Executive Summary

Background

Facing the growing problem of a deteriorating environment (air, water and land), initiatives for regional environmental cooperation in the South Asian countries have been gathering momentum. After a series of working group meetings in the environment sector under the South Asia Subregional Economic Cooperation (SASEC) program, participating countries (Bangladesh, Bhutan, India, and Nepal) identified, among others, air quality management (AQM) as an important area for subregional cooperation. The regional technical assistance (TA) will complement the Male Declaration and support the efforts of the SASEC countries in promoting AQM in the subregion by strengthening the network and sharing of data, monitoring practices, and AQM best practices in other countries; and by formulating an integrated AQM system and action plan that will enhance AQM in the SASEC countries.

The TA is being executed by the Asian Development Bank and supervised by the South Asia Regional Department in close cooperation with the Regional Sustainable Development Department. ADB will coordinate closely with the SASEC countries and CAI-Asia in implementing the TA. In the SASEC countries, the ministries of environment are the national focal points and these are responsible for policy related matters associated with the implementation of the TA. The Central Pollution Control Board has been identified as the implementing agency for India.

One of the objectives of the TA is to develop an integrated AQM system for the subregion. In this regard an integrated AQM system in India has been developed and described briefly in the following sections.

Integrated Air Quality Management System in India

The report on an integrated AQM system in India includes (i) a review of the AQM system in India, (ii) a review of the AQM system existing in other countries, and (iii) the strategic need for an integrated AQM system in India.

Review of Air Quality Management System in India

In India, outdoor air pollution is restricted mostly to urban areas where automobiles are the major contributors, and to a few other areas with a concentration of industries and thermal power plants. The reasons for higher air pollution in India are poor fuel quality, old process technology in industries, setting up industries in the wrong site, no pollution preventive steps in the early stage of industrialization, poor vehicle design, uncontrolled growth of vehicular population, no pollution prevention and control system in small- and medium-scale industries, and their poor compliance with standards. The reasons for higher vehicular pollution are higher vehicular density, the large number of old vehicles, inadequate inspection and maintenance system, poor vehicle design, fuel adulteration, improper traffic management, and inadequate mass transport system.

The Air (Prevention and Control) Act, 1981 and Environment (Protection) Act, 1986 were enacted after the Constitution was passed for environmental protection and improvement in the form of fundamental and direct principles of the State. The scope for development of the AQM system was provided in both acts.
At present various institutions are all involved directly or indirectly in implementing the AQM system, but there still remain some gaps in the Institutional mechanism: (i) coordination within the state and central departments for the AQM is weak and needs to be strengthened; (ii) the information flow between the various components of the AQM system within the institutional structure is poor; (iii) proper manpower is not identified for the AQM system; (iv) the AQM system is not given much importance in state departments; (v) and adequate funds are not allocated for the AQM system.

The various components of the AQM system existing in India includes air quality monitoring including meteorology, air quality standards, emission inventory, source apportionment, dispersion modeling, health impact study, control strategy, and AQM plan. These components have been reviewed and various gaps have been identified.

Gaps in Air Quality Monitoring

(i) Generation of air quality data through air quality monitoring networks involves a large number of monitoring agencies, personnel and equipment for sampling, chemical analysis, data reporting, etc. The involvement of several agencies increases the probability of variations and personal biases reflecting in the data. Therefore, the air quality data statistics are more indicative rather than absolute and perfect.

(ii) Out of 290 sanctioned stations only 196 stations were working as of March 2004. The closure of stations is mostly due to shortage of skilled manpower and adequate funds for maintaining the stations. CPCB is interacting with the respective state pollution boards (SPCBs) for restoring the closed stations.

(iii) The target air quality sampling for 24 hours a day could not be fulfilled at all locations due to various reasons such as power failure, and no backup facility for power, rainfall, and machine breakdown. The values monitored for more than 16 hours are considered as a representative value for assessing air quality.

(iv) In most cases the target frequency of monitoring twice a week or 104 days a year could not be met at some locations due to the reasons already mentioned. In such cases 50 days of monitoring in a year is considered adequate for the purpose of analyzing the data related to the air quality status.

(v) There is no systematic estimation of uncertainty or error in the data. Given that there has been a gradual improvement in data collection over the years, errors in the past were most probably greater.

(vi) There is inadequate financing for operation and maintenance of monitoring instruments, as well as inadequate infrastructure for supporting analytical work and very serious shortage of skilled technical staff.

(vii) Some of the air quality laboratories maintained by SPCBs are not recognized under the Environment Act, 1986. Only the CPCB Air laboratory at Delhi is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL).

(viii) Some SPCBs maintain their own monitoring stations but their data are not accessible to CPCB for analysis and comparison of National Air Monitoring Programme (NAMP) and State Ambient Air Quality Monitoring (SAAQAM) data. Similarly, some of the large industries maintain their own stations as required under environmental impact (EIA) studies. They submit their data to SPCB only. Quality assurance and quality control strategies for these stations are not known. No compilation of these data exists in one place.
CPCB’s calibration facility is not adequate enough to meet the requirements in the entire country. Considering the importance of quality control, a proposal for developing facilities for quality control in ring tests at more places needs to be formulated. Calibration of instruments at all NAMP stations was conducted in 1996 only. The frequency of calibration needs to be increased to improve the data quality.

Air quality data is compiled and published by CPCB but availability of compiled data to data users is delayed. The data interpretation and impact analysis of various interventions on air quality are also not being carried out in detail. There needs to be a dedicated division in CPCB with adequate manpower and infrastructure for coordinating the NAMP network.

There is a need to review the location and number of stations in each city as some locations are not representative.

Adequate funds for monitoring are not allocated. There is a shortage of skilled manpower and infrastructure for monitoring.

**Gaps in Meteorological Data**

Meteorological data is not easily accessible from the Indian Meteorological Department. The data are accessed only on a payment basis, which takes a longer time due to official procedures. The data is received in handwritten form.

Meteorological data from CPCB and SPCB stations are not fully utilized.

There is no compilation of meteorological data by CPCB during the monitoring period.

Cloud cover, atmospheric stability, and visibility data along with upper air data are not being collected on a routine basis.

Analysis and interpretation of air quality data are not done on the basis of meteorological data.

**Gaps in Ambient Air Quality Standards**

Ideally air quality standards should represent concentration of chemical compounds in air that would not pose any health problem to the human population. However, the realistic assessment of human health hazards necessitates a distinction between absolute safety and acceptable risk. To aim at achieving absolutely safety, one would need a detailed knowledge of dose-response relationships in individuals in relation to all sources of exposure, the type of toxic effects elicited by specific pollutants or their mixture, and the existing health status of the human population. However, such comprehensive and conclusive data on environmental contaminants are not available in our country.

It is difficult to demarcate areas like industrial, residential, mixed used and sensitive. No other country has such type of categorization.

Carbon monoxide (CO) standards are very stringent as compared to other countries.

Standards for ozone are not included in the National Ambient Air Quality Monitoring (NAAQM) standards.

The numbers of 104 measurements are not met at any monitoring station due to various reasons. The numbers need to be reduced to some optimum figure.
Gaps in Emission Inventories

(i) The above studies are merely indicative and are mostly based on secondary data where more assumptions have been taken into consideration.
(ii) Inventory of only a few categories of pollutants has been studied.
(iii) A good database for different types of polluting sources is not available.
(iv) An emission factor has not been developed for different categories of polluting sources. Most of the studies have used the WHO emission factor.
(v) Fund requirement for emission inventory study is high and also requires huge manpower.
(vi) Further studies on estimation of emission needs to be done in a holistic manner and involve all the agencies concerned.
(vii) For vehicle emission inventory, data on actual vehicles plying on the road, vehicle usage data, and fuel usage data are not available or well-documented.
(viii) The method used for estimating emission inventory is not uniform.
(ix) Training for comprehensive emission inventory estimation is also not adequate.
(x) No separate funds are allocated for emission inventory.

Gaps in Source Apportionment Studies

(i) Source apportionment studies are not carried out regularly and are not being used for developing AQM plans.
(ii) No uniform guidelines exist for carrying out source apportionment studies.
(iii) Institutions capable of carrying out source apportionment studies are very few in number. This may be due to the large infrastructure required for chemical analysis.
(iv) Source profiles of different sources required for a chemical mass balance model do not exist for Indian conditions. There is a need to develop source profiles.
(v) Source apportionment studies so far carried out in India are restricted to particulate matter (PM) and periods of study are for less number of days and mostly do not cover all the seasons.
(vi) Training for such type of study is not adequate and also not familiarized with the different types of models required for a source apportionment study.
(vii) Separate funds are not allocated for such studies.

Gaps in Dispersion Model

(i) The experience so far has shown that at times the model has been used incorrectly, and the values of various parameters required for modeling are adopted from other countries without understanding their applicability in the Indian context.
(ii) The dispersion model is not routinely carried out for predicting air quality trends, source apportionment, and evaluation of control option or assessment of new source of emission.
(iii) Key input data like location, height of release, temperatures of release, emission rate, atmospheric stability, mixing height, surface roughness, etc. are not easily available.
(iv) Demonstration training for carrying out a dispersion model is not adequate.
(v) Separate funds are not allocated for carrying out a dispersion model.
Gaps in Health Impact Study

(i) There are no plans to establish or strengthen national and local epidemiological monitoring programs that record morbidity and mortality cases associated with air pollution on a regular basis and use environment and health indicators following regional guidelines where they exist. In the absence of epidemiological studies, results from epidemiological literature from industrialized countries are used.

(ii) There is no regular collection of hospital data on air pollution-related data conditions including respiratory, cardio cerebrovascular, congestive heart failure, emergency room visits for respiratory illness, new cases of chronic bronchitis, deaths from cardiovascular, cardiopulmonary, lung cancer, respiratory illnesses, etc. There is no centralized system for collection of health-related data with respect to air pollution.

(iii) Studies to estimate public exposure to potential health impacts from air pollution are restricted to a few cities.

(iv) Health-related data in a particular city have not been taken into consideration before making any policy decision.

(v) f) There is no study available in India on a dose-response function that relates ambient levels of pollutants to impacts on specific assets or certain aspects of health, marginal physical impact per unit of pollution, monetary values per unit of physical impact, and monetary value of benefits/damage due to change in air pollution.

Gaps in Air Quality Control Strategies

(i) Strategies to reduce emissions are often short term in nature, which fail to adequately address the problem.

(ii) More stress has been given to end-of-pipe treatment and best available technology solutions rather than implementing solutions that prevent pollution such as traffic demand management and economic restructuring.

(iii) The various strategies recommended and implemented were not based on a systematic emission inventory and source apportionment studies.

(iv) The synergy between different measures is not fully exploited.

(v) There are no studies conducted on cost-benefit analysis before implementation of strategies.

(vi) There are very few studies carried out to see impact on air pollution after implementation of various interventions.

(vii) Most of the strategies are being replicated in various cities in spite of different local air quality problems.

(viii) There is no generation of separate funds for implementation of strategies through a set of economic instruments.

Gaps in Action Plans Submitted by State Governments/State Boards

(i) Air quality strategies and plans submitted by the state governments or SPCBs are mostly not adequate and integrated. All polluting sources are not adequately mentioned.

(ii) Interagency and center–state coordination is weak. Some of the state governments of the cities concerned have not constituted an interagency task force for preparing and implementing the action plan.
There is no separate establishment of an AQM cell with dedicated manpower and infrastructure in SPCBs for developing and implementing action plans for controlling air pollution.

Separate funds for developing and implementing action plans are not allocated in the SPCB budget.

The use of air quality monitoring data for policy making is not optimal. There is need to improve the assessment of health, environmental, and economic impacts of air quality and to establish the benefits of implementing an action plan.

Inventory of various polluting sources like industry vehicles, natural sources, domestic sources, diesel generator sets, biomass burning, etc. has not been carried out prior to recommendation of an action plan. For some of the few cities a preliminary inventory has been attempted.

Similarly, a source apportionment study with chemical characterization and modeling to identify the sources of pollution responsible for the deterioration in air quality has not been conducted before recommendation of an action plan.

The action plans are weak on public transport and not focused on a clean and efficient public transport system to restrict the growth rate of number and usage of private vehicles in the city. Plans for mass rapid transit systems (bus or rail) are also not addressed.

Some of the action plans did not even include a time target.

Most of the proposed action plans for vehicular pollution control are command-and-control measures stressing improvement in vehicle technology and fuel quality. Financial or economic instruments like parking fee restructuring, emission taxes, incentives, etc. may be considered in the plans.

Generating public awareness is a prerequisite to see through the success of any action plan. Steps like mass awareness campaigns, roadside inspection and maintenance camps, interactive seminars and training, display of air quality data, etc. are not included in the action plans.

The action plans do not propose any initiative for better traffic management and infrastructure augmentation, which go a long way in minimizing road congestion problems.

Inputs like land utilization pattern along with a map are not included.

Cost-benefit analysis study is not included for recommending the various policy interventions.

Strategies are short term in nature, which fail to adequately address the overall problem.

Periodic review of the action plan is not being undertaken to determine the effectiveness of the action plan and the desirability and feasibility to broaden the scope and refine its implementation procedure.

Gaps in Indoor Air Pollution in India

Considerable attention has been paid to the problem of ambient air pollution; however, indoor air pollution particularly one arising from the use of traditional fuels has gained very little attention. There is a need for drawing up a national policy to mitigate the occurrence of preventable pollution-related diseases through measures such as public awareness in the use of safer fuels, the use of stoves which decrease pollution and increase fuel efficiency, and the use of ventilation during cooking.
(ii) Indoor air pollution is not being brought under the Air Act or Environment Act, although there is provision for including it under these acts. No regulation or codes have been specifically developed for indoor air except in the workplace environment, which falls within the occupation health and safety regulations.

(iii) Data generation in indoor air quality in metro cities is poor.

**Review of Air Quality Management System Existing in Other Countries**

A number of measures from the recent experience of AQM in Europe and North America have been identified in this chapter, which could be adapted to suit the needs of other countries throughout the world and the large conurbations and mega cities in Asia where similar problems of poor air quality are being experienced. Measures taken in Europe and North America to improve air quality have included air quality zones in certain parts of the city, regular monitoring of air quality, and the provision of information to the public on air quality as well as specific measures directed at the control and use of motor vehicles. Lessons in urban air quality management can be learnt not only from the European and North American experience but also from other mega cities, which are also pioneering new ways and policies to improve air quality and to address its causes.

To address the air quality problem in Europe, the following key initiatives have been recommended:

(i) Air quality management and regulation should be effectively integrated with that of other environmental sectors (e.g., water, noise, and waste), preferably throughout a single environmental protection agency and a single legal instrument.

(ii) Quality assured assessment of ambient air quality should be undertaken before formulating a strategy for air quality improvements, compiling an inventory of emissions, and mapping emissions.

(iii) A comprehensive air quality management strategy should be drawn up to improve and maintain air quality, addressing all issues of concern and focusing on issues of immediate concern in terms of complying with air quality criteria.

(iv) Arrangements should be put in place for effective public participation and the involvement of interest in a significant role or function to perform in relation to air quality management.

(v) Adequate provision should be made for monitoring, regulation, and enforcement of legislation, regulations, permits and licenses. In particular, sufficient human and technical resources need to be allocated to enable all functions to be properly performed.

(vi) Record keeping and reporting should be performed to meet the requirements of air quality standards and guidelines and to inform the public.

(vii) AQM should be regularly reviewed and updated to ensure that they remain relevant to the key issues of concern.

**Strategic Need for an Integrated AQM System in India**

An AQM system needs to be developed in India for successfully improving the air quality. Action needs to be taken in following components of an integrated AQM system:

(i) Strengthening of institutional mechanism
(ii) Assessment of air quality
- Monitoring
- Emission inventory
- Source apportionment
- Air pollution exposure and damage

(iii) Evaluation of control strategies
(iv) Developing and implementing an air quality management plan

**Action Points for Strengthening of Institutional Mechanism**

(i) A separate AQM cell should be constituted within SPCBs and CPCB.
(ii) Separate coordinators from different departments like Municipal Corporation, State Department of Environment, Traffic Police, development authorities, etc. associated with the AQM system should be identified.
(iii) There should be regular interaction between the Central and state departments concerned.
(iv) An interministerial task force/working group under the chairmanship of the Secretary, State Department of Environment should be constituted, and the proper terms of reference assigned.
(v) Adequate budget for implementation of the AQM system should be allocated from the Central and state funds or through external funding agencies.

**Action Points Air Quality Monitoring System**

(i) Guidelines on the AQM system prepared by CPCB should be followed by the different monitoring agencies.
(ii) The infrastructure and skilled manpower working for the air quality monitoring system need to strengthened.
(iii) Data from SPCB and industry-maintained stations should be regularly compiled, analyzed, and disseminated.
(iv) An AQM information system for proper dissemination of data related to the AQM system with proper manpower and infrastructure should be developed.
(v) Adequate funds need to be allocated for monitoring activities as well as for an air management information system.

**Action Points for Emission Inventory Study**

(i) Guidelines for an emission inventory study should be developed by CPCB.
(ii) Various air polluting sources should be categorized by the SPCB.
(iii) Data from representatives/coordinators of various agencies through questionnaires should be collected by SPCB and CPCB after quality control check of the data for reliability and accuracy.
(iv) Emission factors for various polluting sources based on emission data should be developed.
(v) Emission inventory study through use of different models (Pune regional emission inventory study, international vehicle emission model, etc.) should be regularly carried out.
Action Points for Dispersion Modeling

(i) Uniform methods/guidelines should be prepared for using different types of dispersion model for assessment of source contribution and for other purposes.
(ii) Models from other countries need to be reviewed for Indian conditions.
(iii) Regular training for use and validation of a dispersion model should be given to SPCB staff.

Action Points for Source Apportionment Study

(i) Guidelines for carrying out source apportionment needs to be prepared by agencies like CPCB.
(ii) Regular demonstration-cum-field training needs to be conducted for SPCB staff for carrying out source apportionment studies.
(iii) Source profiles need to be developed through appropriate agencies.
(iv) A separate budget may be allocated for such type of study.
(v) Source apportionment technique should be effectively used for developing an AQM strategy.
(vi) Data on source apportionment studies carried out should be compiled for developing a database at central agencies like CPCB.

Action Points for Air Pollution Exposure and Damage Assessment

(i) Guidelines for carrying out air pollution exposure and damage assessment need to be developed by appropriate agencies.
(ii) Agencies should be identified for carrying out air pollution exposure and damage assessment studies.
(iii) Epidemiological studies should be undertaken to develop dose-response relationships, which will help in developing appropriate air quality standards.
(iv) Various health-related studies carried out should be compiled and database generated at central agencies like CPCB.
(v) Health-related studies should be effectively used as a tool for developing strategy.
(vi) Regular training on health-related studies should be disseminated to SPCBs.

Action Points for Evaluation of Control Strategies

(i) Guidelines for study of evaluation of control options including cost-benefit analysis need to be developed.
(ii) Training for use of such studies needs to be disseminated to SPCBs by the appropriate agency.
(iii) These studies should be effectively used for implementing an AQM strategy.

Action Points for Air Quality Management Plan

(i) Detailed guidelines for preparation of an integrated AQM plan needs to be developed. A comprehensive urban AQM strategy should be formulated using information related to urban planning, ambient air quality, emission inventory, and air quality dispersion models. Strengthening the monitoring network and
institutional capabilities would facilitate an improvement in the enforcement mechanism.

(ii) A working group or interministerial task force headed by the chief secretary of the State should be constituted for developing and implementing an AQM plan. Experience of successful implementation of an AQM plan in one city may be shared by another city/town. SPCBs should also give stress on information exchange and better coordination with each other.

(iii) Concept of public participation should always be considered in developing an integrated AQM plan. Local experience of the public can result in the development of a more efficient and socially acceptable action plan and further getting the public involved will make it more concerned toward achieving the objective of clean air.

(iv) The AQM plan is a dynamic system and needs to improve further based on up-to-date developments of the various components of an AQM system.

(v) Economic instruments need to be put in place to encourage industries to adopt cleaner technologies and other conservation practices and to discourage the overutilization of natural resources.

**Action Points for Indoor Air Pollution**

(i) Air quality guidelines for indoor pollution should be developed by CPCB based on indoor air quality data and guidelines of WHO and Australia.

(ii) Indoor air quality data needs to be generated for different pollutants in urban cities by SPCBs and other organizations.

(iii) Health impact studies of indoor air quality need to be carried out.