trucks(>2l)	Heavy trucks(diesel)	Buses (diesel)	Trains (coal)	Trains (diesel)	Boats/ships (diesel)	Boats/ships (fuel oil)
1980																	
1988																	
1989																	
1990																	
1991																	
1992																	
1993																	
1994																	
1995																	
1996																	
1997																	
1998																	

Source:

Table 1.1.2 (b) Mobile Sources (annual distance traveled in million km)

Year	LPG vehicles	Motor cycles-2stk	Moto cycles-4stk	Gasoline car<1.5l	Gasoline car (1.5-2l)	Gasoline cars and light trucks(>2l)	Heavy trucks-gasoline	Buses (gasoline)	Diesel cars(<1.5l)	Diesel cars (1.5-2 l)	Diesel cars & light trucks(>2l)	Heavy trucks(diesel)	Buses (diesel)	Trains (coal)	Trains (diesel)	Boats/ships (diesel)	Boats/ships (fuel oil)
1980																	
1988																	
1989																	
1990																	
1991																	
1992																	
1993																	
1994																	
1995																	
1996																	
1997																	
1998																	

Source:

Table 1.1.2 (c) Mobile Sources Emission Factors[1]

Emission	LPG vehicles	Motor cycles-2stk	Moto cycles-4stk	Gasoline car (1.5)	Gasoline car (1.5-2l)	Gasoline cars and light trucks(>2l)	Heavy trucks-gasoline	Buses (gasoline)	Diesel cars(<1.5l)	Diesel cars (1.5-2 l)	Diesel cars & light trucks(>2l)	Heavy trucks(diesel)	Buses (diesel)	Trains (coal)	Trains (diesel)	Boats/ships (diesel)	Boats/ships (fuel oil)
Nox																	
SO2																	
Particulate matter (specify size, e.g. ≤15 microns)																	

Source:

1. The units must be specified i.e. g/km traveled, g/kg of fuel weight or g/MJ energy content of fuel.

Table 1.1.2 (d) Major Line Sources

Year	Line source type	Line source length (km)	Location	Vehicle/vessel type	Traffic volume (no. per km)	Traffic speed (km/h)	Annual vehicle/vessel km traveled

Source:

Table 1.2. (a) Industrial Process Activity Levels (thousands tonnes/year)

Country/subregion of country:

Year	Paper and pulp Kraft pulp/dissolving pulp	Paper and pulp Sulphite/semichemical pulp	Copper (blister and other unrefined)	Copper (primary, refined production	Lead (primary, refined)	Lead (secondary, refined)	Zinc (primary, unwrought)	Oil refineries (refinery throughput)	Sulphuric acid production	Nitric acid production	Nitrogen fertilizer production	Ammonia production	Cement production	Agro-processing	Other Industries (Please Specify)
1980															
1988															
1989															
1990															
1991															
1992															
1993															
1994															
1995															
1996															
1997															
1998															

Source:

Notes:

1. Separate tables should also be prepared for subregions of geographically bigger countries

Table 1.2. (b) Industrial process emission factors (kg pollutant per tonne product)

Country/subregion of country:

	SO_2	NOx	NH_3	Particulate matter (specify size, e.g. <15 microns)
Paper and pulp (Kraft pulp/dissolving pulp)				
Paper and pulp (Sulphite/semichemical pulp)				
Copper (blister and other unrefined)				
Copper (primary, refined production)				
Lead (primary, refined)				
Lead (secondary, refined)				
Zinc (primary, unwrought)				
Oil refineries (refinery throughput)				
Sulphuric acid production				
Nitric acid production				
Nitrogen fertilizer production				
Ammonia production				
Cement production				
Other Industries (Please Specify)				

Notes:

1. Separate tables should also be prepared for subregions of geographically bigger countries

AIR POLLUTION DATABASE
PRESSURE VARIABLES

Table 1.3.(a) Major point sources (Power stations)

Station Name	Latitude	Longitude	Fuel type	Fuel consumption (Mt/y)	Emission of SO_2/y	Emission of NOx/y	Emission factor for SO_2	Emission factor for NOx	Emission factor for NH3	Emission factor for SPM	Emission control type (and % efficiency)	Stack height (m)

Source:

Table 1.3.(b) Major point sources (Industrial facilities)

Plant Name	Latitude	Longitude	Product type	Production (t/y)	Emission of SO_2/y	Emission of NOx/y	Emission factor for SO_2	Emission factor for NOx	Emission factor for NH3	Emission factor for SPM	Emission control type (and % efficiency)	Stack height (m)

Source:

AIR POLLUTION DATABASE
PRESSURE VARIABLES

Table 1.4 (a) Agriculture: Total livestock population(million head) and production

Country:

Year	Dairy cows	Cattle other Dairy cows	Buffalo	Sheep	Goats	Camels	Horses&mules	Swine	Poultry	Milk Production(kg/head/yr
1980										
1988										
1989										
1990										
1991										
1992										
1993										
1994										
1995										
1996										
1997										
1998										

Source:

Table 1.4.(b) Agriculture: Livestock population(million head) in cool climate

Country:

Year	Dairy cows	Cattle other Dairy cows	Buffalo	Sheep	Goats	Camels	Horses&mules	Swine	Poultry	Milk Production(kg/head/yr
1980										
1988										
1989										
1990										
1991										
1992										
1993										
1994										
1995										
1996										
1997										
1998										

Source:

Note: Areas with annual average temperatures less than 15' C are defined as cool

Table 1.4 (c) Agriculture: Livestock population(million head) in temperate climate

Country:

Year	Dairy cows	Cattle other Dairy cows	Buffalo	Sheep	Goats	Camels	Horses&mules	Swine	Poultry	Milk Production(kg/head/yr
1980										
1988										
1989										
1990										
1991										
1992										
1993										
1994										
1995										
1996										
1997										
1998										

Source:

Note: Areas with annual average temperatures from 15' C to 25' C inclusive are defined as temperate

Table 1.4 (d) Agriculture: Livestock population(million head) in warm climate

Country:

Year	Dairy cows	Cattle other Dairy cows	Buffalo	Sheep	Goats	Camels	Horses&mules	Swine	Poultry	Milk Production(kg/head/yr
1980										
1988										
1989										
1990										
1991										
1992										
1993										
1994										
1995										
1996										
1997										
1998										

Source:

Note: Areas with annual average temperatures greater than 25' C are defined as warm

Table 1.4. (e) Agriculture: Rice cultivation

Country:

Year	Total area cultivated(000'ha)	Long term variety			Short term variety			Per cent cultivated by irrigation methods			Growing season	Ecosystems(ha)		
		Area cultivated('000'ha)	Season length(days)	Duration of flooding(days)	Area cultivated('000'ha)	Season length(days)	Duration of flooding(days)	Continuously flooded(%)	Dry (%)	Intermittently flooded(%)	average temp.(C°)	Irrigated (5 cm standing water)	Rainfed (intermittent)	Deepwater
1980														
1988														
1989														
1990														
1991														
1992														
1993														
1994														
1995														
1996														
1997														
1998														

Source:

Table 1.4 (d) Agriculture: Livestock population(million head) in warm climate

Country:

Year	Dairy cows	Cattle other Dairy cows	Buffalo	Sheep	Goats	Camels	Horses&mules	Swine	Poultry	Milk Production(kg/head/yr
1980										
1988										
1989										
1990										
1991										
1992										
1993										
1994										
1995										
1996										
1997										
1998										

Source:

Note: Areas with annual average temperatures greater than 25' C are defined as warm

Table 1.5 Natural Sources

Year	Natural source	Area (ha) if relevant	Pollutant	Emission factor	Emission (tonnes/year)

Source:

Table 1.6: Socio-Economic Data

Country/subregion of country:

Year	Population (million)		GDP(Gross Domestic Product) in Millions US$		
	Total Population	Urban Population	Agricultural[1]	Commercial[2]	Industrial[3]
1980					
1985					
1990					
1991					
1992					
1993					
1994					
1995					
1996					
1997					
1998					

Data Source:

Notes:

1. Agricultural sector includes hunting, forestry, and fishing
2. Commercial sector includes wholesale and retails trades, restaurants, and hotels, transport, storage and communication, and finance, insurance, real estate and business services
3. Industrial sector includes mining and quarrying, manufacturing, electricity, gas and water, and construction
4. In addition to the national energy consumption, separate tables should also be prepared for subregions of geographically bigger countries

Table 1.7: Emission Estimates (Gg)

Year[1]	SO_2	NO_x	NH_3	SPM	Note on the estimates

Data Source:

Notes

1: Year: 1980,1985,1990,1991,9992,1993,1994,1995,1996,1997,and 1998 data should be provided for each of the selected monitoring sites.

2: Database should be prepared in digital format (in Excel)

AIR POLLUTION DATABASE
STATE VARIABLES

Table 2.1: Concentration of Sulfur dioxide (ppm)

City	Monitoring site address	Latitude	Longitude	Land use[1]	Location type[2]	Year[3]	# Observations	Exceedences[4]	1st 24hr max	2nd 24hr max	Annual mean

Data Source:

Notes

1: Land use: choose one from Residential/Industrial/Commercial

2: Location type: choose one from Urban and city center/Rural/Suburban

3: Year: 1980,1985,1990,1991,9992,1993,1994,1995,1996,1997,and 1998 data should be provided for each of the selected monitoring sites.

4: Exceedences: number of observations exceed the national standards

5: Total number of records will be 11(see note 3) times the number of monitoring sites

6: Database should be prepared in digital format (in Excel)

Table 2.2: Concentration of Nitrogen dioxide (ppm)

City	Monitoring site address	Latitude	Longitude	Land use[1]	Location type[2]	Year[3]	# Observation	Exceedences[4]	1st 1hr max	2nd 1hr max	Annual mean

Data Source:

Notes

1: Land use: choose one from Residential/Industrial/Commercial

2: Location type: choose one from Urban and city center/Rural/Suburban

3: Year: 1980,1985,1990,1991,9992,1993,1994,1995,1996,1997,and 1998 data should be provided for each of the selected monitoring sites.

4: Exceedences: number of observations exceed the national standards

5: Total number of records will be 11(see note 3) times the number of monitoring sites

6: Database should be prepared in digital format (in Excel)

Table 2.3: Concentration of PM10 (particles with diameters≤ 10 μm) in micrograms/ cubic meter ($\mu g/m^3$)

City	Monitoring site address	Latitude	Longitude	Land use[1]	Location type[2]	Year[3]	# Observation	Exceedences[4]	1st 24hr max	2nd 24hr max	Annual mean

Data Source:

Notes

1: Land use: choose one from Residential/Industrial/Commercial

2: Location type: choose one from Urban and city center/Rural/Suburban

3: Year: 1980,1985,1990,1991,9992,1993,1994,1995,1996,1997,and 1998 data should be provided for each of the selected monitoring sites.

4: Exceedences: number of observations exceed the national standards

5: Total number of records will be 11(see note 3) times the number of monitoring sites

6: Database should be prepared in digital format (in Excel)

Table 2.4: Concentration of Total Suspended Particles in micrograms/ cubic meter ($\mu g/m^3$)

City	Monitoring site address	Latitude	Longitude	Land use[1]	Location type[2]	Year[3]	# Observation	Exceedences[4]	1st 24hr max	2nd 24hr max	Annual mean

Data Source:

Notes

1: Land use: choose one from Residential/Industrial/Commercial

2: Location type: choose one from Urban and city center/Rural/Suburban

3: Year: 1980,1985,1990,1991,9992,1993,1994,1995,1996,1997,and 1998 data should be provided for each of the selected monitoring sites.

4: Exceedences: number of observations exceed the national standards

5: Total number of records will be 11(see note 3) times the number of monitoring sites

6: Database should be prepared in digital format (in Excel)

Table 2.5: Wet Deposition-rain water analysis- (μmol/l)

City	Monitoring site address	Latitude	Longitude	Land use[1]	Location type[2]	Year[3]	Sampling date	SO_4^{2-}	NO_3^-	NH_4^+	Ca^{2+}

Data Source:

Notes

1: Land use: choose one from Residential/Industrial/Commercial

2: Location type: choose one from Urban and city center/Rural/Suburban

3: Year: 1980,1985,1990,1991,9992,1993,1994,1995,1996,1997,and 1998 data should be provided for each of the selected monitoring sites.

4: Database should be prepared in digital format (in Excel)

Table 2.6: Dry Deposition ($\mu g/m^3$)

City	Monitoring site address	Latitude	Longitude	Land use[1]	Location type[2]	Year[3]	Sampling date	SO_4^{2-}	NO_3^-	NH_4^+	Ca^{2+}

Data Source:

Notes

1: Land use: choose one from Residential/Industrial/Commercial

2: Location type: choose one from Urban and city center/Rural/Suburban

3: Year: 1980,1985,1990,1991,9992,1993,1994,1995,1996,1997,and 1998 data should be provided for each of the selected monitoring sites.

4: Database should be prepared in digital format (in Excel)

AIR POLLUTION DATABASE
RESPONSE VARIABLES

Table 3.1: Air Quality Monitoring

City	Number of stations

Total number of air quality monitoring stations in the country	

Table 3.2: National Standards (concentration)

Pollutant	Standards	Unit
SO_2		
NO_2		
PM10		
TSP		
Pb		

Table 3.3:Non-Governmental Organizations

Organization with address	Year of establishment

Table 3.4:Public awareness campaigns

Name of the campaign	Duration	Media used	Target group

Table 3.5: Policies and Legislation

a) International agreements

Agreements related to air pollution	Year of ratification	Sub regional[1]	Regional[1]	Global[1]

Note:

1. Mark the appropriate column to indicate the geographical coverage of the particular action

b) National and sub-national policies and legislation

Policies/legislation related to air pollution	Year of ratification	Nationl[1]	Sun-national[1]

Note:

1. Mark the appropriate column to indicate the geographical coverage of the particular action