

NATIONAL AMBIENT AIR QUALITY MONITORING

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Air Quality Trends and Action Plan for Control of Air Pollution from Seventeen Cities



**CENTRAL POLLUTION CONTROL BOARD
MINISTRY OF ENVIRONMENT & FORESTS**

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Air Quality Trends and Action Plan for Control of Air Pollution from Seventeen Cities

[FOREWORD](#)

[COVER PAGE](#)

[PERSONNEL INVOLVED](#)

[CONTENTS](#)

[FULL TEXT](#)

FOREWORD

Urbanisation in India is more rapid in and around National Capital as well as the State Capitals and, over the years, these cities have become major centers for commerce, industry and education. Enormous increase in number of vehicles has resulted in increased emission of air pollutants and, as a result, levels of air pollutants such as respirable suspended particulate matter are found to exceed the prescribed standards in these cities. The Honorable Supreme Court has also identified sixteen cities in addition to Delhi for which action plans are being formulated and implemented to control air pollution. An attempt has been made in this report to address the pollution problem in these seventeen cities namely Agra, Ahmedabad, Bangalore, Chennai, Delhi, Faridabad, Hyderabad, Jharia, Jodhpur, Kanpur, Kolkata, Lucknow, Mumbai, Patna, Pune, Solapur and Varanasi.

Trends of air pollutants are determined to find the effects of various actions taken so far to control air pollution. Action plans as developed by respective State Governments have also been covered. I am thankful to my colleagues Dr. B. Sengupta, Member Secretary, Dr. R.C. Trivedi, Additional Director and Sh. Naresh Badhwar, Environmental Engineer and Ms. Meetu Puri, SRF for their contribution in preparation of this report.

We hope the report will be useful to all concerned with air quality management in the country.

(V. Rajagopalan)

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CONTENTS

Section No.	Title	Page No.
1.0	Introduction	1
1.1	Air (Prevention and Control of Pollution) Act 1981	2
1.2	National Ambient Air Quality Standards (NAAQS)	2
2.0	Air Quality Monitoring	4
2.1	National Air Quality Monitoring Programme (N.A.M.P.)	4
2.1.1	Objectives	4
2.1.2	Monitoring Locations and Parameters	4
2.2	Non-attainment Areas	5
2.3	Recommendations of the Auto Fuel Policy Report	6
3.0	Action Plans	17
3.1	Guidelines for Preparation of Action Plans for Control of Air Pollution	18
3.1.1	Constitution of Working Groups and Development of Working Strategy for Action Plan Preparation	20
3.2	Action Plan	21
3.3	Constitution of Committees for Surveillance	22
4.0	Agra	23
4.1	Sources of Air Pollution	25
4.2	Ambient Air Quality	25
4.2.1	Violation of NAAQS (24 hourly average)	26
4.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	26
4.2.3	Air Quality Trends in Agra	26
4.2.4	Meteorological Issues	26
4.3	Action Plan for the Control of Air Pollution for the City of Agra	28
4.3.1	Action Taken so far	28
4.3.2	Proposed Action Plan	29
4.4	Findings	31
5.0	Ahmedabad	32
5.1	Sources of Air Pollution	32
5.2	Ambient Air Quality	33
5.2.1	Violation of NAAQS (24 hourly average)	33

Section No.	Title	Page No.
5.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	33
5.2.3	Air Quality Trends in Ahmedabad	33
5.2.4	Meteorological Issues	36
5.3	Action Plan for the Control of Air Pollution for the City of Ahmedabad	36
5.3.1	Action Taken so far	36
5.4	Findings	40
6.0	Bangalore	42
6.1	Sources of Air Pollution	43
6.2	Ambient Air Quality	44
6.2.1	Violation of NAAQS (24 hourly average)	44
6.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	44
6.2.3	Air Quality Trends in Bangalore	44
6.2.4	Meteorological Issues	47
6.3	Action Plan for the Control of Air Pollution for the City of Bangalore	48
6.3.1	Action Taken so far	48
6.3.2	Proposed Action Plan within the Outer Ring Roads Limits of Bangalore	50
6.4	Findings	50
7.0	Chennai	52
7.1	Sources of Air Pollution	52
7.2	Ambient Air Quality	54
7.2.1	Air Quality in terms of Low, Moderate, High and Critical Levels	54
7.2.2	Air Quality Trends in Chennai	54
7.2.3	Meteorological Issues	57
7.3	Action Plan for the Control of Air Pollution for the City of Chennai	58
7.3.1	Action Taken so far	58
7.3.2	Proposed Action Plan	59
7.4	Findings	60
8.0	Delhi	61
8.1	Sources of Air Pollution	61
8.2	Ambient Air Quality	64
8.2.1	Violation of NAAQS (24 hourly average)	64
8.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	64
8.2.3	Air Quality Trends in Delhi	65

Section No.	Title	Page No.
8.2.4	Additional Pollutants Monitored in Delhi	65
8.2.5	Meteorological Issues	68
8.3	Action Plan for the Control of Air Pollution for the City of Delhi	72
8.3.1	Action Taken so far	72
8.3.2	Proposed Action Plan	76
8.4	Findings	78
9.0	Faridabad	80
9.1	Sources of Air Pollution	81
9.2	Ambient Air Quality	81
9.2.1	Violation of NAAQS (24 hourly average)	81
9.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	81
9.2.3	Air Quality Trends in Faridabad	81
9.3	Action Plan for the Control of Air Pollution for the City of Faridabad	83
9.3.1	Action Taken so far	83
9.3.2	Proposed Action Plan	85
9.4	Findings	86
10.0	Hyderabad	87
10.1	Sources of Air Pollution	87
10.2	Ambient Air Quality	87
10.2.1	Violation of NAAQS (24 hourly average)	88
10.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	88
10.2.3	Air Quality Trends in Hyderabad	88
10.2.4	Meteorological Issues	91
10.3	Action Plan for the Control of Air Pollution for the City of Hyderabad	92
10.3.1	Action Taken so far	92
10.3.2	Proposed Action Plan	93
10.4	Findings	94
11.0	Jharia	95
11.1	Sources of Air Pollution	95
11.2	Ambient Air Quality	97
11.2.1	Violation of NAAQS (24 hourly average)	97
11.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	97
11.2.3	Air Quality Trends in Jharia	98
11.2.4	Meteorological Issues	98

Section No.	Title	Page No.
11.3	Action Plan for the Control of Air Pollution for the City of Dhanbad-Jharia	98
11.3.1	Action Plan Proposed	98
11.4	Findings	102
12.0	Jodhpur	103
12.1	Sources of Air Pollution	104
12.2	Ambient Air Quality	104
12.2.1	Violation of NAAQS (24 hourly average)	104
12.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	104
12.2.3	Air Quality Trends in Jodhpur	105
12.2.4	Meteorological Issues	105
12.3	Action Plan for the Control of Air Pollution for the City of Jodhpur	108
12.3.1	Action Taken so far	108
12.3.2	Proposed Action Plan	109
12.4	Findings	110
13.0	Kanpur	111
13.1	Sources of Air Pollution	111
13.2	Ambient Air Quality	112
13.2.1	Violation of NAAQS (24 hourly average)	112
13.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	112
13.2.3	Air Quality Trends in Kanpur	112
13.2.4	Meteorological Issues	115
13.3	Action Plan for the Control of Air Pollution for the City of Kanpur	116
13.3.1	Action Taken so far	116
13.3.2	Proposed Action Plan	117
13.4	Findings	119
14.0	Kolkata	120
14.1	Sources of Air Pollution	120
14.2	Ambient Air Quality	122
14.2.1	Violation of NAAQS (24 hourly average)	122
14.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	122
14.2.3	Air Quality Trends in Kolkata	123
14.2.4	Meteorological Issues	123
14.3	Action Plan for the Control of Air Pollution for the City of Kolkata	128

Section No.	Title	Page No.
14.3.1	Action Taken so far	128
14.3.2	Proposed Action Plan	129
14.4	Findings	130
15.0	Lucknow	131
15.1	Sources of Air Pollution	132
15.2	Ambient Air Quality	132
15.2.1	Violation of NAAQS (24 hourly average)	133
15.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	133
15.2.3	Air Quality Trends in Lucknow	133
15.2.4	Meteorological Issues	133
15.3	Action Plan for the Control of Air Pollution for the City of Lucknow	136
15.3.1	Action Taken so far	136
15.3.2	Proposed Action Plan	138
15.4	Findings	139
16.0	Mumbai	140
16.1	Sources of Air Pollution	140
16.2	Ambient Air Quality	143
16.2.1	Violation of NAAQS (24 hourly average)	143
16.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	143
16.2.3	Air Quality Trends in Mumbai	144
16.2.4	Meteorological Issues	144
16.3	Action Plan for the Control of Air Pollution for the City of Mumbai	149
16.3.1	Action Taken so far	149
16.3.2	Proposed Action Plan	150
16.4	Findings	150
17.0	Patna	152
17.1	Sources of Air Pollution	152
17.2	Ambient Air Quality	152
17.2.1	Violation of NAAQS (24 hourly average)	154
17.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	154
17.2.3	Air Quality Trends in Patna	154
17.3	Action Plan for the Control of Air Pollution for the City of Patna	154
17.3.1	Proposed Action Plan	154
17.4	Findings	156

Section No.	Title	Page No.
18.0	Pune	157
18.1	Sources of Air Pollution	157
18.2	Ambient Air Quality	158
18.2.1	Violation of NAAQS (24 hourly average)	158
18.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	158
18.2.3	Air Quality Trends in Pune	159
18.2.4	Meteorological Issues	159
18.3	Action Plan for the Control of Air Pollution for the City of Pune	162
18.3.1	Action Taken so far	162
18.3.2	Proposed Action Plan	165
18.4	Findings	166
19.0	Solapur	168
19.1	Sources of Air Pollution	168
19.2	Ambient Air Quality	169
19.2.1	Violation of NAAQS (24 hourly average)	169
19.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	169
19.2.3	Air Quality Trends in Solapur	169
19.2.4	Meteorological Issues	172
19.3	Action Plan for the Control of Air Pollution for the City of Solapur	173
19.3.1	Action Taken so far	173
19.3.2	Proposed Action Plan	174
19.4	Findings	175
20.0	Varanasi	176
20.1	Sources of Air Pollution	177
20.2	Ambient Air Quality	177
20.2.1	Violation of NAAQS (24 hourly average)	177
20.2.2	Air Quality in terms of Low, Moderate, High and Critical Levels	178
20.2.3	Air Quality Trends in Varanasi	178
20.3	Action Plan for the Control of Air Pollution for the City of Varanasi	178
20.3.1	Action Taken so far	178
20.3.2	Proposed Action Plan	180
20.4	Findings	181
21.0	Findings and Recommendations	182
21.1	Findings	182
21.2	Recommendations	189

Section No.	Title	Page No.
Annexure- I	National Ambient Air Quality Standards (NAAQS)	191
Annexure -II	Details of Ambient Air Quality Monitoring Stations under National Air Quality Monitoring Programme (NAMP) in Seventeen Cities	192
Annexure-III	Format for Preparation of Proposed Action Plan and Reporting Progress	195
	References	201

List of Tables

Table no.	Title	Page no.
2.1	Road Map for Vehicular Emission Norms for New Vehicles (New Vehicles (except 2 & 3 Wheelers))	6
2.2	Road Map for Vehicular Emission Norms for New Vehicles (New 2 & 3 Wheelers)	7
2.3	Road Map for Reducing Pollution from In-use Vehicles	13
3.1	Approach steps for preparation of action plan for the control of air pollution.	19
8.1	Emission factors used for estimating pollution load.	63
8.2	Air Pollution Load (tonnes/day) from thermal power plants that are not complying with emission norms and have installed ESPs.	63
8.3	Air Pollution Load Generated from Cement Plants.	64

List of Figures

Figure no.	Title	Page no.
4.1	Map of Agra	24
4.2	Trends in Annual Average Concentration of SO ₂ , NO ₂ , RSPM and SPM in Agra	27
4.3	Seasonal variation in RSPM levels at Taj Mahal, Agra during 2005-06.	28
5.1	Trends in Annual Average Concentration of SO ₂ in Ahmedabad.	34
5.2	Trends in Annual Average Concentration of NO ₂ in Ahmedabad.	34
5.3	Trends in Annual Average Concentration of RSPM in Ahmedabad.	35
5.4	Trends in Annual Average Concentration of SPM in Ahmedabad.	35
5.5	Seasonal Variation in Ambient SPM levels at Shardaben Hospital, Ahmedabad.	37
5.5	Seasonal Variation in Ambient RSPM levels at Shardaben Hospital, Ahmedabad.	37
6.1	Trends in Annual Average Concentration of SO ₂ in Bangalore.	45
6.2	Trends in Annual Average Concentration of NO ₂ in Bangalore.	45
6.3	Trends in Annual Average Concentration of RSPM in Bangalore.	46
6.4	Trends in Annual Average Concentration of SPM in Bangalore.	46
6.5	Seasonal Variation in Ambient RSPM levels at Amco Batteries, Bangalore during 2005-06.	47
7.1	Trends in Annual Average Concentration of SO ₂ in Chennai.	55
7.2	Trends in Annual Average Concentration of NO ₂ in Chennai.	55
7.3	Trends in Annual Average Concentration of RSPM in Chennai.	56
7.4	Trends in Annual Average Concentration of SPM in Chennai.	56
7.5	Seasonal Variation in RSPM levels at Monitoring Station at Govt. High School, Chennai.	57
8.1	Map of Delhi	62
8.2	Trends in Annual Average Concentration of SO ₂ in Delhi.	66
8.3	Trends in Annual Average Concentration of NO ₂ in Delhi.	66

Figure no.	Title	Page no.
8.4	Trends in Annual Average Concentration of RSPM in Delhi.	67
8.5	Trends in Annual Average Concentration of SPM in Delhi.	67
8.6	Annual Average Concentration of CO (mg/m ₃) at BSZ Marg, New Delhi.	68
8.7	Trend in Monthly Average Concentration of SO ₂ and NO ₂ in Delhi.	70
8.8	Trend in Monthly Average Concentration of RSPM in Delhi.	70
8.9	Trend in Seasonal Concentration of SO ₂ in Delhi.	70
8.10	Trend in Seasonal Concentration of NO ₂ in Delhi.	71
8.11	Trend in Seasonal Concentration of RSPM in Delhi.	71
8.12	Monthly Average Concentration of CO and Monthly Average Mixing height in Delhi during 2005.	72
9.1	Trends in Annual Average Concentration of SO ₂ in Faridabad.	82
9.2	Trends in Annual Average Concentration of NO ₂ in Faridabad.	82
9.3	Trends in Annual Average Concentration of RSPM in Faridabad.	84
9.4	Trends in Annual Average Concentration of SPM in Faridabad.	84
10.1	Trends in Annual Average Concentration of SO ₂ in Hyderabad.	89
10.2	Trends in Annual Average Concentration of NO ₂ in Hyderabad.	89
10.3	Trends in Annual Average Concentration of RSPM in Hyderabad.	90
10.4	Trends in Annual Average Concentration of SPM in Hyderabad.	90
10.5	Seasonal Variation in RSPM levels at Tarnaka, Hyderabad during 2005-06.	91
11.1	Trends in Annual Average Concentration of SO ₂ , NO ₂ , RSPM and SPM in Jharia.	99
11.2	Seasonal Variation in RSPM levels at MADA, Jharia during 2005-06.	100
12.1	Trends in Annual Average Concentration of SO ₂ in Jodhpur.	106
12.2	Trends in Annual Average Concentration of NO ₂ in Jodhpur.	106
12.3	Trends in Annual Average Concentration of RSPM in Jodhpur.	107

Figure no.	Title	Page no.
12.4	Trends in Annual Average Concentration of SPM in Jodhpur.	107
12.5	Seasonal Variation in RSPM levels at Sojati gate, Jodhpur during 2005-06.	108
13.1	Trends in Annual Average Concentration of SO ₂ at Kanpur.	113
13.2	Trends in Annual Average Concentration of NO ₂ at Kanpur.	113
13.3	Trends in Annual Average Concentration of RSPM at Kanpur.	114
13.4	Trends in Annual Average Concentration of SPM at Kanpur.	114
13.5	Seasonal Variation in RSPM levels at Kidwai Nagar, Kanpur.	115
14.1	Trends in Annual Average Concentration of SO ₂ in Kolkata.	124
14.2	Trends in Annual Average Concentration of NO ₂ in Kolkata.	124
14.3	Trends in Annual Average Concentration of RSPM in Kolkata.	125
14.4	Trends in Annual Average Concentration of SPM in Kolkata.	125
14.5	Trend in Monthly Average Concentration of SO ₂ and NO ₂ in Kolkata.	126
14.6	Trend in Monthly Average Concentration of RSPM in Kolkata.	126
14.7	Trend in Seasonal Concentration of SO ₂ in Kolkata.	126
14.8	Trend in Seasonal Concentration of NO ₂ in Kolkata.	127
14.9	Trend in Seasonal Concentration of RSPM in Kolkata.	127
15.1	Trends in Annual Average Concentration of SO ₂ in Lucknow.	134
15.2	Trends in Annual Average Concentration of NO ₂ in Lucknow.	134
15.3	Trends in Annual Average Concentration of RSPM in Lucknow.	135
15.4	Trends in Annual Average Concentration of SPM in Lucknow.	135
15.5	Seasonal Variation in RSPM levels at Kapoor Hotel, Lucknow during 2005-06.	136
16.1	Map of Mumbai	141
16.2	Trends in Annual Average Concentration of SO ₂ in Mumbai.	145

Figure no.	Title	Page no.
16.3	Trends in Annual Average Concentration of NO ₂ in Mumbai.	145
16.4	Trends in Annual Average Concentration of RSPM in Mumbai.	146
16.5	Trends in Annual Average Concentration of SPM in Mumbai.	146
16.6	Trend in Monthly Average Concentration of SO ₂ and NO ₂ in Mumbai.	147
16.7	Trend in Monthly Average Concentration of RSPM in Mumbai.	147
16.8	Trend in Seasonal Concentration of SO ₂ in Mumbai.	147
16.9	Trend in Seasonal Concentration of NO ₂ in Mumbai.	148
16.10	Trend in Seasonal Concentration of RSPM in Mumbai.	148
17.1	Map of Patna	153
17.2	Trends in Annual Average Concentration of SO ₂ , NO ₂ , RSPM and SPM in Patna.	155
18.1	Trends in Annual Average Concentration of SO ₂ in Pune.	160
18.2	Trends in Annual Average Concentration of NO ₂ in Pune.	160
18.3	Trends in Annual Average Concentration of RSPM in Pune.	161
18.4	Trends in Annual Average Concentration of SPM in Pune.	161
18.5	Seasonal Variation in RSPM levels at Nalstop, Pune during 2005-06.	162
19.1	Trends in Annual Average Concentration of SO ₂ in Solapur.	170
19.2	Trends in Annual Average Concentration of NO ₂ in Solapur.	170
19.3	Trends in Annual Average Concentration of RSPM in Solapur.	171
19.4	Trends in Annual Average Concentration of SPM in Solapur.	171
19.5	Seasonal Variation in RSPM levels at Chitale Clinic, Solapur during 2005-06.	172
20.1	Trends in Annual Average Concentration of SO ₂ , NO ₂ , RSPM and SPM in Varanasi.	179

1.0 Introduction

Urbanization in India is more rapid around the major cities in India. Increase in industrial activities, population both endemic and floating and vehicular population etc. have led to a number of environmental problems, one of them being air pollution. Various contaminants continuously enter the atmosphere through natural and man-made processes and these contaminants interact with the environment to cause disease, toxicity, environmental decay and are labeled as pollutant. Air Pollutants means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment. Environment: includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organisms and properties. Air pollution is basically the presence of air pollutants in the atmosphere. The air has a relative constant composition of gases and is utilized by most of the living organisms in respiration to liberate chemical energy for their survival. This composition determines its quality and is being changed in the recent past due to emission of large amount of un-natural materials in the atmosphere by industries and automobiles. This changed quality became a great threat to survival of life, properties, materials and ecosystem as a whole. In order to arrest the deterioration in air quality, Govt. of India has enacted Air (Prevention & Control of Pollution) Act in 1981. The responsibility has been further emphasized under Environment (Protection) Act, 1986. It is necessary to assess the present and anticipated air pollution through continuous air quality survey/monitoring programs. Therefore, Central Pollution Control Board had started National Ambient Air Quality Monitoring (NAAQM) Network during 1984 - 85 at national level. The programme was later renamed as National Air Monitoring Programme.

An inventory of air pollutants is a necessary first step towards control of air pollution. Air pollutants can be natural or may be the result of various anthropogenic activities like industrial emissions. Further the air pollutants can be primary or secondary depending upon their formation mechanism. Primary pollutants are directly emitted from the source and secondary pollutants are formed in the atmosphere. Meteorological factors play a critical role in ambient concentrations of air pollutants. Even though the total discharge of air pollutants into the atmosphere may remain constant, the ambient concentrations of air pollutants may vary depending upon the meteorological conditions. Keeping all these factors in mind, an attempt is made to address the problem of air pollution in seventeen cities in India identified by Honorable Supreme Court as polluted cities. These cities are Agra, Ahmedabad, Bangalore, Chennai, Delhi, Hyderabad, Kolkata, Lucknow, Kanpur, Faridabad, Jodhpur, Patna, Pune, Solapur, Varanasi, Jharia, and Mumbai. The action plan being implemented in these seventeen cities for controlling air pollution is given. Also the action plan proposed for controlling air pollution is detailed.

1.1 Air (Prevention and Control of Pollution) Act 1981

Government of India enacted the Air (Prevention and Control of Pollution) Act 1981 to arrest the deterioration in the air quality. The act prescribes various functions for the Central Pollution Control Board at the apex level and State Pollution Control Board at the state level. The main functions of the Central Pollution Control Board are as follows:

- To advise the Central Government on any matter concerning the improvement of the quality of the air and the prevention, control and abatement of air pollution.
- To plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution.
- To provide technical assistance and guidance to the State Pollution Control Board.
- To carry out and sponsor investigations and research related to air pollution prevention, control and abatement of air pollution.
- To collect, compile and publish technical and statistical data related to air pollution; and
- To lay down standards for the quality of air and emission quantities.

The main functions of the State Pollution Control Board are as follows:

- To plan a comprehensive programme for prevention, control or abatement of air pollution and to secure the execution thereof;
- To advise the State Government on any matter concerning prevention, control and abatement of air pollution.
- To collect and disseminate information related to air pollution.
- To collaborate with Central Pollution Control Board in programme related to prevention, control and abatement of air pollution; and
- To inspect air pollution control areas, assess quality of air and to take steps for prevention, control and abatement of air pollution in such areas.

1.2 National Ambient Air Quality Standards (NAAQS)

The ambient air quality objectives/standards are pre-requisite for developing management programme for effective management of ambient air quality and to reduce the damaging effects of air pollution. The objectives of air quality standards are: -

- To indicate the levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property.
- To assist in establishing priorities for abatement and control of pollutant level;

- To provide uniform yardstick for assessing air quality at national level;
- To indicate the need and extent of monitoring programme; and

The Central Pollution Control Board had adopted first Ambient Air Quality Standards on November 11, 1982 as per section 16 (2) (h) of the Air (Prevention and Control of Pollution) Act, 1981. The air quality standards have been revised by the Central Pollution Control Board on April 11, 1994 and were notified in Gazette of India, Extra-ordinary Part-II Section 3, sub section (ii), dated May 20, 1994. The revised National Ambient Air Quality Standards are depicted in Annexure-I (Table A1.1). These standards are based on the land use and other factors of the area. The guidelines for declaring sensitive areas as recommended by peer/core group of C.P.C.B. are as follows:

Sensitive areas – sensitive area may include the following:

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

2.0 Air Quality Monitoring

Ambient air quality monitoring is required to determine the existing quality of air, evaluation of the effectiveness of control programme and to identify areas in need of restoration and their prioritization. National Air Quality Monitoring Programme is described in this chapter alongwith details on pollutants measured and their frequency.

2.1 National Air Quality Monitoring Programme (N.A.M.P.)

Central Pollution Control Board initiated National Ambient Air Quality Monitoring (NAAQM) programme in the year 1984 with 7 stations at Agra and Anpara. Subsequently the programme was renamed as National Air Monitoring Programme (N.A.M.P.). The number of monitoring stations under N.A.M.P. has increased, steadily, to 308 operating stations by 2006 covering 115 cities/towns in 25 States and 4 Union Territories of the country.

2.1.1 Objectives

The objectives of the N.A.M.P. are as follows:

- To determine status and trends of ambient air quality;
- To ascertain whether the prescribed ambient air quality standards are violated;
- To Identify non-attainment Cities where air pollutants are exceeded prescribed standards.
- To obtain the knowledge and understanding necessary for developing preventive and corrective measures and
- To understand the natural cleansing process undergoing in the environment through pollution dilution, dispersion, wind based movement, dry deposition, precipitation and chemical transformation of pollutants generated.

2.1.2 Monitoring Locations and Parameters

Under N.A.M.P., four air pollutants viz., Sulphur Dioxide (SO₂), Oxides of Nitrogen as NO₂ and Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM/PM₁₀), have been identified for regular monitoring at all the locations. Besides this, additional parameters such as Respirable Lead and other toxic trace metals, Hydrogen Sulphide (H₂S), Ammonia (NH₃) and Polycyclic Aromatic Hydrocarbons (PAHs) are also being

monitored in 10 metro-cities of the country, since 1990. The monitoring of meteorological parameters such as wind speed and direction, relative humidity and temperature was also integrated with the monitoring of air quality.

The monitoring of pollutants is carried out for 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week, to have 104 observations in a year. N.A.M.P., being a nationwide network, involves several agencies which are Central Pollution Control Board: in Delhi; State Pollution Control Boards: in the respective States; Pollution Control Committees: in the respective Union Territories and National Environmental Engineering Research Institute (NEERI), Nagpur: in 6 metro cities of the country.

CPCB co-ordinates with these agencies to ensure the uniformity, consistency of air quality data and provides technical and financial support to them for operating the monitoring stations. Since the target sampling of 24 hours in a day could not be fulfilled at all the locations due to power failures etc., the values monitored for 16 hours and more are considered as representative values for assessing the ambient air quality for a day. The target frequency of monitoring twice a week, 104 days in a year could not be met in some of the locations, in such cases 40 and more days of monitoring in a year is considered adequate for the purpose of data analysis. The outliers from the data were removed. N.A.M.P. is being operated through various monitoring agencies, large number of personnel and equipment are involved in the sampling, chemical analyses, data reporting etc. It increases the probability of variation and personnel biases reflecting in the data, hence it is pertinent to mention that these data be treated as indicative rather than absolute.

2.2 Non-attainment Areas

The air quality terms is expressed in terms of low, moderate, high and critical for various cities/towns monitored. The concentration ranges for different levels have been selected based on the Notified Standards for different pollutants and area classes by calculating an Excedence Factor (the ratio of annual mean concentration of a pollutant with that of a respective standard). The Excedence Factor (EF) is calculated as follows:

$$\text{Excedence Factor} = \frac{\text{Observed annual mean concentration of a criterion pollutant}}{\text{Annual standard for the respective pollutant and area class}}$$

The four air quality categories are:

- Critical pollution (C): when EF is more than 1.5;
- High pollution (H): when EF is between 1.0 - 1.5;
- Moderate pollution (M): when EF between 0.5 - 1.0; and
- Low pollution (L): when EF is less than 0.5.

It is obvious from the above categorization, that the locations in either of the first two categories are actually violating the standards, although, with varying magnitude. Those, falling in the third category are meeting the standards as of now but likely to violate the standards in future if pollution continues to increase and is not controlled. However, the locations in Low pollution category have a rather pristine air quality and such areas are to be maintained at low pollution level by way of adopting preventive and control measures of air pollution.

2.3 Recommendations of the Auto Fuel Policy Report

A Committee of Experts of national repute was constituted, under the chairmanship of Dr. R.A. Mashelkar, Director General, Council of Scientific & Industrial Research (CSIR) and it was entrusted with the task of recommending an *Auto Fuel Policy* for the country together with a road map for its implementation. The recommendations made in the auto fuel policy report for the country are as follows

(i) Vehicular Emission Norms

The Committee recommends the following road map (Table 2.1 and 2.2) for vehicular emission norms for new vehicles and auto fuel quality, for implementation.

Table 2.1 Road Map for Vehicular Emission Norms for New Vehicles (New Vehicles (except 2 & 3 Wheelers))

Entire Country
Bharat Stage II emission norms From 1 April, 2005
Euro III equivalent emission norms From 1 April, 2010
For Cities of Delhi / NCR, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur and Agra,
(i) Bharat Stage II emission norms Delhi, Mumbai, Kolkata & Chennai Already introduced in the year 2000 & 2001 Bangalore, Hyderabad Ahmedabad, Pune, Surat, Kanpur and Agra From 1 April, 2003

For Cities of Delhi / NCR, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur and Agra,

(ii) Euro III equivalent emission norms for all private vehicles, city public service vehicles and city commercial vehicles.

From 1 April, 2005

(iii) Euro IV equivalent emission norms for all private vehicles, city public service vehicles and city commercial vehicles

From 1 April, 2010

Table 2.2: Road Map for Vehicular Emission Norms for New Vehicles (New 2 & 3 Wheelers).

Emission Norms for 2 / 3 Wheelers to be the same in the Entire Country

. Bharat Stage II norms

From 1 April, 2005

Bharat Stage III norms

Preferably from 1 April, 2008 but not later than 1 April, 2010 in any case.

(ii) Air quality data and research and development

1. Data on air quality is a crucial input to taking policy and investment decisions. Currently, air quality data are insufficient, requiring a major expansion and augmentation of the existing network of air quality monitoring and supervision. To ensure that such data are collected scientifically, it is necessary to provide funding support for strengthening of the network and the supervision / monitoring of data collection.

2. Surveys and studies on the sources of pollution and their apportionment to different sources are a pre-requisite to a proper understanding of what causes pollution and in what proportion. Such studies should be immediately initiated in the polluted cities and the National Capital Territory. National level research institutes, having the necessary manpower, experience, and equipment should be utilized for undertaking such studies.

3. Actions for containing air pollution in cities that suffer from pollution from auto exhaust should be undertaken as a part of a comprehensive scheme for reducing

air pollution from different sources. Several steps should help in determining the actions :

- (a) Identification of critical pollutants in the city and the sources of pollution.
- (b) Analysis and assessment of pollution loads from different sources and contribution of auto exhausts thereto.
- (c) Contribution of different categories of vehicles, inter-city and intra-city, to the pollution loads of critical pollutants.
- (d) Cost benefit analysis of alternative solutions, based on different combinations of fuel – vehicle technology options, for achieving the intended objectives.

(iii) Health effects of air pollution

1. A database linking air pollution/vehicular emission related diseases and air pollution levels should be created for planning of interceptive action. The state governments should collect and analyze this information and disseminate the same to the concerned authorities at regular intervals.

2. The regulatory authorities, R&D institutions dealing with environmental health and medical community should play an active role in the prevention and control of air pollution and adverse health impacts.

3. Concerned government agencies and automobile industry should create public awareness that proper maintenance of vehicles and measures are crucial for reducing vehicular emissions.

4 Research and development needs should be directed towards well designed multi-centric epidemiological studies, based on reliable objective parameters for exposures (outdoor, indoor, occupational) and health outcomes. Studies should be undertaken in the four metropolitan cities and other polluted cities to find out the attributability of environmental pollutants and disease outcomes, health and environmental economics of air pollution, and vehicular emission. A core group of experts from ICMR, CPCB, CSIR and MoE&F, and an apex economic and policy organization should be set up by the MOE&F, whose responsibility should be to steer the research studies.

(iv) Vehicle technology

1. The Government have already formulated an Auto Policy. Its expeditious implementation together with the implementation of recommendations made in the Report should help to achieve the environmental targets. Coordinated implementation of the two sets of Policies is recommended.

2. Declaration of fuel economy standards by automobile manufactures should be made mandatory, who should publish the fuel economy standards (km/liter or km/kg) for each model in the documents that are supplied with each vehicle.

(v) Supply of auto fuels

1. The twin objectives of providing assured supply of auto fuels at minimal costs and meeting the environmental concerns should be achieved by making available—

(a) liquid fuels of the specified quality as main auto fuels throughout the country; and

(b) alternative auto fuels, along with liquid auto fuels, in cities having high vehicular pollution to enable the vehicle owners to meet the prescribed emission norms in such cities by choosing appropriate combination of fuel and engine technology.

2. At the present stage of development of the infrastructure of petroleum imports, production, transportation and distribution, maintenance of assured supplies of gaseous fuels may be difficult in situations of disruption resulting from any unforeseen natural or other factors, external or internal. Therefore, in order to protect the consumer from supply disruptions and price risks, the Committee considers it inadvisable to recommend that city public transport systems use, or be designed for, only gaseous or other non-conventional fuels.

(vi) Alternative auto fuels: CNG and LPG

1. The Motor Vehicles Act and Rules made there under have been amended to allow use of CNG and LPG for automotive purposes. The use of CNG/LPG should be encouraged in the cities affected by high vehicular pollution to enable the vehicle owners to have the choice of fuel and technology combination to meet the tighter emission norms in such cities.

2. Safety of CNG and LPG fuelled vehicles is of paramount importance. The Committee recommends continuance of the present practice of having fixed fuel tanks in CNG and LPG vehicles in line with the practices around the world.

(vii) Other alternative fuels

1. Fuel cells, hydrogen and battery powered vehicles provide non-polluting alternatives. Their development activities and of other alternative fuels and vehicles should be accelerated. A comprehensive programme of policy support, R&D support and other measures for zero emission vehicles should be drawn up.

2. The development of technologies for producing ethanol and bio-fuels from different renewable sources can play a major role in commercialization of bio-fuel vehicles in the country, which should be encouraged by providing R&D and other support through suitable fiscal incentives.

3. Existing facilities for testing and certification of alternative fuel vehicles and components/products should be strengthened to ensure safety, reliability and durability.

(viii) Fiscal regime

1. To put in place the new emission norms, substantial investments would be required to be made to provide appropriate quality fuels and vehicles. It would, therefore, be necessary to give preferential treatment in the form of duty and tax concessions to the oil and auto industry. The Committee recommends the following :

(a) A one-time budgetary support to the refineries in the North-East for upgradation of fuel quality.

(b) Lower custom duty on imported capital goods, equipment and machinery needed for improvement of fuel quality and automobile technology, including CNG, LPG and other alternative fuel technology.

(c) Lower excise duty on indigenously manufactured goods, equipment and machinery needed for improvement of fuel quality and automobile technology, including CNG,LPG and other alternative fuel technology.

(d) 100 per cent depreciation on plant and machinery put up for upgradation of product quality and automobile technology, including CNG, LPG and other alternative fuel technology.

2. In India, CNG and LPG vehicles may not be competitive with conventional fuel vehicles. Where, to meet tighter emission norms, the use of CNG/LPG is provided in any city specific air quality improvement scheme, fiscal concessions/preferential treatment would be necessary for their sustainability. The Committee recommends the following :

(a) Lower customs duty on the imports of CNG and LPG kits.

(b) Lower customs duty on the imports of equipment used for manufacturing/dispensing of CNG and LPG.

(c) Lower duties and taxes on gaseous fuels vis-à-vis liquid fuels.

3. The Committee recommends providing fiscal and financial incentives, both to the manufacturers and users of electric vehicles to make them competitive. The Committee also recommends R&D support for high energy density batteries, insulated gate bi-polar transistors, invertors, new generation of electric motors, etc. and financial support for R&D work in this area.

(ix) Reduction of pollution from in-use vehicles

1. The existing PUC system should be replaced and upgraded to a more reliable computerized system which will ensure better compliance, help identify polluting vehicles and transfer data to a centralized location for further analysis and interpretation.
2. Inspection and maintenance (I&M) system should be introduced in the eleven (11) major cities, identified in the Report on an urgent basis. The same I&M system should be extended to throughout the country.
3. Performance checking of catalytic converters and conversion kits already installed in vehicles should be made mandatory.
4. Promoting public bus transport should be viewed as a top priority area to improve urban road traffic and for controlling air pollution from automobiles.
5. The annual vehicle insurance should be linked with PUC certification, by making the availability of valid pollution check certificates a necessary condition for allowing settling of insurance claims.
6. The tighter emission norms will reduce emissions only from new vehicles. To bring emission improvements in old vehicles, they should be retrofitted with new engines or the emission control devices. Schemes combined with incentives should be developed for the replacement of old polluting vehicles.
7. Appropriate systems should be put in place to check emission warranty for new vehicles. Random checking of CNG/LPG kits or any other emission control devices or retrofit engines for their emission performance is also recommended.
8. In other countries, emission charges are a key instrument for controlling pollution. Such economic instruments should be considered for implementation in India also. To start with, in the metropolitan cities of Delhi, Mumbai, Kolkata, Chennai etc., State Governments may consider levying higher motor vehicle tax on old vehicles.
9. To ensure benefits from the introduction of improved vehicular emission norms and supply of better quality fuels and alternative fuels, quality aspects are crucial. Therefore, supply of liquid fuels of the right quality for conventional fuel vehicles and the use of standard kits of the right quality in alternative fuel vehicles need to be ensured. The following is recommended :
 - (a) Complete the process of correcting the fuel price distortions by removal of subsidies and cross subsidies as early as possible.

- (b) Extend the tank lorry locking system for movement of petrol and diesel to all major cities in the entire country.
- (c) Encourage setting up of consumer pumps by the transport companies operating city public transport.
- (d) Depending on the results of the pilot projects for the use of special markers to detect and prevent adulteration in petrol and diesel, take up the use of markers on commercial basis.
- (e) Set up mechanism for independent inspection and rigorous checks of liquid auto fuels by agencies other than the oil companies, e.g. joint teams of Anti-Adulteration Cell, States Civil Supplies Departments, and State Pollution Control Boards, in the highly polluted cities.
- (f) Make oil companies responsible and accountable for the quality of auto fuels dispensed from their retail outlets.
- (g) Set up the testing facilities and enforcement machinery for checking the quality of conversion kits fitted in the on-road vehicles simultaneously with the introduction of alternative fuels in any city.
- (h) Ensure that any conversion of vehicles to CNG and LPG mode is reported to the registering authority for endorsing the change in the vehicle registration certificate after inspection of the converted vehicle for fitness.
- (i) Set up mechanism for regular inspection of agencies authorized to carry out conversion of vehicles to alternative fuel vehicles by the joint teams of the State Transport Departments and Pollution Control Boards and to ensure that the authorized agencies carry their work only by the trained personnel.
- (j) Put restrictions on dispensing of alternative fuels to the vehicles converted and/or retrofitted to alternate fuel mode if such vehicles do not carry requisite endorsement in the vehicle registration certificate.
- (k) Provide for heavy penalty including impounding of vehicles which are found converted illegally or which do not have requisite endorsement in the vehicle registration certificate.
- (l) Provide for penalties against vehicles including impounding of vehicles, in which the emission control devices fitted by Original Equipment Manufacturers (OEMs) are found to be removed or tampered with.

(x) Road map for in-use vehicles

1. The Committee recommends the road map, given in Table 2.3 for reducing pollution from the in-use vehicles. In addition to the recommendations made in the road map, State Governments / Union Territories can take such special city specific measures as may be necessary to deal with any local problem. These measures should take into account the availability of auto fuels and the security of their supplies to guard against disruption in transport system and hardship to people.

Table 2.3: Road Map for Reducing Pollution from In-use Vehicles

<p><i>For the Entire Country</i></p>
<p>New PUC checking system for all categories of vehicles · to be put in place by 1 April, 2005</p> <p>Inspection & Maintenance (I&M) System for all categories of vehicles · to be put in place by 1 April, 2010</p> <p>Performance checking system of catalytic converters and conversion kits installed in vehicles · to be put in place by 1 April, 2007</p> <p>Augmentation of city public transport system · finalisation of plans by the State Governments/ local authorities. : Not later than 1 April, 2005</p>
<p><i>For the National Capital Territory of Delhi (NCT)</i></p>
<p>New PUC Checking System for all categories of vehicles · to be put in place by 1 October, 2003</p> <p>Inspection & Maintenance (I&M) System for all categories of vehicles · to be put in place by 1 April, 2005</p> <p>Performance checking system of catalytic converters and conversion kits installed in vehicles · to be put in place by 1 October, 2004</p> <p>Augmentation of city public transport system · should be undertaken by the State Government after reviewing the start up schedules and estimated impact of metro rail system.</p> <p><i>Emission norms for city public service vehicles</i> · For city buses, taxis & 3 wheelers, emission norms have already been set under the directions of the Supreme Court.</p>

Emission norms for all inter-state buses from / to Delhi

All inter-state buses originating or culminating in Delhi should conform to the following norms :

- Minimum India 2000 (*Bharat State I*) emission norms : Not later than 1 April, 2004
- Minimum *Bharat Stage II* emission norms : Not later than 1 April, 2008

Emission norms for inter-state trucks loading / unloading goods from / at Delhi

All inter-state trucks originating or culminating in Delhi should conform to the following norms :

- Minimum India 2000 (*Bharat Stage I*) emission norms : Not later than 1 April, 2004
- Minimum *Bharat Stage II* emission norms. : Not later than 1 April, 2008

For the Cities of Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur & Agra

New PUC checking system for all categories of vehicles

- to be put in place by 1 April, 2004

Inspection & Maintenance (I&M) system for all categories of vehicles

- to be put in place by 1 April, 2006

Performance checking system of catalytic converters and conversion kits installed in vehicles

- to be put in place by 1 April, 2005

Augmentation of city public transport system

- finalisation of plans by the State Governments/local authorities : Not later than 1 April, 2004

Emission norms for city public service vehicles

City Buses and Taxis

All city buses and taxis should conform to the following norms :

From 1 April, 2004

Registered after 1 April, 1996 : Applicable emission norms on the date of registration.

Registered before 1 April, 1996 : Minimum 1996 emission norms

From 1 April, 2008

Registered after introduction : Applicable emission norms on the date of *Bharat Stage II* norms of registration

Registered before introduction : Minimum India 2000 (*Bharat Stage I*) of *Bharat Stage II* norms emission norms

3 Wheelers (Autos/Tempos)

All 3 wheelers (Autos/Tempos) should conform to the following norms :

From 1 April, 2004

Registered after 1 April, 2000 : Applicable emission norms on the date of registration

Registered before 1 April, 2000 : Minimum 1996 emission norms

For the Cities of Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur & Agra

From 1 April, 2008

Registered after 1 April, 2000 : Applicable emission norms on the date of registration

Registered before 1 April, 2000 : Minimum India 2000 (*Bharat Stage I*) emission norms

Emission norms for inter-state buses from / to the identified cities

All inter-state buses originating or culminating in the identified cities should conform to the following norms :

· From 1 April, 2004

Registered after 1 April, 2000 : Minimum India 2000 (*Bharat Stage I*) emission norms

Registered before 1 April, 2000 : Minimum 1996 emission norms

· From 1 April, 2008

Registered after 1 April, 2005 : Minimum *Bharat Stage II* emission norms

Registered before 1 April, 2005 : Minimum India 2000 (*Bharat Stage I*) emission norms

2. A crash programme of construction of road by-passes in all metropolitan cities situated on national highways, where by-passes do not presently exist, should be immediately taken up and completed in a time-bound manner.

(xi) Institutional mechanism

1. The existing authorities responsible for enforcing automobile emission norms and fuel quality standards should be brought under a single new Authority, namely, the National Automobile Pollution and Fuel Authority (NAPFA). Details of its organization are given in the Report. The new Authority will be responsible for

- (a) Accreditation of inspection and certification centers for in-use vehicles.
- (b) Conducting surveillance programmes for fuel quality at the national level.
- (c) Ensuring emission warranty compliance of on-road vehicles and auto fuel quality at the retail outlets.
- (d) Implementation and monitoring of regulations through regional centers/laboratories.

An attempt has been made in this report to address the problem of air pollution in seventeen cities identified as polluted cities. These cities are Agra, Ahmedabad, Bangalore, Chennai, Delhi, Hyderabad, Kolkata, Lucknow, Kanpur, Faridabad, Jodhpur, Patna, Pune, Solapur, Varanasi, Jharia, and Mumbai.. City-wise chapters have been prepared in the report. A brief description of city is given followed by information on sources of air pollution in these cities. Air quality trends have been analysed in these cities. A list of monitoring stations under National Air Quality Monitoring Programme (NAMP) in these cities are given in Annexure-II. Air quality trends are plotted for only those stations whose data was available for a considerable number of years. Monitoring stations with atleast 40 days of adequate data in a year have been considered. Action taken to control air pollution and action plan proposed are also detailed. Finally, findings based on ambient air quality data and recommendations are detailed.

3.0 Action Plan

The Honorable Supreme Court of India, in the matter of CWP No. 13029 of 1995, passed the orders on 05.04.2001, regarding formulation and implementation of action plans for control of pollution in selected cities. The Honorable Court stressed the need for such initiatives relating to vehicular pollution in Delhi and directed that action plan for pollution control in the cities/ towns, which do not meet the ambient air quality standards, should be prepared. The court order among other things, stated as under:

“ We may here note that there are as per CPCB data at least nine other polluted cities in India where the air quality is critical. These cities are Agra, Lucknow, Jharia, Kanpur, Varanasi, Faridabad, Patna, Jodhpur and Pune. But there appears to be no effective action plan to address the problems of the cities] ----.If no immediate action is taken then it may become necessary for some orders being passed so as to bring relief to the residents of these cities.”

Further, the court ordered the Union of India and all other governmental authorities as under:

“ Prepare a scheme containing a time schedule for supply of CNG to other polluted cities of India and furnish the same to this court by 9th May, 2002. “

The Honorable Court considered the matter on 09.05.2002 and among other things, issued following direction:

“ Union of India will give a scheme with regard to compulsory switchover of all the two – wheelers, three wheelers and motor vehicles to LPG/CNG in cities other than Delhi which are equally or more polluted”.

On August 14, 2003, the Honorable Supreme Court passed the following direction:

“CPCB’s report shows that the Respirable Particulate Matter (in short “RSPM”) levels in Ahmedabad, Kanpur, Sholapur, Lucknow, Bangalore, Chennai, Hyderabad, Mumbai and Kolkata are alarming.”

“Issue notices to the States of Maharashtra, Andhra Pradesh, Gujarat, Uttar Pradesh, Karnataka and Tamil Nadu. In the Meantime, we direct that the Union of India and the respective States shall draw a plan for lowering the rate of RSPM level in the aforesaid cities. After the plan is drawn, the same would be placed before EPCA. This may be done within a period of two months. We are excluding Mumbai and Kolkata where the respective High Courts are stated to be monitoring the RSPM levels in those cities. EPCA after examining the matter shall submit a report to this Court within a period of four weeks thereafter.”

In wake of issues discussed above Central Pollution Control Board has attempted for preparing action plans for control of air pollution in the cities/ towns, which do not meet the ambient air quality standards. It is aimed at assisting local regulatory bodies for preparing action plan for the control of air Pollution in non-attainment cities.

An action plan presents the prioritized list of abatement and other measures to improve air quality, and to maintain it within pre-described levels in the short and medium term. It outlines the steps required to implement a full air quality management system in any given city, consistent with that city's circumstances, capabilities and needs. For preparing an efficient action plan knowledge of air quality management system is very essential and therefore concepts related to air quality management have also been also discussed in the coming chapter.

3.1 Guidelines for preparation of action plans for control of Air Pollution

An action plan presents the prioritized list of abatement and other measures to improve air quality, and to maintain it within pre-described levels in the short and medium term. It outlines the steps required to implement a full air quality management system in any given city, consistent with that city's circumstances, capabilities and needs.

The aim of the action plan is to identify and implement a least- cost package of measures to improve air quality, such that the marginal costs equals the marginal benefits. Authorities responsible for preparing action plans regarding control of air pollution in their respective cities base their decisions on subjective assessment of economic and social costs, benefits, feasibility and other considerations.

While preparing action plan for control of air pollution the following components should be taken in to consideration

- Constitution of Working group for action plan preparation.
- Development of a working strategy .
- Air quality assessment.
- Environment damage assessment
- Evaluation of various control options
- Cost benefit analysis or cost effective analysis
- Selection of abatement measures, and
- Development of an time bound optimum pollution control strategy i.e. Action Plan.

Assessment of air quality, environmental damage and abatement options are inputs into cost- benefit analysis or cost effective analysis. Cost- benefit analysis and cost effective analysis are also guided by establishment of air quality objectives and economic objectives .The final result of such analysis is an optimum control strategy in the form of action plan, with prioritized abatement measures. All these components required for preparing an effective action plan are described in forth-coming chapters.

Besides above said components other things that are required to be incorporated in action plan is a background note on the city for which action plan has to be prepared. Note on the city should take in to consideration the topography, climatic conditions, land –use pattern, historical significance of the city (if any), prominent environmental problems, health status & steps taken so far for control of air pollution in the city. The background may also include the road network and infrastructure facilities available in the city/town. Any major environmental episode or any serious air pollution hazard being faced by the city/ town, if any, should also find special mention in the background note.

There are three developmental phases in an action plan

- **Phase-I:** Immediate actions. Strategy for immediate control of most urgent problems.
- **Phase-II:** Intermediate actions. Strategy for control in an intermediate time scale (about 5 yrs), based on current development trends.
- **Phase- III:** Long –term action. Strategy for control over a long- time scale (more than 10 yrs), based on long term projection.

Guidelines for preparation of an effective action plan are described in details in the coming chapters which includes, Assessment of air quality and environmental damage, evaluation of abatement option for the control of pollution and development of Optimum control strategy in the form of an action plan. Steps for preparation of action plan are mentioned in comprehensive tabulated form in Table 3.1

Table 3.1: Approach steps for preparation of action plan for the control of air pollution.

S.no	Steps	Remark
1.	Constitution of working group	A working group has to be constituted for preparation of action plan. Working group may include representatives from CPCB, SPCB, local agencies, MoPNG, SIAM, MoRTH, Development authorities, city planners, state transport department, educationalist & researchers of concerned field, representatives from public forum, NGO's etc.
2.	Development of Work Strategy for air quality Management	Working group requires to develop working strategy for air quality management at local level by referring into successful air quality management strategies & practices at international and national levels

S.no	Steps	Remark
3.	Assessment of air quality and environmental damage /Inventory	Involves emission inventory of both mobile and stationary sources, ambient air quality monitoring, identification of non- attainment areas, and ultimately identification of most important (priority) damage categories and priority pollutants.
4.	Evaluation of control options	This involves subjective verification and selection of all technical measures available for controlling pollution , air quality management strategies practiced in India, feasibility of implementation by considering social, environmental, health and finally financial issues.
5.	Optimal control strategy	Ultimately optimal control strategy i.e. action plan is formulated along with time frame required for its implementation.
6.	Constitution of air quality management &surveillance committees	Requires constitution of several committees for management & maintenance of good air quality and reviewing of various actions initiated.

3.1.1 Constitution of Working Group and development of Working Strategy for action plan preparation

Preparation of an effective action plan for air pollution control primarily demands for constitution of a working group for the preparation of the same. State pollution control Boards should hold the responsibility of constituting working group. Working group may include representatives from CPCB, SPCB, MoPNG, SIAM, MoRTH, Development authorities, city planners, State environment & transport department, Local agencies, Individual from education and research institution concerned in the field of air quality management, pollution control, air modeling, environmental economics etc, working group may also include representatives from public forum as public participation is the best policy for effective implementation of any work plan, further NGO's working in the same field may also join hands in working group constitution.

The work of the working group should be firstly to hold a meeting in order to make the work plan . Here sub-groups may also be constituted for distribution of work according to the work plan. Further working group is suggested to hold periodic meetings to review the work done by them and formulate future working plan. Various responsibilities assigned to the working group may be as follows:-

- Development of a working Strategy for air quality management at local level by referring to air quality management plans at international as well as national levels.

- Assessment of air quality and identification of non- attainment areas: Involves emission inventory of both mobile and stationary sources, ambient air quality monitoring, identification of non- attainment areas, and ultimately identification of most important (priority) damage categories and priority pollutants.
- Evaluation of control option for implementation : This involves consultation of all technical measures available for controlling pollution , air quality management strategies practiced in India, feasibility of implementation by considering social, environmental, health and finally financial issues.
- Formulation of an optimal control strategy for pollution control i.e. action plan, along with time frame required for implementation of various control measures.
- Collection of base data for inventory from industries and area sources. This may involve intensive field interactions.

Working group requires to develop work strategy for air quality management at local level by referring into successful air quality management strategies & practices at international and national levels. Thus the most essential step towards air quality management involves development of a working plan which will provide directional aid towards reaching the goal of developing action plan for the control of air pollution. An air quality management system has two main components – Assessment and Actions. Assessment includes analysis options. a third essential component is surveillance or monitoring which is essential to ensure the effectiveness of air pollution control action. The goal of air quality information system is to ensure thorough, ongoing monitoring by keeping the authorities and public informed about the short and long term changes in the air quality; assessing the results of abatement measures; and thereby providing feedback to the abatement strategy.

3.2 Action Plan

The lesson that problem avoidance is cheaper than either retro-fitting of technology or clean-up of polluted sites has been well argued and accepted. . Therefore , there is need to adopt the most cost effective approaches to the most urgent problems. These involve setting incentives and targeting expenditures to promote clean technologies and practices in Industry, transport, energy and urban management. An action plan presents the prioritized list of abatement and other measures to improve air quality, and to maintain it within pre-described levels. After assessment of air quality, environmental damage we came to know about the status of air quality and extend of environmental damage that has taken place in our city of concern. All this exercise helps us in setting priorities in context of making action plan and abatement options are inputs into cost-benefit analysis or cost effective analysis. Cost- benefit analysis and cost effective analysis are also guided by establishment of air quality objectives and economic objectives .The final result of such analysis is an optimum control strategy in the form of action plan, with prioritized abatement measures. Format for Preparation of Action Plan for Pollution Control in Cities/Towns is given in Annexure-III.

3.3 Constitution of Committees for Surveillance

Once action plan for control of air pollution in a particular area has been prepared, there is need of some further work to be done for effective management and maintenance of air quality management plan. This further task calls for constitution of following committees by the state pollution control boards at state level :

- **Committee for Air regulation** :- This Committee should coordinate the statewide air compliance and enforcement program among the state and local air programs. Its special projects should include the development of appropriate computer database, review of the data to recognize trends in non-compliance and assistance to state and local air programs.
- **Committee for air monitoring and mobile sources** : should hold the responsibility for coordinating the state wide emissions monitoring programs and various activities related to control of air pollution emissions from motor vehicles and area sources.
- **Committee for Policy analysis and program management** : Should be responsible for developing air pollution rules; updating the state implementation plan as needed to ensure attainment and maintenance of national ambient air quality standards throughout the state; coordinating all activities related to compilation of statewide air pollutants emissions inventories; and assessing the effectiveness of State pollution control strategy through trend analysis and air quality modeling .
- **Committee for environmental education and public awareness** : should help citizens learn about statewide environmental education activities through and public outreach activities. Massive thrust is provided for mass awareness campaigns regarding air pollution involving community levels organization such as resident association, students, senior citizens, voluntary bodies local action groups and NGO's to look for innovative ways to solve health, transport, housing and environmental problems and strategic plans for their implementation. Public outreach activities may include activities like constitution of eco-clubs where general public can get aware about air pollution, its harmful effects and what initiative an individual himself can take to get rid of pollution, further organizing environment education camps, organizing eco-quiz and awarding prizes to most eco-friendly societies within the city can prove fruitful for public awareness regarding pollution control.
- **Committee for assessment of public health** : Should be assigned with duty of assessing public health within the state as public health status could prove to be the best indicator of effectiveness of air pollution control strategy implemented in state.
- **Committee to structuring fiscal measure to control air pollution** : This committee should look into fiscal measures for controlling air pollution like hiking taxation from inter-state /intercity vehicles, parking charges, Congestion taxes, "polluters pay" charges from polluting industries and vehicles etc. Further money collected this way can be used for the development of the area/ city/ state in environment friendly way

4.0 Agra

Agra, located in the state of Uttar Pradesh of northern India, is well known for Taj Mahal, one of the wonders of the world. King Shah Jahan built Taj Mahal in 17th century AD in the memory of his beloved wife, Mumtaz Mahal. In and around Agra, in addition to Taj Mahal, there are three more world heritage sites, viz. Agra Fort, Fatehpur Sikri and the bird sanctuary at Bharatpur National Park. In addition to above, the Akbar's tomb at Sikandra in Agra (in proximity to Agra) and the Imdad-ud-Daulahs tomb in Agra are proposed to the world heritage sites. Agra, once a flourishing capital of ancient Mughal is today the 24th largest city in India & 4th largest city in Uttar Pradesh, after Kanpur, Lucknow and Varanasi. Looking at history, Agra was made the capital his kingdom by Sikander Lodi of the Afgan dynasty. In 1526, the city was captured by Babur, descendant of the central Asian conqueror Timur. In 1539 and 1540, Sher Shah, the rebel Afghan, defeated Humayun, son of Babur, in two decisive battles, and became the ruler of the Delhi-Agra region. It was then that the Grand Trunk Road through Agra was laid, with shady serais (rest houses) at regular intervals. The Emperor Akbar re-established Mughal rule over Agra and in large parts of north India between 1556 and 1605. Although Babur and Humayun were responsible for some early Mughal architecture, it was under Akbar that Agra grew to great heights. Agra was a leading educational centre during the time of Mughals. The origin of Urdu, a fine blend of Hindi and Persian, is traced to Akbar's court. Akbar built the great Fort of Agra in 1565, and the new capital of Fatehpur Sikri in 1569. Mughal glory, the foundation of which was laid by Akbar, reached its height under Shah Jahan.

The Taj Trapezium Zone, which is in the form of trapezoid is between 27⁰30'N & 77⁰30'E to 27⁰45'N & 77⁰15'E and 26⁰45'N & 77⁰15'E to 27⁰00'N & 78⁰30'E, was notified by the Government of India for intensifying efforts prevention and control of pollution. In 1999, , the Ministry of Environment and Forest, Government of India has notified the Taj Trapezium Zone (Pollution Prevention and Control) Authority for protection and improvement of the environment in the Trapezium.

The Agra city spreads over an area of approximately 140 sq. km. As per 1991 census, Agra had a population of about 9.5 lakhs excluding the daily floating population of 20,000 (approx). The city of Agra is favorably situated commanding administrative, economic and cultural influence over a very large area. Besides its recent development as an international tourist centre and manufacturing centre, since centuries Agra had flourished with trade, commerce and household industries. The urban area of Agra is divided into Nagar Mahapalika (renamed as Municipal Corporation in 1994), Agra Cantonment area and the Dayalbagh and Swamibagh Panchayat. The administrative divisions and the extent of Agra urban area is given in Table 3.1. The municipal area is further divided into three parts viz. the main city, the Trans Yamuna and the Tajganj. The municipal area is divided into 25 wards. The jurisdiction of the Agra Urban Area is under the Agra Development Authority (ADA). The Map of Agra is depicted in Figure 4.1.

4.1 Sources of Air Pollution

The sources of pollutants in the city are domestic, industrial, vehicular, DG Sets and natural sources.

(a) Industrial Air Pollution

The air pollution from the industries is mainly due to fuel used by them. The majority of industries in Agra comprise of foundries. Besides a number of petha industries are operating in the city, which mainly use coal as fuel. In foundries, the principal source of emission is cupola. The volume of gas exhausted and its concentration depends on the cupola, operations, melting rates, characteristic of charging material and the coke. Gases escape while drawing the hot metal and during casting. In the pit type of cupola, emissions are fugitive type. The main pollutants are SPM, sulphur dioxide and carbon monoxide.

Agra is famous for 'petha' (a type of sweet). There are large number of petha manufacturing units. Besides these, there are halwais, kumhars and bharbhujas who use coal, cow dung and wood. Kumhars have to use cow dung because of the type of firing adopted by them.

(b) Vehicular Air Pollution

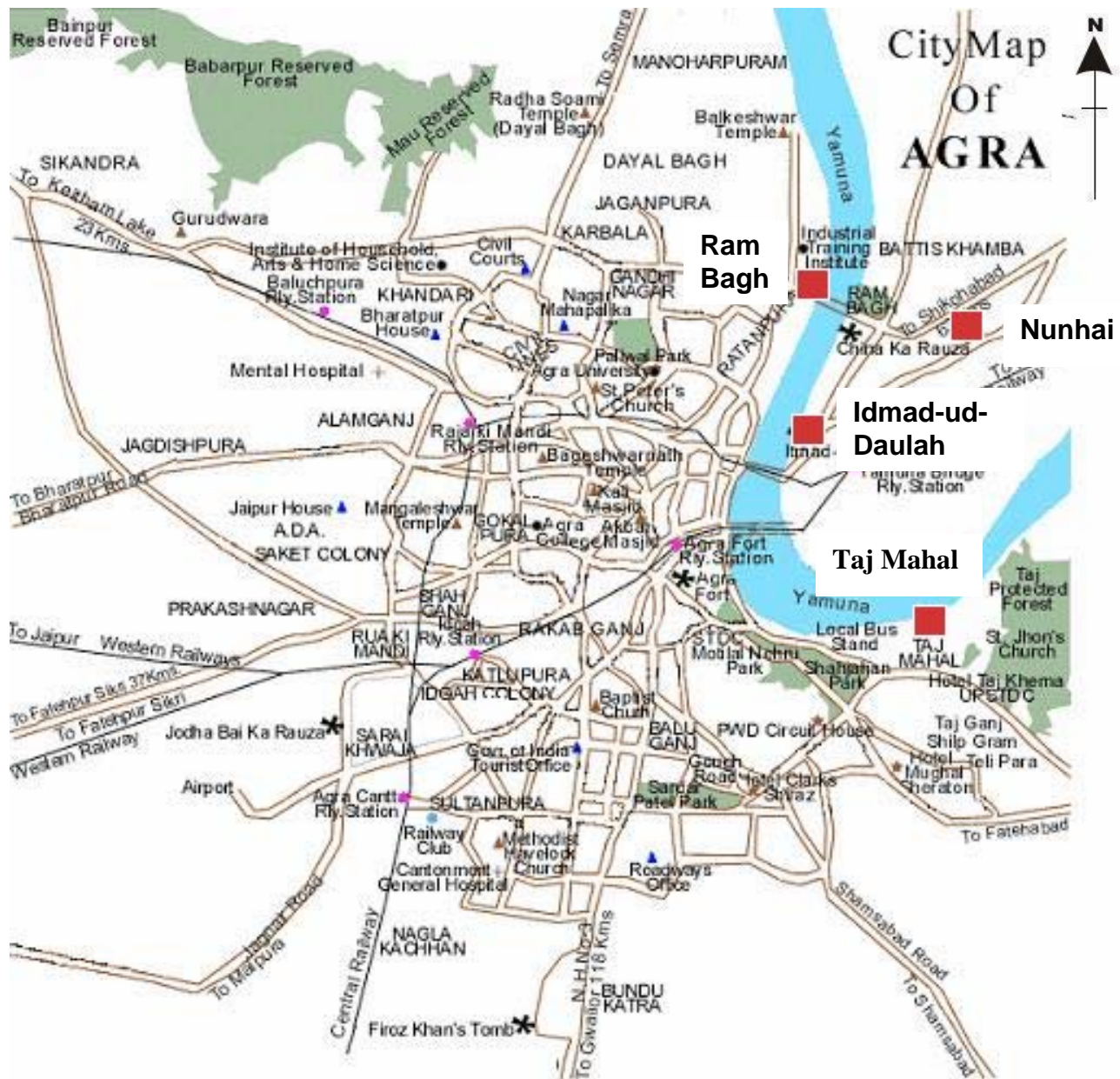
The vehicular emissions are one of the major sources of air pollution affecting the urban population in Agra. Unlike industrial emissions, vehicular pollutants are released at ground level and hence the impact on recipient population will be more. The vehicular growth in the city is high and with high growth, the impact of the air pollution from vehicular growth would be tremendous.

(c) DG Sets

Due to power breaks daily, a number of DG sets are used in the city. The fuel consumed by the DG Sets by different sectors and the average consumption of diesel varies as per the capacity of the generators.

4.2 Ambient Air Quality

Central Pollution Control Board is monitoring ambient air quality at four monitoring stations in Agra. These monitoring stations are located at Taj Mahal, Nunhai, Itmad-ud-daulah and Rambagh. Entire Taj Trapezium is considered as a sensitive area. The status and trends of ambient air quality is described in this chapter.



■ Location of Ambient Air Quality Monitoring Station

Figure 4.1: Map of Agra

4.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ are not violated. NAAQS (24 hourly average) of NO₂ and RSPM are violated. NAAQS (24 hourly average) of SPM are also violated.

4.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

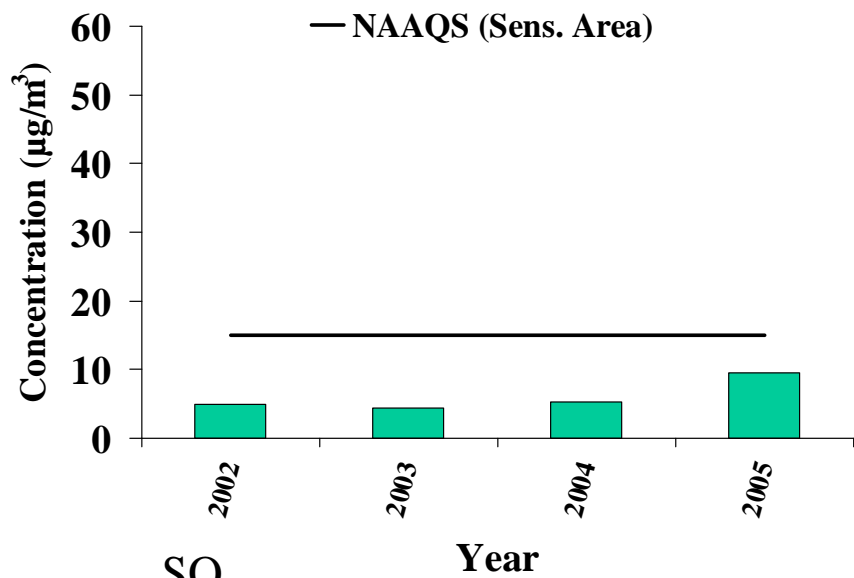
Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in Agra. High and critical levels of NO₂ were observed in Agra. Critical levels of RSPM and SPM are observed in Agra.

4.2.3 Air Quality Trends in Agra

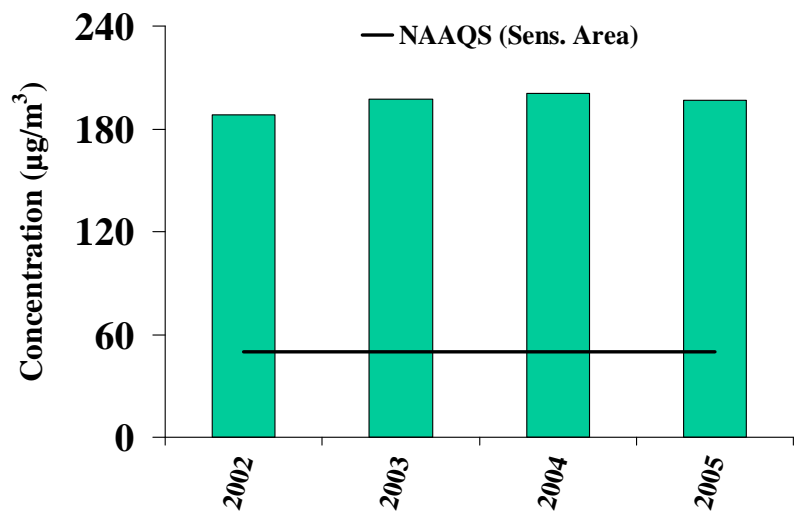
Trend in annual average concentration of SO₂, NO₂, RSPM and SPM is depicted in Fig. 4.2. SO₂ levels were lower than the NAAQS (annual average) during all the monitored years. NO₂ levels exceeded the NAAQS (annual average). RSPM levels exceeded the National Ambient Air Quality Standard (Annual Average). SPM levels exceeded the National Ambient Air Quality Standard (Annual Average).

4.2.4 Meteorological Issues

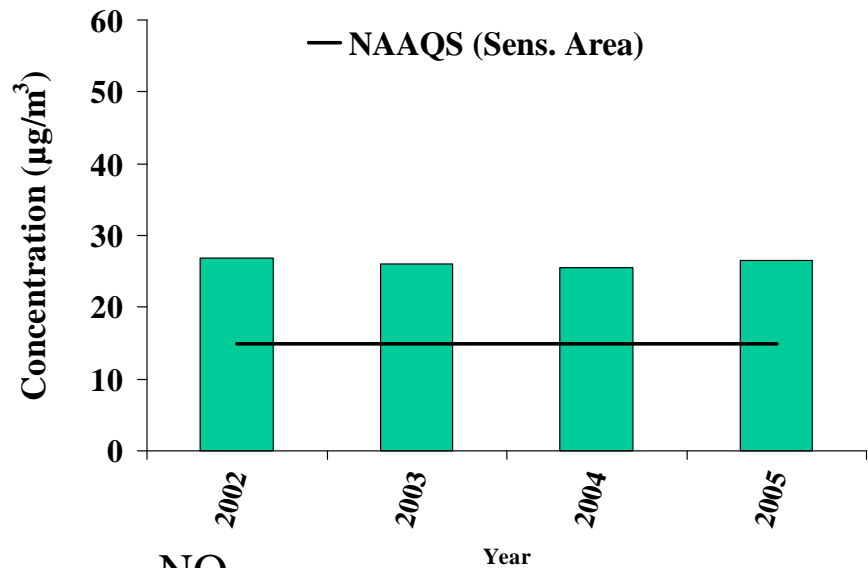
Meteorological factors play an important role in air pollution studies particularly in pollutant transport irrespective of their entry into the environment. Seasonal variation in RSPM levels is depicted in Figure 4.3. The concentrations are maximum in winter months and are lower during summer and monsoon months. The monsoons result in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources and increase mixing processes. During winter, there is increased atmospheric stability, which in turn allows for less general circulation and thus more stagnant air masses. Stagnant air masses allow more accumulation of pollutants in any given area. During the winter, atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. The winter months are relatively much calmer than other months. The prevailing calm conditions facilitate more stability to the atmosphere and consequently slow dispersion of pollutants generated and help in build up of pollutants in vicinity of the pollutant sources.



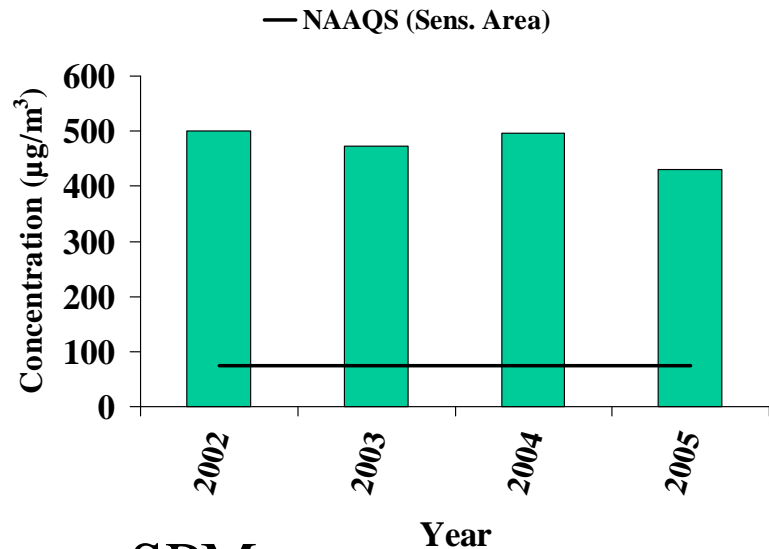
SO₂



RSPM



NO₂



SPM

Figure 4.2: Trends in Annual Average Concentration of SO₂, NO₂, RSPM and SPM in Agra.

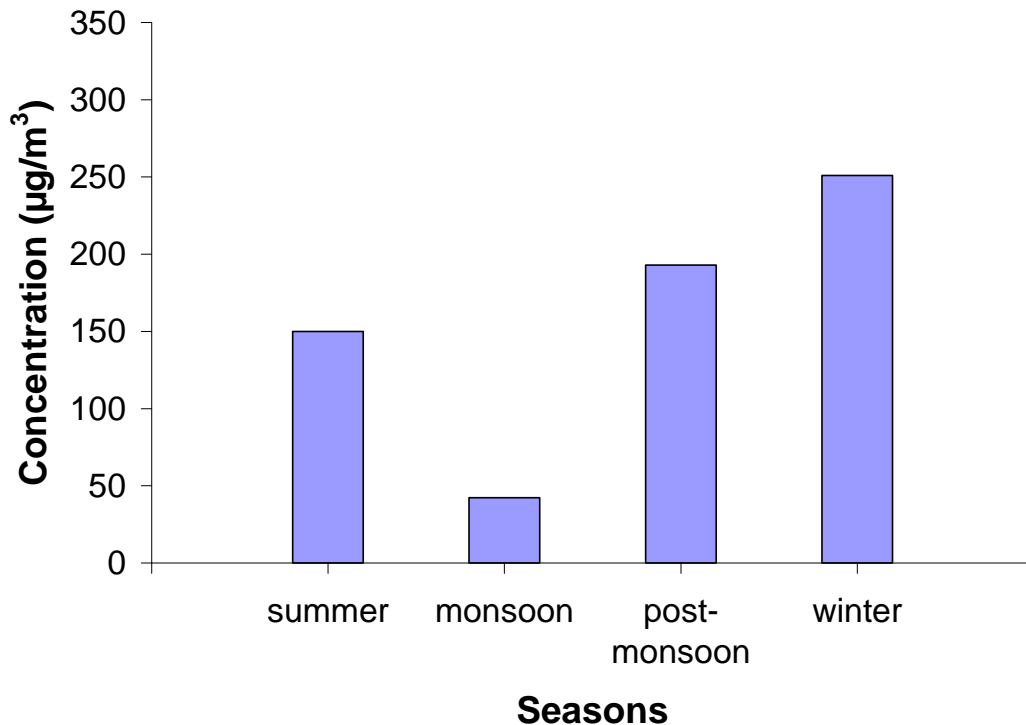


Figure 4.3:- Seasonal variation in RSPM levels at Taj Mahal Agra during 2005-06.

4.3 Action Plan for the Control of Air Pollution for the city of Agra (As on October 2003)

4.3.1 Action taken so far

(a) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- In zone I,II & III 114 industries are drawing natural gas for use in production processes.
- Strict vigil on compliance of 292 industries that were directed by the Supreme Court not to use coal or coke. Out of 292 industries 87 has been connection for CNG by GAIL.
- All the brick kilns within the radius of 20 kms of significant monuments of Agra city have been closed.
- New Industries using coal and coke are not being allowed to set up in Agra Trapezium zone in Uttar Pradesh.

- Regular monitoring of ambient air quality in the Agra city. Currently four monitoring stations are there in the Agra city.

(b) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Phasing out of grossly polluting vehicles plying within the city area. Age limits for different categories of vehicles has already been fixed by RTA.
- Diesel driven 7 seater tempos fitted with scrubber only are being issued registration . Till now 205 such vehicles have been fitted with the scrubbers.
- Restriction on plying diesel driven tempo-taxi and auto rickshaws on MG road and prohibition of all type of commercial vehicles within the radius of 500 meters of Taj Mahal.
- Supply of diesel having sulphur content 0.05% since April 2003.
- Strict checking of vehicular emissions for in-use vehicles

4.3.2 Proposed Action Plan

The city of Agra has been divided into five different zones & action plan has been proposed in a zone wise manner

(a) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- It is proposed to supply CNG as fuel for processing /production & it is also proposed to replace DG sets with Gas generators. It is proposed to implement the same in different zone in the following manner:
 Zone-I : Already started.
 Zone-II & III : By Sept'02 laying of pipe lines expected & by supply expected by Oct 2002.
 Zone-IV: If gas is available then one year from the date of approval
 Zone-V: As per GAIL it is a no gas zone due to safety reasons.
- Restriction on supply and usage of coal. Coke, wood, rice husk, baggase to the industries situated in the city limit of Agra.
- D.G sets installed by Industries/ commercial establishments in no gas zones shall be fitted with wet scrubber 7 acoustic enclosures.
- Only small scale Service & Business related Enterprises (SSSBE) that are essentially required within the city, should be allowed in the designated commercial areas/ authorized markets/ authorized shopping plaza.

- Strict vigil on compliance of 292 industries that were directed by the Supreme Court not to use coal or coke.
- Petha Industries operating in the city shall be shifted to Kalindi Vihar site identified for this industry and shall operate by CNG/LPG only

(b) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:

- Setting up of CNG/LPG retail outlets within Agra City for supplying CNG/LPG to the vehicles in a phased manner. For the establishment of CNG station for vehicles and piped natural gas at Agra the total project cost will be around Rs. 102 crores The detailed engineering work are in progress for project implementation. One Auto LPG dispensing station is already stationed and is expected to be operational by October 2003.
- Phasing out grossly polluting vehicles plying within the city in a phased manner.
- Commercial vehicles including 3 wheelers, Tempo, Auto Rickshaws, Taxis, Buses etc being used for public transport are proposed to be converted to clean fuel like CNG/ LPG etc in a phased manner. Till; such time these vehicles shall be fitted with wet scrubber /filter and a notification for compulsory wet scrubber / dry filter shall be made.
- Stop plying diesel driven tempo-taxis and auto rickshaws on MG road and prohibition of all type of commercial vehicles within the radius of 500 mts of Taj Mahal.
- Notification and compliance for fitting of filter/wet scrubber in tempo, Taxi, 3 wheeler, city buses diesel ambassador taxi, commercial jeeps, light / medium goods vehicles heavy goods vehicles registered in Agra.
- Supply of ultra low sulphur diesel (0.05%) and premixed petrol in Agra.
- Ban on supply of loose 2T oil at petrol pumps and supply of only premixed 2T oil gasoline in all petrol pumps
- Checking for adulteration.
- Strict checking of vehicular emissions &PUC.
- Better traffic management.
- Introduction of clean fuels like CNG/LPG

(c) Other Measures

- Construction of footpaths / widening of roads up to the boundary limit along the major roads to minimize natural dust & congestion.
- Declaration of land for up o appropriate distance behind Taj as green corridor.
- Providing LPG for domestic and commercial use.
- Notification for declaring Agra/TTZ as sensitive are thereby restricting further sitting of red category industries in Agra with suitable modification for CNG based industries.

(d) Scheme for switching over to LPG/CNG

- For CNG two online stations and 5 daughter stations are proposed to be commissioned by GAIL within 15 months after approval .In zone –I CNG is already being supplied, Zone-II & III it is proposed to supply CNG by Oct'02 while in Zone-IV supply will be ensured within one year after approval. While zone-V is no gas zone.
- For LPG work has been initiated for establishment of one Auto LPG stations by IOC. One workstation has been established by IOC and supply is expected within one month.

4.4 Findings

SO₂ levels are with the prescribed National Ambient Air Quality Standards for sensitive areas. The reason for low levels of SO₂ may be various measures taken such as reduction of sulphur in diesel, implementation of stricter emission norms and commensurate fuel quality. NO₂, RSPM and SPM levels exceed the prescribed National Ambient Air Quality Standards for sensitive areas. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers, resuspension of traffic dust, commercial and domestic use of fuels, etc.

5.0 Ahmedabad

Ahmedabad is one of the major industrial cities in India. It has been called the 'Manchester of the East' due to its many textile industries. The city lies on both sides of the Sabarmati River. Ahmedabad, one of the major industrial centers in India, has often been called the 'Manchester of the East'. The city is the major entry point to the west coast state of Gujarat famous for its Asiatic lions in the Gir Forest, temple of Somnath, Lothal; the site of a Harappan or Indus Valley civilisation; Jain temples at Palitana and a distinct regional cuisine. The state offers many fairs and festivals in its numerous temple towns and is a major centre for hand-crafted textiles in the country. Sabarmati Ashram, about 6 km. from the city, was Mahatma Gandhi's headquarters during the long struggle of Indian independence. In the urban areas, the air quality is affected mainly by vehicular emissions in addition to industrial emissions. It is reported that 85% of the urban CO emissions are due to petrol-driven vehicles, 35-65% of unburnt hydrocarbons are due to two-and three-wheelers, and 90% of NOx emissions are due to diesel-driven vehicles.

5.1 Sources of Air Pollution

The city of Ahmedabad became aware to the problem of air pollution in a big way after a Suo-Moto writ SCA 9989/95 taken by the Hon'ble High Court of Gujarat. Various measures have been taken by the Gujarat Pollution Control Board and the State Government to reduce the air pollution in the city.

There are various sources of pollution in city of Ahmedabad which can be categorised under the broad basis as under:

1. Industrial sources
2. Vehicular sources
3. Air pollution arising out of coal fired hearths in slum units; small bakeries and roasting centres and small refineries of precious metal and burning of dry leaves and other refuse.

(a) Vehicular Sources

In vehicular pollution, it was found out that the major source of pollution is from the three wheeler scooter rickshaws running on petrol mixed with kerosene. Ahmedabad has approx. 45000 nos. of three wheelers, out of which ,90% of vehicles are on road. Transport and the police departments have taken number of actions for deterring the free mixing of kerosene with petrol and going to the extent of confiscating the scooter rickshaws found to be using adulterated fuel. It will be pertinent to note that so far the police/transport department has confiscated 1500 number of rickshaws.

(b) Industrial Sources

As far as industrial pollution is concerned, it may be attributed to air polluting industrial units, which are about 490 in number within the Municipal Limits on periphery of the city.. Most of these units have provided the air pollution control measures. Electricity Company runs a power plant in the heart of the city.

(c) Other Sources

In the smaller industrial units, bakeries, units of roasting seeds etc. the Municipal Corporation takes various actions to reduce the air pollution at their level under the Bombay Panchayat and Municipal Corporation Act.

5.2 Ambient Air Quality

Ambient air quality is carried out at eight monitoring stations by Gujarat Pollution Control Board. The monitoring is carried out under National Air Quality Monitoring Programme (NAMP). Five of these stations have been recently started. Status and Trends of air pollutants are described in this section.

5.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ are not violated. NAAQS (24 hourly average) of NO₂ are also not violated at most of the monitoring stations. NAAQS (24 hourly average) of RSPM and SPM are violated at most of the monitoring stations.

5.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in residential areas and industrial areas of Ahmedabad. Low and moderate levels of NO₂ were observed in Ahmedabad. Critical level of RSPM were observed in residential areas and industrial areas of Ahmedabad. Critical levels of SPM are also observed in residential areas of Ahmedabad.

5.2.3 Air Quality Trends in Ahmedabad

Trend in annual average concentration of SO₂ in residential areas and industrial areas is depicted in Fig. 5.1. SO₂ levels are well below the NAAQS (Annual average) in residential areas and industrial areas. Trend in annual average concentration of NO₂ in residential areas and industrial areas is depicted in Fig. 5.2. NO₂ levels in residential areas and industrial areas were within the NAAQS (annual average) during all the monitored years. A decreasing trend has been observed in ambient NO₂ levels which may be due to various measures taken for vehicular pollution control such as introduction of Euro-II norms etc. Trend in annual average concentration of RSPM in residential areas and industrial areas in Ahmedabad is depicted in Fig. 5.3. Decreasing trend has been observed in ambient RSPM levels in residential areas and industrial areas which may be due to various measures taken. Trend in annual average concentration of SPM in residential areas and industrial areas in Ahmedabad is depicted in Fig. 5.4.

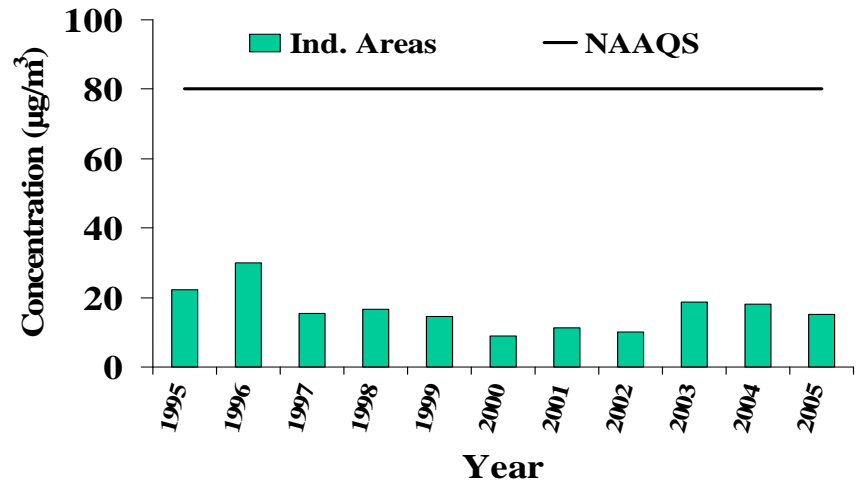
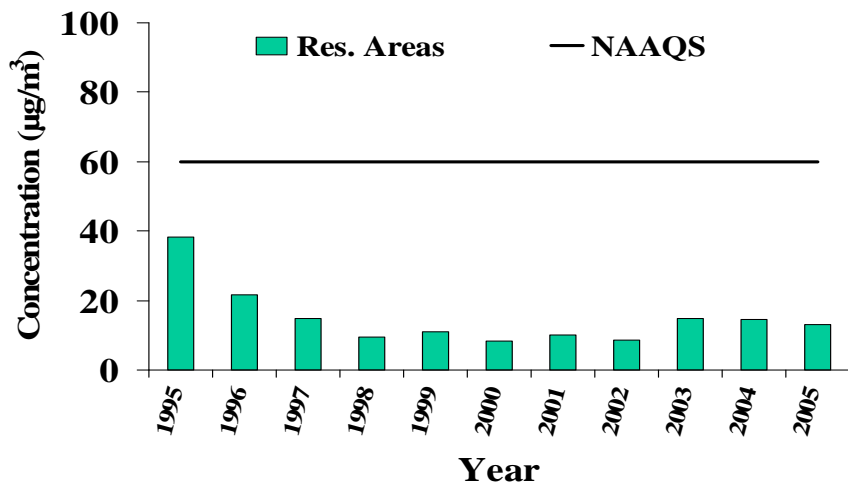


Figure 5.1: Trends in Annual Average Concentration of SO₂ in Ahmedabad.

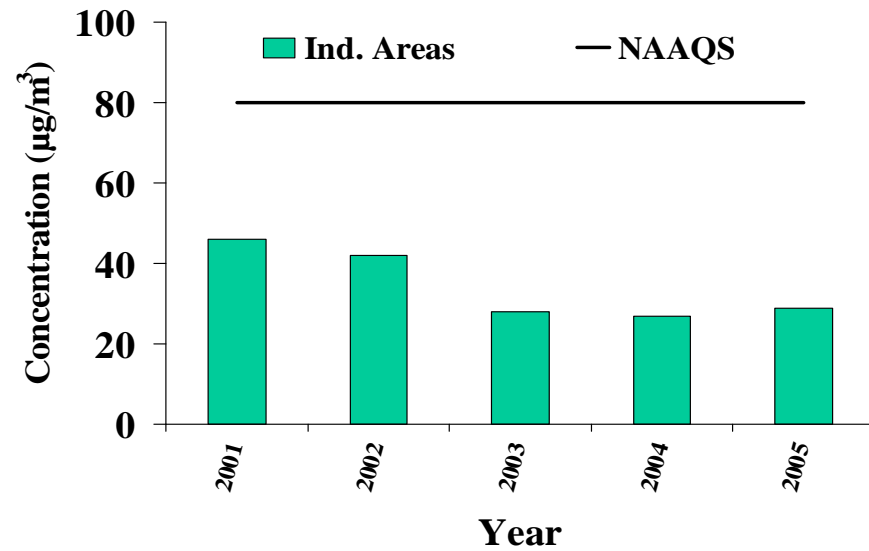
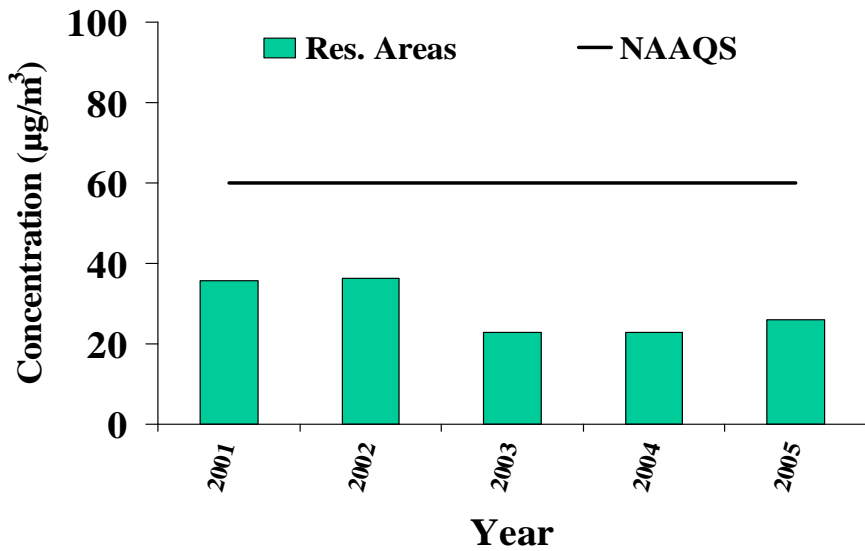


Figure 5.2: Trends in Annual Average Concentration of NO₂ in Ahmedabad.

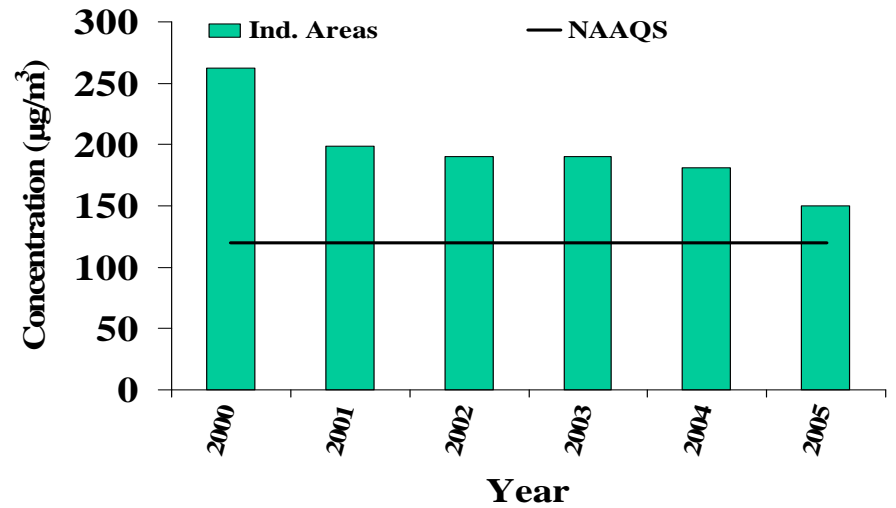
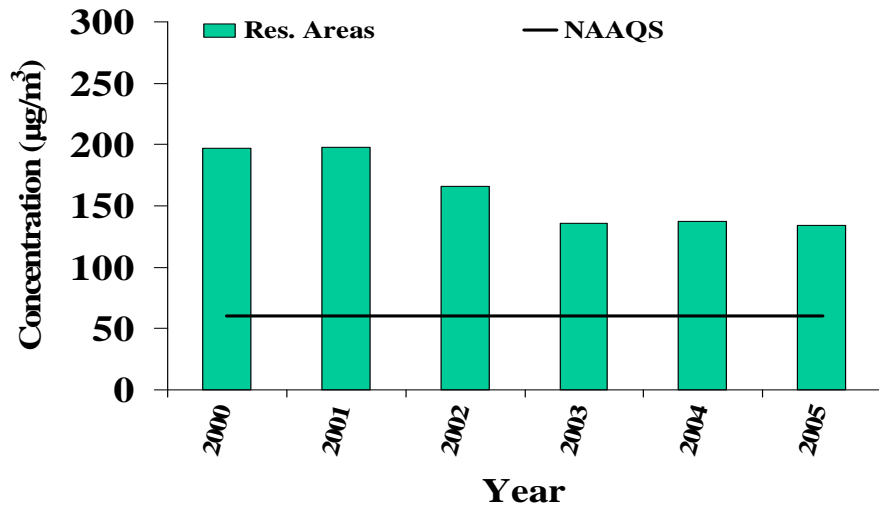


Figure 5.3: Trends in Annual Average Concentration of RSPM in Ahmedabad.

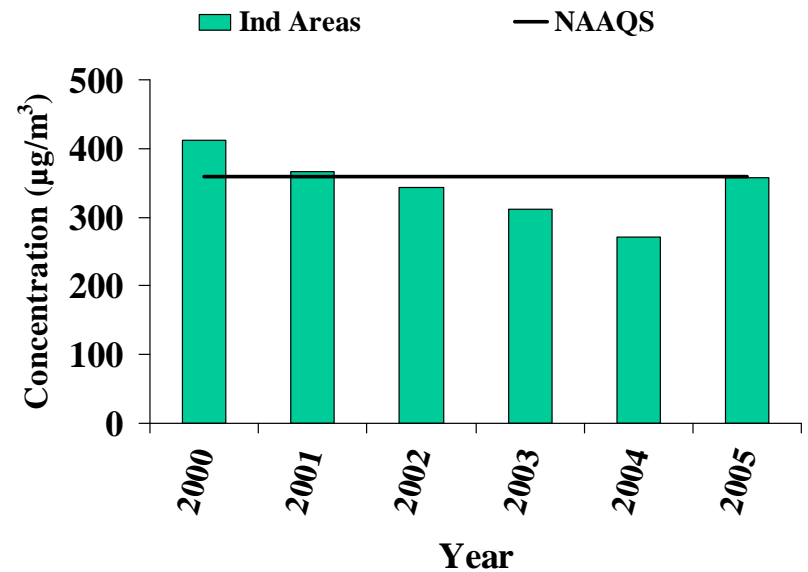
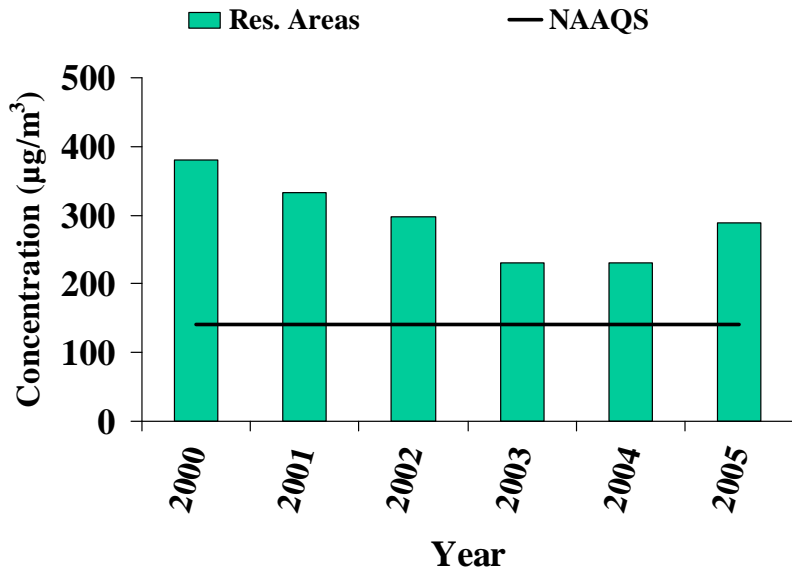


Figure 5.4: Trends in Annual Average Concentration of SPM in Ahmedabad.

5.2.4 Meteorological issues

Meteorological factors play an important role in determining ambient concentrations and it is important to analyse ambient air quality with respect to meteorological factors such as wind speed etc. Seasonal variations in SPM and RSPM levels at monitoring station located at Shardaben Hospital, Ahmedabad during 2002-03 is depicted in Fig. 5.5 and 5.6 respectively.

High levels are observed during winter months and lower levels are observed during monsoon months. The winter months are relatively much calm than other months. The prevailing calm conditions facilitate more stability to atmosphere and consequently slow dispersion of pollutants generated and help in build up of pollutants in vicinity of the pollutant sources. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher SPM concentrations.

5.3 Action Plan for the Control of Air Pollution for the city of Ahmedabad (As on March 2006)

5.3.1 Action taken so far

(a) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- Air polluting industries are monitored for compliance as per CPCB guidelines/norms. Monitoring by special vigilance squad is carried out. Consent under the Air Act 81 is granted if industries have provided adequate APC measures and the quality of emission is as per the specified norms. In 2004, 1595 industrial units monitored under the Air Act 1981. GPCB has also intensified ambient air quality monitoring at critically polluted industrial areas to pin point the sources of pollution and to take punitive action thereof.
- A plan for highly polluting industries to switch over to natural gas has been formulated wherein two critical groups were identified i.e. as many as 146 industries having major boilers and about 500 foundries.
- Regarding upgrading of Air Pollution Control (APC) technology: about 150 wet scrubbers have been installed. 2 units have started installing ESP's. For verification of performance of modified APC by units, the Board has carried out 4 rounds of monitoring of the identified units. Actions taken under Air Act. has caused total closure issued to 27units and total notices issued to 501units.
- Foundry association has come forward for switching over to Natural Gas (NG). Series of meetings were held to work out program and review. More than 400 units have submitted forms and load assessment survey carried out by Adanis. One foundry converted to NG for pilot scale studies. Certain technical and operational issues are being addressed. About 110 foundries have been identified where gas supply can be made available and these units are being directed accordingly.

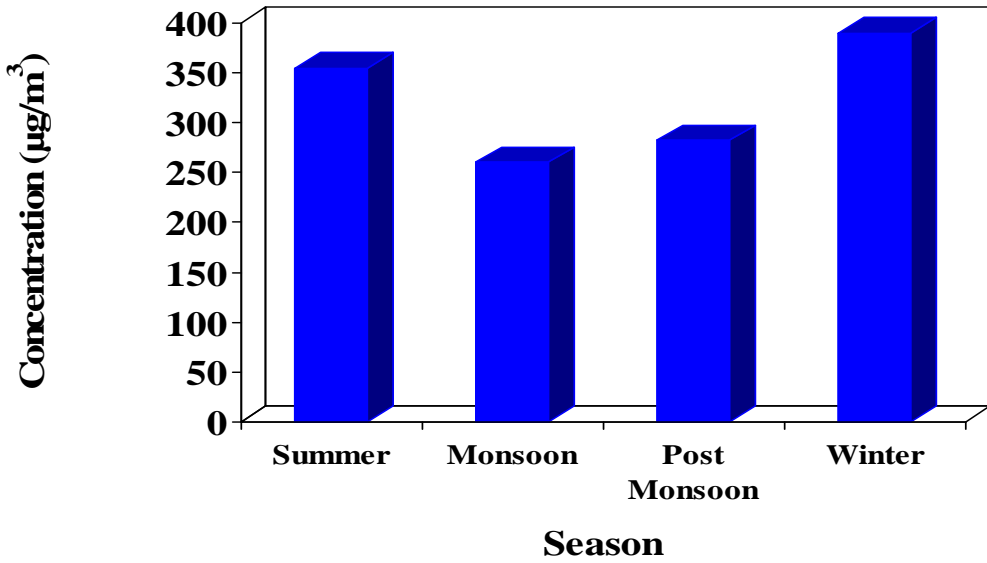


Figure 5.5: Seasonal variation in Ambient SPM levels at Shardaben Hospital, Ahmedabad.

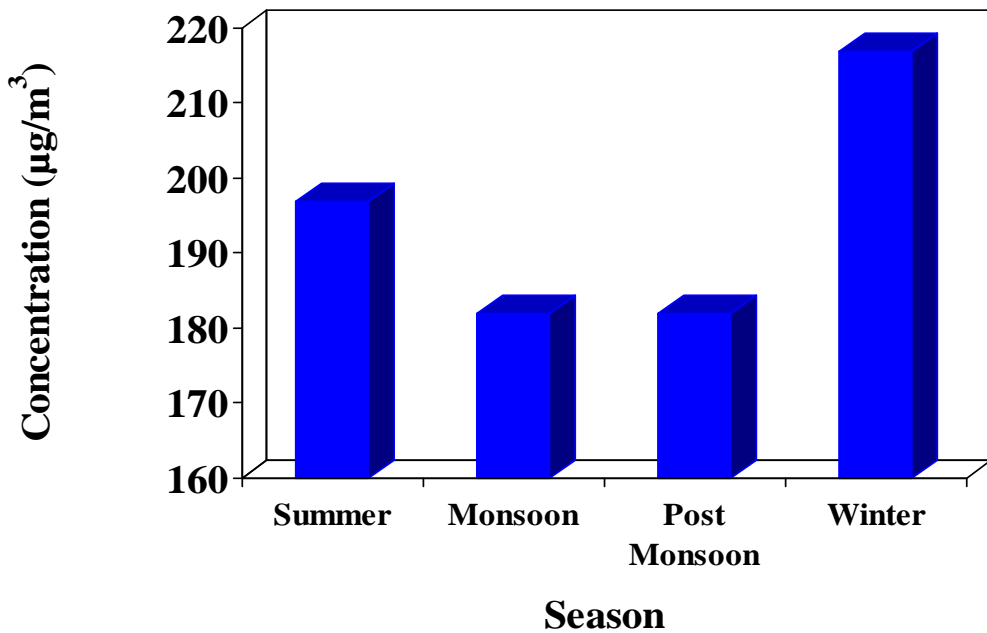


Figure 5.6: Seasonal variation in Ambient RSPM levels at Shardaben Hospital, Ahmedabad.

- Adanis have signed contracts with 190 industrial units in Vatva, Naroda, Rakhial and Narol areas. With total contracted quantity of 2.27 lakh scmd. Gas is supplied to approx. 110 units at present and total quantity supplied – 90,000 scmd. As many as 19 units from identified highly polluting units have signed contracts for NG supply and supply is commissioned to 3 such units. There are two power plants in the city. One is gas based & the other is coal based. Washing & beneficiation of coal is not carried out because imported and Indian coal is used Imported coal and Indian coal(<25% ash) is used by having adequate mixture of two . ESP's are installed in Power plants. 70% Fly Ash generated in power plants is utilized by cement mfg. Companies and also for mfg. bricks, hollow/ solid blocks, paving slabs, cable tiles etc. and remaining 30% goes to ash pond.
- In context with D.G sets, supply of electricity is regular and so DG sets are not in use except for the emergency and power failure. Emission standards are observed through monitoring as per CPCB notifications.
- The GPCB has already initiated various actions for the implementation of the “ Charter on Corporate Responsibility” in Gujarat for the industries covered under the 17 categories.
- Revamping of AAQ monitoring stations has already been completed by GPCB
- GPCB has given necessary instructions to all the industrial estates in the city for the development of green belt all along the periphery.

(b) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Government has constituted a Task Force in June 2002, under the Chairmanship of the Chief Secretary to implement the recommendations made during a seminar organized by GPCB to discuss the problems of the Air Pollution in Major urban areas in Gujarat.
- For Ahmedabad no new four wheelers are registered without Bharat Stage–II compliant.
- Bharat Stage (B.S.) – III norms implemented for new vehicles in Ahmedabad City.
- Supply of fuel (Petrol and Diesel) conforms to B.S.–III specifications in Ahmedabad w.e.f 1-4-2005.
- Ethanol blend petrol was launched in Gujarat in year 2003 and premium grade MS(Petrol)/HSD (low sulfur) introduced in the city by the Oil Companies.
- Diesel run rickshaws within the city limits and AUDA areas have been banned.
- Actions being taken by AMC and AUDA regarding regular cleaning of roads, widening and carpeting of roads, removal of debris and proper cleaning after digging of roads
- Construction of flyover ,under bridges: traffic & transportation management has been undertaken by AMC and AUDA so far Shreyas Flyover – 85% completed, Vasna-Pirana River bridge- 50% completed. Daxini Soc. Flyover – started in Jan'06, Dudheshwar-Vadaj River bridge-To be started in March'06. AUDA has completed Ring Road project and has decided to take-up 7 projects for Road and Bridges for AUDA area under URBAN 2005 Programs (3 Railway over bridge, 3 Fly over bridge and 1 Elevated Road).
- All petrol pumps have provided 2T oil dispensers.

- Actions have been taken up for regular inspections of petrol pumps, vehicle checking and vigil over unauthorized sale of Naphtha, Solvent, Kerosene 293 petrol pumps were inspected during Year 2005. Civil Supply Dept. detained 689 vehicles for using kerosene; solvent etc. 5 units inspected in Ahmedabad and seized inferior lubricant oil worth Rs. 2,13,920.
- Special drive for checking grossly polluting vehicles as well as adulterated fuel in vehicles has been carried out by a joint teams of Traffic Police, RTO, Civil supply, FSL. Rickshaws running on adulterated fuel detained during Year 2005 were 857; Year 2006 (upto 13-3-06) were 244. Total 8007 rickshaws detained for other offences in 2005. For not obtaining PUC, 710 cases filed in year 2005.
- Up gradation of the PUC system has been carried out by Transport Department, 112 new PUC centers have been registered in Ahmedabad; Petrol (Four gas analyzer) – 62; Petrol (Two gas analyzer) – 37; Diesel – 13. Only Computerized photo PUC certificates are being issued. RTO has checked working of 23 PUC centers and 16 Centers were found working properly. ARAI has been requested to educate about proper working of PUC equipments also.
- Ahmedabad Municipal Corporation (AMC) has submitted first report regarding action plan to augment public transportation from the current 10 per cent of commuter needs to 40 per cent: Centre for Environmental Planning and Technology (CEPT) has prepared Bus Rapid Transit System (BRTS) scheme for AMC. As per AMTS sources, Commuters using public transport has now increased to 14% from earlier 7%.
- AMTS phased out 342 old buses in the last 4 years. In the year 2003- 04, 226 old buses have been phased out. While 140 buses phased out in last year. AMC has phased out 108 old vehicles in first phase. 72 more old vehicles will be phased out in the second phase
- Intensified drive to check vehicular emissions & implementation of the ban on supply of loose 2-T oil.
- Diversions of heavy vehicles such as trucks/luxury Buses/etc away from the city has been taken by the office of police commissioner.
- For checking fuel adulteration in the city a team consisting of Forensic Science Lab (FSL), RTO; Civil Supplies and Traffic police has been formulated. The task force has inspected 47 outlets from 1st June –04 to 13th August-04. RTO and civil supplies dept with the help of FSL team has been continuously looking after implementation of the Naptha, kerosene and solvents control order.
- AMTS has already started scraping the old buses generating high pollution. AMTS has scraped 114 buses in last 6 months.
- 11 Solar Traffic Signals are approved out of which 9 have been installed. Total Penalty was Rs. 3.04 crores in 2003 for traffic rules violation and in 2004, it was Rs. 4.60 crore

(c) Scheme for switching over to LPG/CNG

- In accordance with orders of Hon'ble Supreme court a time bound scheme for switching over to LPG/CNG mode has been proposed.
- State Government has formed Task Force to work out conversion of buses and autorickshaws to CNG mode .So far 13 kit manufacturers have been registered
- GSPC has already initiated various actions for the implementation of CNG project and establishment of CNG network in the state with the total investment of Rs. 650 crores (250 crores for Ahmedabad). Various studies have been conducted

and the work is under progress in this regard. The GSPC has also proposed conversion of different type of vehicles to CNG as fuel, in a phased manner.

- Government of Gujarat has constituted a committee for the identification of plots for CNG/LPG fuelling stations in AMC and AUDA limits. AMS and AUDA have agreed to reserve such plots.
- Status of CNG infrastructure for auto gas supply in the city is as follows
 - Steel ring pipeline – 55 kms. completed except one railway crossing (Akhbar nagar)
 - Total Compression Capacity : About 2,00,000 kgs / day
 - CNG dispensed at present : 95,000 kgs /day. (AEGL-80,000, HPCL-15,000)
 - Only six stations are made on-line. More on-line stations are required,
 - Only one dedicated station for AMTS buses is operational. Few more dedicated stations required for AMTS and GSRTC buses.
 - Adanis have planned to put up total 45 stations by March, 2007
 - Prof. Shivananda Swamy has submitted a paper indicating that at an optimum level about 60 dispensing stations appear reasonable service level both from consumer and vendor perspective.
- Total 199 CNG buses put on road and 90 CNG buses are plying on Ahmedabad-Gandhinagar route.
- 16206 registered CNG rickshaws on road (as on 10-3-2006). About 1000 more cases are in process for registration. RTA has introduced ban on movement of old rickshaws (pre 1991) w.e.f. 31- 12-05 in AMC, AUDA area. Transport Dept. and Civil Supply dept. have held meetings with kit suppliers and bankers to ensure reasonable price for kits and easy finance.

(d) Domestic Waste

- AMC is collecting garbage by door to door collection. AMC has setup 15 compost pits at Muni Gardens. Public Notices were issued by AMC repeatedly in news paper banning burning of bio mass, wastes in open. AUDA has given instruction to Grampanchayats and Nagarpalicas to ban burning of bio mass. AUDA is developing land fill site for solid waste.

5.4 Findings

The levels of SO₂ are well within the NAAQS in both the residential as well industrial areas in the city of Ahmedabad. The interventions behind reduction in SO₂ levels are many such as implementation of the road map proposed by Auto Fuel Policy etc. Only Bharat Stage-III new vehicles have been registered in Ahmedabad. Other measures include introduction of alternate fuel like CNG, reduction in percentage of sulphur in coal used in thermal power plants. Many industrial units have switched over to Natural Gas,

The ambient air quality levels of NO₂ are also within the prescribed standard and a decreasing trend has been observed in the levels of NO₂ in both the residential as well as industrial area during past few years. The reasons behind reduction in NO₂ may be introduction of improved vehicular technology in the form of Bharat Stage –III vehicles, improvement in traffic management has also caused smooth traffic flow

thereby reduction in idling emissions. Banning of diesel driven auto rickshaws in the city and diversion of heavy diesel driven vehicles out of the city can also cause considerable reduction in NO₂ levels in the ambient air.

The levels of RSPM in are although exceeding the NAAQS, but decreasing trend has been observed during past few years. Reduced RSPM levels may be because of introduction of improved vehicular technology as well as better fuel quality, Further alternate fuel like natural gas in both vehicles as well industrial units also causes reduction in particulate emissions. Implementation of pollution control devices like wet scrubbers and ESP's in industrial units and thermal power plants, implementation of CREP in highly polluting industrial units, improvement in traffic management has caused smooth traffic flow thereby reduction in idling emissions. Banning of diesel driven auto rickshaws in the city and diversion of heavy diesel driven vehicles out of the city etc. Utilisation of approx 70% of the fly ash generated in the thermal power plants may also cause reduction in RSPM levels.

6.0 Bangalore

Bangalore the capital city of Karnataka occupies an important position not only in the state but also in the country. It is considered as one of the major Industrial, commercial and educational center in southern India and also as Information Technology and Bio Technology center. Urbanisation in India is more rapid around national capital and state head quarters. The city of Bangalore with is no exception. The city has taken dubious distinction of being the fastest growing metropolis in the country. The polarized development has significant impact on culture, economy and growth of not only surrounding areas but also on the city itself.

The Bangalore City Corporation (Bangalore Mahanagara Palike-BMP) limits are enclosed within $12^{\circ} 50'$ to $13^{\circ} 10'$ N lat. and $77^{\circ} 45'$ E long at an average elevation of about 900 meters. Guided by its topographical features and the fact that this region did not have any perennial rivers to cater its water resources, a large number of tanks were constructed from time to time in the past to augment its water resources for various uses. About 262 tanks (lakes) dotted the region's landscape. For this reason the city is also known as a 'City of Tanks'. These water bodies also maintained the ground water and open wells in the regions. Bangalore is also famous as the 'Garden City of India'; As the capital of Karnataka this city is the sixth largest metropolis in the country and has been a nerve centre for the various cultural, social and religious activities. It has also developed as a centre for science and learning, all of which have contributed to its growth. Due to its climatic conditions and strategic locations the city has drawn in a large number of both private and public sectors industries, many of which are prominent,

Bangalore is endowed with a very salubrious and equable climate and hence classified as seasonally dry tropical savanna climate with four seasons. The dry season with clear bright weather from December to February. The summer season is from March to May which is followed by south-west monsoon season from June to September. October and November constitute the post monsoon season or retreating monsoon season. The main feature of the climate are the appreciable temperature ranging from an average high of 33° C in April to 20.4° C in January (Bangalore district Gazetteer). In recent times the mercury has gradually risen to much higher temperatures during summer (April) about the order of 36° C to 37° C. In late April 2000 temperature of Bangalore crossed 38° C – supposed to be an all time high over the last 56 years. The mean annual rainfall of about 900 mm in Jun-Sept (accounting for 54% of the annual rainfall) and Oct-Nov, with opposite wind regimes corresponding to SW and NE monsoons respectively. The average monthly relative humidity ranges from 85% between Jan-Oct to 44 % in dries March. The high wind speed averages 17 kmph during the westerly winds in the month of July and a minimum of 8-9 kmph during th4e months of April and October.

6.1 Sources of Air Pollution

In Bangalore the sources of air pollution are vehicular, industrial, commercial and domestic activities. The point sources of pollution are mainly large and medium scale industries involving processes and large number of D.G. sets causing large scale air emissions, while automobiles constitute the most non-point polluting source. Small-scale industries burning up fuel for processing, hotels and households using cooking fuels are some other sources.

(a) Vehicular Sources

The problems associated with air pollution in Bangalore are mostly due to the large number of privately owned motor vehicles, adulterated fuel supply, vehicles of obsolete two stroke technologies, road congestion, poor public transit system, bad maintenance etc. Over the years there has been a dramatic increase in the number of vehicles particularly the two wheelers that are added to the already burgeoning vehicular population. The absence of an efficient local transit system provided by the Bangalore Metropolitan Transport Corporation (BMTC) has led to this addition in the number of vehicles. The problem has manifested in congestion and parking besides the problems of pollution and energy waste.

(b) Industrial Sources

Bangalore has a long history of industrialization and even before 1926, the District gazetteer has recorded 46 industries which have grown to 426 large and medium scale industries in 1998-99. The concentration of the industries in and around Bangalore City has also considerably increased in recent times.

Also the increase in the number of industrial layouts have risen from year to year with major additions from the electronic and manufacturing units at the industrial areas at White Field, Jigani Industrial Estate, Electronic City near Anekal, Bommasandra Industrial area, Bidadi Industrial area and Peenya Industrial Estate. The industrial growth in and around Bangalore has naturally catalyzed more commercial activity and there by increased pollution. There are about 4,399 registered factories located in Bangalore urban district, out of which about 4,015 factories are located in and around Bangalore city alone. Out of these about 215 are coming under the category of industries involving hazardous processes.

(c) Other Sources

Apart from vehicular and industrial sources, there are other sources which contribute to ambient air pollution. One of these sources is Diesel Generating Sets. Due to discontinuous power supply, there are large number of DG sets in commercial establishments and industries. These DG sets are a significant contributor of air pollutants.

6.2 Ambient Air Quality

Ambient air quality is carried out at present at six monitoring stations in Bangalore. Three of these monitoring stations have recently been started. Status and Trends of air pollutants in Bangalore are described in this section.

6.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated at almost all the monitoring stations. NAAQS (24 hourly average) of RSPM are violated at many monitoring stations especially in residential areas. NAAQS (24 hourly average) of SPM are violated in residential areas.

6.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in residential areas and industrial areas of Bangalore during many years. Low and moderate levels of NO₂ were observed in Bangalore during many years. High levels of RSPM and SPM were observed in residential areas of Bangalore.

6.2.3 Air Quality Trends in Bangalore

Trend in annual average concentration of SO₂ is depicted in Fig. 6.1. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels which may be due to various measures taken such as reduction of sulphur in diesel. Trend in annual average concentration of NO₂ is depicted in Fig. 6.2. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during many years.

Trend in annual average concentration of RSPM in residential areas and industrial areas is depicted in Fig. 6.3. RSPM levels exceed the NAAQS (Annual Average) in residential areas whereas RSPM levels in industrial areas are within the prescribed NAAQS (Annual Average). Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 6.4. SPM levels exceed the NAAQS (Annual Average) in residential areas during many years whereas SPM levels in industrial areas are within the prescribed NAAQS (Annual Average).

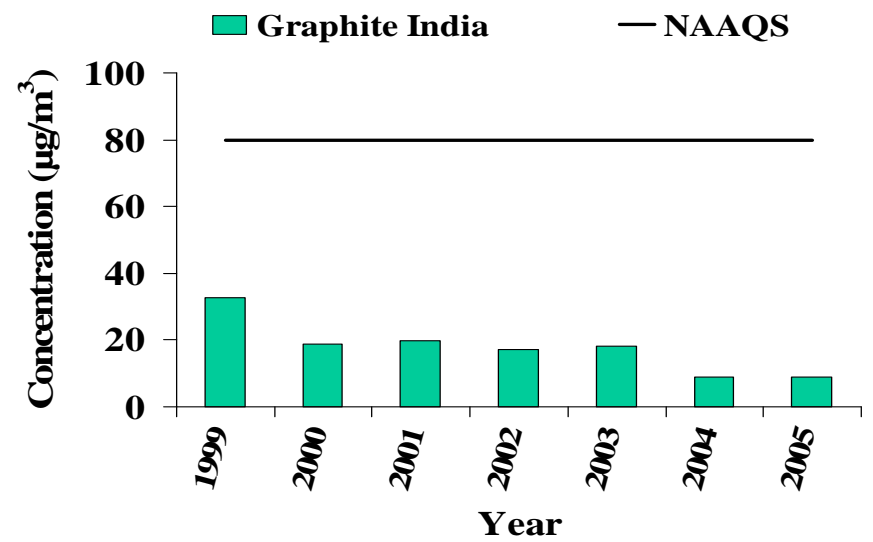
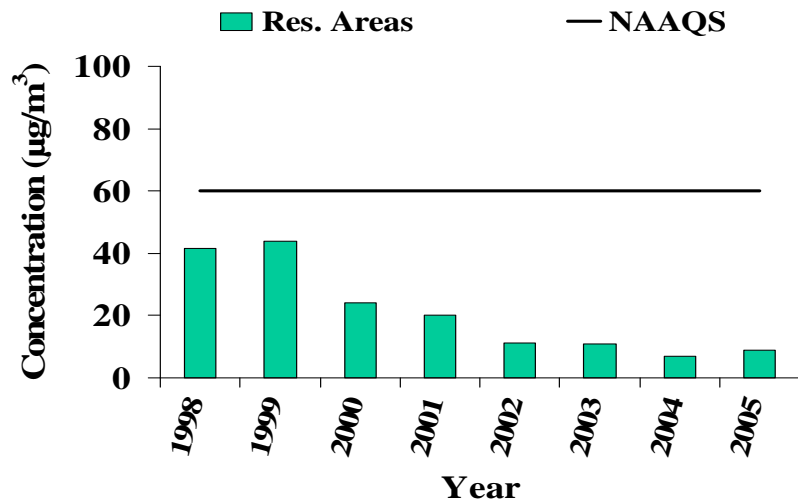


Figure 6.1: Trends in Annual Average Concentration of SO₂ in Bangalore.

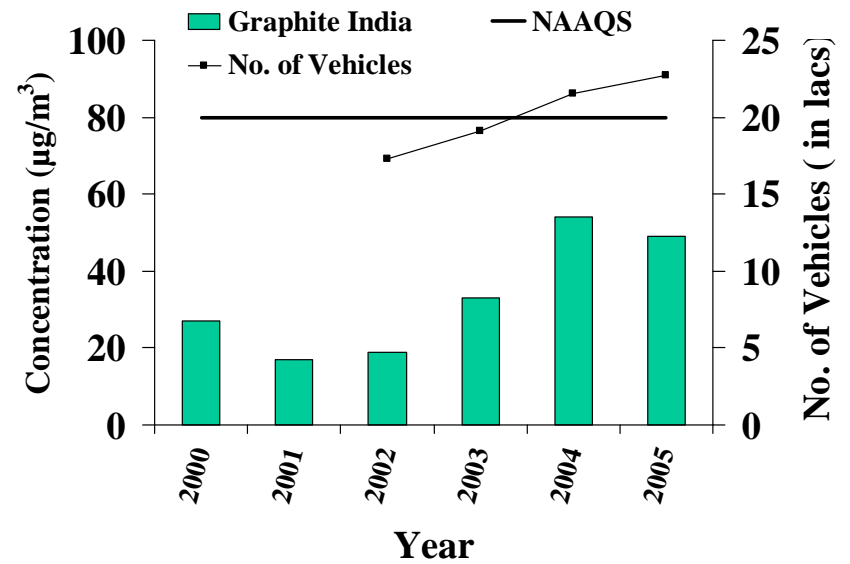
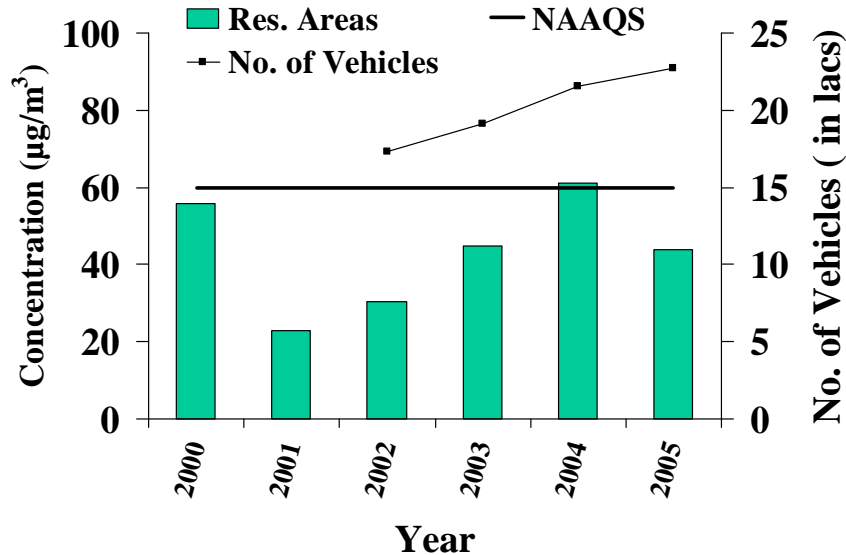


Figure 6.2: Trends in Annual Average Concentration of NO₂ in Bangalore.

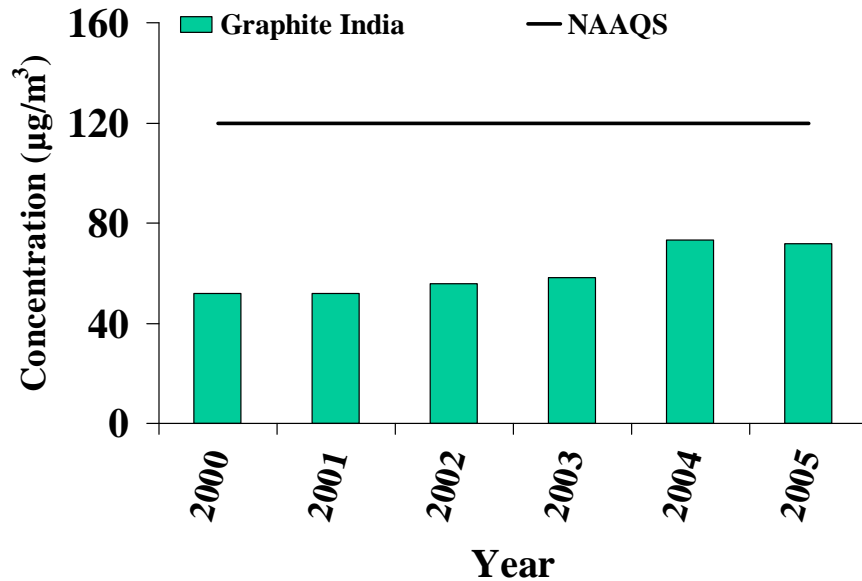
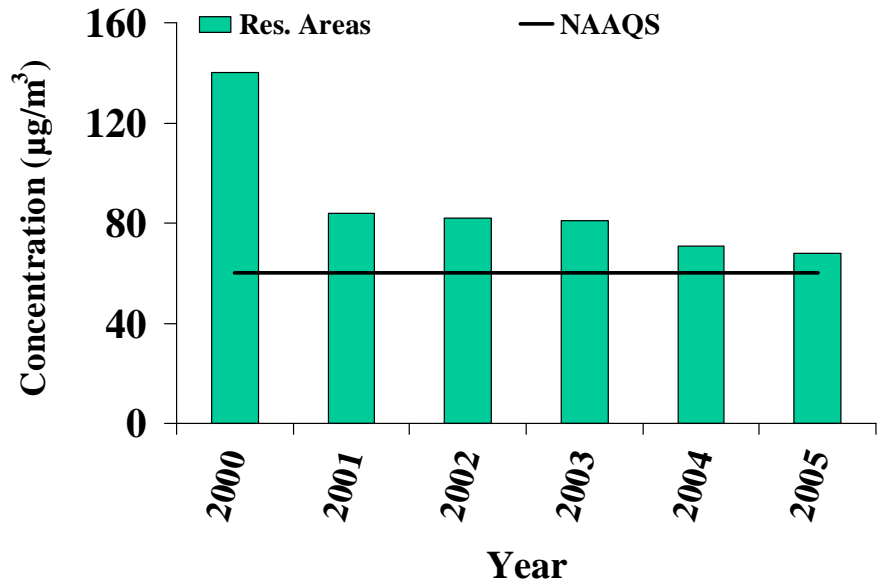


Figure 6.3: Trends in Annual Average Concentration of RSPM in Bangalore

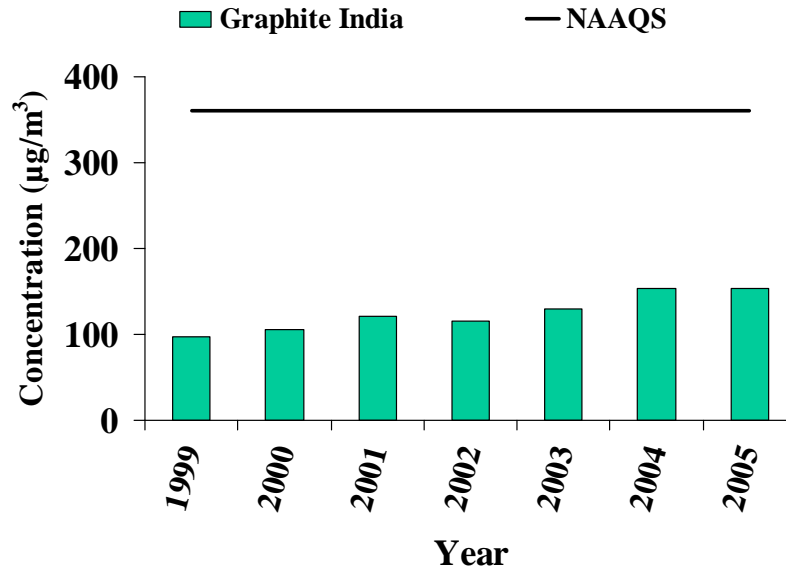
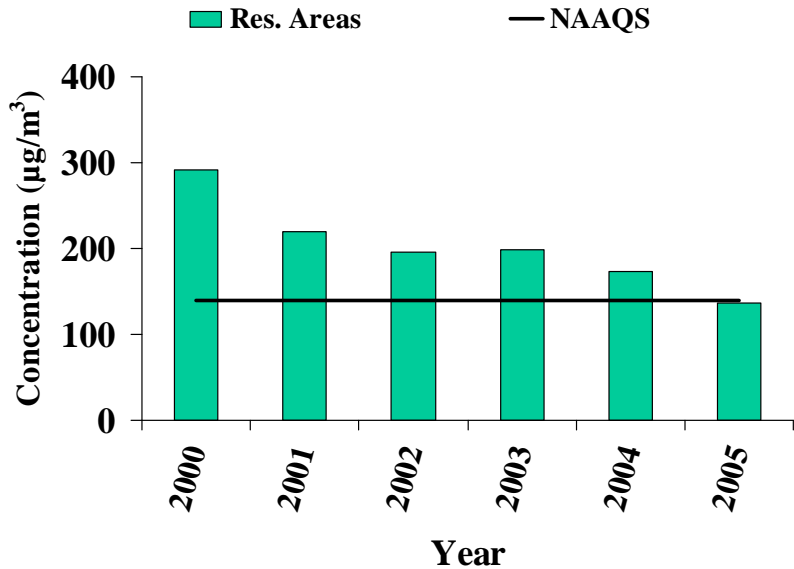


Figure 6.4: Trends in Annual Average Concentration of SPM in Bangalore.

6.2.4 Meteorological Issues

Meteorological factors play an important role in determining ambient concentrations of air pollutants. It is essential to understand the correlation between meteorological factors and ambient air quality to correctly interpret the data and also to assess the effect of various pollution control measures on ambient air quality. More are the calm conditions allow for less dispersion of pollutants results in their build up in ambient atmosphere and hence higher levels. Seasonal variation in RSPM levels at monitoring station located at Amco Batteries, Bangalore during 2005-06 is shown in Fig. 6.5.

RSPM Levels are generally higher during winter months and lower during monsoon months. During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources.

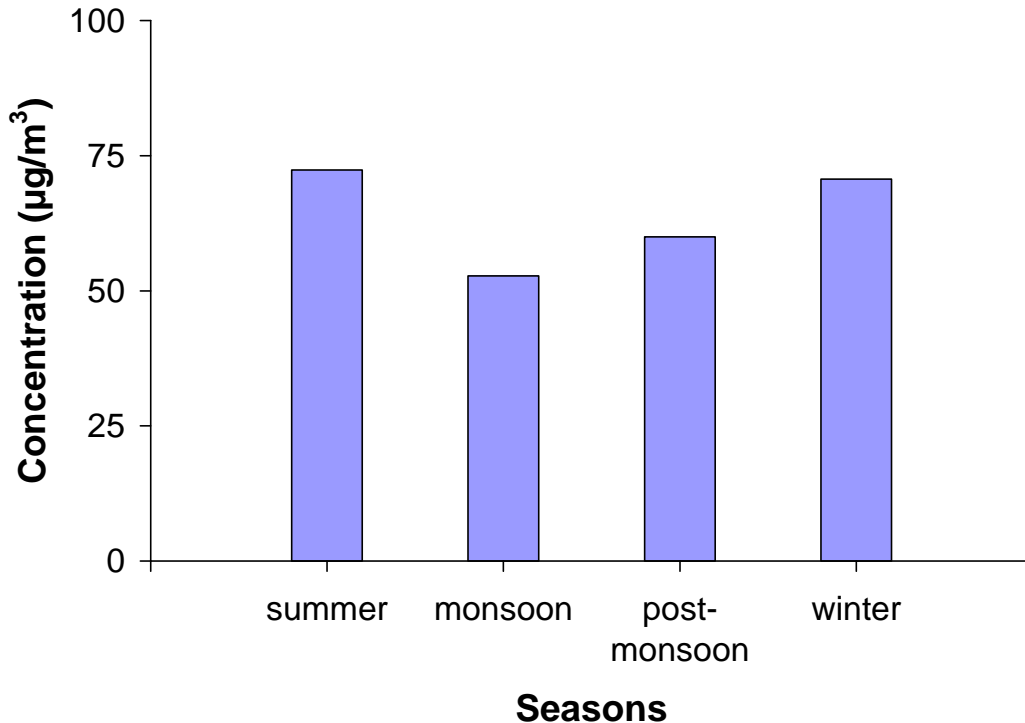


Figure 6.5: Seasonal variation in RSPM levels at Amco Batteries, Bangalore during 2005-06.

6.3 Action Plan for the Control of Air Pollution for the city of Bangalore (As on February 2005)

6.3.1 Action taken so far

(a) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- In exercise of powers under Sec 19 of the Air (Prevention and Control of Pollution) Act 1981 the entire state was declared as air pollution control area by the department of Forest, Ecology & Environment on 30.05.88
- Task Force for control of Air Pollution in Bangalore city set up on 10.09.2001 under the chairmanship Additional Chief Secretary to Government of Karnataka.
- To reduce traffic congestion, 108 roads converted to one-way, 5 flyovers, 3 railway under pass on outer ring road and 2 railway over bridges completed. 206 km of road asphalted.
- Green Diesel and Green petrol (Sulphur 0. 05%) is supplied in Bangalore ORR area from 1.4.2003.
- The state government of Karnataka has issued an notification in December 2004 wherein all the auto are required to convert to Bi-fuel mode. By June 2006 all the auto will be converted to Bi-fuel mode.
- By the December 2004, a total of 12,878 autos were plying on a bi fuel (LPG and petrol) mode By July 18, 2006, 51937 autos are required to be retrofitted to LPG mode.
- State Level Steering Committee on development of bio-fuels constituted on 16.07.2003 under the chairmanship of Additional Secretary and Development Commissioner.
- As on December 2004 a total 13 Auto LPG Dispensing Stations were operating in the city, It was further agreed that by March 31, 2005 another 4 stations would be built taking total to 17.
- The state level coordinator has also estimated that based on the current consumption of 80 kl/day of LPG, the requirement of auto LPG by the end of July 2006 (when all autos are converted) will be 430kl/day for autos only.
- Transport Department has approved Bajaj 4 stroke (rear engine) LPG auto rickshaws in Bi-fuel mode on 25.01 2003.
- Department of Forest, Ecology and Environment has issued notification dated 20.11.2004 for installation of pre-mix oil dispensers for 2 stroke 2 & 3 wheelers and to ban sale of loose 2T oil.
- Supply of 5 % ethanol blended petrol in 20 districts from 9.5.2003 and in the remaining 7 districts from the month of September.
- 219 Emission testing Centers were provided with web cameras for issue of PUC certificate.

- BMTC has increased their fleet size from 2491 to 3108 buses during the period from 31.3.2001 to 1.10.2003.
- DFEE has issued G.O.No.FEE 69 ENV 2003 dated 23.1.2003. In this regard the Transport Department has taken the following measures:
 - Strict inspection for renewal of fitness certificate under the supervision of senior officers
 - Painting red strip around the body of more than 15 years old transport vehicles for easy identification.
 - Vehicles not loading and unloading in the city are made to move on outer ring road only.
 - Movement of goods vehicles inside the outer ring road is restricted during day time.
 - Green tax is introduced with effect from 1.4.2002 for the transport vehicles aged more than 7 years at the rate of Rs.200/- at the time of renewal Green tax is also being levied on all 15 year old two wheelers and also on other than two wheeler non-transport vehicles at the rate of Rs.250/- and Rs.500/- respectively at the time of renewal registration.

In view of the above total number of vehicles above 15 years age has drastically come down from 48.659 to 22.925 during the last 2 years.

- The movement of inter-state and inter-city buses has been prohibited on 8 roads in Bangalore city. Bus terminal is being developed on Mysore road and is intended to operate number of schedules going towards Mysore directly from that terminal to decongest the city centre.
- Stricter drives to check adulteration of the fuel Food and Civil Supplies Department. The department has reported that 309 fuel stations have been checked during April to July 2003.
- Measures are enforced by Food and Civil Supplies Department to prohibit the misuse of PDS kerosene in adulteration of petrol.
- Supply of PDS kerosene denied to the cardholders with LPG connection.
- Introduction of coupon system to ensure supply of PDS kerosene to genuine cardholder etc.

(b) Industrial Pollution

Department of Ecology and Environment has issued Notification No.FEE 120 ECO 2002. Dt. 16.03.04 for mandatory use of 0.05% Sulphur containing HSD by industries located within ORR limits in DG sets and liquid fuelled boilers. This has been stipulated as a condition in consent order issued by KSPCB. The industries are also required to furnish an affidavit that they are using HSD containing 0.05% sulphur only in DG Sets, boilers etc.

6.3.2 Proposed Action Plan within the outer ring road limits of Bangalore:

- Implementation of the B.S-III norms from April 1, 2005. and supply of commensurate fuel.
- The state government of Karnataka has issued an notification in December 2004 wherein all the auto are required to convert to Bi-fuel mode. By June 2006 all the auto will be converted to Bi-fuel mode.
- As on December 2004 a total 13 Auto LPG Dispensing Stations were operating in the city, It was further agreed that by March 31, 2005 another 4 stations would be built taking total to 17.
- Introduction of “No PUC Certificate –No fuel” scheme in petrol/diesel bunks by October 2004.
- Augmentation of the services by BMTC by 17 % by increasing fleet size from 3106 buses at present to around 4330 by end of October 2005.
- The Bangalore Metro Rail Project-Phase I envisages 2 Corridors namely East West (18.1 kms.) and North South (14.9 kms. Out of length of 33 kms.6 kms. Shall be underground and the remaining 26.3 kms. Elevated at ground surface. It is proposed to start construction of the project in April 2005. The project is expected to carry 8.2 lakhs passengers daily in the year 2009. 10.2 lakhs in 2011 and 16.1 lakhs in 2021.
- Upgrading the PUC centers to meet new norms of government of India by March 31, 2005.
- Karnataka State Pollution Control Board to install one online ambient air quality monitoring station by June5, 2004.
- Increase sales tax and to impose entry tax on white kerosene (Superior Kerosene Oil) to curb adulteration with petrol.
- Strengthen vigilance and surveillance to check adulteration of fuels.
- Mandatory self registration of kerosene wholesalers and production of end use certificates before Civil Supplies Department.

6.4 Findings

The levels of SO₂ in the ambient air are very well within the prescribed NAAQS A decreasing trend has been observed in ambient levels of SO₂. The reasons for decreasing trend may be implementation of Bharat Stage-III norms for all the new vehicles in the city and use of commensurate fuel (Diesel with 0.035% S and petrol with 0.015% S). The Department of Ecology and Environment has notified for mandatory use of 0.05% Sulphur containing HSD by industries located within ORR limits in DG sets and liquid fuelled boilers.

RSPM levels in residential areas are exceeding the prescribed NAAQS but have shown a decreasing trend in residential areas. SPM levels in residential areas are also exceeding the prescribed NAAQS but have shown a decreasing trend.

Reduction in RSPM and SPM levels in residential areas may have been caused by combination of many interventions such as implementation of stringent emission norms for both new as well as in-use vehicles, improvement in the fuel quality, switching over to LPG as automotive fuel, better traffic management through by-passing of heavy vehicles and development of better traffic infrastructure, stricter drive for checking adulteration, augmentation in public transport system, imposing green tax on old vehicles etc. The RSPM and SPM levels in industrial areas are within the prescribed NAAQS.

7.0 Chennai

Chennai, the fourth largest city in India, is the capital of the state of Tamil Nadu and is located on the eastern sea-coast of the sub-continent at an Latitude of 13'04" North and a longitude of 80'15" East. It is located at the center of an extensive network of surface, sea and air transportation facilities serving South India and is well connected to the rest of India. The Chennai Metropolitan Area (CMA) comprises of the city of Chennai and its outlying urban and rural areas. The outlying area consist of 5 townships, 4 municipalities, 23 town panchayat and village panchayats. The extent of the CMA is 1179 sq. km.

Chennai has a tropical climate with a mean annual temperature of over 30 ° C and it varies from 20 ° C to 45 ° C. Humidity ranges from 50% to 90%, with the highest prevailing during monsoon. Cool sea breezes blows almost throughout the year providing relief from the normally high temperature. The city experiences an average rainfall of about 110 cm, mostly during the North East Monsoon period between October and December. The south West monsoon occurs between June and September, during which period also the city gets some rainfall. Rise in population and growth in economic activity have led to increase in pollution in Chennai. With good infrastructure facilities, the city has become a major center for commerce, industry and education. At the same time, the civic amenities have not kept pace and the unabated migration of floating population has compounded the problem. The land use regulations are not strictly followed as the awareness among the public is lacking. The city map is depicted in Figure 7.1.

7.1. Sources of Air Pollution

Air pollution is identified as a matter of environmental concern in all metropolitan cities. With the increasing commercial and industrial activities, the transport system is also increasing day by day in Chennai City. As a result, traffic congestion has steadily increased causing acute shortage of parking space and deterioration in quality of air. In Chennai city air pollution is contributed by the following sectors

1. Vehicular Sources
2. Industrial Sources
3. Domestic Sources
4. Other Sources

(a) Vehicular Sources

M.T.C. is operating 2773 vehicles with a schedule of 2554 vehicles catering to the needs of traveling public in Chennai Metropolitan area and adjoining areas. Only during peak hours, demand is not able to be met by M.T.C. and during non peak hours the occupancy in the buses is less than 50% . M.T.C. is carrying 35 lakhs of passengers per day. In addition to this, Mass Rapid Transit System (MRTS) and electric trains are operated by Southern Railways.

(b) Industrial Sources

There is no major air polluting industries within Chennai city other than the power plants. As far as the industrial sector is concerned the major source of pollution is from the utilities like Boilers and Generator sets.

➤ Process Emission Sources and Boilers

For all the process emission sources and boiler of higher capacity air pollution control measures such as dust collectors and wet scrubbers are insisted by Tamil Nadu Pollution Control (TNPC) Board. The industrial units are also insisted to switch over to cleaner fuels such as LSHS, LDO etc., to control the SO₂ emission.

➤ Power Plants

There are two power plants located within the city limit. Though these power plants are using only LSHS, Naphtha as fuel, they have also been insisted to provide scrubber for the control of emissions.

(c) Domestic Sources

Most of the house hold within the city use only LPG as fuel and the emission inventory for the domestic emission has not been carried out so far.

(d) Other Sources:

Apart from this, the major source of air pollution in Chennai city is from the coal and iron ore handling units located within the Chennai Port Trust area.

(i) Incinerators

There were more than 60 individual incinerators that were operated by the hospitals for the disposal of Bio Medical Wastes. However, based on the policy decision taken by the Board, all these hospitals were instructed to stop the independent operation of the incinerator and to become a member of the common Bio-medical waste treatment and disposal facility which is operational at Thenmelpakkam village situated 50 kms away from Chennai city. As such, no individual incinerator is allowed to operate within Chennai city.

(ii) Burning of garbage / Bio mass

Indiscriminate burning of garbage/biomass is taking place within Chennai city particularly in the garbage dump yard and transfer point maintained by Chennai Corporation. Recently, CMDA has commenced works on the installation of power plant using biomass from the Koyambedu Vegetable Market. The Board has issued several notices and direction to the Chennai Corporation for the proper management of municipal solid wastes and in particular to avoid indiscriminate burning of municipal wastes.

(iii) Generators:

There are about 928 Generators have been installed within the Chennai City. Almost all the generators use only diesel as fuel and operated only during power failure which is a rare occurrence within Chennai City.

(e) Climate and Natural Sources

Climate and natural sources play an important role in contributing to the pollution levels of Chennai in addition to man made sources. Pre-monsoon calms contribute to increased pollution levels due to lack of mixing between different atmospheric levels. In winter, ground based temperature inversions constraint dispersion of pollutants. As the city of Chennai is located adjacent to the coast of sea, the strong wind conditions prevailing almost through out the year contribute to the dispersability of air and its concentration.

7.2. Ambient Air Quality

Ambient air quality is carried out in Chennai by Tamil Nadu State Pollution Control Board and National Environmental Engineering Research Institute (NEERI). The monitoring is carried out under National Air Quality Monitoring Programme (NAMP). Tamil Nadu State Pollution Control Board and NEERI are operating three ambient air quality monitoring stations each. Status and Trends of air pollutants are described in this section.

7.2.1 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. In general low levels of SO₂ and NO₂ were observed in residential areas and industrial areas of Chennai. High levels of RSPM and SPM were observed in residential areas of Chennai during some years.

7.2.2 Air Quality Trends in Chennai

Trend in annual average concentration of SO₂ in residential areas and industrial areas is depicted in Fig. 7.1. The SO₂ levels were lower than the NAAQS (annual average) during all the monitored years in residential areas and industrial areas. Trend in annual average concentration of NO₂ in residential areas and industrial areas is depicted in Fig. 7.2. NO₂ levels were lower than the NAAQS (Annual average) in residential areas and industrial areas during all the monitored years.

Trend in annual average concentration of RSPM in residential areas and industrial areas is depicted in Fig. 7.3. RSPM levels were lower than the NAAQS (annual average) during many years in residential areas and industrial areas. Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 7.4. RSPM levels were lower than the NAAQS (annual average) during many years in residential areas and industrial areas.

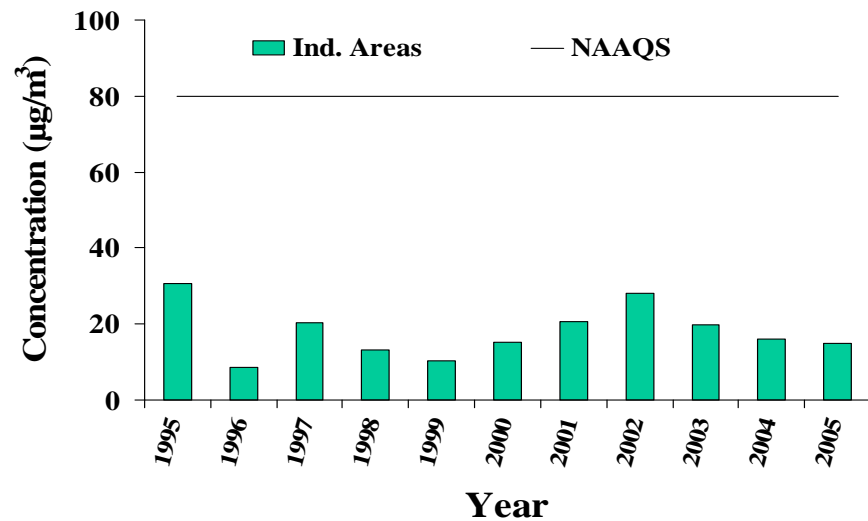
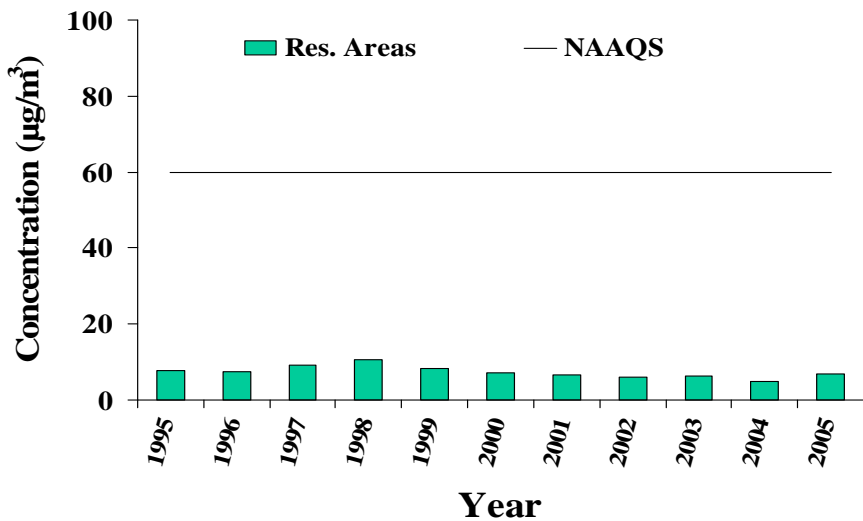


Figure 7.1: Trends in Annual Average Concentration of SO₂ in Chennai.

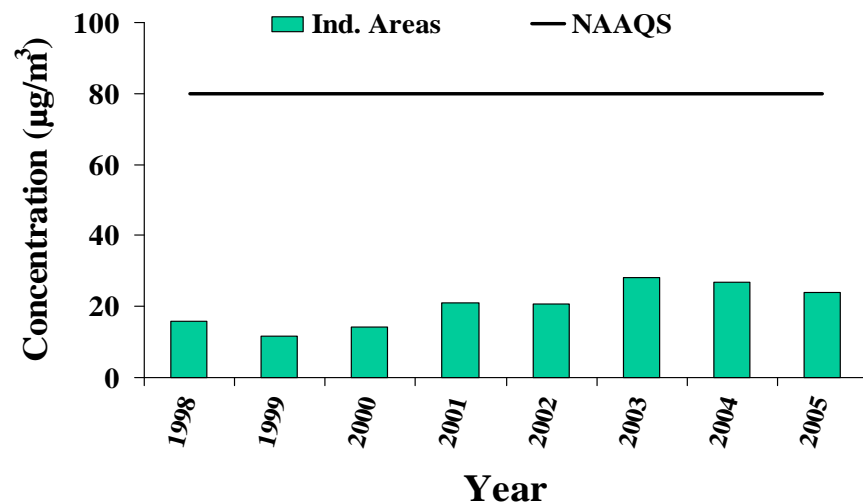
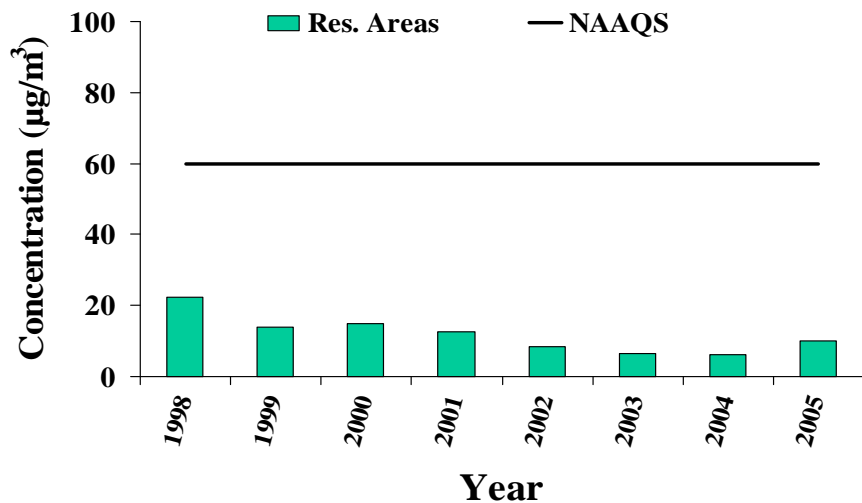


Figure 7.2: Trends in Annual Average Concentration of NO₂ in Chennai.

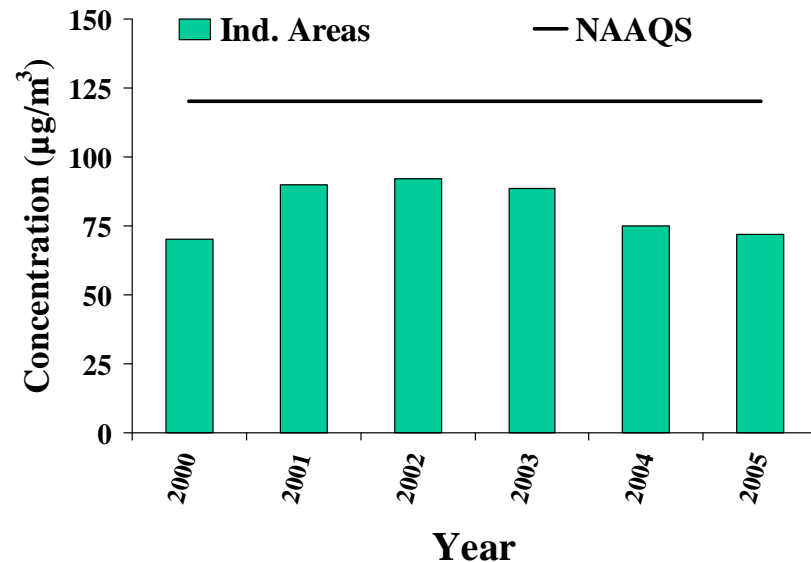
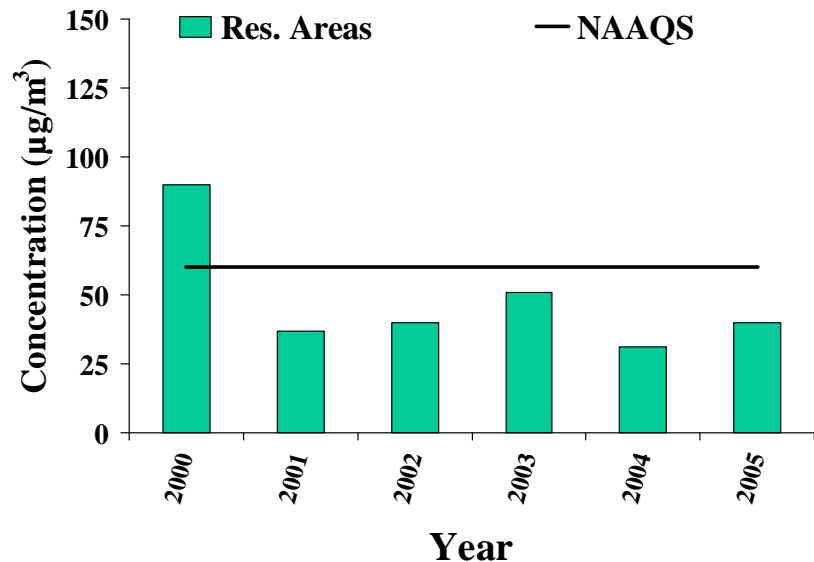


Figure 7.3: Trends in Annual Average Concentration of RSPM in Chennai.

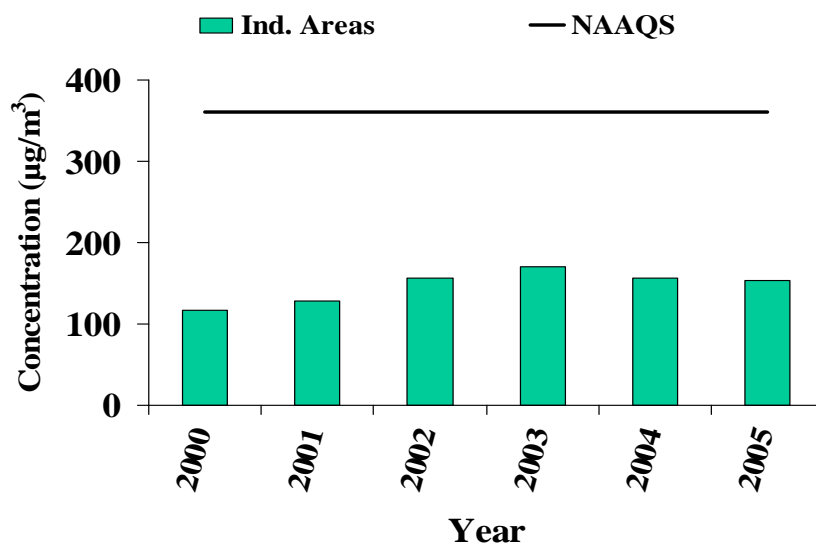
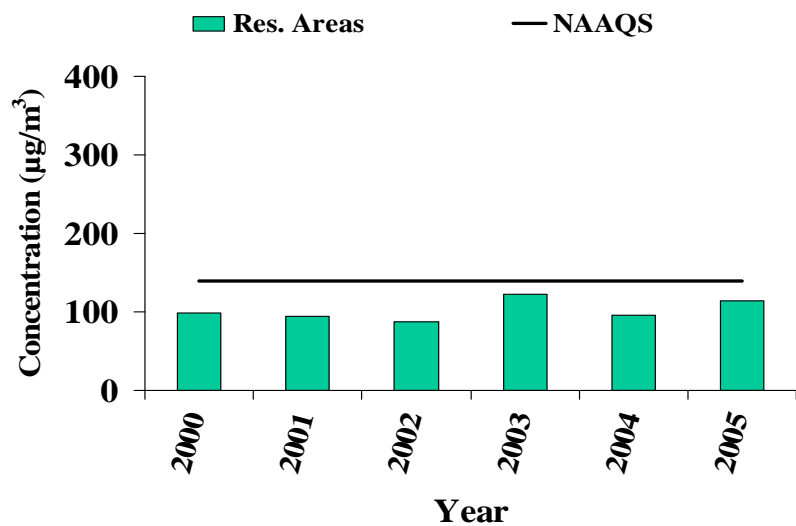


Figure 7.4: Trends in Annual Average Concentration of SPM in Chennai.

7.2.3 Meteorological Issues

It is well established that meteorological factors such as wind speed, etc. playing a critical role in determining ambient concentration of air pollutants. It is essential to understand the underlying meteorological factors for determining effectiveness of any pollution control strategy. Seasonal variations in RSPM levels at monitoring station located at Govt. High School, Chennai during 2002-03 is depicted in Fig. 7.5. The concentrations are maximum in winter months and are low during summer and monsoon months. A plausible explanation for these results may be found by examining meteorological conditions. During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources, increase mixing processes and the winds coming from the marine environment will have less background concentrations than that of continental air masses.

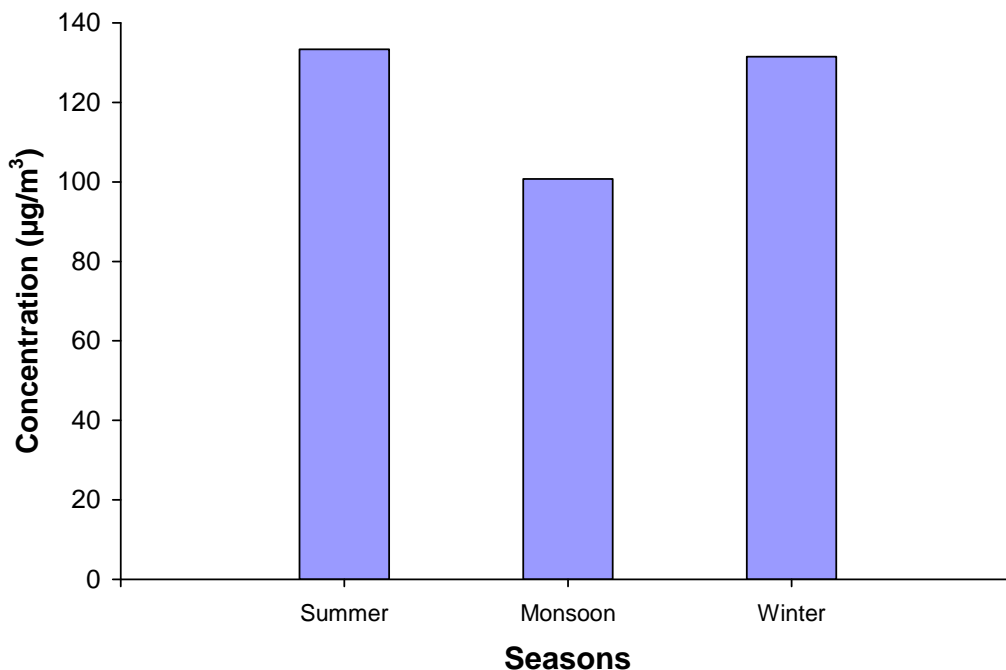


Fig 7.5: Seasonal Variation in RSPM Levels at Monitoring Station at Govt. High School, Chennai.

7.3 Action Plan for the Control of Air Pollution for the city of Chennai (As on June 2004).

7.3.1 Action taken so far

(a) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- No new polluting units permitted within the city.
- No new incinerators permitted within the city, old incinerators being phased out.
- Common facilities are set up outside the city for the incineration of bio-medical waste.
- The industries have been directed to develop a green belt of at least 25 % of the project area. Green belt is also being developed by industries on road sides and common places. Renewal of consent to operate is based on compliance with this condition.
- Periodic inspection of industries and monitoring of ambient air quality and source emission is carried out for compliance.
- All stacks from industrial units are to be fitted with online stack monitor with computer recording arrangements.

(b) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Bharat Stage –II norms have been implemented for the registration of new passenger car from 1-7-2001.
- Emission norms for in-use vehicles in consultation with MoRTH & MoEF have been implemented in Chennai city for all vehicles from 1-1-1997.
- Catalytic Converter fitted passenger car have been registered since , 1997.
- Periodic inspection of in use vehicles in Chennai is conducted by the officials of Transport Dept and Police Department.
- Supply of unleaded petrol from February 2000.
- In Chennai city low sulphur diesel (0.05%) is supplied since 1-7-2001
- Supply of pre-mixed 2T oil since 1-4-2002.
- Entry of heavy vehicles restricted by the road in Chennai city during peak hrs.
- Ring roads have been constructed to avoid the entry of inter city vehicles in the city .
- Mass transport system (Metro rail) introduced from Beach to Thiru Myilai in first and extension to Velachery in phase II is under progress.
- Fiscal measures like structuring parking fees and road tolls has been implemented .
- Five Auto LPG Dispensing Stations (ALDS) are functioning in Chennai City.12 LPG retrofitting Centers have been set up in the city.
- Green tax has been levied for vehicles more than 15 years old from May 2003.

- 112 private emission centers and 3 Tamil Nadu Pollution Control Board emission testing centers in the city have been authorized to check emission.
- Encroachment on the roads being removed to reduce congestion.

7.3.2 Proposed Action Plan

(a) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- To provide scrubbers to reduce emissions from M/s GMR power Corporation .
- To Shift the entire coal handling from Chennai port to Ennore Port by December 2004.
- To shift the entire iron ore handling from Chennai port to Ennore Port by December 2005.

(b) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:

- Implementation of emission norms in accordance with the road map proposed by the expert committee on Auto Fuel policy and to supply commensurate fuel accordingly.
- LPG as auto fuels (autorickshaws and taxis) in Chennai city. Oil companies have promised to setup 28 ALDS. Presently Seven ALDS are functioning. Creation of LPG infrastructure for the auto-gas supply in the city. 28 stations by March 2005.
- Introduction of Low Benzene(1%) petrol
- State government to submit plan for transition of vehicles to LPG by February 28, 2005, with dates and targets, for transition to LPG of autos;
- State government to submit plan on augmentation of public transport: in the city by March 31, 2005
- State government to ensure that all PUC stations adhere to the new norms set by Central government and ensures that system is working effectively by March 31, 2005.
- State government to organize one large scale (coordinated) and surprise inspection to check adulteration in the city at different points and to submit report to EPCA by March 31, 2005.
- To check adulteration of fuel and illegal sale of kerosene to vehicles. So far 770 kerosene licenses were cancelled due to violation of control order and other illegal activities.
- Phasing out of grossly polluting vehicles.
- Improvement of Public Transport system. MTC replaced 117 buses by complying with Bharat stage-II norms during 2002-2003. 25 buses are to be replaced during 2003-2004.
- Upgradation of existing vehicle emission testing centers to computerized emission testing centers.
- Prohibition of movement of heavy goods vehicles except essential services in Chennai city on 19 important roads.

- National Highways Authority of India under the MoRTH have under taken the work of constructing a bye pass road to Chennai connecting NH45, NH4 & 5. The total length of the bye-pass road is 31.40 Km.

7.4 Findings

Levels of SO₂ and NO₂ in Chennai are generally well within the NAAQS (Annual avg.). NAAQS (24-hourly avg.) wrt to SO₂ and NO₂ were also not violated. RSPM levels have also not violated prescribed NAAQS during many years. One of the reason for low levels of pollution in coastal cities like Chennai is that it has excellent ventilation effects due to sea and land breezes which reduces pollution levels. During some years NAAQS (24 hourly avg.) wrt RSPM was violated in residential areas which may be due to emission from vehicles, resuspension of traffic dust, emission from industries etc.

8.0 Delhi

New Delhi is the capital of India and is divided into two parts old Delhi and New Delhi. Old Delhi was build in 17th century and consist of walled city with city gates, the enormous Red Fort and Jama Masjid of Shaha Jahan, temples, bazaars and famous street known as Chandni Chowk. The hub of New Delhi is Rajiv Chowk earlier known as Connaught Place and streets that radiate from it. The Delhi city is located in North India, Latitude 28°24'17" and 28°53'00" N, Longitude 77°45'30" and 77°21'30" E and approximately 216 m above mean sea level (MSL). Delhi is located in the subtropical belt. The climate is mainly influenced by its inland position and the prevalence of air of the continental type during the major part of the year (IMD 1991). Extreme dryness with an intensely hot summer and cold winter are the characteristics of the climate (IMD, 1991). Air of oceanic origin penetrates during the three monsoon months July, August, September and causes increased humidity, cloudiness and precipitation. The two post monsoon months October and November constitute a transition period from the monsoon to winter conditions. Different seasons play a important role in determining ambient concentrations of air pollutants as described in the following sections. The map is depicted in Figure 8.1.

8.1 Sources of Air Pollution

(a) Vehicular Emissions

Vehicular emissions constitute a very important component of any strategy to control air pollution in Delhi. Delhi has the maximum number of on-road vehicles amongst other metro cities with a vehicle population over 48 lakhs.

(b) Industrial Emission

There are three thermal power plants at Indraprastha, Badarpur and Rajghat. The industries emit suspended particulate matter, hydrocarbons, sulphur dioxide, oxides of nitrogen and carbon monoxide. The emissions from power plants include sulphur dioxide, oxides of nitrogen and suspended particulate matter. The industrial pollution load has been estimated for thermal power plants and cement plant in Delhi. The emission factors used to estimate the air pollution load from coal based thermal power plants are given in Table 8.1.

Table 8.1: Emission factors used for estimating pollution load.

Type of Coal	Particulates Kg/t of coal burnt	SO ₂ Kg/T of coal burn
Pulverised general	8.0 (A) A=Percent of ash content of coal say 40% $8.0 \times (40) = 320$ Kg/T of coal burnt	19(S) S=Percent sulphur content of coal say 0.3 = $19 \times (0.3) = 5.7$ Kg/t of coal burnt. Say 6 Kg/t of coal burnt.

NO_x load is estimated considering NO_x emission factor as 9 kg/tonne of coal (Source: - *Rapid Assessment of Sources of Air, Water, and Land Pollution, World Health Organisation, Geneva, 1982*). The air pollution load is estimated using the above emission factors. As per MINAS, coal requirement per unit of power generation is 0.6 T/MW/hr and this figure is used to estimate air pollution load.

Air pollution load from thermal power plants that are not complying with emission norms and have installed ESPs are given in Table 8.2. It is considered that removal efficiency of PM in these thermal power plants is 95%.

Table 8.2 : Air Pollution Load (tonnes/day) from thermal power plants that are not complying with emission norms and have installed ESPs.

State	Thermal capacity	SO ₂	NO _x	PM	
				Without control device	With control device
Delhi	1083	61	91	3242	162

The particulate matter pollution load from cement plants is shown in Table 8.3. The emission factors for particulate matter emissions without air pollution control devices and with air pollution control devices for a dry type cement manufacturing industry are 358 kg/tonne of clinker production and 1.2 kg/tonne of clinker production respectively (Source: Development of Emission Factors for Cement Industries, Jan. 2001, CPCB Publication, Comprehensive Industry Document Series: COINDS/59/2000-2001). As per the information available in C.P.C.B. all the operating cement plants have adequate facilities to comply with the standards.

Table 8.3: Air Pollution Load Generated from Cement Plants.

States	Annual Installed Capacity* (Million Tonnes)	Pollution load generated in tonnes/day	
		Without control device	With control device
		PM	PM
Delhi	0.5	542	2

- - Source:- :- Basic Data 2000 Cement Industry, Cement Manufacturer's Association, New Delhi, Feb. 2001.

(c) Climate and Natural Sources

Climate and natural sources also play an important role in contributing to the pollution levels of Delhi in addition to man-made sources. The region has a semi-arid climate. A sporadic pre-monsoon feature is dust storms when winds from the west deposit large concentrations of suspended particulate matter in the atmosphere of Delhi. Pre-monsoon calms contribute to increased pollution loads due to lack of mixing between different atmospheric levels. In winter, ground-based temperature inversions constrain dispersal of pollutants.

8.2 Ambient Air Quality

Ambient air quality is measured at seven locations in Delhi by Central Pollution Control Board. Out of these seven locations four monitoring stations are located in residential area. These stations are at Nizamuddin, Ashok Vihar, Janakpuri and Siri Fort. Two locations are in industrial area. These locations are Shahdara and Shahzada Bagh. One monitoring station is located at Bahadurshah Jafar Marg (ITO Intersection) which represent traffic intersection. Status and trends of air pollutants measured in Delhi are described in this section.

8.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated. NAAQS (24 hourly average) of RSPM and SPM are violated at most of the monitoring stations.

8.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in residential areas and industrial areas of Delhi. Low and moderate

levels of NO_2 were observed in Delhi. Critical level of RSPM were observed in residential areas and industrial areas of Delhi during many years. Critical levels of SPM are also observed in residential areas of Delhi.

8.2.3 Air Quality Trends in Delhi

Trends in annual average concentration of sulphur dioxide in residential areas, industrial areas is shown in Fig.8.2. A decreasing trend is observed in SO_2 levels in residential areas and industrial areas. SO_2 levels at all the monitored locations were lower than the NAAQS (annual average) during all the monitored years. Trends in annual average concentration of nitrogen dioxide in residential areas and industrial areas is shown in Fig. 8.3. NO_2 levels at locations in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years.

Status and Trend in annual average concentration of respirable suspended particulate matter (RSPM) in residential areas and industrial areas is shown in Fig. 8.4. RSPM levels at locations in residential areas were higher than the NAAQS (annual average). Trend in annual average concentration of SPM is shown in Fig. 8.5. SPM levels in residential areas were higher than the NAAQS (annual average) during all the monitored years.

8.2.4 Additional Pollutant Monitored in Delhi

(a) Carbon Monoxide (CO)

The annual average concentrations of CO at BSZ Marg, ITO Intersection ranged between $3258 \mu\text{g}/\text{m}^3$ and $5587 \mu\text{g}/\text{m}^3$ during the period 1995 to 2002. The annual average concentrations of CO is shown in Figure 6.9. The percentage violation of the NAAQS (8-hourly average) was more than 70% during all the years of monitoring. High levels of CO might be attributed to increase in vehicular population especially passenger cars in Delhi. Despite an increase in number of vehicles, CO levels have reduced during last few years. The decrease may be attributed to measures such as conversion of three wheelers of CNG in Delhi.

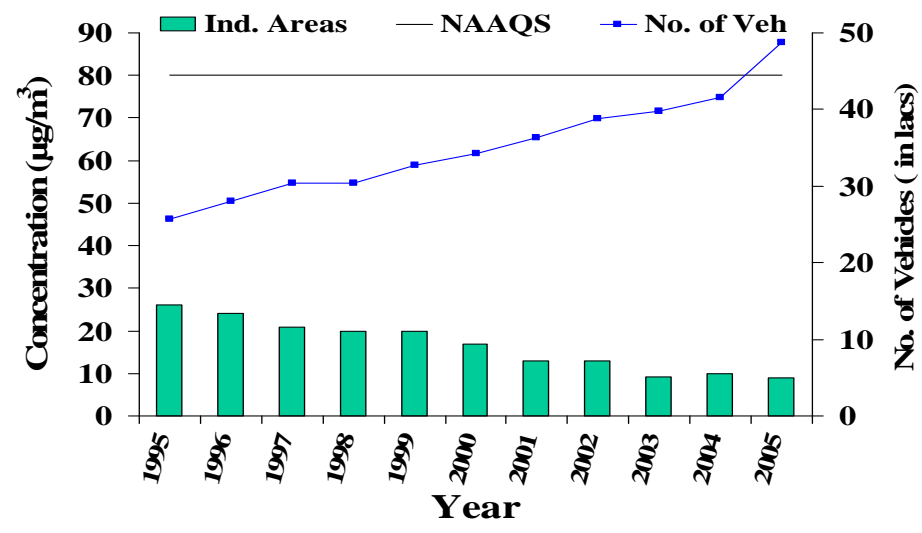
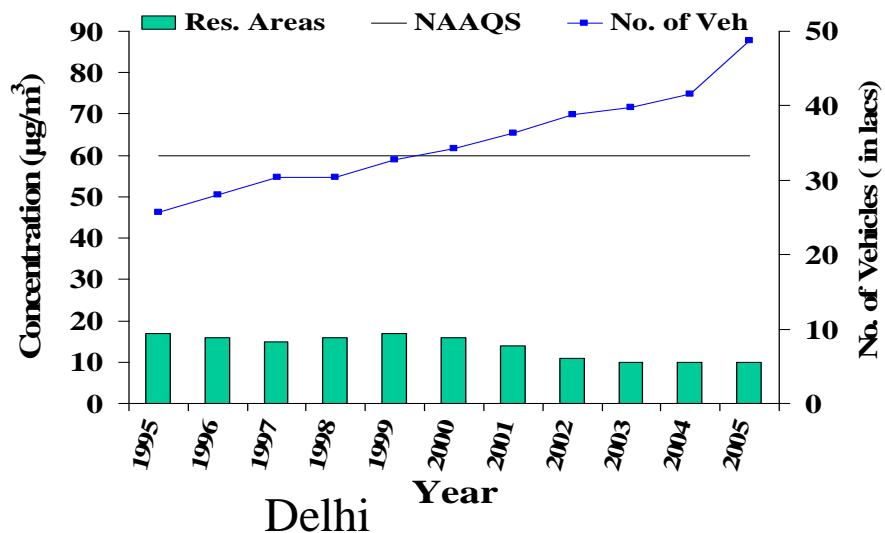


Figure 8.2: Trends in Annual Average Concentration of SO₂ in Delhi.

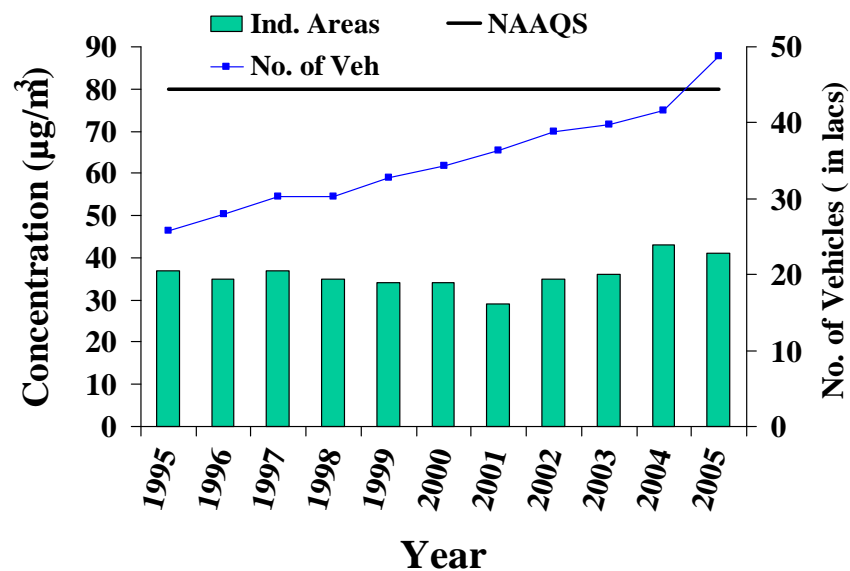
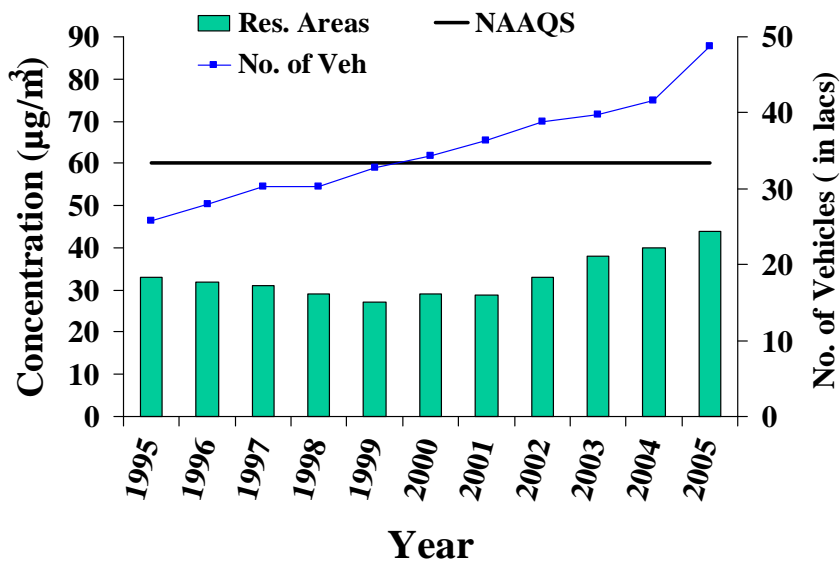


Figure 8.3: Trends in Annual Average Concentration of NO₂ in Delhi.

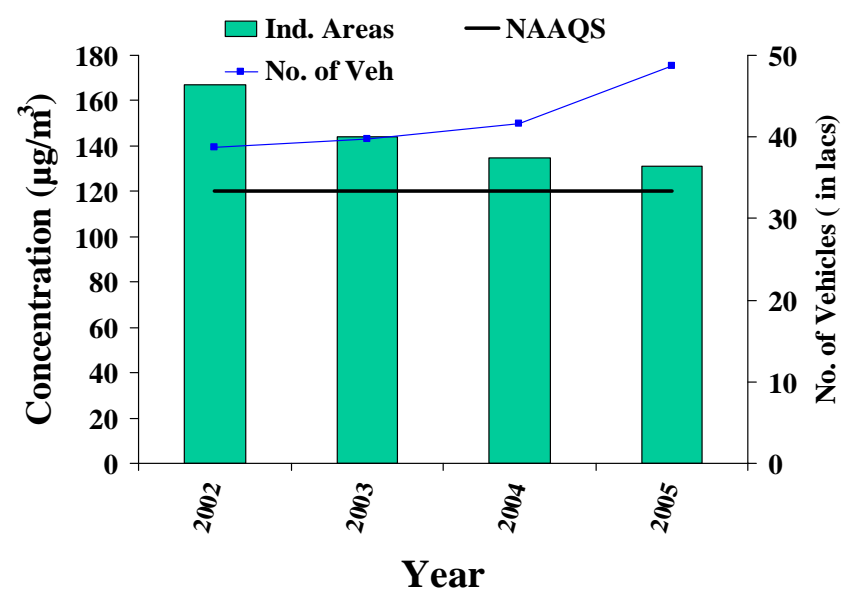
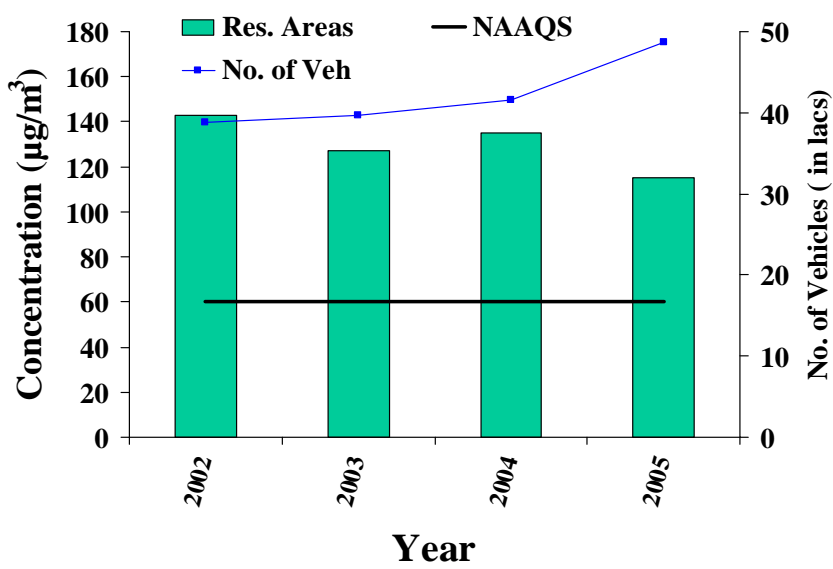


Figure 8.4: Trends in Annual Average Concentration of RSPM in Delhi.

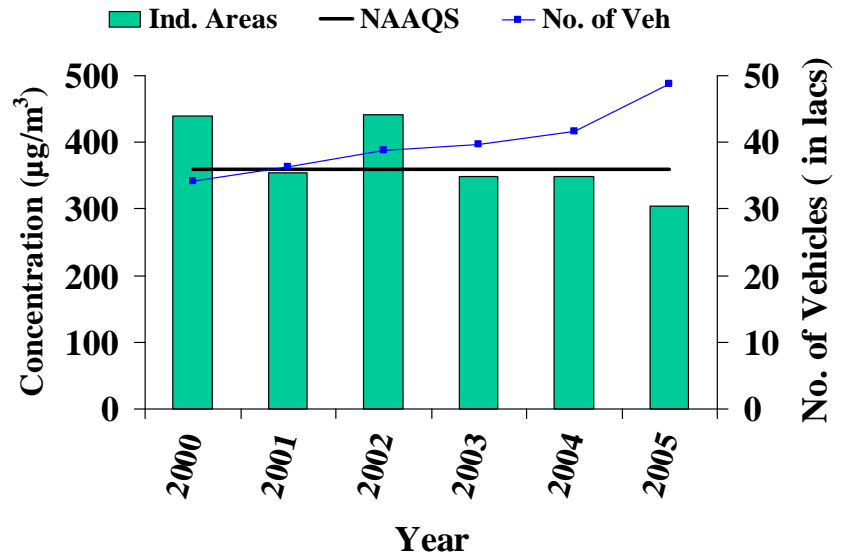
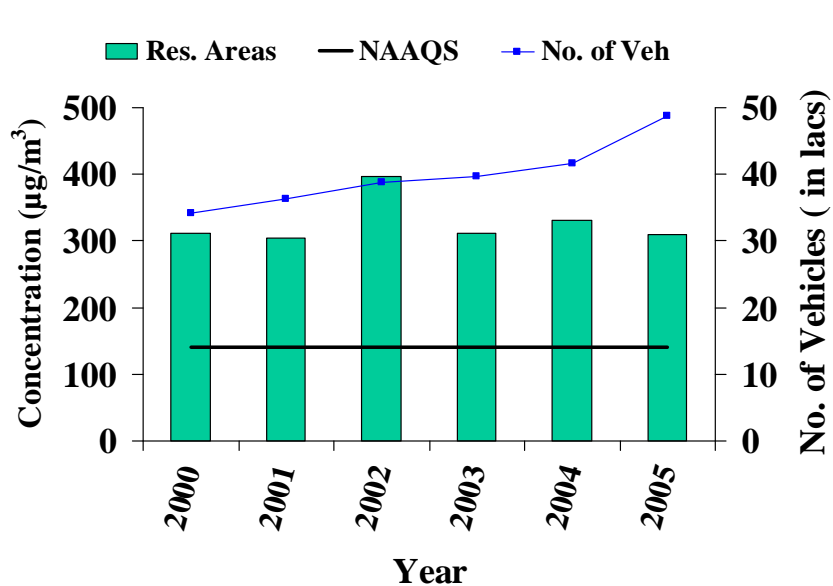


Figure 8.5: Trends in Annual Average Concentration of SPM in Delhi.

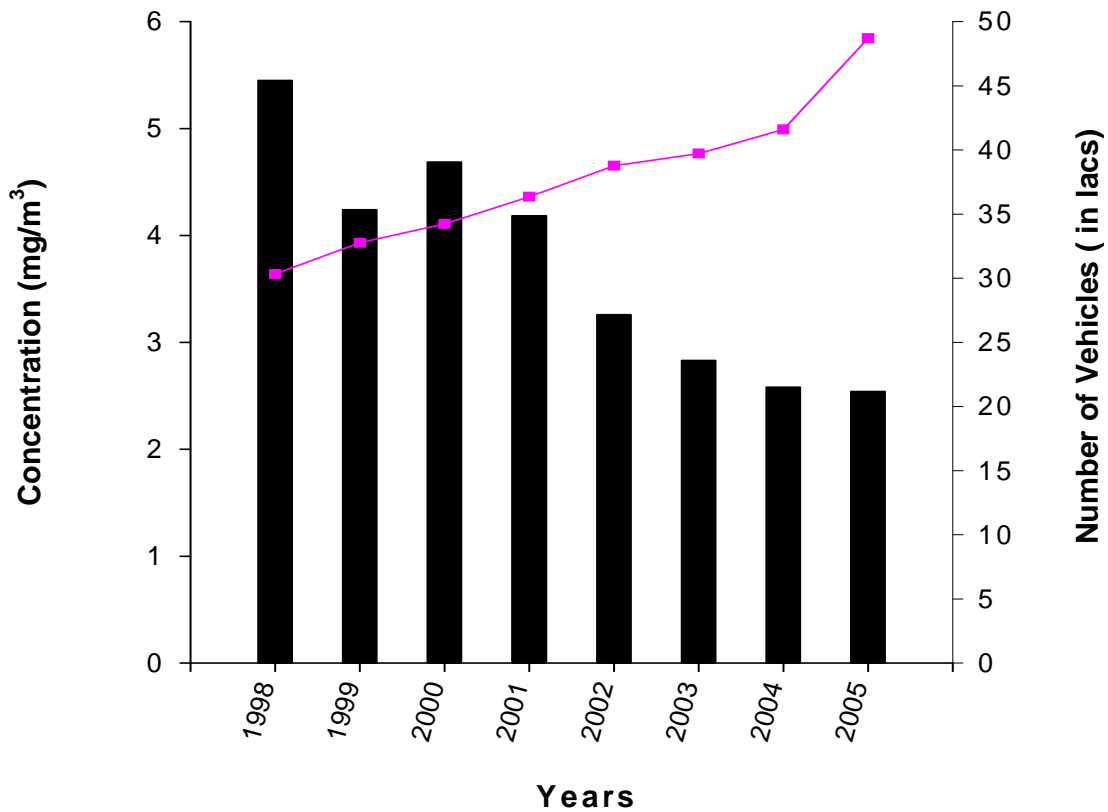


Figure 8.6: Annual Average Concentration of CO (mg/m³) at BSZ Marg, New Delhi.

8.2.5 Meteorological Issues

Meteorological factors play a important role in air pollution studies particularly in pollutant transport irrespective of their entry into the environment. The wind speed and direction play a major role in dispersion of air pollutants. The wind direction is the measurement of direction from which the wind is blowing, measured in points of compass viz. North, South, East, West or in Azimuth degrees. Wind direction has an important role in disturbing and dispersing pollutants from stationary and mobile sources in horizontally long downwind areas.

The wind speed is the measure of horizontal motion of wind relative to the surface of earth per unit time. The effect of wind speed on air pollution is two fold. It determines the travel time from a source to a given receptor while on the other

causes dilution of pollutants in downwind direction. The stronger the wind the greater will be the dissipation and dilution of pollutants emitted. A knowledge of the frequency distribution of wind direction as well as wind speed is essential for accurate estimation of the dispersion of pollutants in the atmosphere. The frequency distribution of wind speed and direction varies considerably from month to month.

Trend in monthly average concentration of SO₂ and NO₂ is depicted in Figure 8.7. Trend in monthly average concentration of RSPM is depicted in Fig 8.8. Trend in seasonal concentration of SO₂ is depicted in Figure 8.9. Trend in seasonal concentration of NO₂ is depicted in Figure 8.10 and trend in seasonal concentration of RSPM is depicted in Figure 8.11. The concentrations are higher in winter months and are lower during monsoon months. Particulate matter concentrations are also higher during summer months. A plausible explanation for these results may be found by examining meteorological conditions. The strong and medium winds during April to June creates turbulent conditions and local disturbances in the environment which cause frequent dust storm and hazy conditions. These dust storms and hazy conditions build up high particulate matter levels in the ambient air, mostly constituting soil borne particles.

The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources, increase mixing processes and the winds coming from the marine environment will have less background concentrations than that of continental air masses. During monsoon, mostly winds from East prevail. Most frequent rains washes down the air borne particulates and other pollutants generated and dispersed from the sources in the environment, therefore the period from July to September is cleaner period in the year. The general meteorology during the winter is dominated by high pressure causing increased atmospheric stability, which in turn allows for less general circulation and thus more stagnant air masses. Stagnant air masses allow more accumulation of pollutants in any given area. During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. The winter months are relatively much calm than other months. The prevailing calm conditions facilitate more stability to atmosphere and consequently slow dispersion of pollutants generated and help in build up of pollutants in vicinity of the pollutant sources.

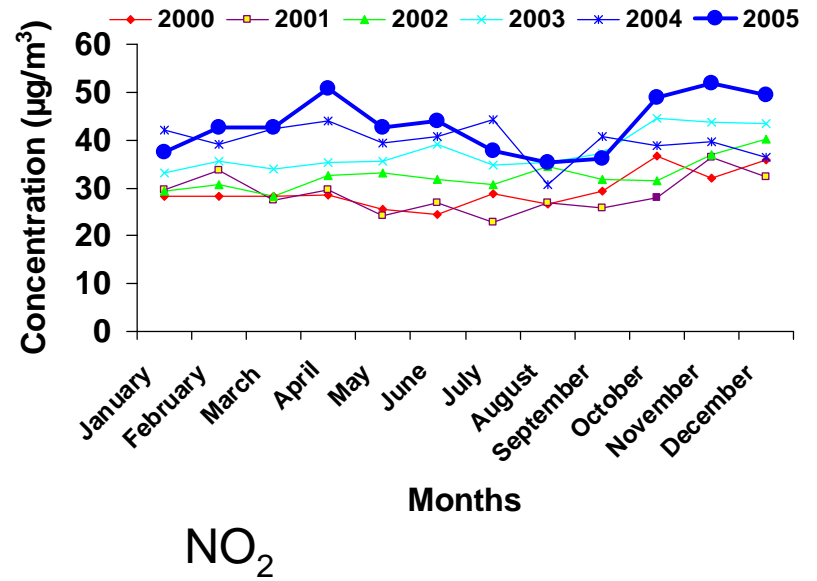
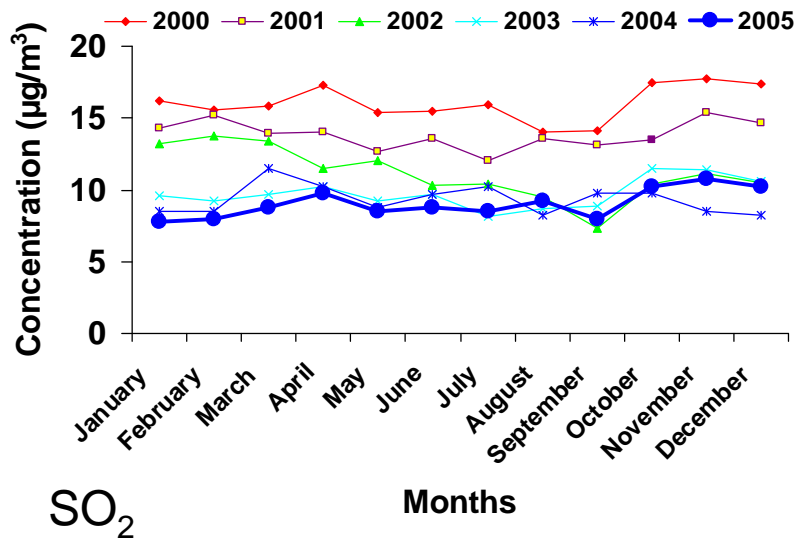


Figure 8.7: Trend in Monthly Average Concentration of SO₂ and NO₂ in Delhi.

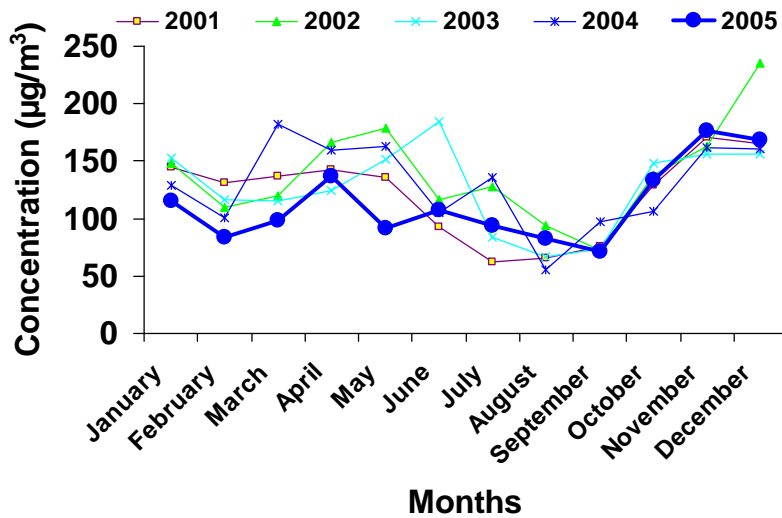


Figure 8.8: Trend in Monthly Average Concentration of RSPM in Delhi.

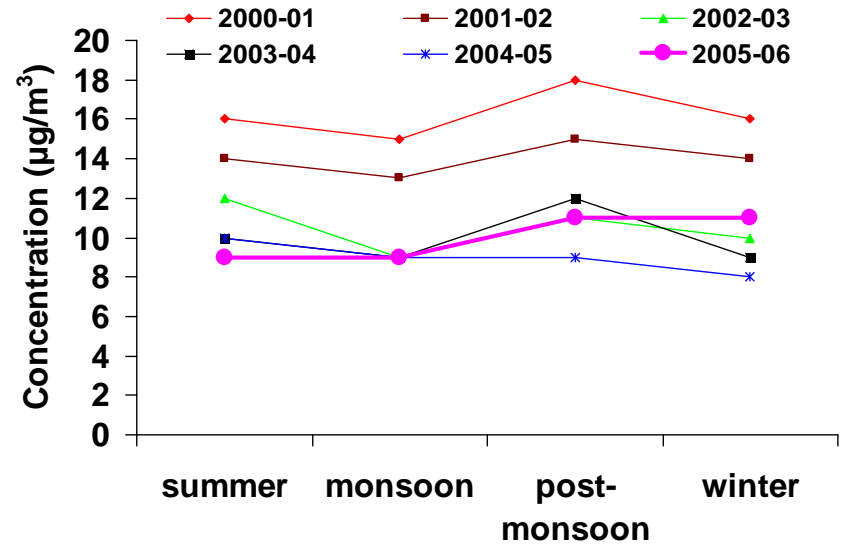


Figure 8.9: Trend in Seasonal Concentration of SO₂ in Delhi.

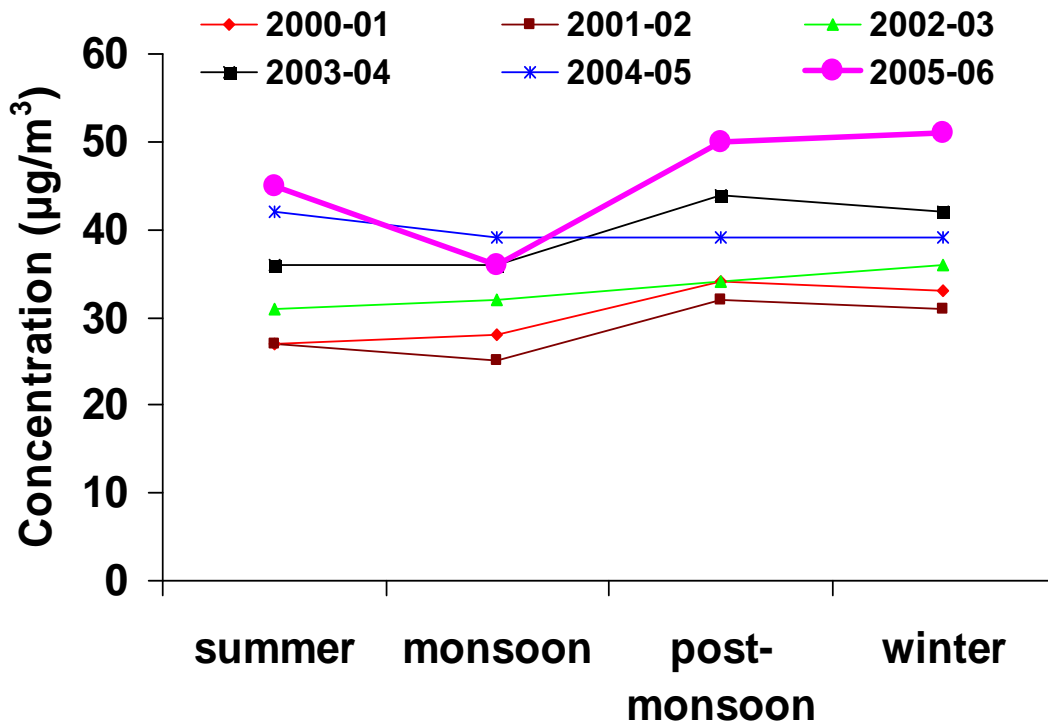


Fig 8.10: Trend in Seasonal Concentration of NO₂ in Delhi.

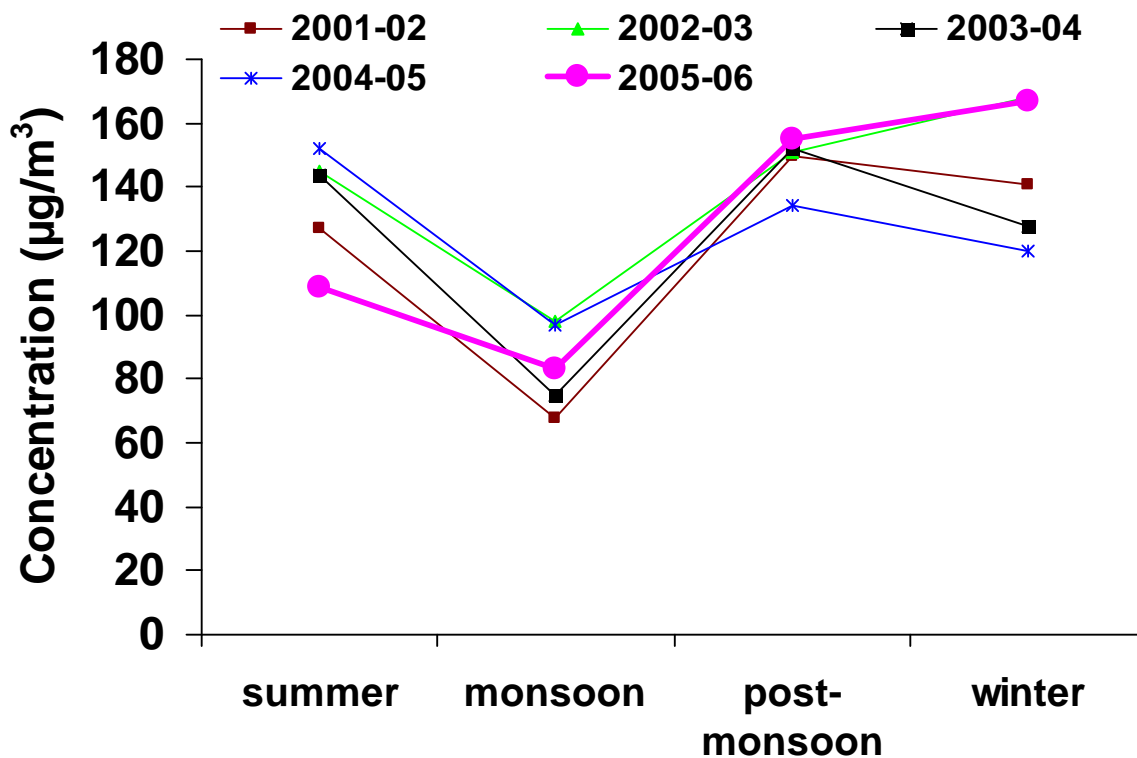


Fig 8.11: Trend in Seasonal Concentration of RSPM in Delhi.

Monthly average concentration of CO during 2005 and monthly average mixing height (in meters) is depicted in Figure 8.12. During winters as the mixing height reduces, the CO levels increase. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher CO levels.

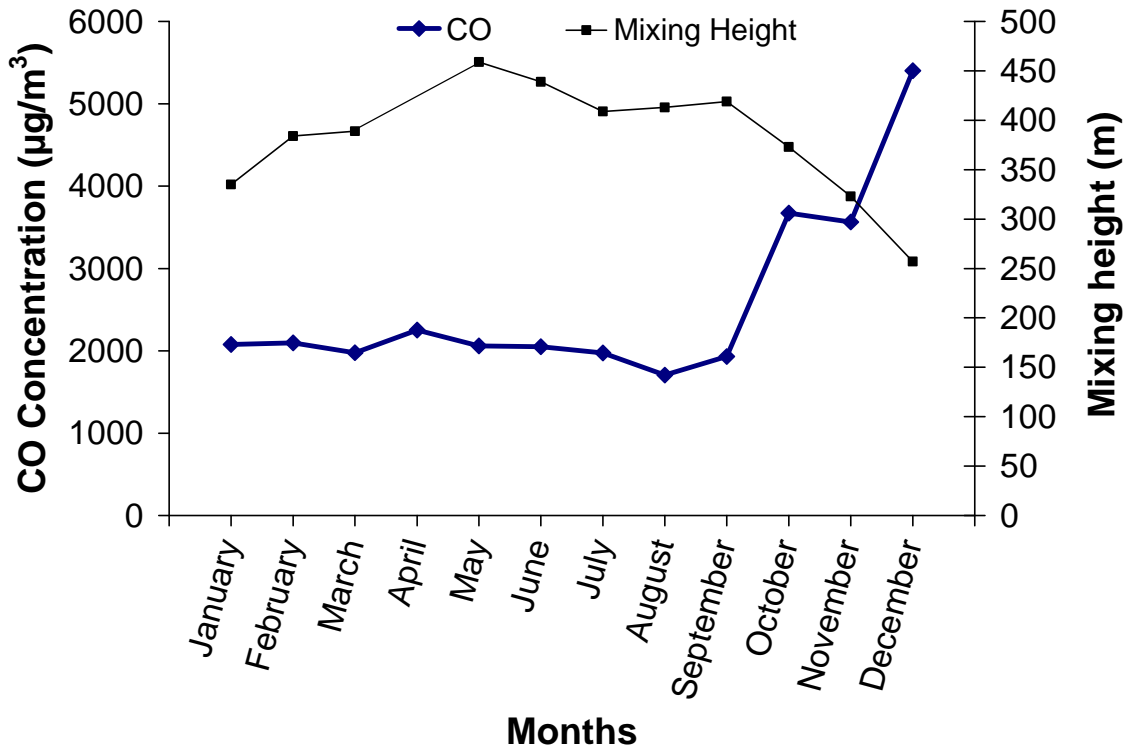


Figure 8.12: Monthly average concentration of CO and monthly average mixing height in Delhi during 2005.

8.3 Action Plan for the Control of Air Pollution for the city of Delhi (As on February 2005)

8.3.1 Action taken so far

(a) Vehicular Pollution Control

The salient features of actions taken to control vehicular pollution are as follows:

(i) Vehicular emission norms have been progressively tightened during last few years in Delhi as well as NCR. During 1990-91 for the first time the mass emission norms were notified for vehicles at manufacture stage as well as for the vehicles in use. In 1996 more stringent norms came into force. In year 1998 the Government notified emission norms for vehicles fitted with catalytic converters, which were over 50% stricter than the 1996 norms. In 1996 Hon'ble Supreme

Court directed that all Government vehicles in Delhi would be converted to CNG mode or fitted with catalytic converter. Further one of the major strides toward improved air quality in the last few years was attributed to July 1998 Order, in which the Supreme Court of India required the conversion of all public vehicles which includes diesel driven buses, taxis (diesel & petrol) and petrol driven three wheelers in Delhi to compressed natural gas (CNG). Bharat stage-I emission norms were implemented during 1999 for all categories of new vehicles except 2&3 wheelers. Further during 2000 Bharat stage-II emission norms were implemented for all the categories of new 4- wheelers. Now Bharat stage-III emission norms have been implemented for all the categories of new 4-wheelers. For 2 & 3 wheelers B.S-II emission norms have been implemented during 2005.

(ii) There has been considerable improvement in the quality of both diesel as well as gasoline during last few years. The contents of sulphur in Diesel have been reduced to 0.035% from 0.5% during 1996. In gasoline also the content of sulphur have been reduced to 0.015%. The content of lead have been reduced from 0.15g/l in 1996 to 0.013g/l in 1995 and further the percentage of lead has been further lowered to 0.005g/l during 2005. The percentage of Benzene which one of the carcinogenic pollutant in gasoline has been reduced from 5% during 1996 to 3% in 2000 and further 1% in 2001. In parallel to the emission norms those have been implemented in Delhi, the commensurate quality of fuel has also been made available. To check adulteration in fuel, independent fuel testing laboratories are being established at Noida and Gurgaon.

(iii) New & more stringent PUC norms have been implemented for in-use vehicles from October 2004.

(iv) To prevent the use of 2T oil in excess than the required quantity, premixed 2T oil dispensers have been installed at all the petrol filling stations in Delhi. Sale of loose 2T oil has been banned from December 1998 in NCT-Delhi. The specifications for 2T oil have been notified by Ministry of Environment & Forests under the Environment (Protection) Act, 1986 on the recommendation of Central Pollution Control Board, which became effective from 01/04/1999. The specifications required for use of low smoke 2T oil, which is one of the causes of pollution from 2-Stroke engines.

(v) The use of catalytic converter, which convert hazardous gases emission from vehicles into simple gases has been made mandatory since April, 1995 in four metro cities and in 45 cities from 1st September, 1998. The new passenger cars have been allowed to register only if they are fitted with catalytic converters in Delhi, Mumbai, Calcutta and Chennai. Emission norms for such vehicles had also been notified under Motor Vehicle Rules during January, 1998. These emission norms are stricter by 50% than 1996 norms.

(vi) Compressed Natural Gas (CNG) is better and clean fuel providing limited emissions of various toxic gases. CPCB has acted a lead role in supply of CNG

(vii) To promote the use of catalytic converter and CNG in controlling air pollution, financial incentives such as providing subsidies for catalytic converter and CNG is being promoted.

(viii) The use of LPG as alternate fuel in automobiles has been made applicable for which amendment has been made in Motor Vehicles Act to legally permit the use of LPG as automobile fuel. The use of Propane as automobile fuel is also being promoted. Battery driven vehicles have also been introduced in few corridors in Delhi.

(ix) The commercial vehicles more than 20-year old had been prohibited from plying with effect from October 1998, followed by phase out of 17 to 20 years old commercial vehicles from 15th November, 1998 and 15 year to 17 years old vehicles from 31st December, 1998 in Delhi. Registration of new auto-rickshaws with conventional front engine had been banned from May, 1996 and the registration of old defense services and govt. auctioned vehicles has been banned from April, 1998 in NCT - Delhi. All auto rickshaws and taxies registered before 1990 are replaced with new vehicles on clean fuels. Registration on alteration of vehicle by replacing petrol engine with diesel has been banned from 1st April 1998 in Delhi.

(x) It has been possible to reduce 30 - 40% pollution loads generated by vehicles, through proper periodical inspection and maintenance of vehicles. Such inspection and maintenance of vehicle is being ensured in Delhi.

(xi) Restriction has been imposed on Goods Vehicles operation during day time peak traffic hours in Delhi since August 1999. Extreme left lane on the roads in NCT - Delhi has been earmarked exclusively for the use of Heavy Transport Vehicles (HTV's). New ISBT's are to be built at entry points in North and South-West to avoid pollution due to entry of inter state buses. Two-wheeler parking has been banned in Cannought Place from 31st Jan. 2003.

(xii) To discourage the use of individual motor vehicles by the public, public transport system being augmented from time to time in various urban areas. The number of buses on roads have been increased in Delhi and private sector has

been allowed for operation of the public transport buses. Simultaneously, the Mass Rapid Transport System (MRTS) Project had been launched and Metro rail has been inaugurated for Tiz Hazari to Shahdara section on 25th Dec. 2002

(b) Industrial Pollution Control

The salient features of actions taken to control industrial pollution are as follows:

(i) Directions under Section 5 of E(P)A, 1986 have been issued on April 1996 and July 1996 to all the three power plants located in Delhi for completing the following in a time bound manner

- Comply with emission and liquid effluent standard.
- Submission of action plan for switching over the beneficiated coal with an ash content of not more than 34%.
- Submission of action plan to achieve 20% utilization of fly-ash by Dec. 1997.
- Installation of opacity meter in all units to ensure compliance with the standards.
- Coverage of abandoned ash ponds with top soil.

(ii) All stone crushers have been closed down in Delhi and shifted to Pali in Rajasthan.

(iii) All the hot mix plants have been closed down and shifted to other states.

(iv) As per the directions of Hon'ble Supreme Court, 168 hazardous industries have been closed down in Delhi.

(c) Information Dissemination/Mass Awareness

The following steps have been taken to create mass awareness of air pollution.

- Messages/Articles related to vehicular emission are disseminated through newsletters, pamphlets, newspapers, magazines, television, radios, Internet, workshops and exhibitions.
- Ambient air quality data is being displayed through display system near ITO and also published in newspapers and put on CPCB website on Internet.
- NGO's working in vehicular pollution control are being encouraged for mass awareness.

8.3.2 Proposed Action Plan

(a) Vehicular Pollution Control

The salient features of the action plan to control vehicular air pollution in Delhi is as follows:

(i) To implement emission norms in accordance with the road map proposed by the expert committee on Auto Fuel Policy.

(ii) Euro IV equivalent emission norms for all private vehicles, city public service vehicles and city commercial vehicles by 2010. However a review meeting of the expert committee on Auto Fuel Policy is scheduled during 2006, wherein implementing Euro-IV in Delhi are proposed to be preponed.

(iii) Bharat stage-III emission norms for all categories of 2 & 3 wheelers preferably by 2008 but not later than 2010.

(iv) Supply of fuel quality for both diesel and gasoline which is commensurate with the emission norms implemented.

(v) Inspection & Maintenance (I&M) System for all categories of vehicles to be put in place by 1.4.2005.

(vi) Performance checking system of catalytic converters and conversion kits already installed in vehicles to be put in place by 1.10.2004.

(vii) Augmentation of city public transport system to be undertaken by the State Government after reviewing the start up schedules and estimated impact of metro rail system.

(viii) Emission norms for city public service vehicles for City Buses, Taxis & 3 Wheelers, emission norms have already been set under the directions of the Supreme Court.

Emission norms for all Inter-State buses from/to Delhi

- Minimum Bharat Stage-I emission norms : Not later than 2007
- Minimum B.S-II emission norms : Not later than 2011

Emission norms for all Inter-State trucks loading/unloading from/at Delhi

- Minimum Bharat Stage-I emission norms : Not later than 2007
- Minimum B.S-II emission norms : Not later than 2011

(ix) In order to strike the appropriate model balance, an extensive mass transport system including a metro, commuter rail and buses will be required. Considering

this, 245 km of a metro system network to cater to demand upto 2021 is being planned. Even after a fully developed rail based Mass rapid Transit System has come into existence, the bus system will continue to ply the role of the main mass transport system provider. The bus system is proposed to be augmented to 10000 CNG buses within a year on Stage carriage to be supplemented with about 4000 CNG buses on chartered and premium services. Premium bus services will be introduced on selected routes. High capacity Bus Systems on selected corridors of 100 km is planned. In addition, on 32 km of selected corridors, Electric Trolley buses will also be introduced in order to reduce congestion and pollution. A Light rail Transit for the walled city is being considered. In order to improve the bus system dedicated busways/lanes are being planned on designated road corridors.

(x) Development of bus terminals is very important for efficient operation of any bus system. Three directional Inter State Bus Terminals (ISBTs) have already been provided and two more are to be taken up at Dwarka and Narela. Site at ISBT at Dwarka has been handed over by DDA to Transport department. Other site at Narela is yet to be handed over to Delhi Govt. by DDA. The services at the existing ISBTs at Kashmere gate, Anand Vihar and Sarai Kale Khan will be further improved.

(xi) Intermediate Public Transport System (IPT) modes will continue to play an important role even in the future as feeder services to the main mass transport system and providing accessible movement in pre-designated areas. Therefore, steps are being taken to strengthen this system by proper regulation and discipline.

(xii) A number of additional measures will be taken to reduce vehicular pollution by providing CNG buses, strengthening the Pollution Under Control (PUC) system, introduction of strict inspection and Certification Systems and promotion of advanced technologies. Special focus will be on safety certification and stringent inspection of all transport vehicles. A safety council to set standards for vehicle safety and fitness is being set up shortly.

(xiii) A number of flyovers, bridges and pedestrian subways are under construction and many more are being contemplated. In addition, existing roads are being widened and new roads constructed. The peripheral expressway and NH2 bypass are being taken up to siphon off inter-city traffic passing through Delhi

(xiv) Integration of all modes of transport is necessary to achieve the potential of each mode. Feeder systems to metro and commuter rail will be provided. Facilities for parking of personalized modes, autos and taxis are proposed at all stations. Time table and fare integration for metro rail and buses are also contemplated.

(xv) The financial investments are proposed to be buttressed by institutional measures to ensure effective and efficient functioning of the transport system in an integrated manner. For this, it is proposed to set up an integrated Metropolitan Transport Authority (IMTA) which will look after regulatory issues like fares and tariffs as well as provisioning and common functions/services for metro, rail and bus systems.

(xvi) In order to make the transport system user-friendly, many amenities for commuters are being introduced. Some of these are Help Line for bus, taxi and auto rickshaw passengers, a Unified Bus Time Table, route guide maps/ folders, directory of chartered bus service, fare charts from point to point, more prepaid taxi/auto rickshaw booths and improved bus terminal designs and enhanced service standards at Inter State Bus Terminals (ISBTs) etc. Wherever feasible the needs of special groups like the physically challenged and senior citizens as well as economically weaker sections will be accommodated by encouraging user friendly technologies for access and seating as well as concessional passes on mass transport. Training programmes are also being planned for drivers of buses, mini buses and autos to make them responsive and helpful to commuters.

(xvii) Two autonomous fuel testing laboratories to be established for monitoring fuel quality specifications and adulteration. One laboratory at NOIDA has been commissioned. Other laboratory to be set up at Gurgaon, which has been kept in abeyance as the funding pattern for operation and maintenance is yet to be resolved.

(xviii) Automated inspection and maintenance facilities to be set up for commercial vehicles in coordination with private sector.

(b) Industrial Pollution Control

Implementation of CREP (Common Responsibility for Environment Protection) for 17 categories of highly polluting Industries.

8.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Delhi. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, use of cleaner fuel such as CNG etc. Other measures include implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality. Also there has been a change in domestic fuel used from coal to LPG which may have contributed to reduction in ambient levels of SO₂.

Levels of NO₂ are within the prescribed NAAQS. One of the major sources of NO₂ are vehicles and number of vehicles in Delhi have increased exponentially over the years. Various measures have been taken such as implementation of stricter vehicle emission norms, measures taken to reduce traffic congestion such as non-destined heavy vehicles have been prohibited entry, other heavy vehicles are allowed to enter during night-time and many flyovers have been constructed. RSPM levels have also started to decrease despite exponential increase in number of vehicles. Measures that have been taken to reduce RSPM include conversion of diesel buses to CNG mode, implementation of Bharat Stage-III norms etc. SPM levels have been fluctuating. SPM is contributed by natural sources, resuspension of dust, vehicles etc. A reduction in CO levels has been observed despite increase in number of vehicles which may be attributed to measures such as conversion of three wheelers of CNG in Delhi.

9.0 Faridabad

Faridabad was founded in A.D. 1607 by Shaikh Farid, treasurer of Jahangir, with the object of protecting the highway which passed through the town. Shaikh Farid built a fort, a tank and a mosque. Later, it becomes the headquarters of a pargana which was held in jagir by the Ballabgarh ruler. Faridabad became 12th District of Haryana State on 15th August, 1979. Faridabad is about 25 Kilometers from Delhi in 28° 25' 16" North Latitude and 77 ° 18' 28" East Longitude. It is bounded by Union Territory of Delhi (National Capital) on its north, Gurgaon District on the west and State of Utter Pradesh on its east & south. Delhi-Mathura National Highway No.2 (Shershah Suri Marg) passes through centre of District. The district is having an area of 2151.00 K.m. District having a share of 4.86% of the total state land accommodates a population of 21,93,276 (2001 Population census figures) 10.40 percent of the state population. Only 55 Sq. Km. is area under forest, which is about 2.61% of the total geographical area of the District. The district has almost flat plains. The river Yamuna flow on its entire eastern boundary. Its density according to 2001 population census is 1020 persons per Sq. km. against 372 in the state. It is the most densely populated district in the state.

The district has semi arid climate. The average annual rainfall is 350.4 millimeters. The soils varies from sandy to sandy loam. The under ground strata bearing water varies from 60 to 110 feet from ground. During the year 2000-01, 1.63 lakhs hectares forming about 76.00 percent of the total area was available for cultivation. The total cropped area of the district was 2.65 lakhs hectares. Out of which 75 percent was shown under Food grains (Cereals), 2.5% was under Pulses and 22.5% was commercial crops. Among food grains, wheat area at 51% was at top, Paddy with 10.9% of the came next. Barley was sown in 1% of the total cropped area. Faridabad is famous for Heena Production on agriculture sector while tractors, motorcycles, switch gears, refrigerators, shoes and tyres are other famous industrial products of the city. For the ease of Civil Administration, Faridabad district is divided into five sub divisions viz. Faridabad, Ballabgarh, Palwal, Hodal & Hathin. Each Sub Divn. is headed by an Sub Divisional Officer (C).

The Faridabad and Ballabgarh Complex is situated at Sher Shah Suri Marg known as Delhi Mathura Road at 32 km from New Delhi in the state of Haryana. There are now about 15,000 small, medium and large industries in this complex providing direct and indirect employment to nearly half a million people and ranks 9th largest industrial estate in Asia. The combined turnover is estimated to be about Rs. 1500 billion. A variety of engineering products from Forgings to Tractors, Clutch Assembly to leaf springs are being manufactured by the industries in this belt. The total land are occupied by the industries is about 6948 hectares.

9.1 Sources of Air Pollution

The main sources of air pollution in Faridabad are vehicles, industries and natural dust. Pollution from local factories and industrial units such as brick kilns, thermocol, plastic and cement factories has affected the health of humans, crops and animals. Air pollution is linked to industrial estates in the nearby towns of Ballabgarh and Faridabad. Number of vehicles have increased over the last 20 years. Old vehicles (three-wheelers and phatphats) plying in the town, mushrooming industrial units with boilers and furnaces — particularly those using wood, rice husk and coal — and the two thermal power plants at Faridabad and Badarpur are some of the major sources of air pollution. Due to power shortage, there are high power generators being used by the industrial units and by the malls.

9.2 Ambient Air Quality

Haryana State Pollution Control Board is monitoring ambient air quality at two monitoring stations in Faridabad. These stations are located at Regional Office, Haryana State Pollution Control Board representing residential area and the other monitoring station is located at Shivalic Global Industries representing industrial area. The status and trends in ambient air quality is detailed in following sections.

9.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated in residential area..

9.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ and NO₂ were observed in residential areas and industrial areas of Faridabad. Critical levels of RSPM and SPM were observed in residential areas of Faridabad.

9.2.3 Air Quality Trends in Faridabad

Trend in annual average concentration of SO₂ is depicted in Fig. 9.1. A decreasing trend has been observed in ambient SO₂ levels in Faridabad which may be due to various measures taken such as reduction of sulphur in diesel etc. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. Trend in annual average concentration of NO₂ is depicted in Fig. 9.2.

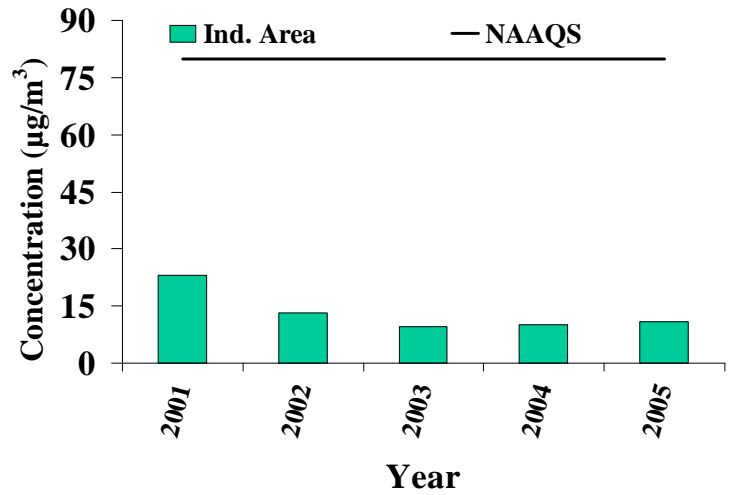
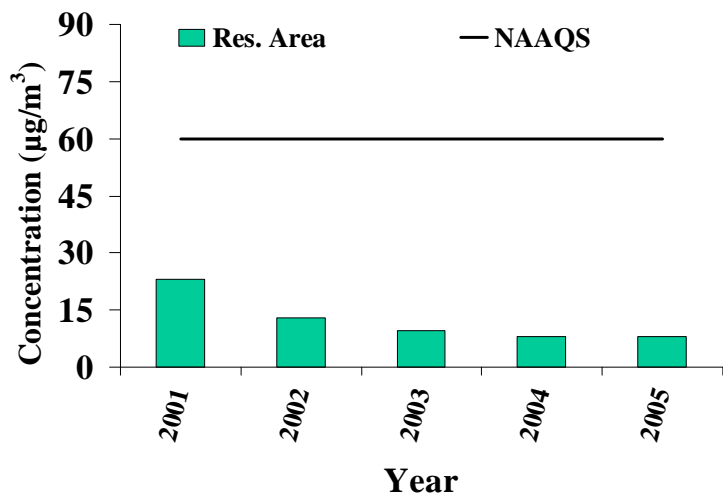


Figure 9.1: Trends in Annual Average Concentration of SO₂ in Faridabad.

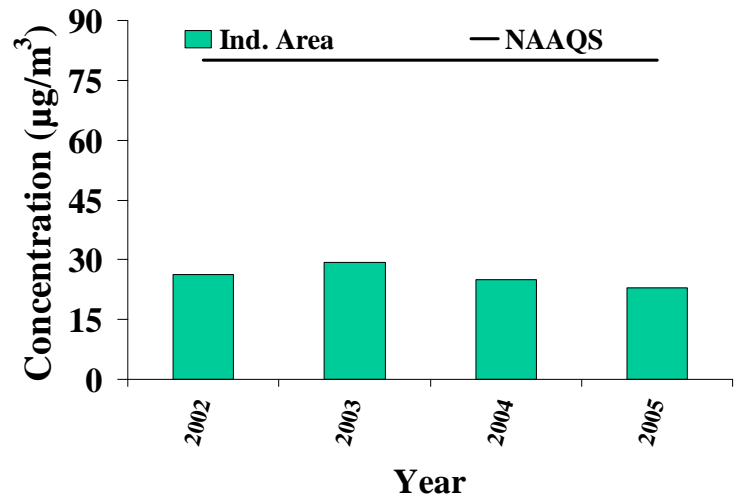
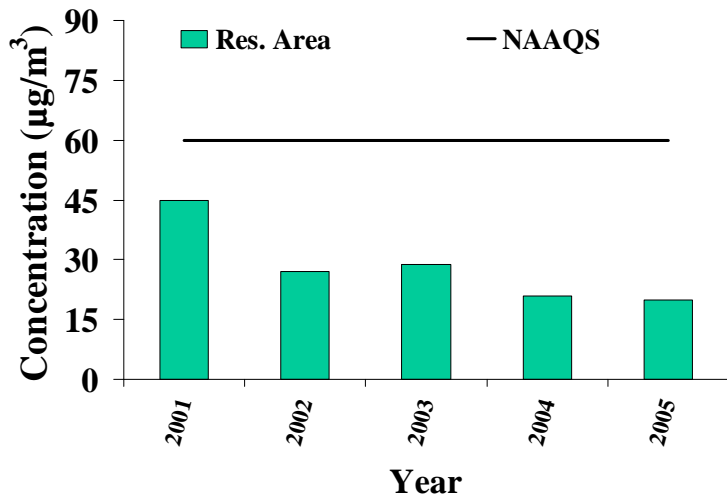


Figure 9.2: Trends in Annual Average Concentration of NO₂ in Faridabad.

A decreasing trend has been observed in ambient NO₂ levels in residential areas of Faridabad despite increase in number of vehicles. The decreasing trend may be due to various measures taken such as introduction of Bharat Stage III norms for new vehicles etc. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored year

Annual average concentration of RSPM in residential areas and industrial areas is depicted in Figure 9.3. RSPM levels exceeded the National Ambient Air Quality Standard (Annual Average). Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 9.4. SPM levels in residential areas and industrial areas were higher than the NAAQS (annual average).

9.3 Action Plan for the Control of Air Pollution for the city of Faridabad (As on June 2004).

9.3.1 Actions Taken so far

(a) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Reduction of sulphur content in diesel and petrol to 0.05%.
- Task force has been formulated under the Chairmanship of Deputy Commissioner, Faridabad at district level for rigorous auditing and inspection of the PUC centers.
- In order to check the adulteration of fuel, Haryana Govt. has put up special cell for monitoring of retail outlets, depots and oil tankers etc.
- The Distt Authorities are keeping strict vigil that solvent like naphtha kerosene etc are not made available to the unauthorized persons/dealers.
- High penalty imposed on defaulting (with adulterated fuel) vehicles.
- Haryana State Transport Deptt. has given different colour codes to three wheelers depending upon the life of the vehicle.
- For the purpose of retail vending of CNG/PNG, M/s Indraprastha Gas Ltd, have engaged a technical consultant for preparation of detailed feasibility report for expansion of its supply of CNG/PNG in the adjoining towns of Delhi which includes the towns of Faridabad and Gurgaon.
- The State govt. has issued notification on 24.12.2003 vide which the age for the operation of various type of transport vehicles has been fixed.

(b) Industrial Pollution

Almost all the industries covered under Air Pollution Act and using fuel other than oil and electricity have already installed the Air Pollution Control devices.

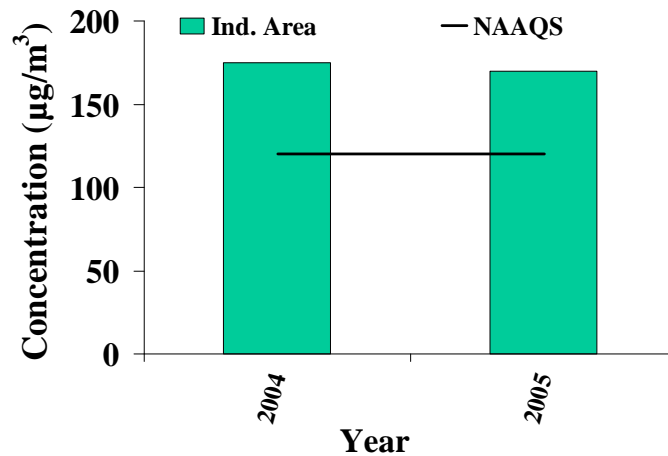
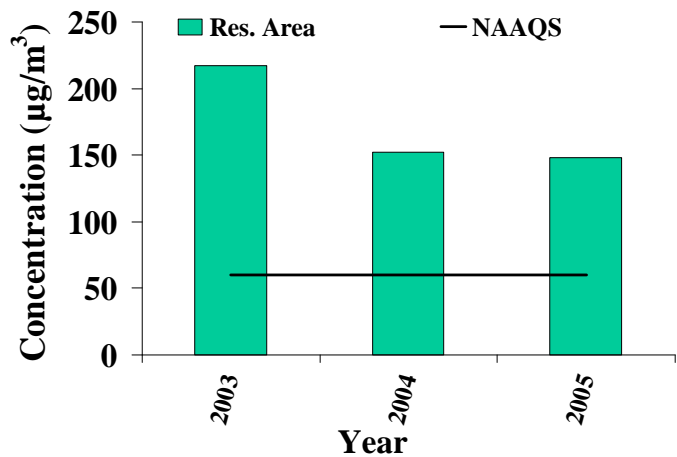


Figure 9.3: Trends in Annual Average Concentration of RSPM in Faridabad.

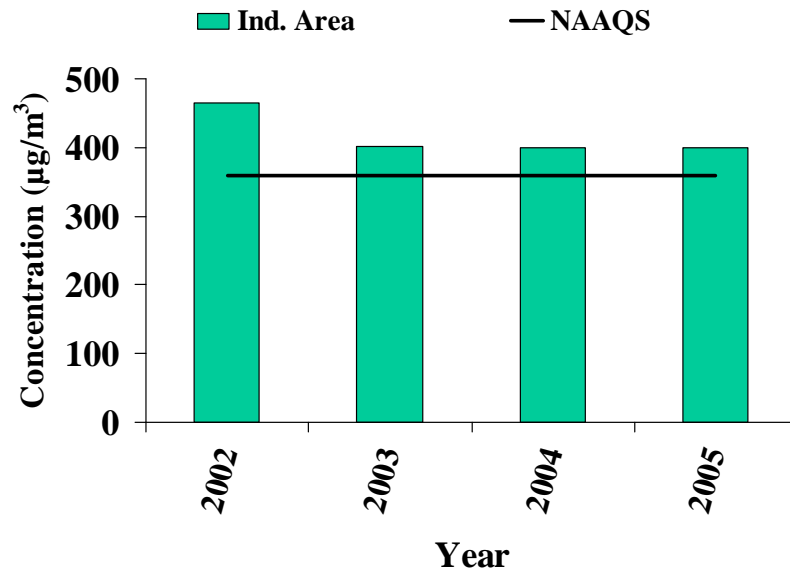
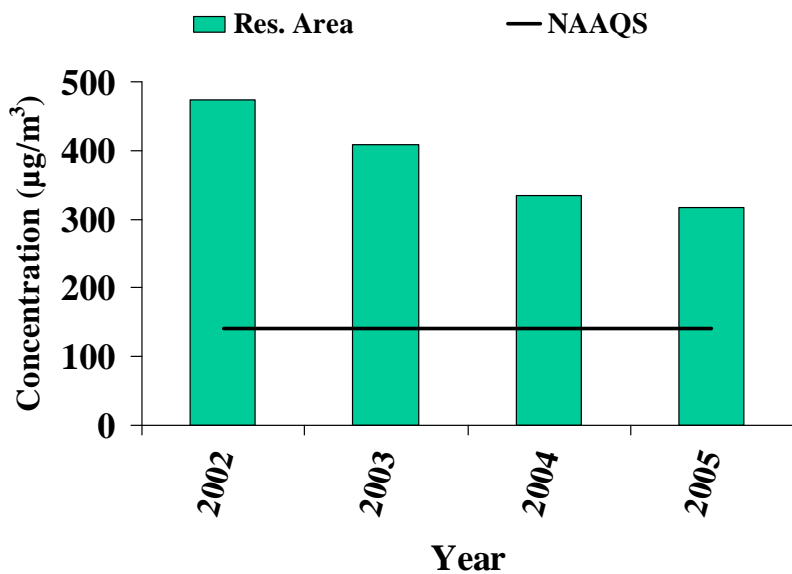


Figure 9.4: Trends in Annual Average Concentration of SPM in Faridabad.

9.3.2 Proposed Action Plan

(a) Vehicular Pollution

The salient features of action plan proposed to control vehicular pollution are as follows:

- Introduction of vehicular emission norms as per the road map proposed by the expert committee on Auto Fuel Policy.
- Reduction in benzene content to 1 % in gasoline.
- To supply fuel compatible with implemented emission norms.
- The draft notification is under preparation for phasing out of 15 year old commercial vehicles and all diesel three wheelers.
- Upgradation of PUC system. Implementation of new emission norms for in-use vehicles from October 2004
- On-road inspection of vehicles by the representatives of F&S Deptt, Transport Authority and Haryana SPCB.
- Improved centralized I&M programme to replace existing PUC system.
- Bye passing of Interstate/city vehicles and restriction of entry of non-destined commercial vehicles in the city.
- Stricter drive to check the adulteration of fuel.
- Installation of pre-mix oil dispensers and ban on sale of loose 2T oil to be planned by IOC.
- Haryana State Government has decided to approve "Authorized testing Stations" for the grant /renewal of certificate of fitness to all type of motor vehicles registered/intended to be registered in Faridabad.
- Up gradation of Public Transportation System. Besides maintaining its bus fleet of 3500 buses, Haryana Transport department has floated a new privatization scheme through which it is intended to grant 2476 bus permits situated on various routes in the state.

(b) Industrial Pollution

The salient features of action plan proposed to control industrial pollution are as follows:

- Stricter & Regular inspection and monitoring of industries to ensure compliance.
- Closure of clandestine /unauthorized Industries.
- Fuels like CNG, LDO, HSD to be introduced in industries instead of rice husk, coal etc.
- Ultra low sulphur diesel to be used by industries for their generating sets.
- Industries using rice husk as fuel to dump rice husk ash in a landfill outside Faridabad town.
- Thermal Power Plants in Faridabad and Badarpur should keep their ESP's functioning efficiently.
- Encourage tree plantation.

9.4 Findings

A decreasing trend has been observed in ambient SO₂ levels in Faridabad which may be due to various measures taken such as reduction of sulphur in diesel, implementation of stringent emission norms for new as well as in-use vehicles, improved fuel quality, use of better fuels like CNG in industries, etc. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored year. A decreasing trend has been observed in ambient NO₂ levels in residential areas of Faridabad despite increase in number of vehicles. The decreasing trend may be due to various measures taken such as introduction of Bharat Stage III norms for new vehicles etc. In residential area, decreasing trend has been observed in SPM and RSPM levels which may be due to measures such as implementation of stringent emission norms for new as well as in-use vehicles, improved fuel quality etc.

10.0 Hyderabad

Hyderabad is the capital of Andhra Pradesh and is famous as the former seat of the fabulously wealthy Nizams of Hyderabad. In Hyderabad, lively bazaars surround huge and impressive Islamic monuments dating from the 16th and 17th century. The city was founded in 1590 by Muhammad Quli, the fourth of the Qutab Shahi kings. The old city of Hyderabad straddles the River Musi while, to the north, the Hussain Sagar Lake effectively separates Hyderabad from its twin city Secunderabad. Most of the historic monuments, Salar Jung Museum are all in the old city. The Hyderabad urban agglomeration has grown rapidly during eighties and nineties. In the last two decades the number of vehicles have grown enormously. Currently there are over 11 lacs vehicles in the city.

10.1. Sources of Air Pollution

The major sources of air pollutants include vehicles and industries. Two wheelers and cars have recorded very high growth rates in the nineties. Most of the two-wheelers are 2-stroke contributing to the bulk of unburnt hydrocarbons and carbon monoxide.

(a) Vehicular Sources

The number of on-road vehicles in the city of Hyderabad is over 11 lakhs. About 79% of the total vehicle fleet is two wheelers. In this city, 9% of the fleet is gasoline cars, 6% three wheelers & 2% taxis & trucks.

(b) Industrial Sources

There are large number of small and medium scale industries located in Hyderabad/ Secunderabad. Industrial units are located in industrial areas of Azamabad, Azamabad, Chandulal Baradhari, Sanath Nagar and scattered units in Amberpet, Bahadurpura, Candrayangutta and Musheerabad. All these units are surrounded by residential area. Most of the industries located in the city have provided pollution control systems such as cyclones, scrubbers and bag filters.

10.2. Ambient Air Quality

Ambient air quality is carried out at present at nine monitoring stations in Hyderabad under National Air Quality Monitoring Programme (NAMP). Andhra Pradesh Pollution Control Board is carrying out monitoring at six monitoring stations and three of these monitoring stations have been started recently. NEERI is carrying out monitoring at three monitoring stations. Status and Trends of air pollutants in Hyderabad are described in this section.

10.2.1 Violation of NAAQS (24 hourly Average)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated during many years. The NAAQS (24 hourly average) of SPM are violated in residential areas and NAAQS (24 hourly average) of RSPM are violated during many years in residential areas.

10.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

In general low levels of SO₂ are observed in residential and industrial areas in Hyderabad. Low and moderate levels of NO₂ are observed in Hyderabad. High levels of RSPM and SPM were observed in residential areas of Hyderabad during many years.

10.2.1 Air Quality Trends in Hyderabad

Trend in annual average concentration of SO₂ in residential areas and industrial areas is depicted in Fig. 10.1. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. A decreasing trend has been observed in Hyderabad which may be due to various measures taken such as reduction of sulphur in diesel. Trend in annual average concentration of NO₂ in residential areas and industrial areas is depicted in Fig. 10.2. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored years.

Trend in annual average concentration of RSPM in residential areas and industrial areas is depicted in Fig. 10.3. A decreasing trend has been observed in residential areas of Hyderabad which may be due to various measures taken. Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 10.4. SPM levels in residential areas were higher than the NAAQS (annual average) during many years whereas SPM levels in industrial areas were lower than the NAAQS (Annual average) during many years.

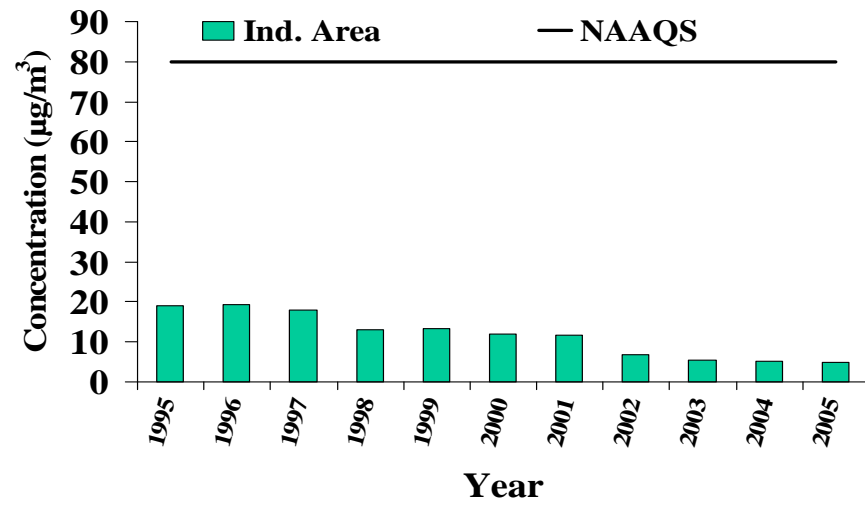
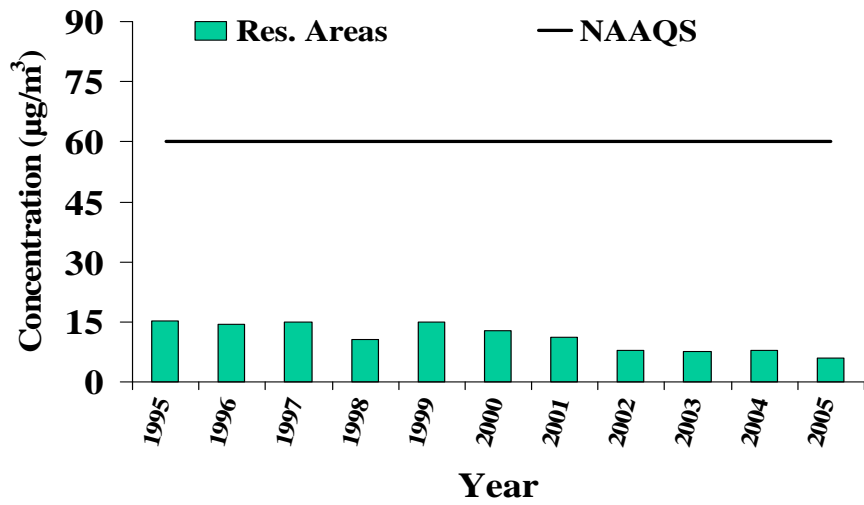


Figure 10.1: Trends in Annual Average Concentration of SO₂ in Hyderabad.

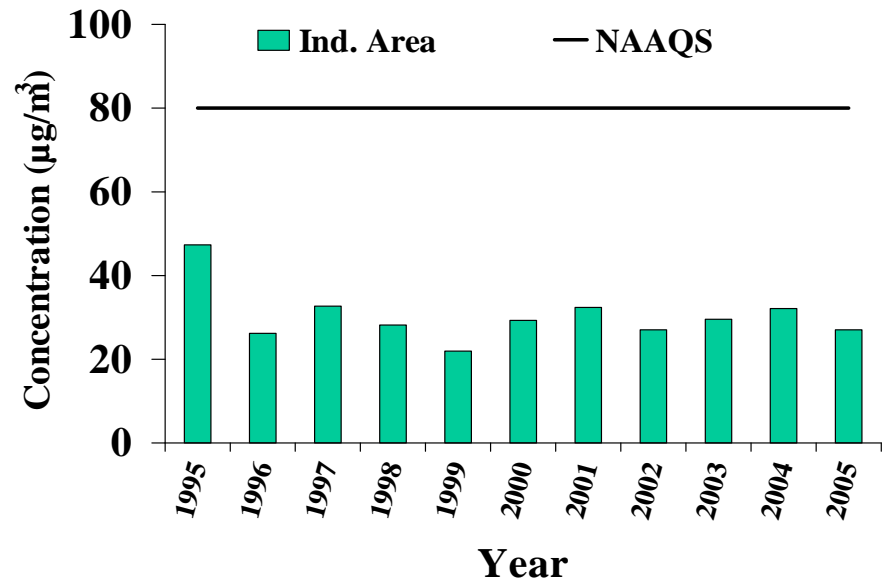
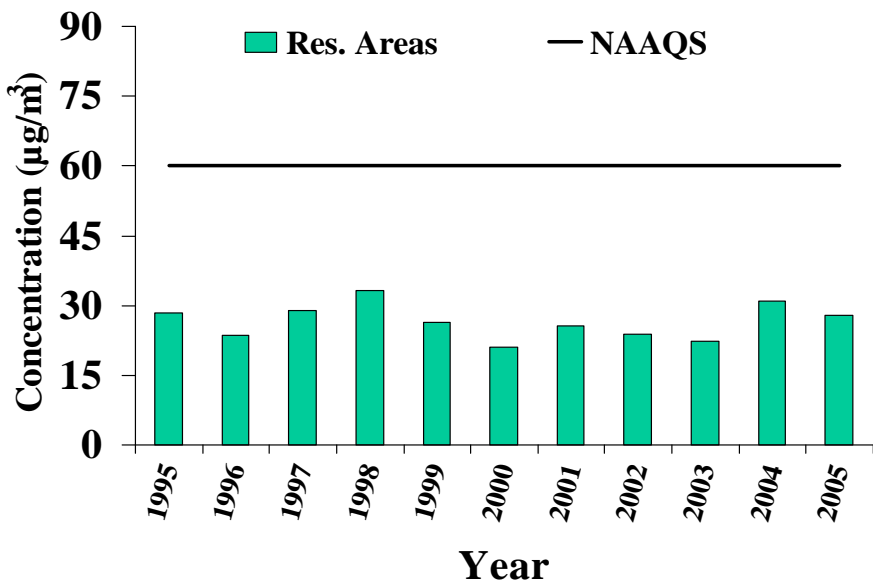


Figure 10.2: Trends in Annual Average Concentration of NO₂ in Hyderabad.

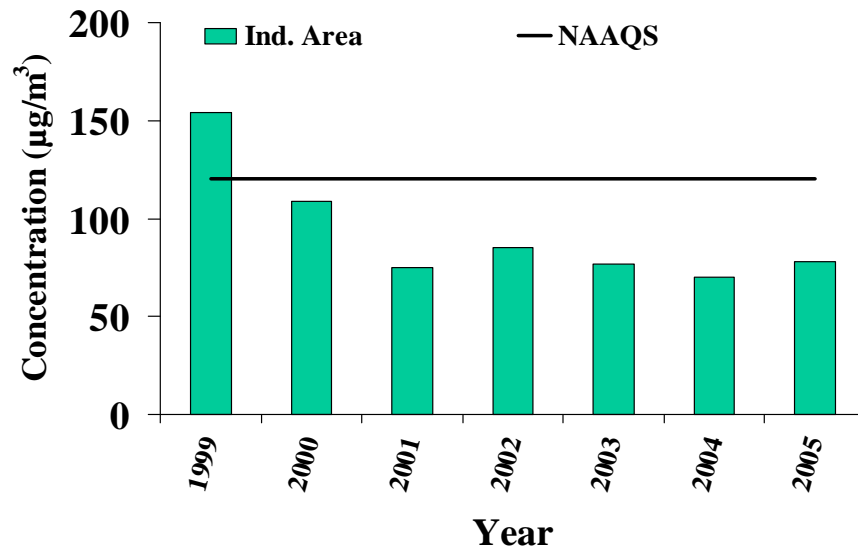
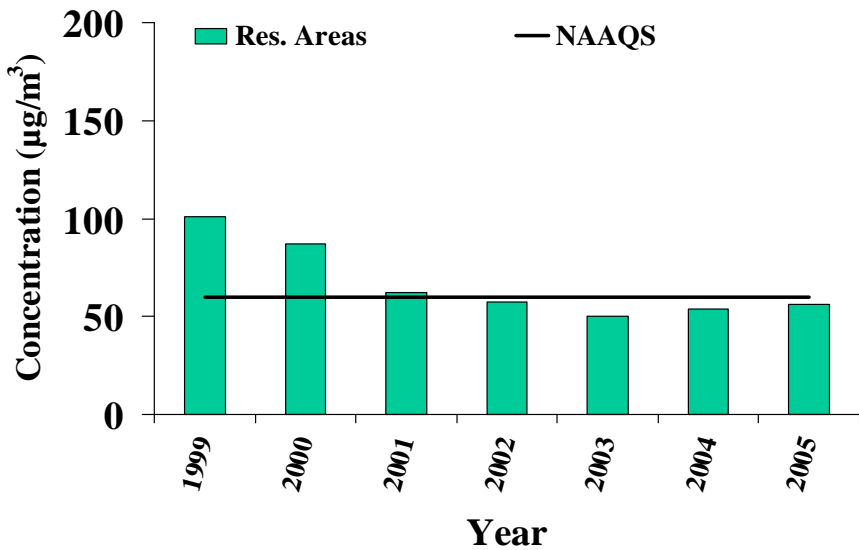


Figure 10.3: Trends in Annual Average Concentration of RSPM in Hyderabad.

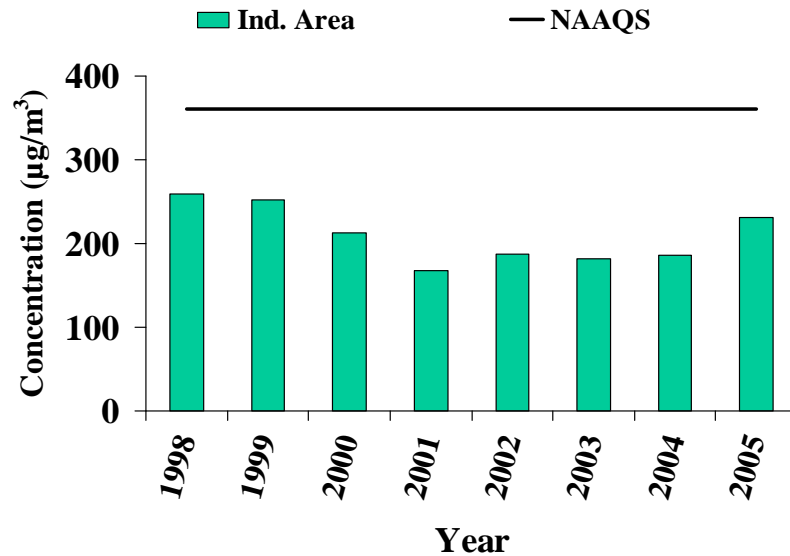
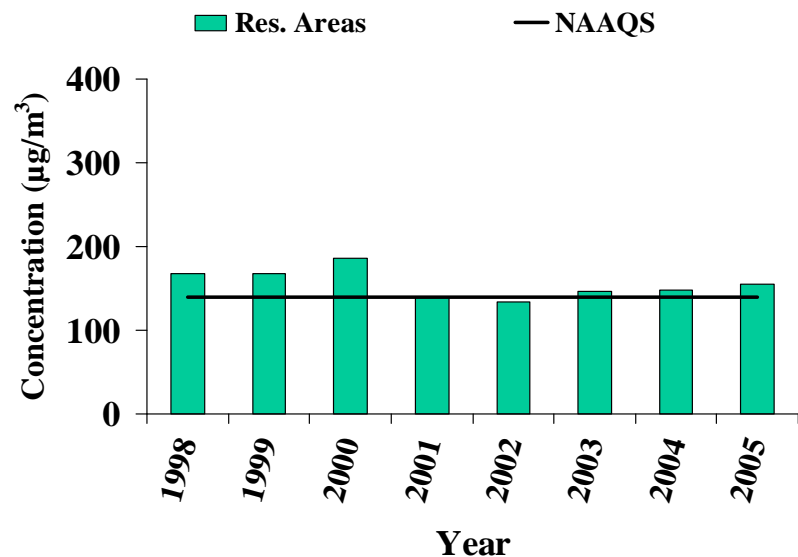


Figure 10.4: Trends in Annual Average Concentration of SPM in Hyderabad.

10.2.4 Meteorological Issues

Meteorological factors play an important role in determining ambient concentrations of air pollutants. It is important to understand the effect of meteorological factors such as wind speed on ambient levels of air pollutants. Seasonal variation RSPM levels at Tarnaka, Hyderabad during 2005-06 is shown in Fig 10.5. During winter months total calm percentages are more and the concentration of NO_2 is also higher than the other seasons. The general meteorology during the winter has atmospheric stability, which in turn allows for less general circulation and thus more stagnant air masses. Stagnant air masses allow more accumulation of pollutants in any given area. During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources, increase mixing processes

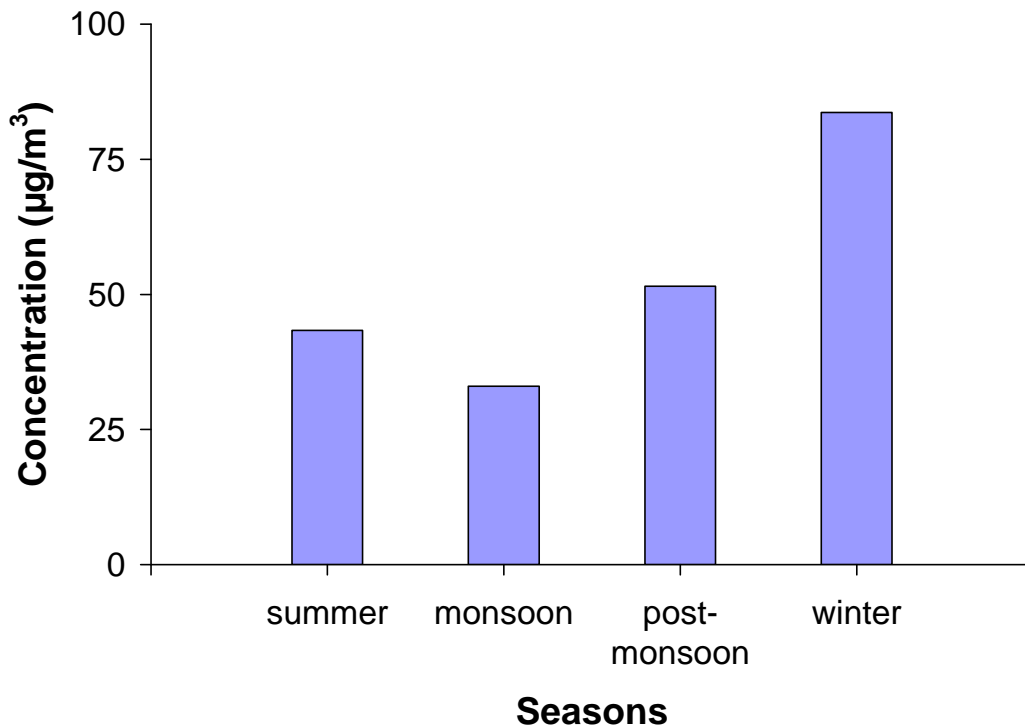


Figure 10.5: Seasonal Variation in RSPM levels at Tarnaka, Hyderabad during 2005-06.

10.3 Action Plan for the Control of Air Pollution for the city of Hyderabad (As on February 2005)

10.3.1 Action taken so far

- Five Mobile Task Forces has been constituted on 09.08.2002 to look after various issues related to implementation of action plan.
- The number of Ambient Air Quality Monitoring Stations has been increased from 9 to 21 stations. APPCB has one online ambient air monitoring station and one mobile air monitoring station

(a) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- Since , 2000, with an intention of carbon sequestration , Hyderabad Urban Development Authority (HUDA) has taken up Urban Greening Project. This project is upto 2006.
- Since 1999 Municipal Corporation of Hyderabad has taken up a total of 2652.39 hectares of the avenue plantation till date.
- Periodic checks on all the air polluting industries in the HUDA area are being conducted. Seven non-complaint industries have been identified so far.

(b) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Bharat Stage –II emission norms implemented.
- Improved quality fuel made available.
- PUC certificates to all 3 & 4 wheelers have been made mandatory from 01.08.2002 and for 2 wheelers from 01.09.2002.
- Upgradation of PUC centers for petrol by 1st October , 2002 and for diesel by November 1st , 2002.
- 122 Polluting Centers are computerized in the city. No-Fuel without PUC drive commenced. Seven computerized online PUC centers have been networked on a pilot basis.
- 280 pre-mixed 2T Oil dispensing stations have been installed.
- 2 task forces are operating since 4-5-2002 to check the adulteration of oil & fuel.
- Nine LPG dispensing stations are operational out of targeted 45 stations. 23 plots have been identified for setting up multi fuel dispensing station. Till November 2004, 1475 vehicles are converted to LPG out of 63.414 Faster

- Multi Model Transport System (MMTS) to improve mass transportation system has been introduced. The MMTS was inaugurated on 9-8-2003. Electric trains are in operation. The required road network and other facilities are being worked out.
- Restriction on plying of interstate/intercity buses and restriction of entry to non-destined commercial vehicles in city.
- Various mass awareness programmes organized.

10.3.2 Proposed Action Plan

(a) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- Implementation of the “Charter on Corporate Responsibility” in Hyderabad for the industries covered under the 17 categories.

(b) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:

On the basis of recommendations of the Cabinet Sub- committee following action plan has been proposed to controlling vehicular pollution.

- Bharat Stage –III emission norms will be implemented for all categories of 4-wheeled vehicles with effect from April 2005. Supply of the commensurate fuel will also be done accordingly.
- All in-use petrol driven 3 wheelers to be converted to LPG by October 2005.
- In respect of ‘No Fuel without PUC,’ programme, a Committee consisting of RTA concerned and the Traffic Police in mobile teams is proposed under the overall supervision of the Transport Commissioner has been constituted. The committee is empowered to check all visibly polluting vehicles including RTC and SETWIN buses. The teams will also verify PUC certificates issued without proper check and the source of such certification, so that action can be taken comprehensively.
- Phasing out of older vehicles was required to be taken but in the absence of specific orders from the apex courts directing the government for amending the CMV act, it may not be legally feasible to phase out vehicles based on their age.
- Issue of Necessary amendment of Motor Vehicle Act to apprehend and penalize the use of adulterated fuel in vehicles from January 2004.
- To augment existing pre- mixed 2T oil petrol outlets.

- To augment number of PUC Centers along with increase in tariff for emission testing.
- APSRTC has proposed to convert 538 buses to Euro-I norms every year till 2005 for plying in HUDA limits.

(c) Scheme for switching over to LPG/CNG

- Nine LPG dispensing stations are operational out of targeted 45 stations. 23 plots have been identified for setting up multi fuel dispensing station. Till November 2004, 1475 vehicles are converted to LPG out of 63.414 Faster conversions could lead to traffic hazards and long lines outside the 9 LPG stations.
- There is a possible availability of CNG for the city and buses would be targeted for conversion. Conversion action plan of the RTC buses is awaited from the transport department in next 1 month.

10.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Hyderabad. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, implementation of stringent emission norms for both new as well as in-use vehicles along with improved fuel quality. NO₂ levels are also within the prescribed NAAQS (Annual average) during all the monitored years despite increase in number of vehicles. RSPM levels have shown a decreasing trend in Hyderabad which may be due to measures taken such as implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality Implementation of CREP (Common Responsibility for Environment Protection) in 17 categories of highly polluting Industries, implementation of urban greening project and measures like introduction of pre-mixed 2-T oil, checking adulteration traffic management, etc.

11.0 Jharia

Jharia is a block level town of the Dhanbad district where coal-mining activities are carried out. Jharia coal fields is located in Dhanbad district, between latitude 23° 39' to 23° 48' N and longitude 86° 11' to 86° 27' E. It is situated at the heart of the Damodar river valley and is about 250 km NW of Calcutta and about 1150 km SE of Delhi. The maximum extent of the coalfield is about 38 km from East to West and 19 km from North to South. Jharia Coal field in Jharkhand is the richest coal bearing area in India which contains large quantities of high grade coking coal. However, this area also contains a large number of mine fires which have been burning for several decades. This is the most exploited coalfield because of available metallurgical grade coal reserves. Mining in this coalfield was initially in the hands of private entrepreneurs, who had limited resources and lack of desire for scientific mining. The mining method comprised of both opencast as well as underground. The opencast mining areas were not backfilled, so large void is present in the form of abandoned mining. Extraction of thick seam by caving in past at shallow depth has damaged the ground surface in the form of subsidence and formation of pot holes or cracks reaching upto surface, enhancing the chances of spontaneous heating of coal seams and mine fire. This coalfield is engulfed with about 70 mine fires mine fires, spread over an area of 17.32 sq. km., blocking 636 million tonnes of coking coal and 1238 million tonnes of non-coking coal. Around 34.97 sq. km. area of the Jharia coal fields is under subsidence. It is mentioned in Jharia coal fields reconstruction program that 70% of the underground production of coal would come by caving and balance 30% by stowing and thus about 101 sq. km. underground mining area would be affected by subsidence. The other factor, which damages the land in Jharia coal fields, is opencast mining and overburden dumps.

11.1 Sources of Air Pollution

Owing to large coal deposit, the main activity of the region is coal mining and coal based industries. The various sources of pollution in Dhanbad-Jharia can be categorized as under:-

(i) Mining

The mining and other related activities have been carried out in this region for a long time. With increasing awareness on environmental protection, State Pollution Control Board has taken several measures and declared this region as "problem Area".

There are a total of 86 coalmines including opencast as well as under ground in the study region. Mining activity primarily leads to air and land pollution. The various activities leading to air pollution are as under:-

- i. Coal and rock dust in course of stripping, loading unloading and transportation.
- ii. Dust generated due to the operation of vehicles including both HEMM and Trucks/Dumpers.
- iii. Dust during blasting hole drilling
- iv. Dust from exposed surface of dumps, coal benches, flanks of open cast mines.
- v. Generation of dust during the operation of coal handling plants and loading of coal into wagons.
- vi. Katchha Haul Roads in open cast mines areas cause large air borne particulates.
- vii. The abandoned mine area not reclaimed properly
- viii. Old explored mines, where no mining activity is carried out for long time and not declared as abandoned mines and therefore, not reclaimed.

(ii) Vehicular Emission and Transportation:-

The total number of registered vehicles in Dhanbad is 44562 and in Jharia is 36414. The type of vehicles includes trucks, dumpers, buses, cars two and three wheelers. Because of the two strokes engine of the two wheelers, the problem of air pollution has magnified.

The traffic census data shows that the major contributor to air pollution from vehicles are passenger vehicles comprising two, three and four wheelers. The percentage of heavy vehicles during day hours is around 25%. Through traffic census could not be carried out during the night hours, but it is learnt that during night hours, large number of heavy trucks are quite frequent on these roads.

(iii) Small Scale Industries

There are a total of 103 small-scale industries in the study area. Majority of them are the following types:-

- Hard coke plant behive type
- Soft-coke plant
- Four numbers of by-product type of coke plants
- Flour mill
- Re-rolling mill
- Chemical plants
- Coke manufacturing

The process in the hard coke industries includes burning of pulverized coal in the oven for 24-72 hours depending upon the oven type. The extract is then quenched with water. During the burning process, volatile gases and unburnt hydrocarbon escapes into the atmosphere.

The state board has taken timely action to curb this problem and directed all such units to increase the stack height to achieve better dilution and dispersion. This has given visible result in the area.

(iv) Soft coke manufacturing

Soft coke is used for the domestic purpose. The manufacturing process involves burning of coal at low temperature. Earlier it was done in open creating large air pollutants in the ambient air environment. To cater this problem, the state board has taken stringent action and directed all such units to construct an oven with a stack of desired height and burn coal in the oven. This has given a great relief in the area.

(v) Domestic coal burning

In mining areas, falling mainly in the jurisdiction of Bharat Coking coal Ltd. (BCCL), soft coke is produced by conventional 'Bhatta' method also called stack burning. Coal of 50mm to 200mm size are heaped in stack covered by a thin layer stack coal and lighted. In this method, it is allowed to burn for 72 hours and then quenched with water. This uncontrolled burning of coal releases large quantity of volatile and unburnt hydrocarbon in the atmosphere besides creating the problem of fly ash.

11.2 Ambient Air Quality

Jharkhand State Pollution Control Board is measuring ambient air quality at MADA, Jharia. The status and trends in ambient air quality is detailed in following sections.

11.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ are not violated. NAAQS (24 hourly avg.) of NO₂ was violated during some years. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated.

11.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in Jharia. Moderate levels of NO₂ were observed in Jharia during

many years. High and critical levels of RSPM were observed in Jharia. Moderate levels of SPM were observed during many years in Jharia.

11.2.3 Air Quality Trends in Jharia

Trend in annual average concentration of SO₂, NO₂, RSPM and SPM is depicted in Fig. 11.1. SO₂ levels in Jharia were lower than the NAAQS (annual average) during all the monitored years. NO₂ levels in Jharia were lower than the NAAQS (annual average). RSPM levels are exceeding the National Ambient Air Quality Standard (Annual Average). SPM levels in residential areas were higher than the NAAQS (annual average) during many years.

11.2.4 Meteorological Issues

Meteorological factors play an important role in air pollution studies particularly in pollutant transport irrespective of their entry into the environment. Seasonal variation in RSPM levels at MADA Jharia is depicted in Figure 11.2. The concentrations are higher in winter months and are lower during monsoon months. Atmospheric dispersion is typically at a minimum during winters and therefore the pollutants will not be as widely dispersed. Winter months also experience more calm conditions. The prevailing calm conditions facilitate more stability to the atmosphere and consequently slow dispersion of pollutants generated and help in build up of pollutants in vicinity of the pollutant sources. During the monsoons, precipitation removes particulate matter via associated wet deposition process. Also, high wind velocities result in transport of particulate matter away from sources and increase mixing resulting in lower concentrations. During winter, there is increased atmospheric stability, which in turn allows for less general circulation and thus more stagnant air masses.

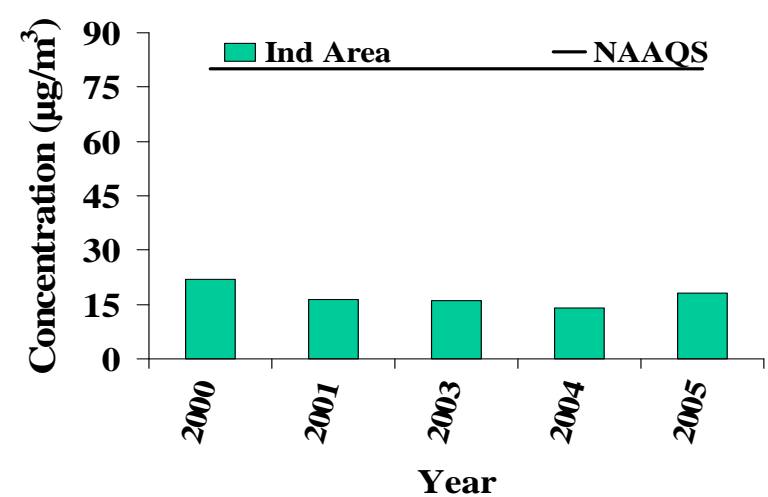
11.3. Action Plan for the Control of Air Pollution for the city of Dhanbad-Jharia (As on February 2004).

11.3.1 Action Plan Proposed

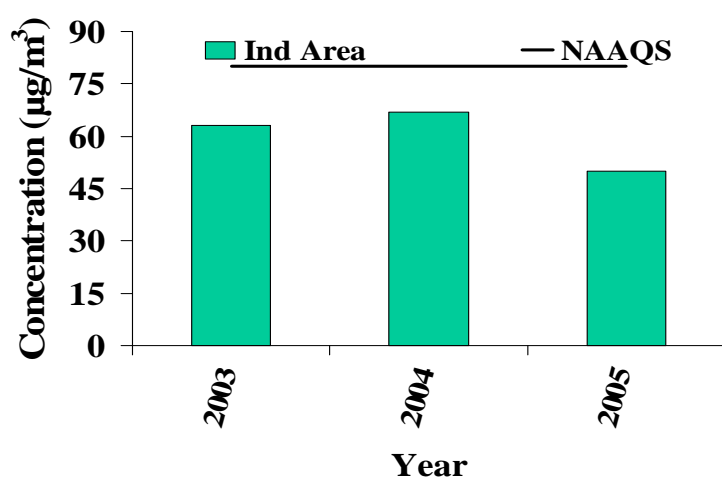
(a) Industrial Pollution

The salient features of action plan proposed to control industrial pollution are as follows:

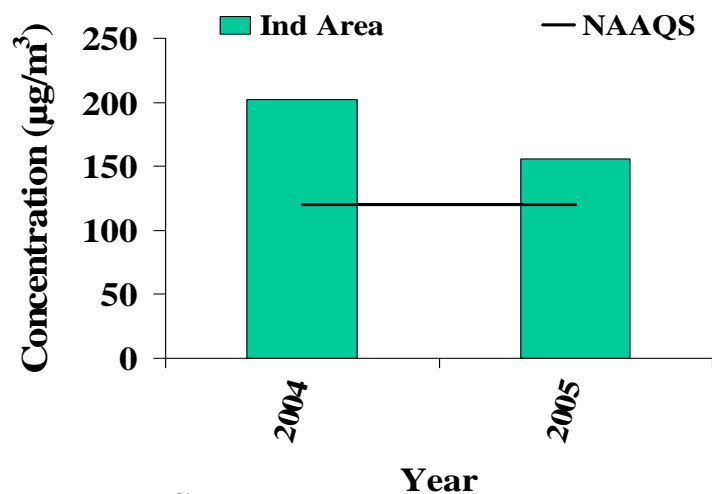
- Organization of the inventories of the polluting industries, i.e., large, medium and small scale has already been commenced.



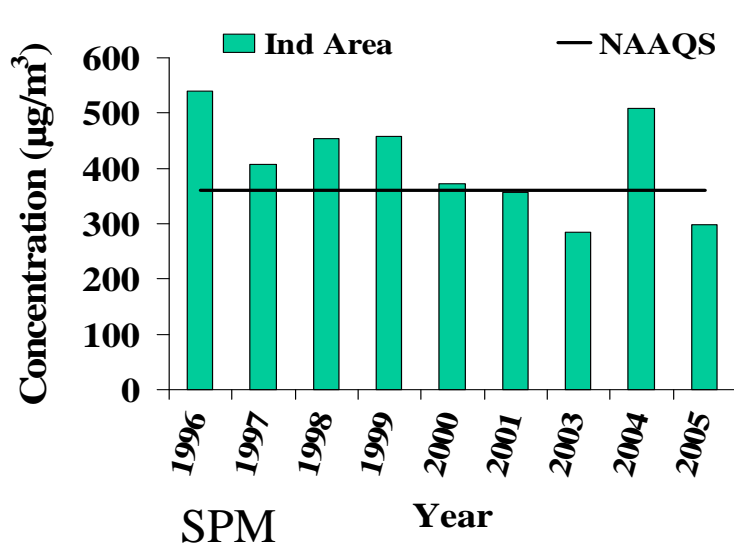
SO₂



NO₂



RSPM



SPM

Figure 11.1: Trends in Annual Average Concentration of SO₂, NO₂, RSPM and SPM in Jharia.

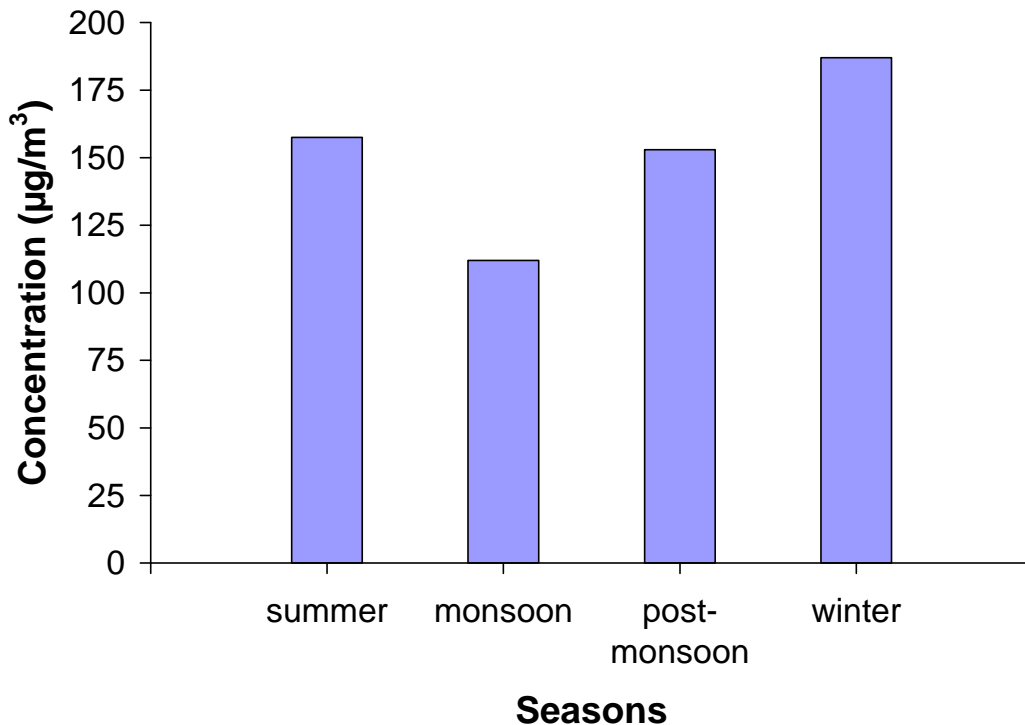


Figure 11.2: Seasonal Variation in RSPM levels at MADA Jharia during 2005-06.

- Control of industrial emissions ensuring compliance to standard.
- Identification and closure of clandestine/unauthorized operations
- Round the clock vigilance of industries for identification & control of clandestine emissions
- Compliance to standards in DG sets
- Verification of compliance to specified norms under Air Act would be intensified.
- Ambient Air Quality monitoring at critically polluted industrial areas in the town to be intensified.
- All the time vigilance on coming up of new industries.
- All the industrial plants to develop a green belt all along the periphery. To ensure reclamation of mined out areas.
- There are many abandoned mine out areas where mining is not being carried out for the long time. Such mines should be immediately declared abandoned and should start reclamation.
- Dense tree plantation to be carried out on overburden, which left necked.
- Illegal open burning of coal to prepare soft coke.
- Soft coke manufacturing by 'Bhatt' method (stack burning).

(b) Vehicular Pollution

The salient features of action plan proposed to control vehicular pollution are as follows:

- Inventory of emission load from all categories of vehicles with respect to different pollutants to be done.
- Notification of vehicle emission norms in accordance with the road map proposed by the expert committee on Auto Fuel Policy.
- Introduction of clean-fueled vehicles like CNG/LPG/Hybrid Battery etc.
- Necessary equipments to verify vehicular emission would be purchased to intensify drive for checking vehicular emission so as to take necessary action against the defaulters.
- To ensure that no loose kerosene is sold within the vicinity of petrol stations.
- Intensify the implementation of the ban on supply of loose 2-T oil at Petrol Station/Service garages.
- All new vehicles for Dhanbad-Jharia would be registered only if they are Bharat-II compliant.
- Diversion of bulk public vehicles from Kendua-Dhanbad Road to Kendua-Jharia Road.
- Diversion of traffic density from Dhanbad-Saridhella-Govindpur road towards Dhanbad-Baliapur-Sindri Road.
- Counter checking of pollution under control certification so as to ascertain its reliability.
- Construction of fly-overs and road connecting to mining areas by 31.4.2004.
- Diversion of traffic load from Dhanbad-Patherdih-Sindri Road to Railway by increasing frequency of Dhanbad-Sindri local train.
- Regulation of traffic in peak hours at major traffic intersections.
- Restriction on movement of trucks and carrier vehicles in urban areas.
- Mining areas & colony in the area to be provided with good plantation and permanent roads.
- Construction of ring road along the periphery of Jharia coalfield and link and feeder roads connecting the centers of activities to the ring road. The ring road shall be connected to NH-2 and NH-32 suitable link roads by 31.4.2004.
- Strengthening and construction of new road.

(c) Ambient Noise Control

The salient features of actions plan proposed to control vehicular pollution are as follows:

- Control of noise pollution from industrial sources.
- Measures for control of traffic noise.
- Notification for restricted use of loud speakers for social and religion functions and its effective implementation.

11.4 Findings

SO₂ levels at Jharia were within the prescribed NAAQS during all the monitored years. The reasons for low levels of SO₂ may be measures taken such as reduction of sulphur in diesel. NO₂ levels were also within the prescribed NAAQS (Annual average) although NAAQS (24 hourly avg) of NO₂ was exceeded during some years. RSPM levels were above the prescribed NAAQS and SPM levels also exceeded prescribed NAAQS during many years. The reason for high RSPM and SPM levels may be widespread coal mining in the areas.

12.0 Jodhpur

Jodhpur, one of the largest district of Rajasthan state is centrally situated in Western region of the State, having geographical area of 22850 sq. Kms. It has population of 28.81 lacs as per 2001 census. The district stretches between 2600' and 27037' at north Latitude and between 72 55' and 73 52' at East Longitude. This district is situated at the height between 250-300 meters above sea level. The length of the district from North to South and from East to West is 197 Km.& 208 Km. Respectively. This district comes under Arid zone of the Rajasthan state. It covers 11.60% of total area of arid zone of the state. Some of the area of Great Indian Desert THAR also comes with in the district. General slope of the terrain is towards west. Despite its arid climate, Jodhpur is blessed with a variety of flora and fauna. A survey conducted by district administration with the help of forest officials shows 162 flora and 144 fauna at Machia Safari situated only 10 kms from Jodhpur. Extreme of heat in summer and cold in winter is the characteristic of the desert. Jodhpur is no exception. The temperature varies from 49 degree in summer to 1 degree in winter. The rainy days are limited to maximum 15 in a year. The average rainfall is 302 mm.

Soil of the district is classified mainly as sandy and loamy. Bajra (pearl millet) is the major crop in Kharif. Jodhpur has excellent ground water in many part of district. In Rabi Wheat, Pulse and a variety of masala like Jeera, Dhania and Red chilly are also grown. It is one of the major production centre for Guar. There is no perennial river in the district. However, there are important rivers in the district viz. Luni and Mithri rivers. Main sources of irrigation besides rainwater are dug-wells tube-wells. The highest-irrigated area in district is in Bilara Tehsil followed by Bhopalgarh and Osian tehsil. The major and important minerals of the district are sand stones and Lime stones. Fawn & Red colours sandstone of the district is very popular and found in abundance. Besides this Building stones, stone slabs and flagstones are mined in the district on regular basis. Minerals like quartz & clays of various colours & dolomite are also available in the district. On account of arid climate, negligible percentage of the total reporting area for the land use in the district are covered under forests. Due to sandy soil only scrub and thorny bushes of vegetation are found in the forest areas of the district. The main species of trees are Kumat, Kair, Khejri, Babul, Bir, Jal khara, Pilu, etc. Fruit bearing trees are promegranates and guavas. The fauna of the district include jackal, Jungle Cat, Indian Fox, Black Buck, Chinkara, common hare, etc. The birds commonly found are Baya, koyal, parrot, Vulture, Jungle Crow, bulbul, House Sparrow, Kite, Sand Grouse, Common quail, grey partridge, little egret, etc.

12.1 Sources of Air Pollution

The main sources of air pollution are natural dust and vehicles. There are industrial units engaged in manufacture of cement, industrial gases, textiles, derivatives of Gaur Gum, Chemicals, Plastics, electronics, electrical, mineral based, S.S. utensils etc. There are 62 rolling mills engaged in processing of stainless steel Sheets/Patta.

As on 31.03.2002 there are 26 large & medium scale units working in the district. As on 31.3.2002 there are 15177 units registered with District industries center. Share of textile units is predominant and is followed by units based on live stock resources and their number are 3742 & 2839. There were 1337 units based on agricultural resources and number of forest based units were 1250. The number of chemical units were 835 and there were 2447 mechanical and allied units and 882 units were engaged in production of building materials. There are large number of handicraft units engaged in production of items of white metal, wooden toys, fancy items of sheep and decoration. A large number of artisan based industries are engaged in screen printing of cloth, shoe embroidery, dyeing and printing of clothes, salt making, etc.

12.2 Ambient Air Quality

Rajasthan State Pollution Control Board is monitoring ambient air quality at three monitoring stations under National Air Quality Monitoring Programme (NAMP). These stations are located at Sojati gate, RIICO Office and Maha Mandir Police Thana. In addition, three monitoring stations are being operated under State Air Quality Monitoring Programme (SAMP). The status and trends in ambient air quality is detailed in following sections.

12.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated.

12.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in residential areas and industrial areas of Jodhpur. Low levels of NO₂ were observed in Jodhpur during many years. Critical levels of RSPM and SPM were observed in residential areas.

12.2.3 Air Quality Trends in Jodhpur

Trend in annual average concentration of SO₂ is depicted in Fig. 12.1. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. Trend in annual average concentration of NO₂ is depicted in Fig. 12.2. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored year

Annual average concentration of RSPM is depicted in Figure 12.3. RSPM levels are exceeding the National Ambient Air Quality Standard (Annual Average) in residential areas. Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 12.4. SPM levels in residential areas were higher than the NAAQS (annual average).

12.2.4 Meteorological Issues

Meteorological factors play a important role in air pollution studies particularly in pollutant transport irrespective of their entry into the environment. The wind speed and direction play a major role in dispersion of air pollutants.

Seasonal variation in RSPM levels at monitoring station at Sojati gate, Jodhpur during 2005-06 is depicted in Figure 12.5. The concentrations are higher during winter and summer months and are low during monsoon months. A plausible explanation for these results may be found by examining meteorological conditions. The strong and medium winds during summer months creates turbulent conditions and local disturbances in the environment which cause frequent dust storm and hazy conditions. These dust storms and hazy conditions build up high particulate matter levels in the ambient air, mostly constituting soil borne particles.

The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources, increase mixing processes and the winds coming from the marine environment will have less background concentrations than that of continental air masses. The winter months of are relatively much calm than other months. The prevailing calm conditions facilitate more stability to atmosphere and consequently slow dispersion of pollutants generated and help in build up of pollutants in vicinity of the pollutant sources. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher SPM & RSPM concentrations.

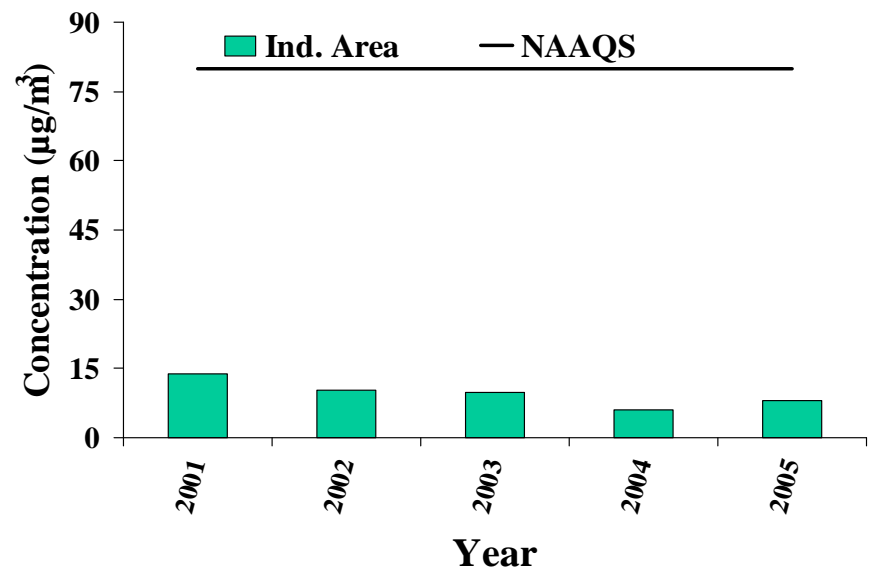
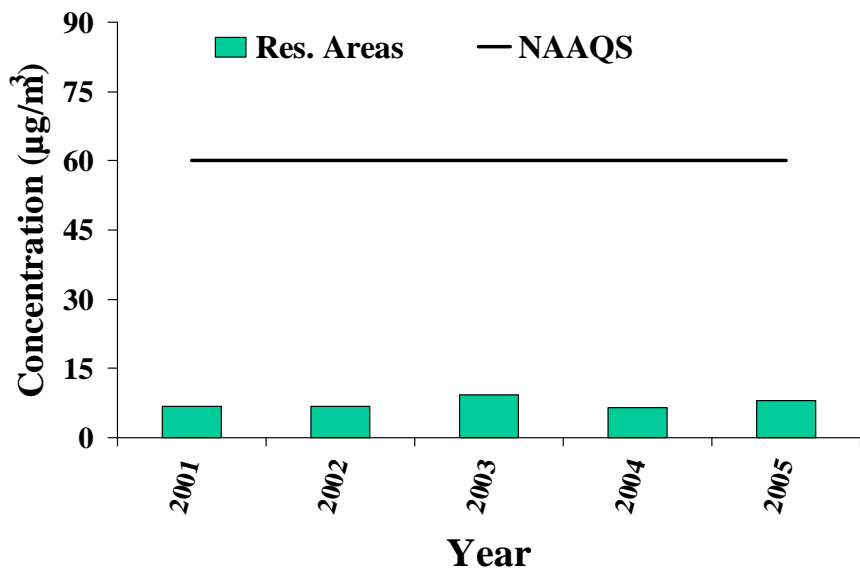


Figure 12.1: Trends in Annual Average Concentration of SO₂ in Jodhpur.

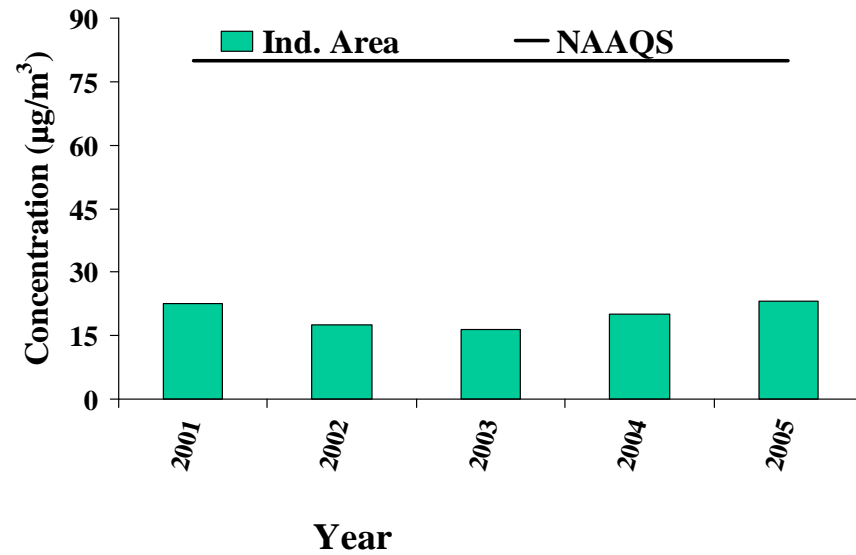
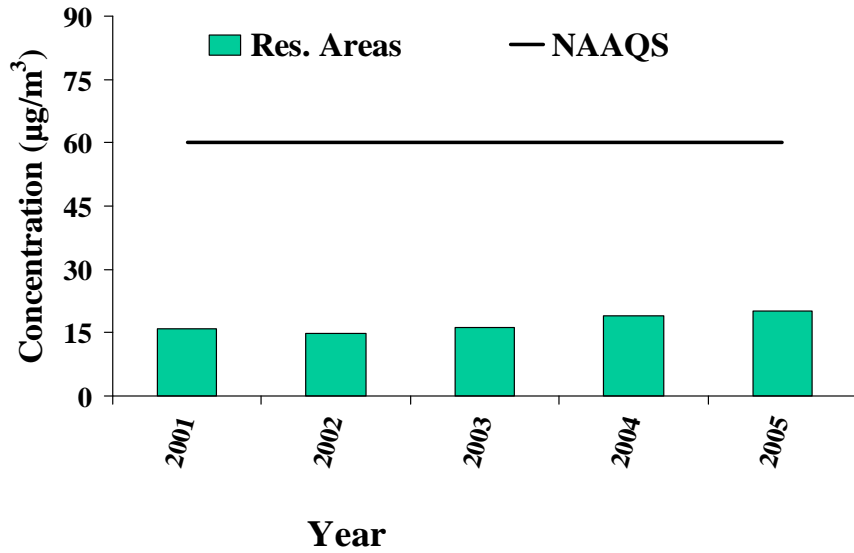


Figure 12.2: Trends in Annual Average Concentration of NO₂ in Jodhpur.

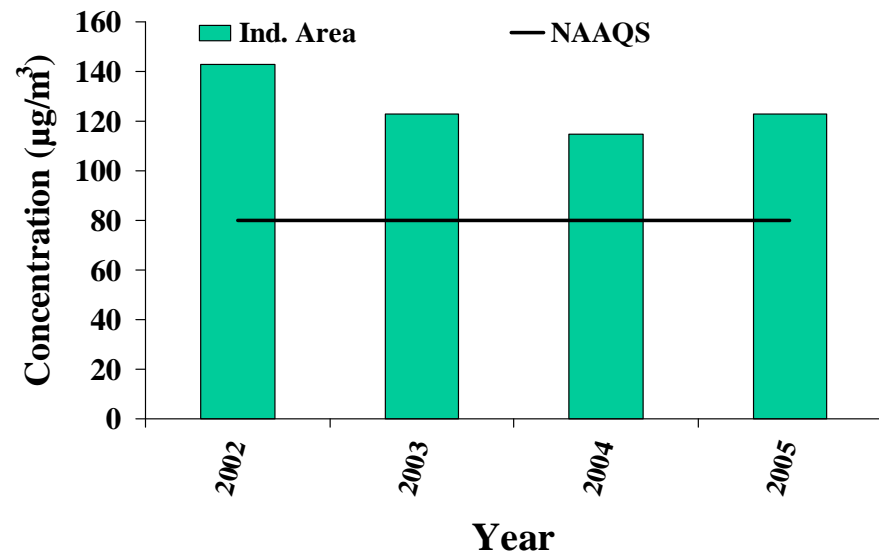
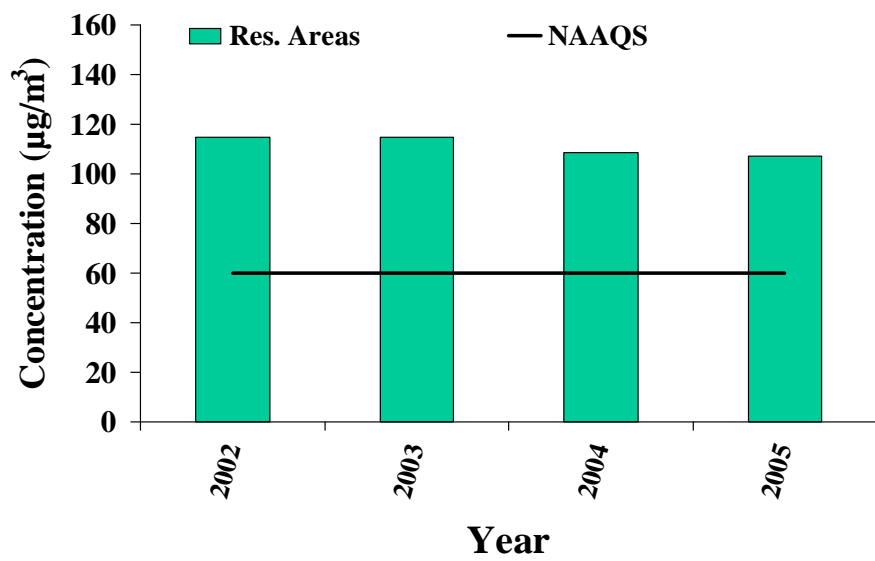


Figure 12.3: Trends in Annual Average Concentration of RSPM in Jodhpur.

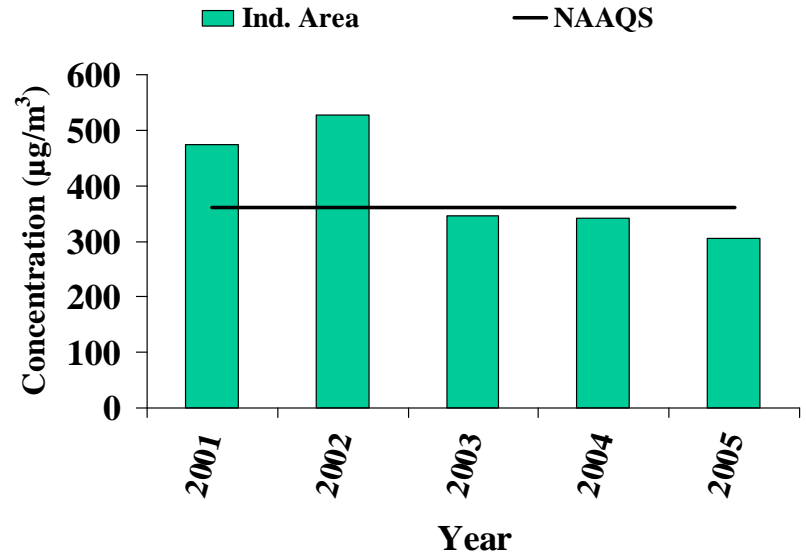
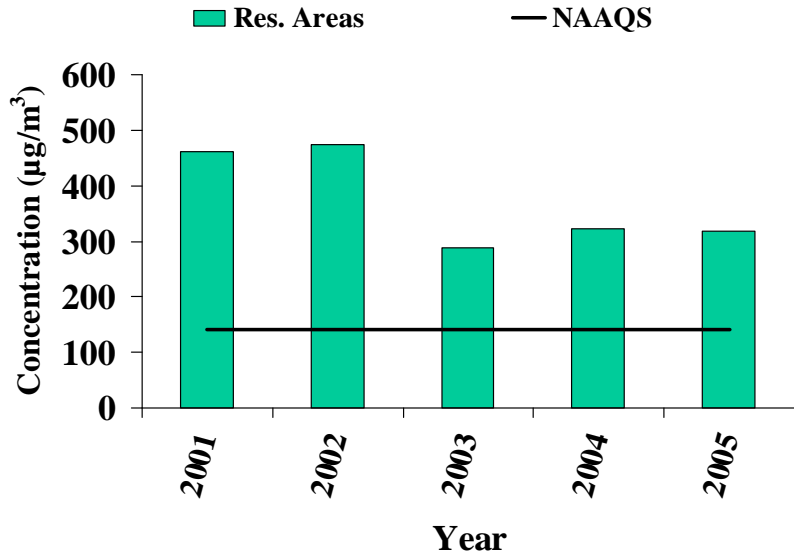


Figure 12.4: Trends in Annual Average Concentration of SPM in Jodhpur.

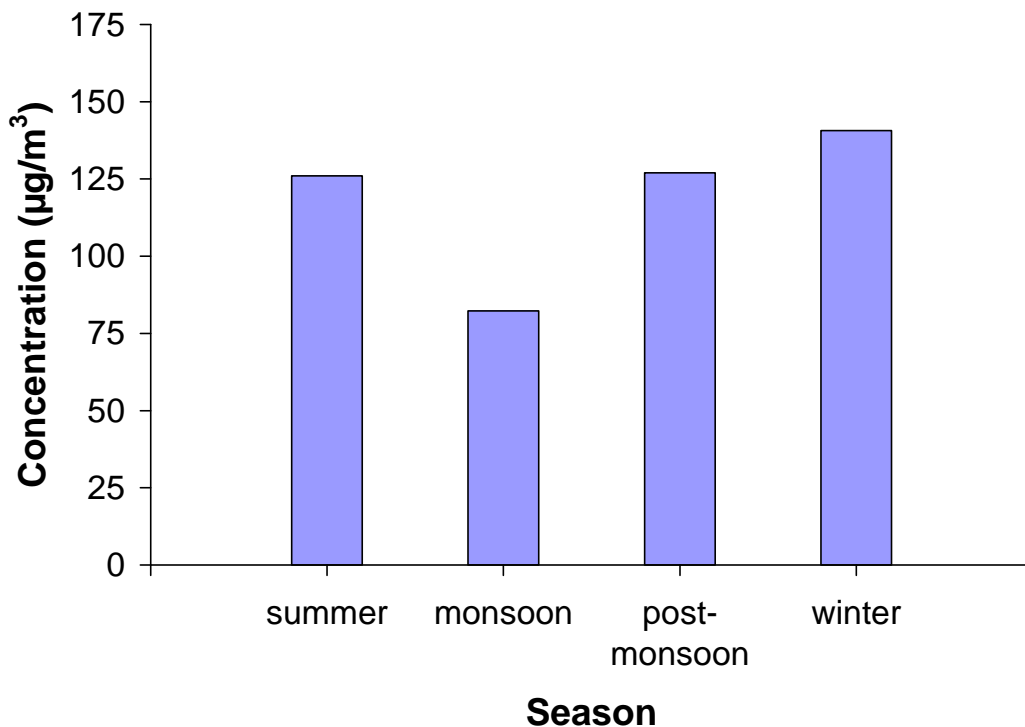


Figure 12.5: Seasonal variation in RSPM levels at Sojati Gate, Jodhpur during 2005-06.

12.3 Action Plan for the Control of Air Pollution for the city of Jodhpur (As on October 2003)

12.3.1 Action Taken so far

(a) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Shifted Transport companies from busy city areas to Transport Nagar situated in Industrial area.
- Routing heavy vehicles through bye pass.
- Tempos have been removed from heavy traffic routes in the city and have been directed through alternate roads.
- Trucks are allowed to enter in main city area of Jodhpur after obtaining pass from additional Distt. Magistrate.
- Number of city buses has been reduced to 50% as compared to earlier.
- Better traffic management system.

- Introduced of Pollution control certificates & effective checking rules. 18 PUC centers have been authorized by transport department.
- Initiated long term plan for construction of over Bridge/under Bridge on railway crossings in the city.
- Ban on plying of vehicles which are more than 15 years old .
- Heavy traffic areas have been identified and one-way traffic has been introduced.
- Improvement and development of many other roads have been taken up under Asian Development Bank (ADB) project.
- Tenders have been prepared by ADB for construction of three flyovers in the Jodhpur city.
- Action taken for control of high-speed vehicles.
- Checking of vehicles emitting smoke with the help of smoke meters available with the traffic police.
- Removal of pressure horns from vehicles along with development of silence zones.
- Sulphur content in diesel reduced to 0.25 % from September 2000. Unleaded petrol being supplied from April 2000.
- Dense plantation work has been taken up in Jodhpur and nearby areas by the Forest department.

12.3.2 Proposed Action Plan

(a) Vehicular Pollution

The salient features of action plan proposed to control vehicular pollution are as follows:

- Already prepared traffic master plan.
- Effective checking of vehicular emissions.
- Incorporation of environmental policy parameters in urban planning.
- Reduction in sulphur in diesel from 0.25% to 0.05 %.
- Supply of premixed 2 T oil.
- Phasing out all grossly polluting vehicles.
- Development of green belt around the city.
- Master plan to shift various commercial activities located in densely populated areas to outside area to the outskirts of the city.
- Assessment of air pollution problems in the city.

(b) Other measures

New Industries/commercial activities causing pollution in residential / commercial areas not to come up.

(c) Constitution of Inter Agency task force

The implementation of the action plan shall be monitored by the high power committee headed by Principal Secretary, Environment, Govt. of Rajasthan.

12.4 Findings

SO₂ levels were within the prescribed NAAQS during all the monitored years. The reason for low levels of SO₂ may be various measures taken such as reduction of sulphur in diesel, banning of old vehicles etc. NO₂ levels are also within the prescribed NAAQS during all the monitored years. The reasons for low levels of NO₂ may be various measures taken such as banning of old vehicles, better traffic management etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS in residential areas. The reason for high particulate matter may be natural dust esp dust storms, resuspension of dust, vehicles etc.

13.0 Kanpur

Kanpur is the biggest city of the state and is main centre of commercial and industrial activities. Formerly known as Manchester of the country is now also called the commercial capital of the state. It is situated on the most important national highways no. 2 & 25 and state highway. It is situated on bank of holy river Ganga and is about 126 meters above the sea level. Kanpur is also divisional headquarters of Kanpur commissionery consisting of districts namely Kanpur-Nagar, Kanpur-Dehat, Etawah, Auraiya, Farrukhabad and Kannauj

Kanpur is one of the biggest producer of Textile and Leather products and they are exported in bulk. Apart from leather and textile industry, the fertilizer, chemicals, two wheelers, soaps, Pan Masala, hosiery and engineering industries are also operating in the city. The highest number of ordnance factories are situated in the city. Kanpur is the main city of Industrial and commercial activities in the state. The offices of various financial institutions and banks are also located in the city. The Major trading areas are Leather products, pan masala, spices, textiles, fertilizers & chemicals, hosiery, soaps & detergents, electrical goods and general merchant

Nestled on the banks of the eternal Ganga, Kanpur stands as one of North India's major industrial centers with its own historical, religious and commercial importance. Believed to be founded by king Hindu Singh of the erstwhile state of Sachendi, Kanpur was originally known as 'Kanhpur'. Historically, Jajmau on the eastern outskirts of present day Kanpur is regarded as one of the most archaic townships of Kanpur district.

13.1 Sources of Air Pollution

Emission load from domestic & commercial sources reveals major particulate pollution is from use of coal followed by wood and related fuel. Vehicular emissions inventory reveals that approximately 194 tonnes of pollutant are emitted daily from the vehicular sources. Among vehicular sources also 2 wheelers are contributing maximum to the total load. There are more than 70 large-scale industries, which are mainly of leather products, cotton textiles, chemical products, metal industries etc. While there are 138 small scale industries which are mainly for leather products, metal products, food products, rubber & Plastics, cotton textiles etc. Inventory of industrial sources shows that Panki thermal Power plant contributes maximum towards total load from industrial sources. After this other major sources are Panki Industrial area, Dadanagar Industrial area, Fazalganj Industrial area etc.

13.2 Ambient Air Quality

Uttar Pradesh State Pollution Control Board is monitoring ambient air quality at five monitoring stations in Kanpur. Three of these stations are located in residential areas in Kidwai Nagar, Deputy Ka Padao, Sharda Nagar and two stations are located in industrial areas in Jajmau and Fazalganj. Two of these stations have been started recently. The status and trends in ambient air quality is detailed in following sections.

13.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated.

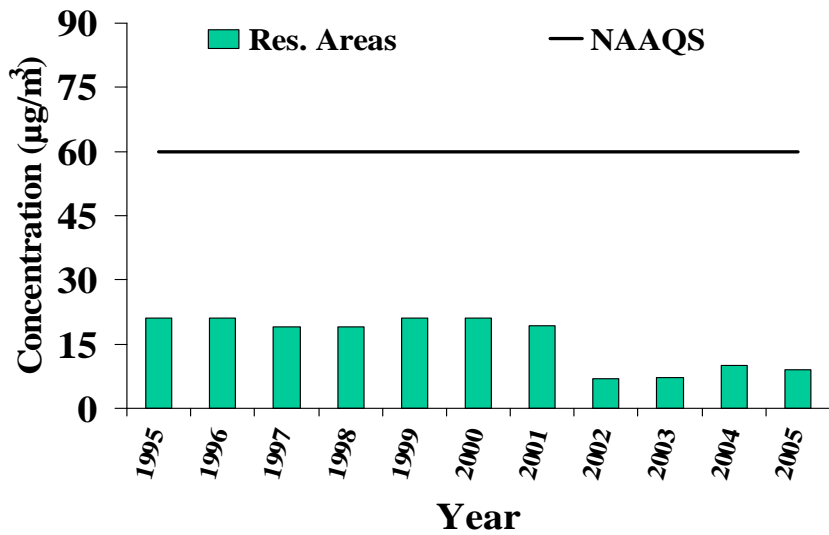
13.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in residential areas and industrial areas of Kanpur. Low levels of NO₂ were observed in Kanpur during many years. Critical levels of RSPM were observed in residential and industrial areas of Kanpur. Critical levels of SPM were observed in residential areas and high levels of SPM were observed in industrial areas during many years.

13.2.3 Air Quality Trends in Kanpur

Trend in annual average concentration of SO₂ is depicted in Fig. 13.1. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. A decreasing trend has been observed in SO₂ levels which may be due to measures taken such as reduction of sulphur in diesel etc. Trend in annual average concentration of NO₂ is depicted in Fig. 13.2. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored year

Annual average concentration of RSPM is depicted in Figure 13.3. RSPM levels are exceeding the National Ambient Air Quality Standard (Annual Average) at all the locations. A decreasing trend has been observed in ambient RSPM levels which may be due to measures taken such as reduction of sulphur in diesel etc. Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 13.4. SPM levels in residential areas were higher than the NAAQS (annual average) from 1997 to 2004. SPM levels in industrial areas were lower than the NAAQS (annual average) during all the monitored years.



Kanpur

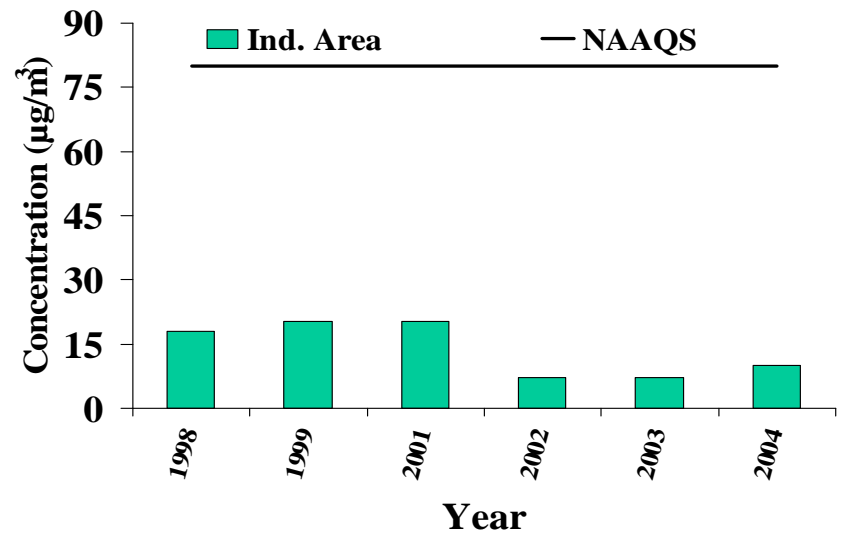


Figure 13.1: Trends in Annual Average Concentration of SO₂ at Kanpur.

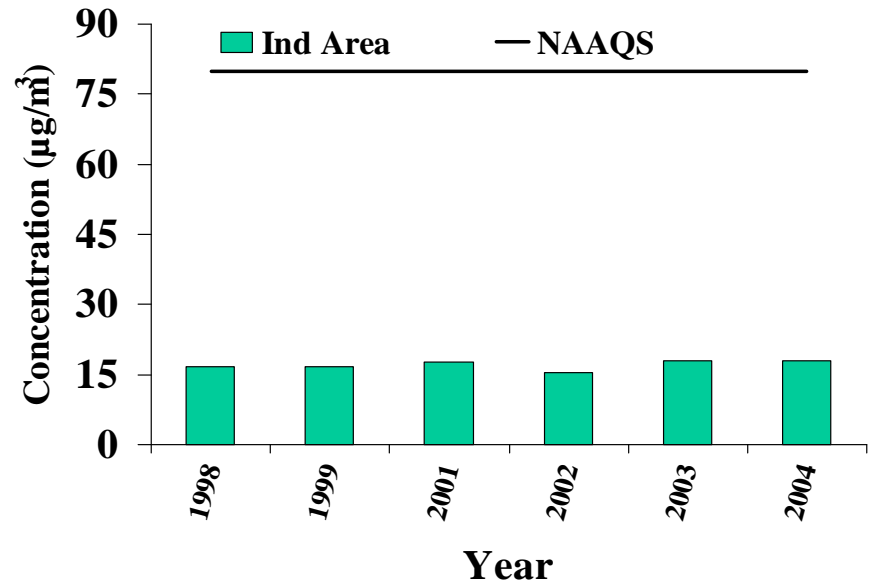
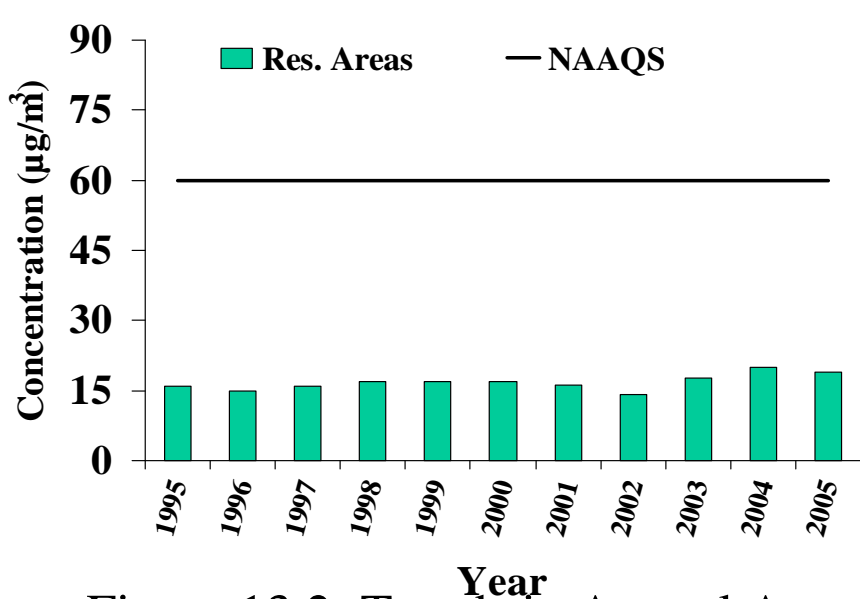


Figure 13.2: Trends in Annual Average Concentration of NO₂ in Kanpur.

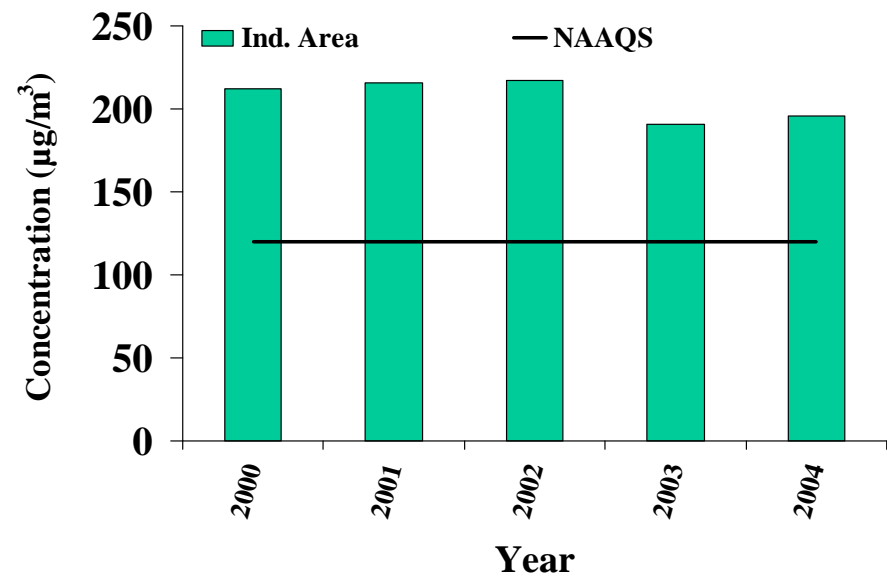
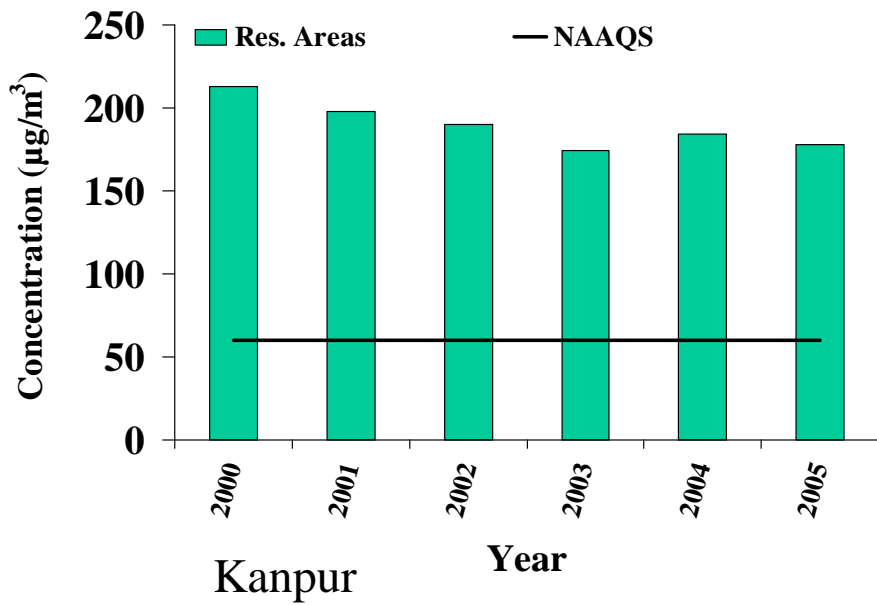


Figure 13.3: Trends in Annual Average Concentration of RSPM at Kanpur.

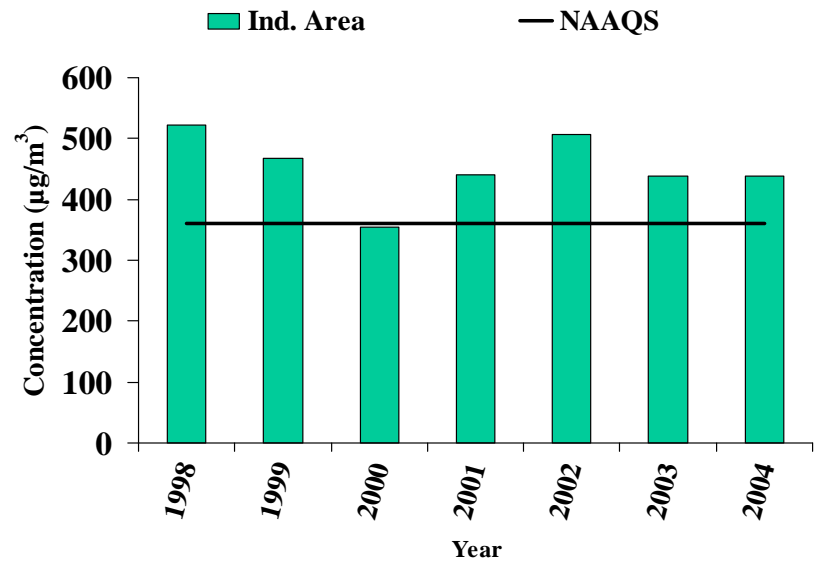
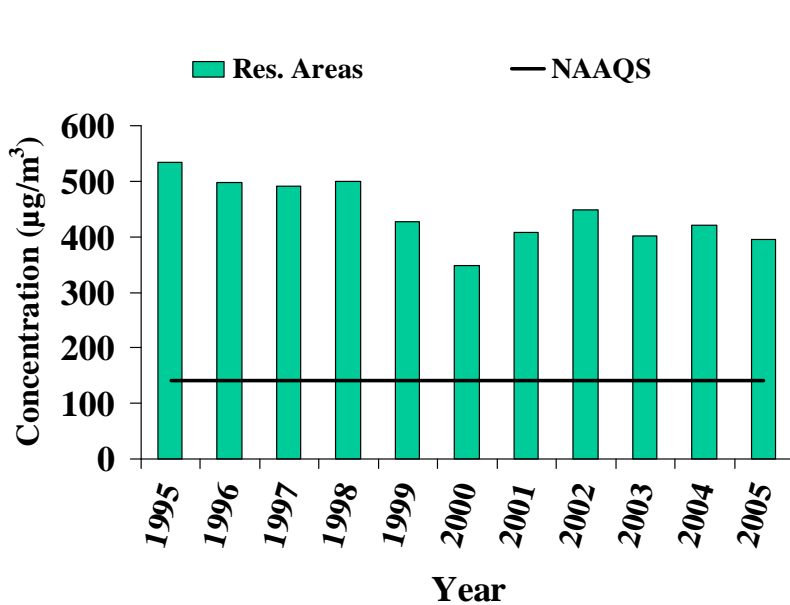


Figure 13.4: Trends in Annual Average Concentration of SPM at Kanpur.

Note:- Data for 2005 for Industrial Area, Kanpur is inadequate.

13.2.4 Meteorological Issues

Meteorological factors play a important role in air pollution studies particularly in pollutant transport irrespective of their entry into the environment. Seasonal variation in RSPM levels at ambient air quality monitoring station at Kidwai Nagar during 2004-05 is depicted in Figure 13.5. The concentrations are higher in winter months and are lower during monsoon months. The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. During monsoons, particulate matter are removed from the atmosphere by via wet deposition processes. Further wind velocities will allow for pollutant transport away from sources and increase mixing processes. During winter, there is increased atmospheric stability, which in turn allows for less general circulation and thus more stagnant air masses. Stagnant air masses allow more accumulation of pollutants in any given area. During the winter, atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. The winter months of are relatively much calm than other months. The prevailing calm conditions facilitate more stability to atmosphere and consequently slow dispersion of pollutants generated and help in build up of pollutants in vicinity of the pollutant sources.

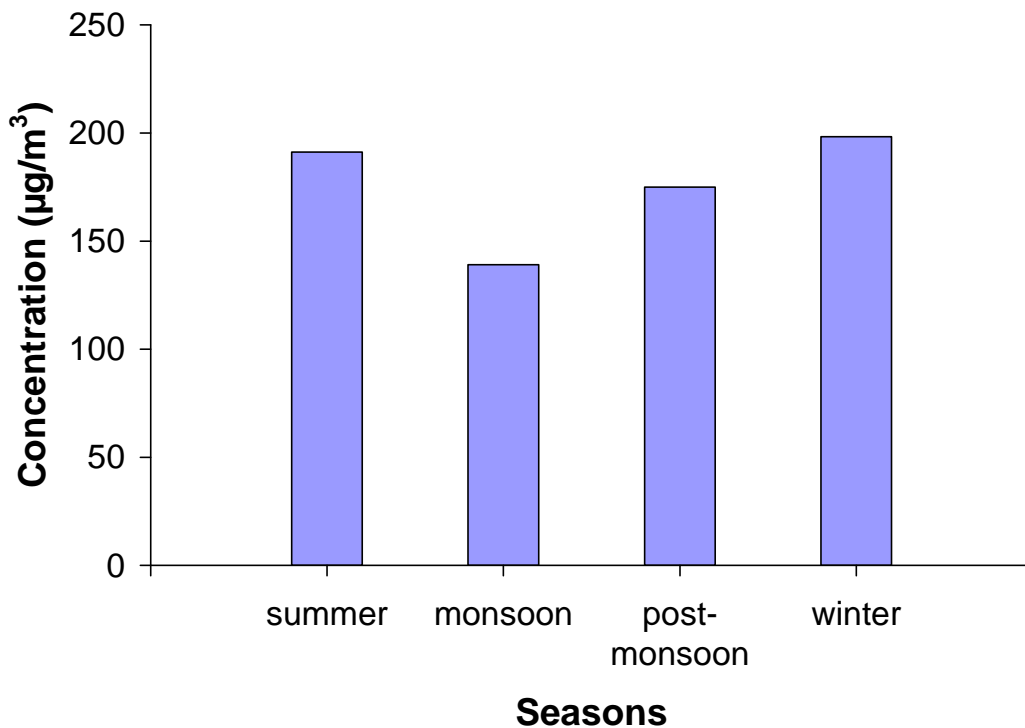


Figure 13.5: Seasonal Variation in RSPM levels at Kidwai Nagar, Kanpur.

13.3 Action Plan for the Control of Air Pollution for the city of Kanpur (As on February 2005)

13.3.1 Action taken so far

The action taken so far for controlling air pollution are as follows.

(i) Oil Companies: regular monitoring of auto fuels for any adulteration, Introduced low sulphur (0.05%) auto fuel. Introduced ethanol blended gasoline Also premixed 2T oil dispensers installed

(ii)State Transport Department: Registration of all new vehicles is being done as per auto fuel policy road map. Age of the vehicles has been fixed. Three wheelers only with catalytic converter/ scrubber are being registered and allowed to ply within the Municipal limits. Battery operated three wheelers are being encouraged. PUC is made mandatory for all the vehicles and is issued for a period of six months.

(iii) Traffic Police: Traffic system being regulated manually. Traffic restriction are being imposed in peak hours. Some of the congested roads have been identified for one way traffic.

(iv) Forest Department: Tree plantation is being encouraged along road side under social forestry programmes.

(v) Uttar Pradesh Pollution Control Board: Regular industrial air quality monitoring / ambient air quality monitoring is being done. Uttar Pradesh SPCB has issued guidelines & notification for strict compliance of the exhaust norms, Regular public awareness is being carried out. Inventorisation is being done for all air polluting industries and no new industry is being issued NOC in Non-confirming area.

(vi) Central Pollution Control Board: CPCB has prepared Environment Management Plan for Kanpur city.

(vii)Directorate of Industries: Registration of new industries is being done as per master plan of the city.

(viii) Kanpur Development Authority: Kanpur Development Authority has revised its old master plan. In the revised master plan, major by pass and MRTS system has been proposed. Four fly over have already been completed.

(ix) Kanpur Nagar Nigam: Prohibitory order has been given on open refuse burning. Regular sweeping and cleaning operations are being done.

(x) Kanpur Electricity Supply Company: Maintenance & modernization of old under ground cabling is done.

13.3.2 Proposed Action Plan

A time bound action plan has been proposed in which different organizations have been entrusted with several duties in the form of both long and short term measures as follows:

(i) Traffic Police: Traffic police has been entrusted with the responsibility of better traffic management, checking fuel quality, improving I & M procedure, etc.

(ii) Regional Transport department: Regional transport department has been entrusted with the responsibility of traffic & road management; expansion of pre-mixed 2T oil outlets; restriction in registration of 2 stroke 2/3 wheelers; phasing out older and grossly polluting vehicles in a time bound manner; restriction in movement of goods vehicles in urban and congested areas; higher road taxes on older vehicles; promotion of alternate cleaner fuels like CNG, LPG and battery operated vehicles.

(iii) Directorate of Industries: Directorate of industries is not to set new industry in residential and sensitive areas. While existing industries are to be shifted from these areas in a phased manner. Inventorisation has been planned and is being executed.

(iv) Transport Dept.: Transport department has been entrusted with the responsibility of phasing out older vehicles. Old tempos are to be banned on certain routes by 2006. Parking alternatives shall be provided in all congested commercial areas and gradual introduction of CNG buses. 250 CNG buses are proposed to bring in Kanpur.

(v) Kanpur Nagar Nigam: Kanpur Nagar Nigam is entrusted responsibility regarding proposal for generation of energy from Municipal Solid waste. More parking areas are being proposed as per master plan. Recreational areas with green belt have been proposed in the city in annual plans. Proposal of shifting congested Lohamandi, Sabjimandi by 2008. Other responsibilities include proper Infrastructure development and maintenance, environmental Management and removal of encroachments etc.

(vi) Kanpur Development authority: 25 parking spaces with 15000 sq.mt road space has been proposed by 2010. Six flyovers have been proposed at different locations by 2010. Six new subways have also been proposed. Other activities include infrastructure development and management.

(vii) Uttar Pradesh Pollution Control Board: Uttar Pradesh SPCB is entrusted with the responsibility of updating of inventorisation status of industries. Three new ambient air quality monitoring stations have been proposed with data display. Proper inspection and monitoring of polluting sources is to be carried out. Also shifting of polluting industries is to be carried out and air pollution control devices are to be installed etc. 60 polluting industries have been identified so far and action plan for controlling pollution of these industries is required to be prepared.

(viii) GAIL : GAIL is to supply 0.3837 MMSCMD of the natural gas by the year 2006 and 0.6352MMSCMD by the year 2013. Natural Gas pipeline has already been built upto Faizal ganj in the city. GAIL has committed to setup one more station in Faizal ganj. Two more stations will be built in Nanachawk and Vijaynagar. Site for mother station has been acquired.

(ix) Oil Companies: Oil companies are entrusted with the responsibility of promotion of superior quality and cleaner fuels. Also they have to give written undertaking to the state government about the quality of the fuel being supplied.

(x) Central Pollution Control Board: Recommendations made in EMP are persuaded through various regulatory agencies. Also CPCB will coordinate in implementation of the action plan.

(xi) Kanpur Electricity Supply Company: Kanpur Electricity Supply Company is entrusted responsibility regarding proposal for modernization of old under ground cabling by 2020

(xii) Forest Department: Forest department is entrusted responsibility of development of green belts. Proposal have been made for tree plantation on both side of all national highways by 2008 and in all areas as identified in proposed master plan 2010.

(xiii) Non conventional Energy development Agency: Non conventional energy development agency is entrusted responsibility regarding promotion of non conventional energy resources

Besides above several other organizations were also entrusted with other responsibilities for controlling air pollution in Kanpur city.

(xix) Scheme for switching over to LPG/CNG

In accordance with orders of Honorable Supreme court no time bound scheme for switching over to LPG mode has been proposed. Though Oil Companies have been asked to promote use of cleaner fuels like LPG/CNG etc, Even Gas authority of India is also entrusted with the responsibility of CNG supply in the city and opening CNG outlets at all necessary points in the city.

13.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Kanpur. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, etc. Other measures include implementation of implementation of stricter emission norms for new vehicles, and commensurate fuel quality. NO₂ levels are also within the prescribed NAAQS during all the monitored years. The reason for low levels of NO₂ may be various measures taken such as implementation of stricter emission norms, better traffic management etc. RSPM levels exceed prescribed NAAQS and SPM levels also exceed prescribed NAAQS. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, resuspension of traffic dust, commercial and domestic use of fuels, etc.

14.0 Kolkata

Kolkata and Howrah, the twin cities situated on the eastern and the western side of the river Hooghly, were established a few hundred years ago. During the British Rule, Kolkata was initially the capital of the country and later to Bengal. Due to the availability of infrastructural facility which included river fronts. A port and an abundance of water and raw materials for industrial activity such as coal. Minerals, jute etc., industrial development took place predominantly in these two cities and in the fringe areas mostly by the side of the river. Whereas Howrah saw a tremendous growth in the industries such as iron foundries, hot rolling mills, metal finishing units etc, a number of thermal power stations and various process industries of different sizes started functioning in Kolkata. As most of these industries were built long before the environmental concern come to the forefront, they generate various forms of emissions in large quantities because of their outdated technology and absence of pollution abatement measures. After the introduction of pollution control legislation, most of these industries have been put on environmental compliance. Recently attention has been given to the small sector industries and it is expected that they would also be able to comply with the emission norms. The Board has been making efforts to bring about improvements in this sector through a process of partnership, technology transfer and financial assistance.

Industrial emissions in the city and its suburbs are caused by coal burning in thermal power plants and other industries, Besides, the emissions from rapidly increasing numbers of vehicles are also largely responsible for the high level of air pollution in the city atmosphere. Over the last decade the number of registered automobiles in Kolkata has increased by 52 percent. The effective road area available in Kolkata is less than 5 percent of the total area. In Howrah the pattern is similar or worse. Very high automobile density, disproportionately low percentage of road network, congestion and traffic jams aging vehicles and unscientific traffic management are the major reasons for high emission of air pollutants from automobiles.

At an average altitude of 6m above MSL, Kolkata's climate is moderate, the temperature varying between 40 °C to 80° C with extremes of 43 ° C and 5 ° C. The average Relative Humidity varies between 83 % and 47% with average monthly rainfall of 130 mm and heaviest going upto 320 mm in a month. The mean wind speed varies between 16.2 and 3.5 kmph.

14.1 Sources of Air Pollution

Like any other metropolitan city, Kolkata is also polluted by various sources, such a transportation, power generation, industrial and domestic emissions. The vehicular and industrial sources are described below.

(a) Vehicular Sources

Major Causes of Air Pollution from Automobiles are as follows:

- High emission from two and three wheelers
- Poor fuel quality (high sulphur, benzene and olefin)
- Adulteration of fuel
- Violation of emission norms
- Lacking in maintenance of vehicle
- Large number of old vehicles in use (high emitters)
- Erratic traffic behavior leading to congestion (jam) and more emission of gases
- Older vehicle engine technology
- Inadequate road space preventing better mobility of traffic
- Poor maintenance of roads reducing traffic speed
- Inadequate traffic management
- Increase in Population of vehicles

(b) Industrial Sources:

There are 252 different product categories of industries being operated in the city metropolitan area. Under registration of small scale sector there were 8897 units existing in 1988 and the number has increased to 29515 in 1998. This indicates that the growth of small-scale units has attained more than 200 percent in the ten year span. Most important industries within Calcutta Metropolitan Area other than Tanneries and Thermal Power Plants are chemicals, metals, acid, paints & varnish, mineral oils, coal, lead smelters, battery, textiles, drugs, glass and ceramics, soap and detergents, dyes, rubber, plastic, leather, food and beverages etc. There are more than 12,000 industries in the city causing air and water pollution.

Following are major power generating units within Calcutta Metro area. All the units are under the management of Calcutta Electric Supply Corporation (CESC).

Power Plant	Based on	Install capacity
Titagarh Thermal Power Plant	Coal	240 MW
Southern Generation Station	Coal	135 MW
Budge Bude Thermal Power Plant	Coal	500 MW
Mulajore Thermal Power Plant	Coal	100 MW
Cossipore Thermal Power Plant	Coal	90 MW

Fly ash is at present mainly used in land reclamation, structural landfills and road making. Though not in a large scale, the use of coal ash in local brick manufacturing units is also in practice, but its use in cement manufacturing units is yet to be initiated.

A rough estimate of the contribution of particulate matter emission from industrial sources in the city is given in the following table.

Type of unit	Emission (tonne/day)	
	Before installation of pollution control device	After installation of pollution control device
Power Plant	570 (95%)	17 (53%) New Cossipore – 16 Thermal Station Southern Thermal Station – 1
Other Big industries	18 (3%)	1 (3%)
Small units	14 (2%)	14 (44%)
Total	602	32

14.2. Ambient Air Quality

Ambient air quality is monitored at three locations in Kolkata by National Environmental Engineering Research Institute (NEERI) under National Air Quality Monitoring Programme (NAMP) of CPCB. West Bengal State Pollution Control Board is also monitoring ambient air quality at large number of monitoring stations in Kolkata. Status and trends of air pollutants are described in this section.

14.2.1 Violation of NAAQS (24 hourly Average)

In general it has been observed that NAAQS (24 hourly average) of SO₂ are not violated. The NAAQS (24 hourly average) of NO₂, were violated during RSPM and SPM are violated during many years.

14.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

In general low levels of SO₂ are observed in Kolkata. Moderate and high levels of NO₂ were observed in Kolkata. Critical levels of RSPM and SPM were observed in residential areas and high levels of RSPM are observed in industrial areas.

14.2.3 Air Quality Trends in Kolkata

Trends in annual average concentration of SO₂ in residential areas and industrial areas is depicted in Fig. 14.1. Annual average concentration of SO₂ in residential areas were lower than the NAAQS (Annual Average) during all the monitored years. A decreasing trend has been observed in annual average concentration of SO₂ in ambient air which may be due to various measures taken such as reduction of sulphur in diesel. Annual average concentration of NO₂ in residential and industrial areas is shown in Fig. 14.2. A decreasing trend has been observed in annual average concentration of NO₂ in ambient air which may be due to various measures taken such as introduction of Bharat Stage –III norms etc.

Trend in annual average concentration of RSPM in residential and industrial areas is shown Fig. 14.3. RSPM levels in residential areas and industrial areas were higher than the NAAQS (annual average). Trend in annual average concentration of SPM in residential and industrial areas is shown in Fig. 14.4. SPM levels in residential areas were higher than the NAAQS (annual average).

14.2.4 Meteorological Issues

Meteorological factors play an important role in determining ambient air quality levels. It is essential to understand the governing meteorological factors for correct interpretation of ambient air quality levels. Trend in monthly average concentration of SO₂ and NO₂ is depicted in Figure 14.5. Trend in monthly average concentration of RSPM is depicted in Fig 14.6. Trend in seasonal concentration of SO₂ is depicted in Figure 14.7. Trend in seasonal concentration of NO₂ is depicted in Figure 14.8 and trend in seasonal concentration of RSPM is depicted in Figure 14.9. The concentrations are maximum in winter months and are lower during monsoon months. A plausible explanation for these results may be found by examining meteorological conditions. During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher concentrations. The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources, increase mixing processes. Calm conditions result in less dispersion of pollutants resulting in building up their levels and hence higher concentrations.

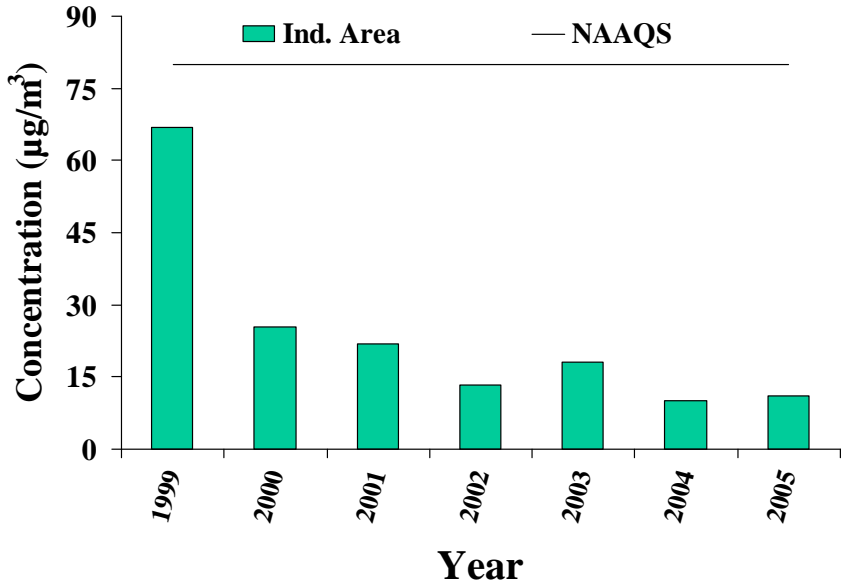
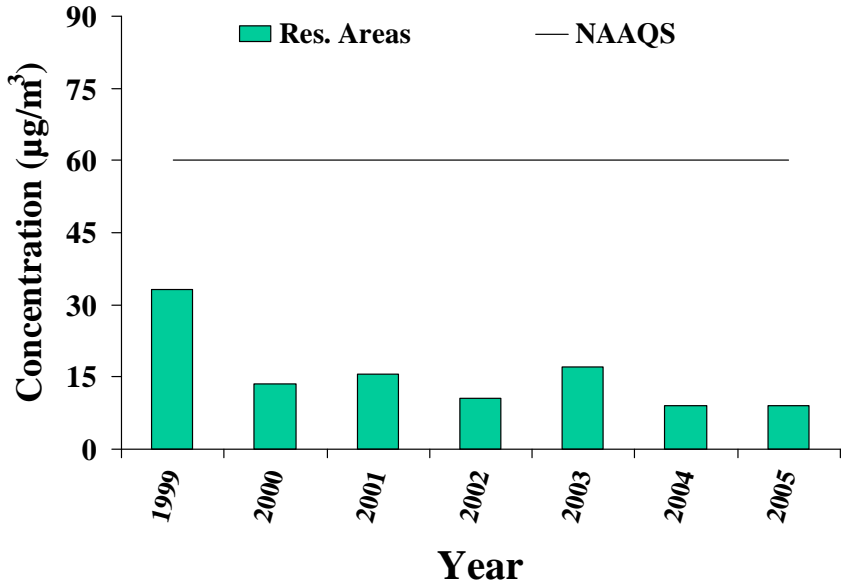


Figure 14.1: Trends in Annual Average Concentration of SO₂ in Kolkata.

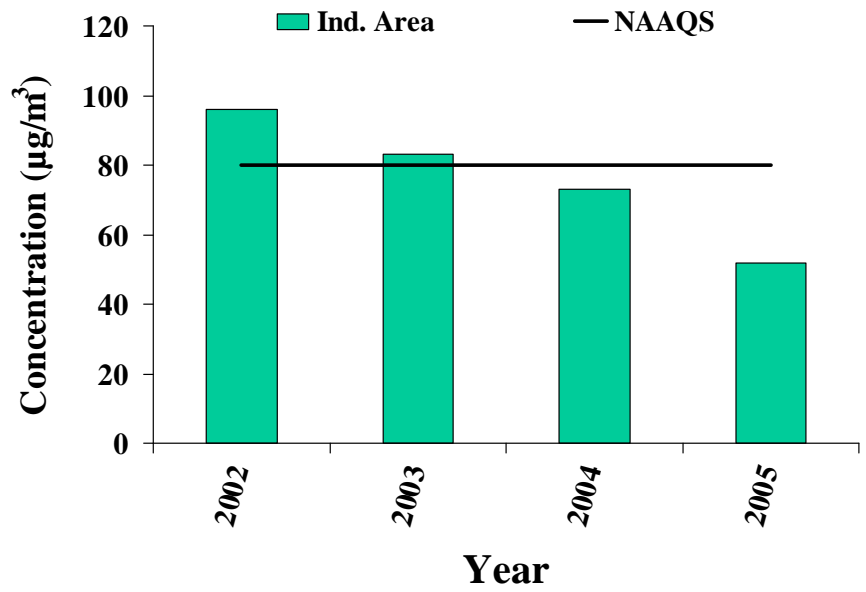
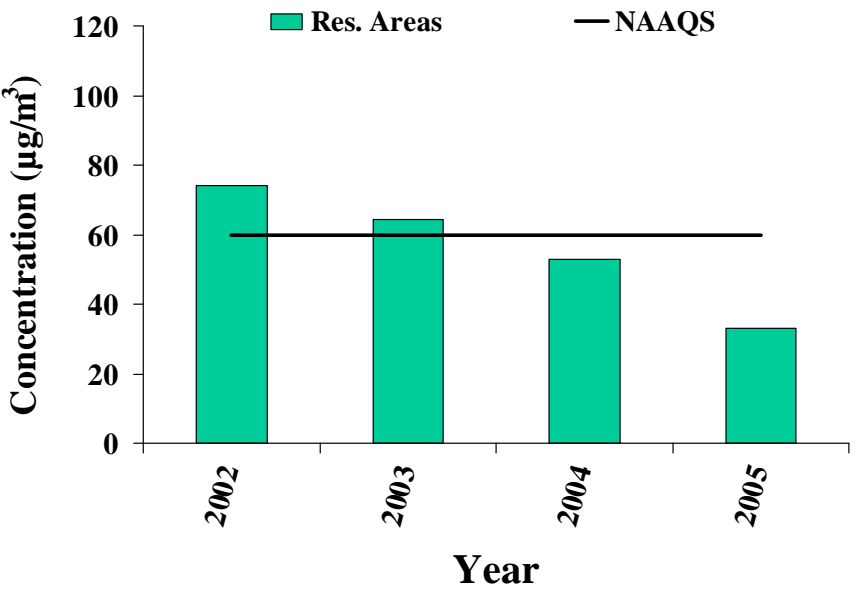


Figure 14.2: Trends in Annual Average Concentration of NO₂ in Kolkata.

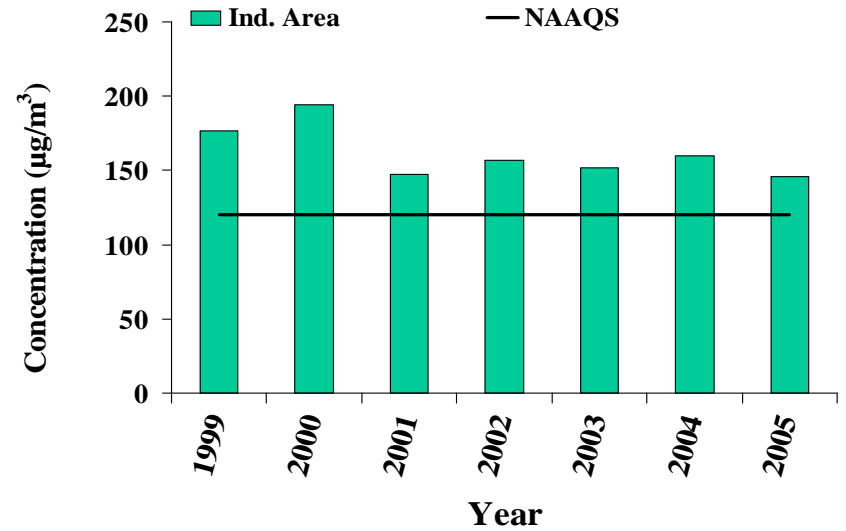
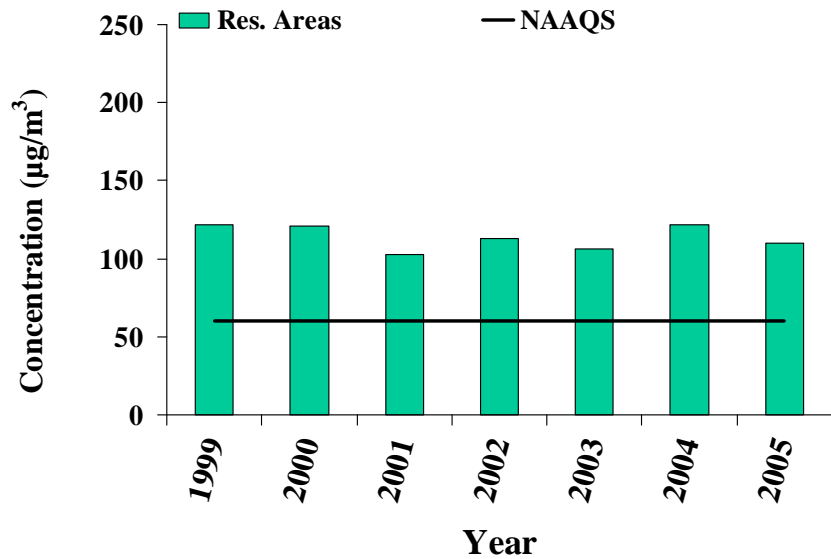


Figure 14.3: Trends in Annual Average Concentration of RSPM in Kolkata.

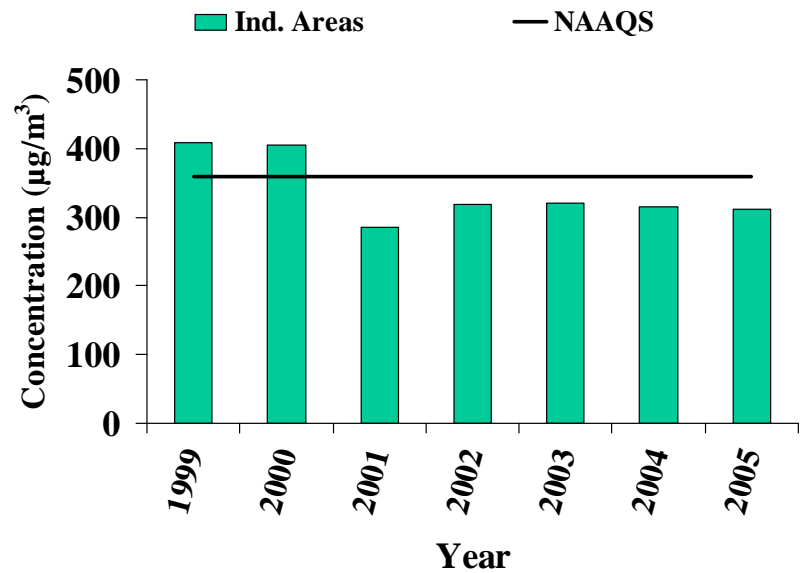
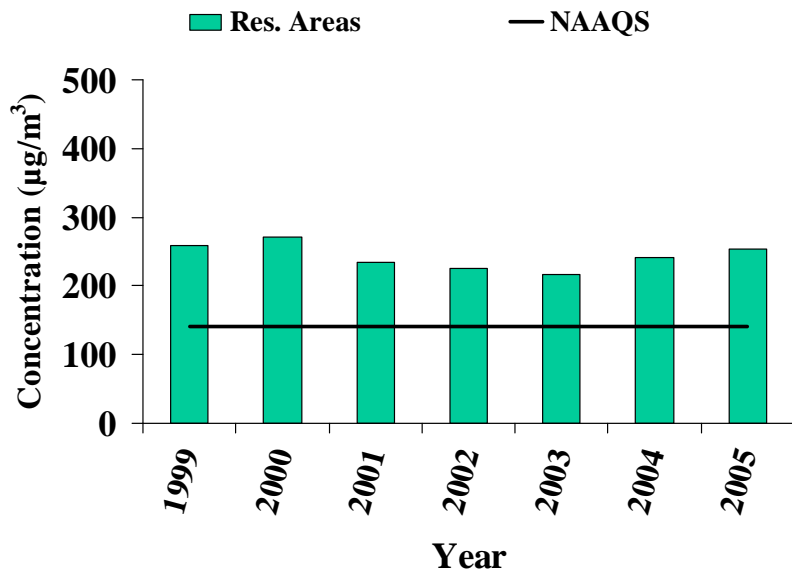


Figure 14.4: Trends in Annual Average Concentration of SPM in Kolkata.

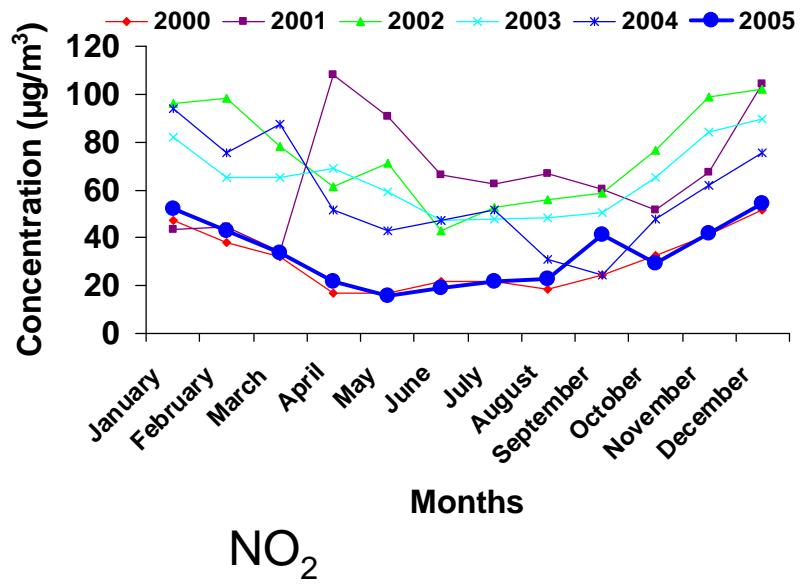
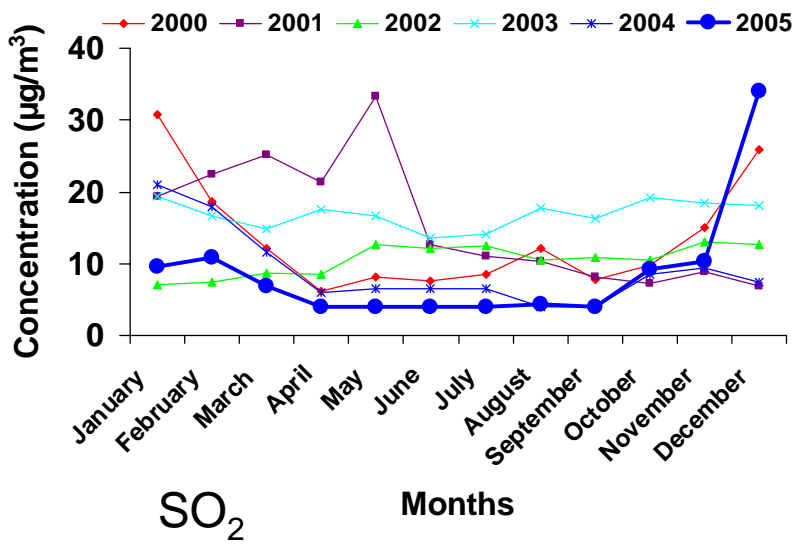


Figure 14.5: Trend in Monthly Average Concentration of SO₂ and NO₂ in Kolkata.

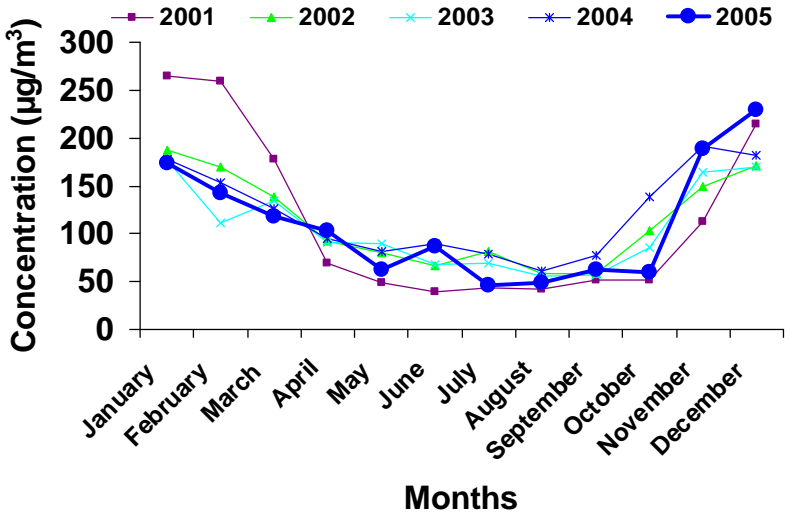


Figure 14.6: Trend in Monthly Average Concentration of RSPM in Kolkata.

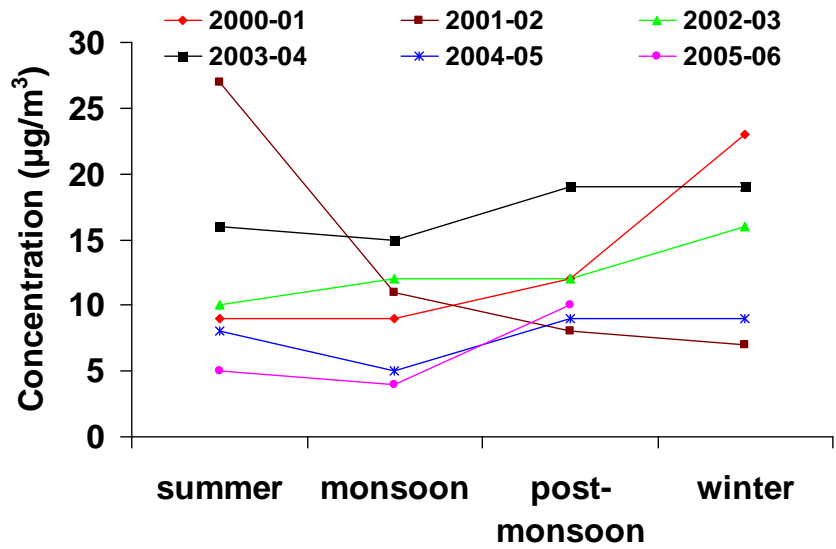


Figure 14.7: Trend in Seasonal Concentration of SO₂ in Kolkata.

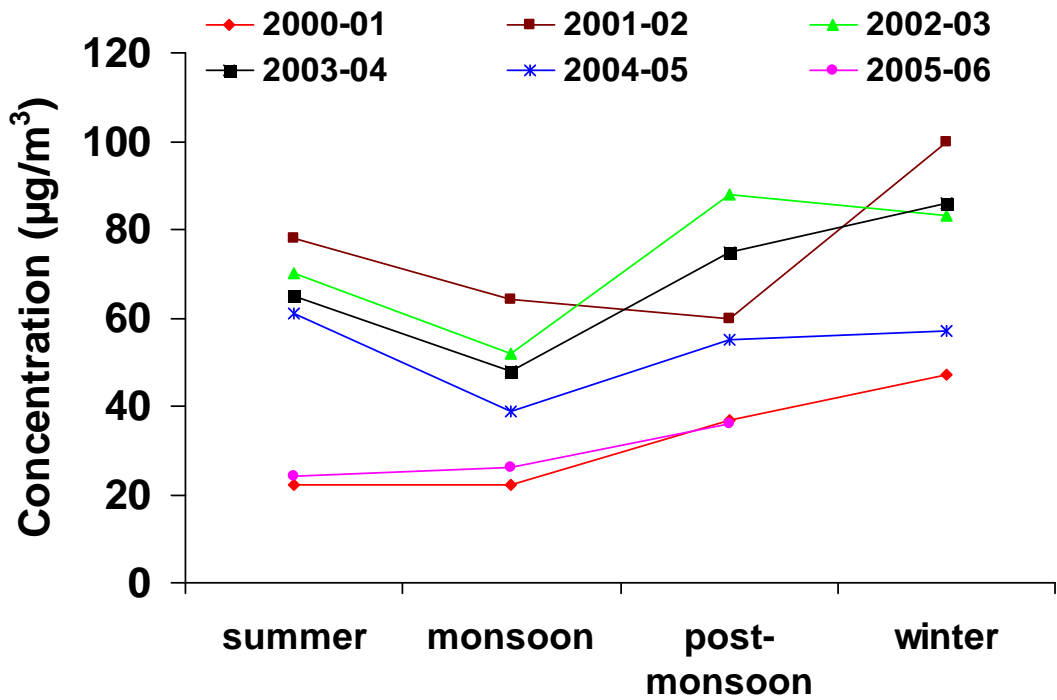


Fig 14.8: Trend in Seasonal Concentration of NO₂ in Kolkata.

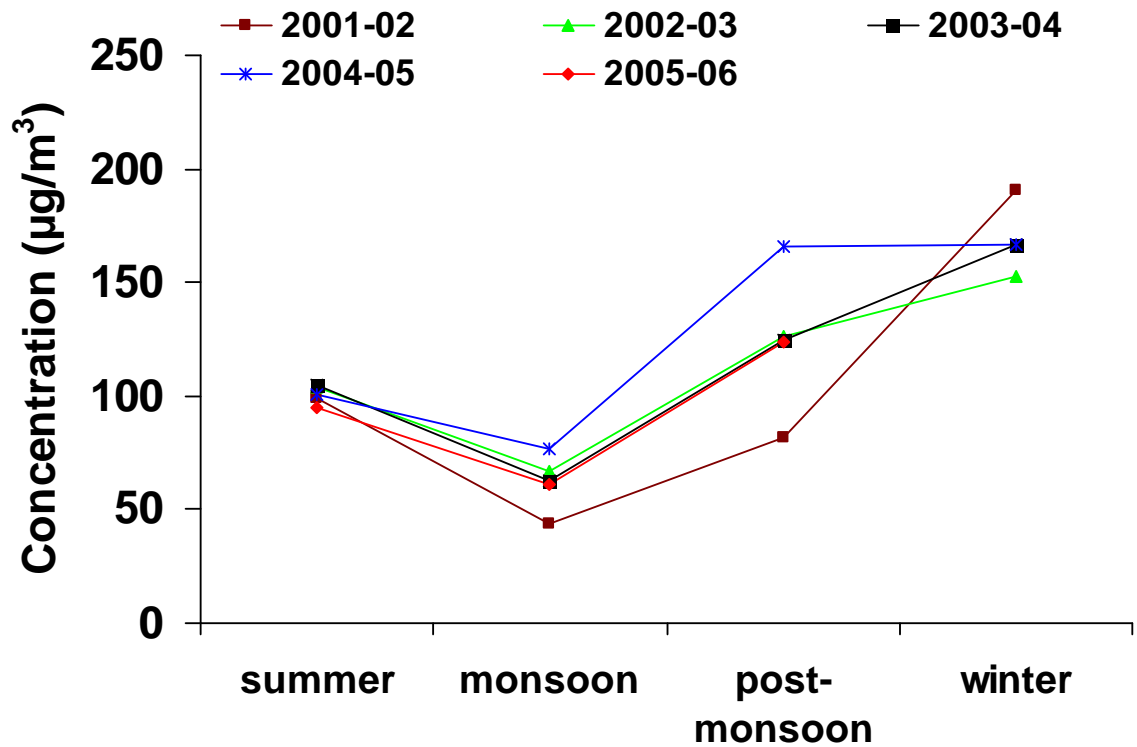


Fig 14.9: Trend in Seasonal Concentration of RSPM in Kolkata.

14.3 Action Plan for the Control of Air Pollution for the city of Kolkata (As on September 2002)

14.3.1 Action taken so far

(a) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- Stricter location policy for new industrial units restricting setting up of polluting industries (red Category) in municipal area of KMA.
- Ensuring regulatory compliance for grossly polluting industries.
- Introduction of stricter emission standards for boilers, ceramic kilns, foundries and rolling mill of KMA with effect from 11.05.2001.
- Mandatory use of clean fuels.
- Financial assistance for installation of pollution control devices in small-scale industries etc.
- Regularly complying industries are felicitated with Environmental excellence awards.
- M/s Coal India Ltd. , M/s Eastern Coalfield Ltd., M/s Bharat Coking Coal Ltd. have been requested not to supply coal to the industries which have been ordered to discontinue the use of coal.
- About 67 % of the coal fired boilers and about 73 % of the coal fired ceramic kilns have already been converted to oil fired ones.

(c) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Introduction of Euro-I norms for all new private vehicles.
- Bharat stage-II norms for all new four wheeled passenger cars.
- Ban on supply of loose 2T oil.
- Improvement in the fuel quality.
- Up gradation of emission testing centers.
- Unleaded petrol was made available from 01.02.2000.
- Selling of pre-mixed 2-T oil made mandatory with KMA from 15.11.2001.
- Benzene content in petrol reduced to 3 % from 2001.
- Sulphur content in petrol and diesel reduced to 0.05 % with effect from 01.07.2001.

- Only LPG driven three wheelers are registered in Kolkata from June 2003. Emission norms for CNG vehicles (all categories) and LPG vehicles (heavy duty) with effect from May 2002 respectively.
- Gasoline blended with 5 % ethanol mandatory from January 2003.

14.3.2 Proposed Action Plan

(a) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- Scheme for compliance of emissions standards for new Cossipore Generating Station. Electrostatic precipitators will be erected in all the six boilers in a phased manner.
- For other large and medium industries, the strict monitoring schedule to check their compliance will continue. Repeated non-compliance will be dealt with technical hearing, imposition of suitable bank guarantees and forfeiture of the same and also closure in extreme cases for failing to come on compliance path within a given time schedule.
- West Bengal Pollution Control Board has notified stricter emission standards than national standards for particulate matter emission in small scale industries operating coal fired boilers, coal fired ceramic kilns, coal fired hot rolling mills and small cast iron foundries etc.
- Future action plan under Corporate responsibility for environment protection for highly polluting 18 categories of industries have been approved and will be implemented in a time bound manner.
- Emission norms for new diesel engines for genset application will be made available in a phased manner from January- July 2004

(b) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:

- Bharat stage-III & Bharat stage-IV emission norms will be implemented for new vehicles (except 2 & 3 wheelers) from 2005 & 2010 respectively
- For 2 & 3 wheelers Bharat –II & Bharat stage-III emission norms will be introduced by 2005 & 2008/10 respectively.
- Sulphur in diesel will be reduced to 0.035% & 0.005% by 2005 & 2010 respectively.
- Inspection & maintenance system for all categories of in-use vehicles will be introduced from April 2006
- New PUC checking system will be introduced for all categories of in-use vehicles by October 2004
- Augmentation of mass transport system by April 2004.
- Stricter emission norms will be made applicable for inter-state buses and trucks.

- Switch over to LPG as automotive fuel in all the vehicles or compliant to Bharat stage-II.
- Introduction of marker system for detection of adulteration of fuels.
- No PUC – No petrol policy will be implemented.
- Action plan proposed for pollution control from vehicular sources includes time bound action plan for switch over to LPG as automotive fuel in all the vehicles or compliant to Bharat stage-II.
- Time bound phasing out programme of old taxis, auto rickshaws, goods carriers, buses, heavy & medium transport vehicles.
- Improvement in fuel quality through supply of low benzene (1%) gasoline in Kolkata region.
- A working group has been constituted for recommending action plan for switch over of 2 wheelers, 3 wheelers & motor vehicles operating in Kolkata to LPG/CNG.

(c) Scheme for switching over to LPG/CNG

In accordance with orders of Honorable Supreme court a time bound scheme for switching over to LPG mode has been proposed though some constraints in switching over to LPG have also been mentioned. The scheme for being operational is subjected to the pre-requisites like the establishment of evenly distributed network of at least 75 dispensing stations within six months. Financial institutions are to make funds available to the owners of the existing diesel vehicles for changeover to Bharat stage-II or petrol –LPG engines.

14.4 Findings

SO₂ levels were within the prescribed NAAQS in Kolkata. A decreasing trend has been observed in ambient SO₂ levels which may be due to various measures taken such as implementation of stricter vehicles emission norms and commensurate fuel quality, conversion of the coal fired boilers and coal fired ceramic kilns to oil fired ones etc. Decreasing trend has also been observed in ambient NO₂ levels which may be due to various measures taken such as implementation of stricter emission norms etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS in residential areas. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers and emission from power plants, resuspension of traffic dust, commercial and domestic use of fuels, etc.

15.0 Lucknow

Straddling both banks of the Gomti River, a tributary of the Ganges, Lucknow is the capital of India's most populous state, Uttar Pradesh. Modern Lucknow is largely the creation of the nawabs of Oudh and parts of the city still retain an 18th-century flavour. The nawabs were the descendants of the Persian merchant adventurer, Saadat Khan, who was rewarded for his services to the Mughal court with the governorship of the province in 1732. His successor, Safdarjung, ruled from Delhi. The fourth of the ten nawabs, Asaf-ud-Daula, moved the court to Lucknow and turned the city into a centre of Urdu poetry, courtly diction, music and dance. At the beginning of the 19th century, under Ali Khan, the court blossomed. The city is still famous for its cultivated manners and refined urbane culture. It remains the home of light-classical North Indian music and the Kathak school of dance.

Lucknow has traditionally produced silver and bidri work (gun-metal inlaid with silver) and traded in copper, brass and cotton. Lucknow is an important rail junction and has excellent connections with most of northern India. A kilometer or so west of the Residency are the two fascinating Imambaras. In 1784, Asaf-ud-Daula built the Bara Imambara. This great vaulted hall, reputedly the largest room in the world, is 50 meters (165 feet) long and its 15-metre (50-foot) high roof is unsupported by pillars. The hall, the great mosque and its two supporting minarets were built as part of a famine relief project. Most of the underground passages are now blocked, but an external stairway leads to the labyrinth on the upper floor known as the Bhulbhulaiya. In front of the Imambara is an impressive gateway, Rumi Darwaza, built in imitation of Istanbul's Sublime Porte. Beyond the gateway, the Husainabad Imambara stands in a large quadrangle in front of an inlaid marble tank. The main building contains the silver throne of the nawabs. Opposite the Husainabad Imambara is the Baradari (summer house) built by Ali Shah and now housing a small portrait gallery. The Jama Masjid to the west of the Imambara is one of the few in India closed to non-Muslims.

Climate of Lucknow is distinctly continental. As the nearest large body of water i.e. the Bay of Bengal is more than 960 kms. eastward, the temperature exhibits a large range of variation between day and night. Lucknow experiences both very dry hot summer and very cold winter in every year. It is clear from past 68 years data (during the period 1931 to 1998) that sometimes the temperature in summers may go as high as 48.3°C and may drop as below as -1.0°C in winter. The normal date of onset of Southwest Monsoon over the city of Lucknow is 18th June and the withdrawal date is 30th September. The trend of rainfall in past 68 years shows that the average annual rainfall is 1004.8 mm. The trend (during 1952-1998) shows that 85.5% of the average annual rainfall occurs during the four monsoon months viz. June, July, August and September. In general minimum and maximum values of Relative Humidity are observed during the months of April and August respectively. Total length of road network in Lucknow city is 172.445 km. There are 72 major roads in the city, which are classified

according to their length. Out of them 27 roads are less than 1 km. in length, 30 have 1-3 km. length and only 15 have more than 3 km. length.

14.1 Sources of Air Pollution

The main sources of air pollution in Lucknow are vehicles, industries and resuspension of dust etc.

(a) Vehicular Sources

The two wheelers dominate the total number of vehicles. Of late, the numbers of three wheeler tempos have shown a declining growth trend. This is an outcome of Hon. High Court directives on restricting their movement and strict pollution control measures enforced. There is steady growth in most of the categories of the vehicles.

(b) Industrial Sources

Lucknow is basically not an industrial city but there are four identified industrial areas where many large, medium and small-scale industries have been clustered. These are Talkatora industrial area, Aishbagh industrial area, Sarojini Nagar industrial area and Amousi industrial area. As the Talkatora and Aishbagh are congested, of late the industries are growing at Amousi and Sarojini Nagar. As per the information available from UP pollution Control Board, during 1997, 69 industries of different categories were operating in Lucknow city and urban areas. During the previous years some industries were closed and some of new industries were have come up. The majority of the industries operating at Lucknow belong to the types coming under Iron & Steel, General Engineering, Service Stations & Workshops, Plywood & Timbers. In Lucknow most of the polluting units have installed pollution control equipments for treatment of their wastewaters or for emission control as per the directives of U.P. Pollution Control Board.

15.2 Ambient Air Quality

Uttar Pradesh State Pollution Control Board is monitoring ambient air quality at five monitoring stations in Lucknow. Four monitoring stations are located in residential areas at Kapoor Hotel, Hazratganj, Mahanagar, Aminabad and Aliganj and one monitoring station is located in Industrial area at Talkatora Two of these stations have been recently started. The status and trends in ambient air quality is detailed in following sections.

15.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated.

15.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ and NO₂ were observed in residential areas and industrial areas of Lucknow. Critical levels of RSPM were observed in residential and industrial areas of Lucknow. Critical levels of SPM were observed in residential areas of Lucknow.

15.2.3 Air Quality Trends in Lucknow

Trend in annual average concentration of SO₂ is depicted in Fig. 15.1. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. A decreasing trend has been observed in ambient levels of SO₂ which may be due to various measures taken such as reduction of sulphur in diesel etc. Trend in annual average concentration of NO₂ is depicted in Fig. 15.2. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored year

Annual average concentration of RSPM is depicted in Figure 15.3. RSPM levels are exceeding the National Ambient Air Quality Standard (Annual Average). Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 15.4. SPM levels in residential areas and industrial areas were higher than the NAAQS (annual average).

15.2.4 Meteorological Issues

Meteorological factors play a important role in air pollution studies particularly in pollutant transport irrespective of their entry into the environment. Seasonal variation in RSPM levels at ambient air quality monitoring station at Kapoor Hotel, Lucknow during 2005-06 is depicted in Figure 15.5. The concentrations are higher in winter months and are lower during monsoon months. During the monsoons, precipitation removes particulate matter via associated wet deposition process. Also, high wind velocities results in transport of particulate matter away from sources and increases mixing resulting in lower concentrations. During winter, there is increased atmospheric stability, which in turn allows for less general circulation and thus more stagnant air masses.

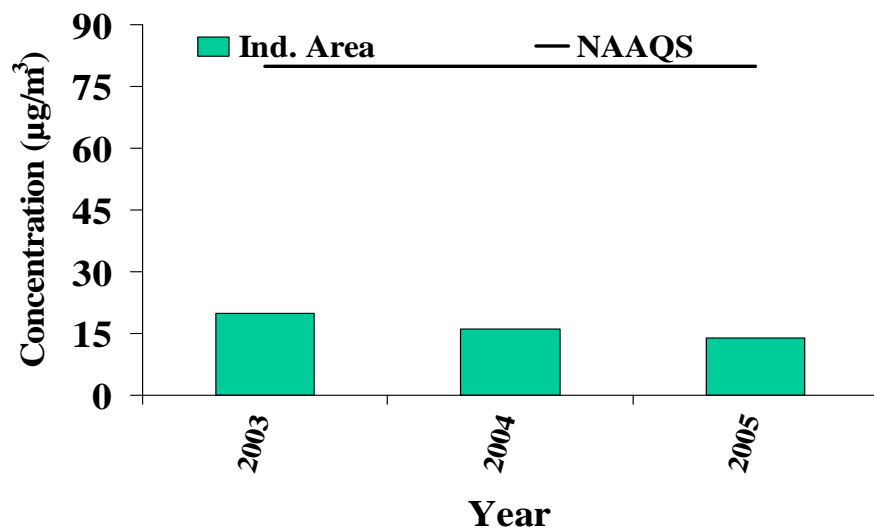
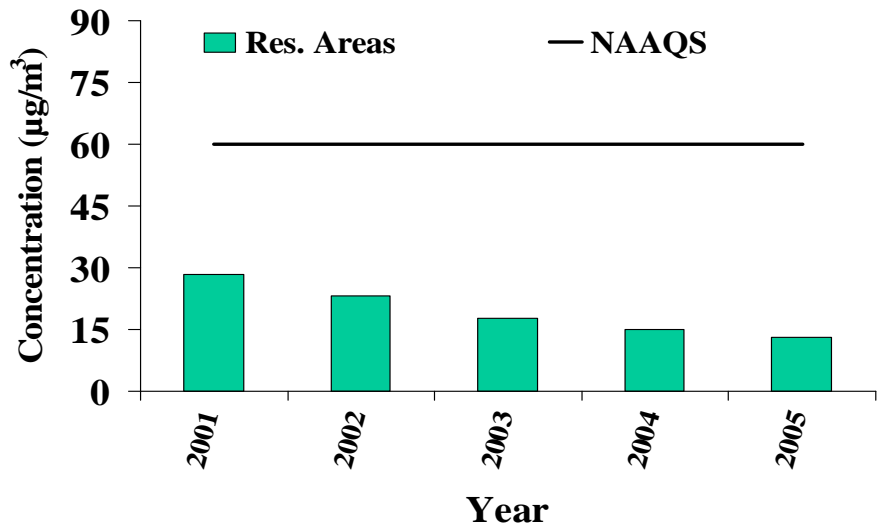


Figure 15.1: Trends in Annual Average Concentration of SO₂ at Lucknow.

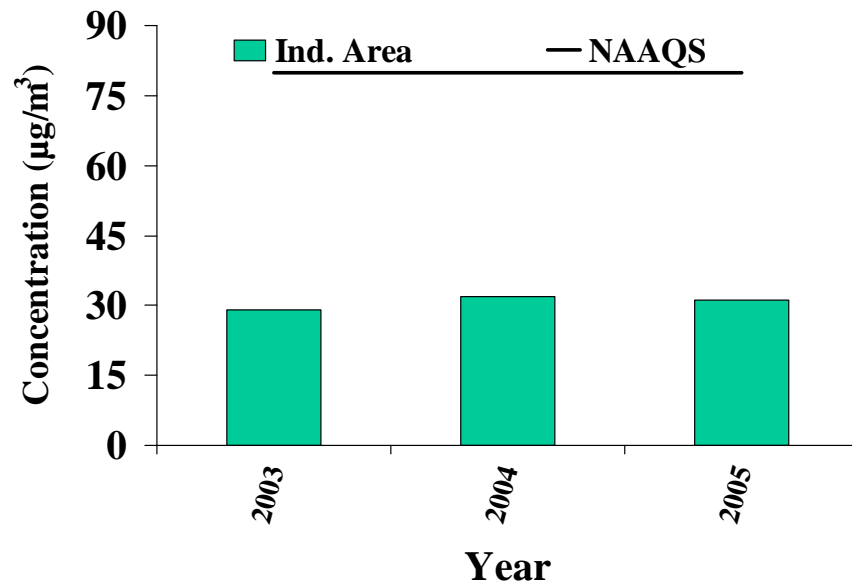
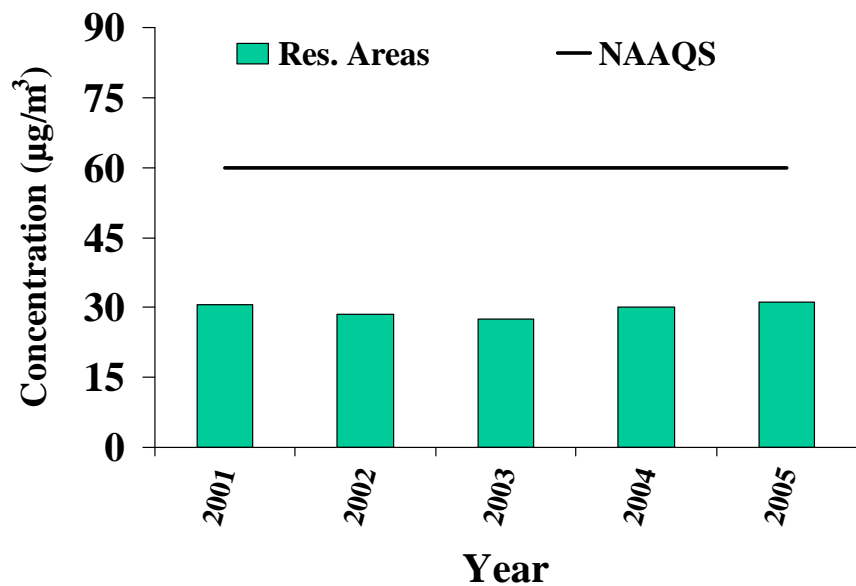


Figure 15.2: Trends in Annual Average Concentration of NO₂ in Lucknow.

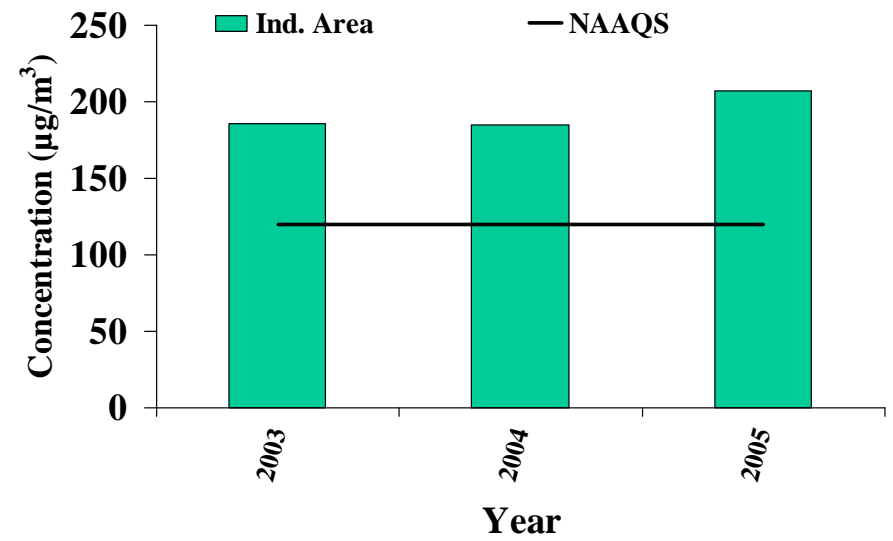
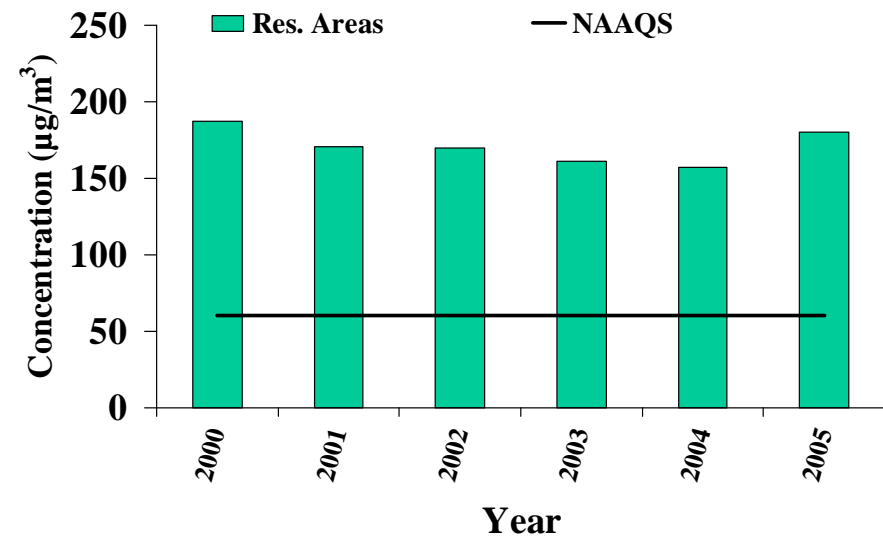


Figure 15.3: Trends in Annual Average Concentration of RSPM at Lucknow.

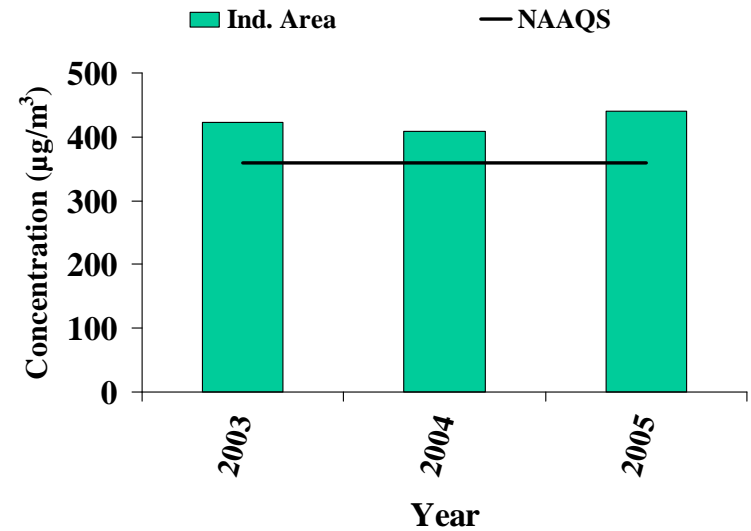
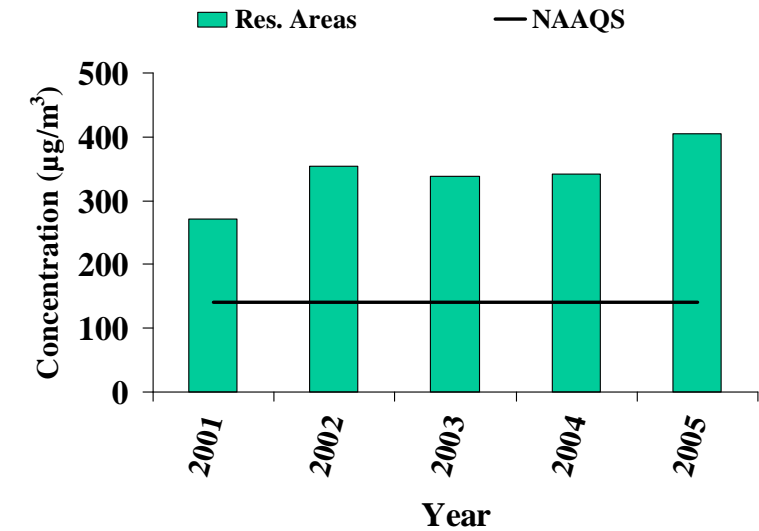


Figure 15.4: Trends in Annual Average Concentration of SPM at Lucknow.

During the winter, atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. The winter months are relatively much calmer than other months. The prevailing calm conditions facilitate more stability to the atmosphere and consequently slow dispersion of pollutants generated and helps in build up of pollutants in vicinity of the pollutant sources

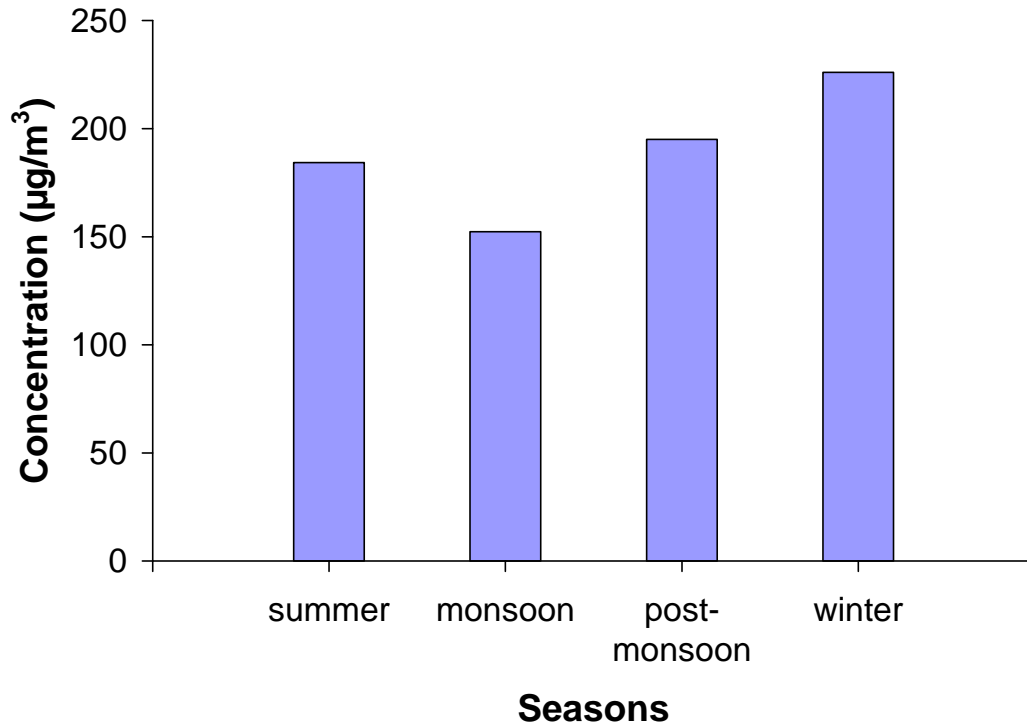


Figure 15.5: Seasonal variation in RSPM levels at Kapoor Hotel, Lucknow during 2005-06.

15.3 Action Plan for the Control of Air Pollution for the city of Lucknow (As on February 2005)

15.3.1 Action taken so far

(a) Domestic Pollution

The salient features of actions taken to control domestic pollution are as follows:

- Notification of banning of open garbage burning.
- Use of coal/ wood/ diesel for preparation of food items on commercial basis has been banned by Nagar Nigam and cooking gas (LPG) is the only allowed food for such activities.

(b) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- Sitting policy for new Industries. Red category of Industries not permitted within municipal areas of Lucknow Nagar Nigam. While green industries with power load less than 5 KVA are considered on case to case basis.
- State Government has identified 43 polluting industries, out of these 5 have been issued show cause notice and one has been closed

(c) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Implemented Bharat stage-I emission norms for all categories of vehicles with effect from 01-04-2000.
- Compliance of emission norms for in use vehicles.
- Fuel quality matching Bharat stage-II emission norms is already being achieved.
- Introduction of low benzene (1%) petrol.
- Auto LPG facility has already been developed at one retail outlets i.e. M/s SSR filling station, Jankipuram Lucknow. The facility is provided with storage capacity of 7.5 cubic meter. One more such facility has also been planned for the city.
- PUC mandatory for all the vehicles and is issued for a period of six months
- In the city, 2T pre-mixed fuel oil is already dispensed from most of the retail outlets & there has been ban on supply of loose 2T oil.
- Fuel adulteration checks are already been carried out at the retail outlets by the oil company officials. One mobile lab is also based in Lucknow, which visits retail outlets regularly to detect fuel adulteration.
- Older polluting vehicles have been phased out.
- Old Vikram tempos are banned on certain routes.
- Only scrubber fitted tempos are allowed to ply in the city.
- Encroachment by Patri Dukandars is being removed.
- Parking alternatives have been provided in Hazaratganj etc.
- For the improvement of public transport system circular railways is already functional in Lucknow as mass transport system by 25.12.2002.
- Introduction of alcohol blended gasoline from 01.01. 2003.
- Nagar Nigam has done work of approximately Rs. 14 crore in last 2 yrs for widening and improvement of road surface and construction of concrete roads in densely populated areas.
- Constructed several bridges/flyovers for the smoother flow of traffic.

15.3.2 Proposed Action Plan

(a) Domestic Pollution

The salient features of actions plan to control domestic pollution are as follows:

- Notification for banning of open burning of garbage.
- Promotion of use of LPG as domestic fuel.
- Improved electricity supply in the city to discourage the use of DG sets.

(b) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- Organization of the inventories of the polluting industries.
- Inspection & monitoring of industries to ensure compliance.
- Identification and closure of unauthorized industrial operations.
- All commercial establishments having DG sets of capacity 7.5 KVA and above shall install wet scrubber and acoustic chamber.
- Action plan under Corporate responsibility for environment protection for highly polluting 17 categories of industries to be implemented in a time bound manner.
- All the moderate air polluting small scale industries to be provided with adequate pollution control system by December 2004.

(c) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:

- Notification & Implementation of emission norms in accordance with the road map proposed by the expert committee on Auto fuel Policy and to supply commensurate fuel accordingly.
- Conducting vehicular emission inventory.
- Introduction of clean fuels like CNG/LPG/Hybrid battery etc.. For Lucknow city, after availability of LPG/ CNG fuel, a period of minimum 1 year shall be required for installation of CNG/LPG conversion kits in vehicles. On trail basis, IOC is developing Auto LPG facility at one retail out let. Expected commissioning is by March 2003.
- GAIL India Ltd. has proposed a natural gas project for the city of Lucknow. There has been significant delay in setting up CNG stations since the earlier stated deadline of June 2004. The first mother station will be built by August 15, 2005 at Amausi. Two more stations, one daughter booster station in

Gomti nagar and one online station in Charbagh will be set up by December 2005.

- Branch pipeline Project of IOC for connecting Lucknow with a pipeline from Allahabad- Kanpur section. The said project shall ensure smooth supply of petroleum products in Lucknow.
- The State Government to submit a report on the implementation of the CNG vehicle programme and public transport plan based on CNG with deadline by February 15, 2005
- The State Government to submit report on parking policy for the city by February 2005.
- New PUC norms to be implemented from March 2005.
- Commercial vehicles more than 15 yrs old to be phased out.
- State Government has decided to lower down the age limit of the city buses from 9 to 5 years.
- Periodic auditing to be undertaken for 49 PUC centers in the city.
- Quarterly on - road inspection camps are to be organized by the Transport Department with the help of UPPCB.
- Providing more open space in the city as per master plan for the Lucknow city.
- Construction of two flyovers to be completed by June 2004.

(d) Other Measures

- Awadh Forest Division Lucknow has made an ambitious plantation project starting from 2000-01 to 2009-10 in order to make Lucknow green, clean & beautiful.

15.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Lucknow. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, use of cleaner fuel such as LPG etc. Other measures include implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality. NO₂ levels are also within the prescribed NAAQS during all the monitored years. The reason for low levels of NO₂ may be various measures taken such as implementation of stricter emission norms, phasing out of old polluting vehicles, better traffic management etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers, resuspension of traffic dust, commercial and domestic use of fuels, etc.

16.0 Mumbai

Mumbai, the financial capital of India is located at western coast of India. The character of Mumbai has been steadily transformed from a historical capital of Bombay Province to the largest commercial and industrial center of the country. Mumbai has become national nucleus of trade and industry. There are large office/business complexes and important medical, industrial and educational centers. It's the center for India's important textile industry as well as the financial center and an important base for overseas company. Mumbai is an island connected by bridges to the mainland. The principal of the city is concentrated at the southern end of the island; the northern end is comparatively lightly populated.

As a result of the industrial and commercial development there has been a consistent influx of migrants from all over the country resulting into increase in population growth. The population of Mumbai has recorded a phenomenal increase after Independence. The present population has crossed the 10 million and further growth is projected. This does not take into account the floating population and the traffic that criss-crosses Mumbai from the adjoining areas. Despite the Government giving high priority to developmental issues to accommodate increasing population, urban infrastructure has been taxed and it is now clear that further development can be sustained only if it is within the ecological carrying capacity of the region. The degradation of the environment with regard to air, water and land components is directly the result of such several factors. The map of Mumbai is depicted in Figure 16.1.

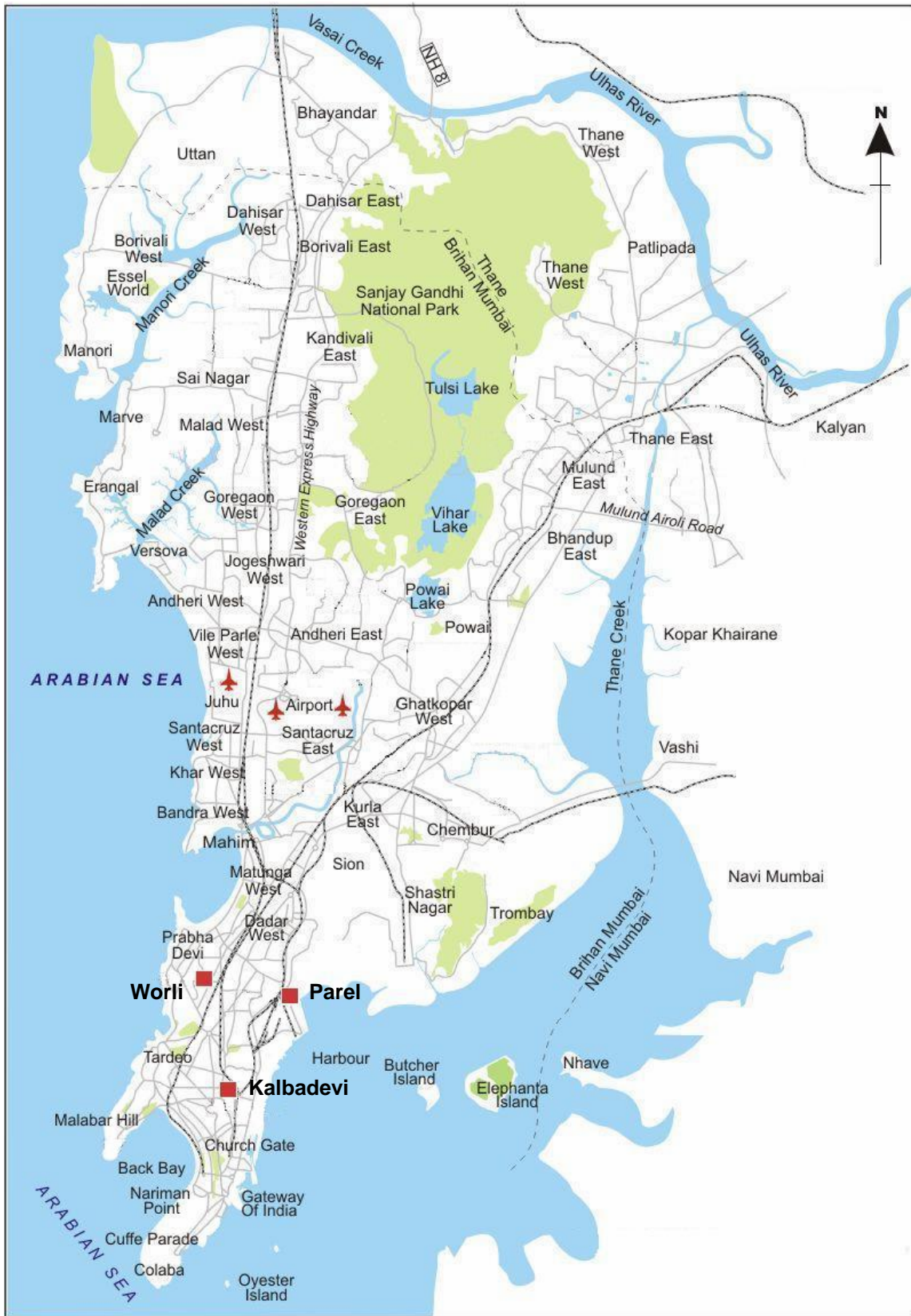
16.1 Sources of Air Pollution

The vehicle pollution and industrial emissions add to the air pollution through discharge of gaseous and particulate air pollutants. The major sources of air pollution in Mumbai are emissions from vehicles, industries, domestic solid waste, hazardous wastes, hospital wastes. Vehicles and industries being one of the major sources are described below:

(a) Vehicular Sources

Vehicular pollution is due to:

- Increase in population of vehicles, particularly the personalised vehicles.
- Most in-use vehicles (pre-1990) are of the old engine design specially taxis and are high emitters of pollutants
- High emissions of carbon monoxide and hydrocarbons from 2 and 3 wheelers consisting of two stroke engines



■ Location of Ambient Air Quality Monitoring Station
Figure 16.1: Map of Mumbai.

- Inadequate road and traffic network unable to meet the needs of the increasing population, leading to traffic congestion and traffic jams. Such areas and traffic intersections are regions of high levels of pollution.

➤ **Pollution from 3-wheelers**

There are 79784 nos. of three-wheelers in Mumbai. They are petrol-driven, powered by 2-stroke engines and are source of emission of carbon monoxide and hydrocarbons. Pollution check conducted reveal that the levels are so high that they go beyond the measurable scale of test instruments. In addition, it is commonly believed that kerosene is mixed with petrol, which results in emissions of thick black smoke.

➤ **Pollution from 2-wheelers**

Because of the inherent drawback in design of the 2-stroke engine, 2-wheelers emit about 30-40% of the fuel unburnt / partially burnt. Most of the population of the 272796 nos. of 2-wheelers are powered by 2-stroke engines. Presently, 2-wheelers account for significant quantum of emission of the hydrocarbons and carbon monoxide. As these emissions are invisible, the general public is not aware of the role of 2-wheelers in the deteriorating air quality.

➤ **Pollution from diesel trucks**

The diesel trucks, similar to buses, emit high levels of smoke and fine particulate matter. Annual renewal of permits must be strictly done only if the vehicle conforms to satisfactory inspection and maintenance measures for pollution control. Controlling the overloading of trucks requires to be enforced vigorously.

(b) Industrial Sources

Government of Maharashtra vide its notification No.ENV.1093/237/CR.43/DI/, dated 6.11.95, issued u/s 19 of Air (P&CP) Act, 1981, has declared entire State of Maharashtra as Air Pollution Control Area for implementation of the said Act.

The estimated fuel consumption, MT/month, in the industries is as under:

S.No.	Fuel	Mumbai	Thane
1.	Furnace oil	306 million lit/year	6365
2.	LDO	46 million lit/year	840
3.	Natural Gas	233 million lit/year	552
4.	LSHS	1488 million lit/year	1764
5.	Coal	information awaited	210
6.	Others	583 million lit/years	582

The major air polluting industries are:

- Thermal Power Plants
- Fertiliser plants
- Acid manufacturing units
- Pesticides
- Petroleum refineries
- Petrochemical Complex
- Foundries/Iron & Steel
- Chemical industries

MPCB has granted about 20,000 consents under Section 21 of the Air (P&CP) Act, 1981, to air polluting industries. The air pollutant load from above oil refineries located in Mumbai is shown as follows:

Refinery	Crude processed in tonnes/day	Average emission of SO ₂ in kg/hr	Average emission of SO ₂ in tonnes/day	Hydrocarbon load (tonnes/day)
BPCL, Mumbai	21822	461	11.1	272
HPCL, Mumbai	17452	446	10.7	218
Total	39274	907	21.8	490

16.2 Ambient Air Quality

Ambient air quality monitoring is carried out at three locations in Mumbai by National Environmental Engineering Research Institute (NEERI) under National Air Quality Monitoring Programme (NAMP). The three monitoring stations are located at Worli, Kalbadevi and Parel. The status and trends of air pollutants is described in this section.

16.2.1 Violation of NAAQS (24 hourly Average)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated. The NAAQS (24 hourly average) of SPM are violated in residential areas and NAAQS (24 hourly average) of RSPM are violated during many years.

16.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

In general low levels of SO₂ are observed in Mumbai. Also, low levels of NO₂ are observed during many years. High levels of SPM are observed in residential

areas. High levels of RSPM are observed in residential areas during many years. Critical levels of SPM were observed in residential years during many years.

16.2.1 Air Quality Trends in Mumbai

Trend in annual average concentration of SO₂ is shown in Fig 16.2. Annual average concentration of SO₂ was lower than the NAAQS (annual average) during all the monitored years in residential and industrial areas. A decreasing trend is observed in annual average concentration of sulphur dioxide which may be due to various measures taken such as reduction of sulphur in diesel, introduction of CNG vehicles etc..

Trends in annual average concentration of NO₂, is shown in Fig 16.3. Annual average concentration of NO₂ was lower than the NAAQS (annual average) during all the monitored years in residential and industrial areas. A decreasing trend has been observed in ambient NO₂ levels which may be due to various measures taken such as introduction of Euro-III norms etc. Trend in annual average concentration of RSPM, is shown in Fig 16.4. Annual average concentration of RSPM exceeded the NAAQS (annual average) during all the monitored years in residential areas. Trend in annual average concentration of SPM is shown in Fig 16.5. Annual average concentration of SPM exceeded the NAAQS (annual average) in residential areas

16.2.4 Meteorological Issues

Trend in monthly average concentration of SO₂ and NO₂ is depicted in Figure 16.6. Trend in monthly average concentration of RSPM is depicted in Fig 16.7. Trend in seasonal concentration of SO₂ is depicted in Figure 16.8. Trend in seasonal concentration of NO₂ is depicted in Figure 16.9 and trend in seasonal concentration of RSPM is depicted in Figure 16.10. The concentrations are higher in winter months and are lower during monsoon months. A plausible explanation for these results may be found by examining meteorological conditions. During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher concentrations.

The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources, increase mixing processes. One of the reasons for low levels of pollution is that it is a coastal city and excellent ventilation effects due to sea and land breezes reduces pollution levels.

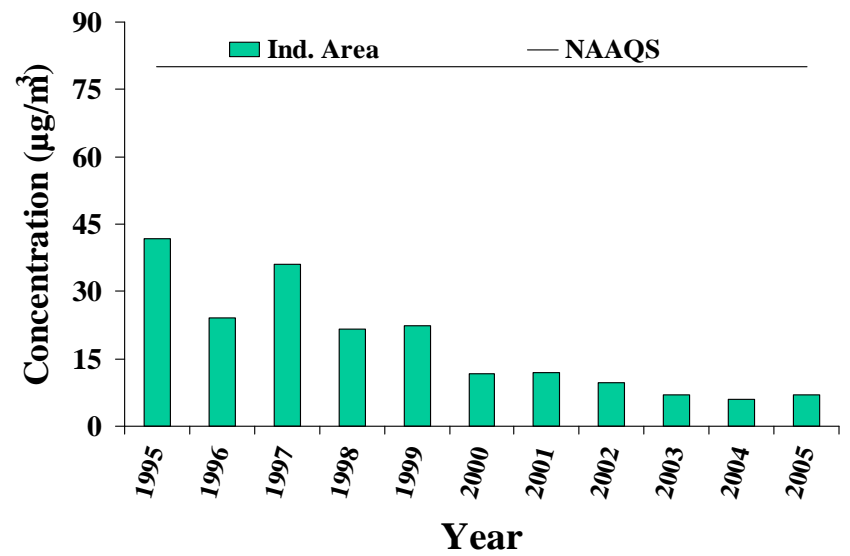
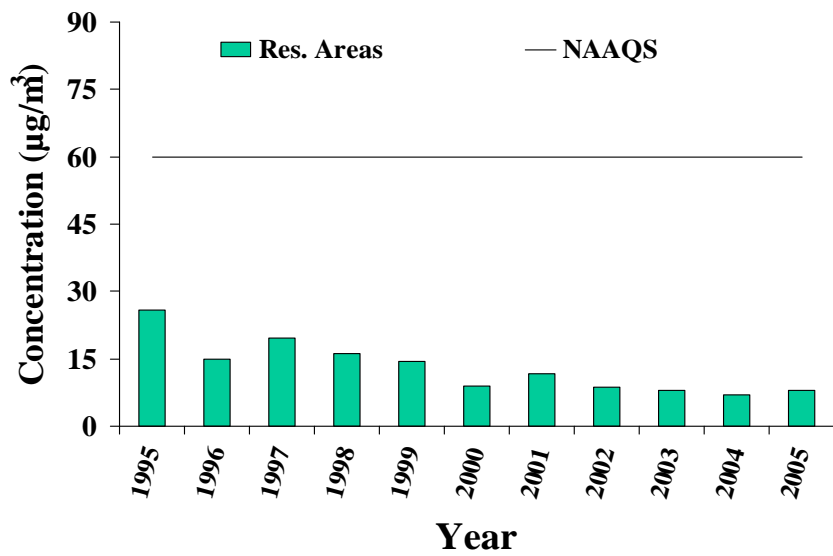


Figure 16.2: Trends in Annual Average Concentration of SO₂ in Mumbai.

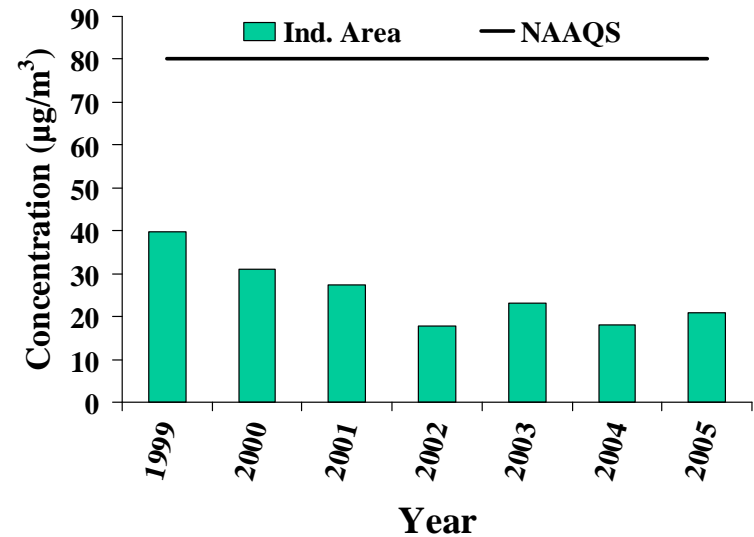
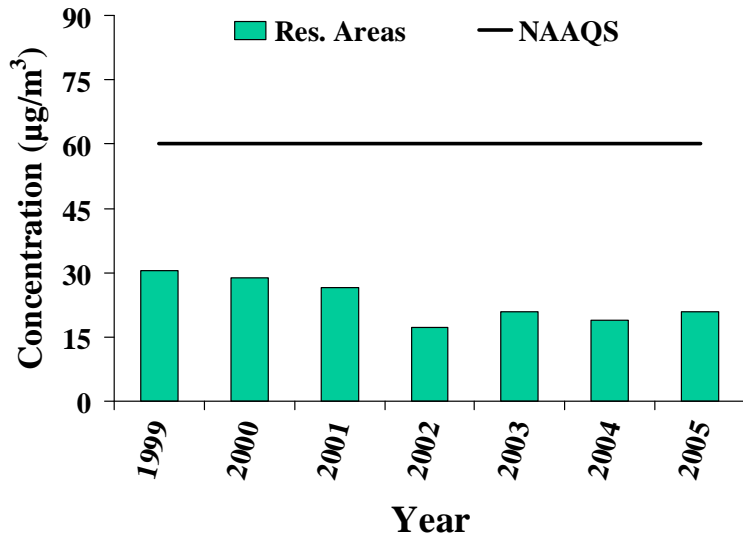


Figure 16.3: Trends in Annual Average Concentration of NO₂ in Mumbai.

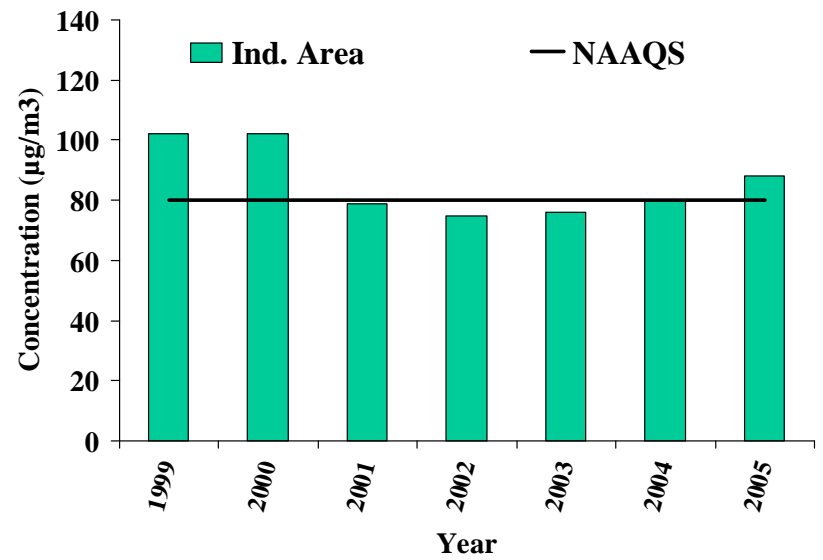
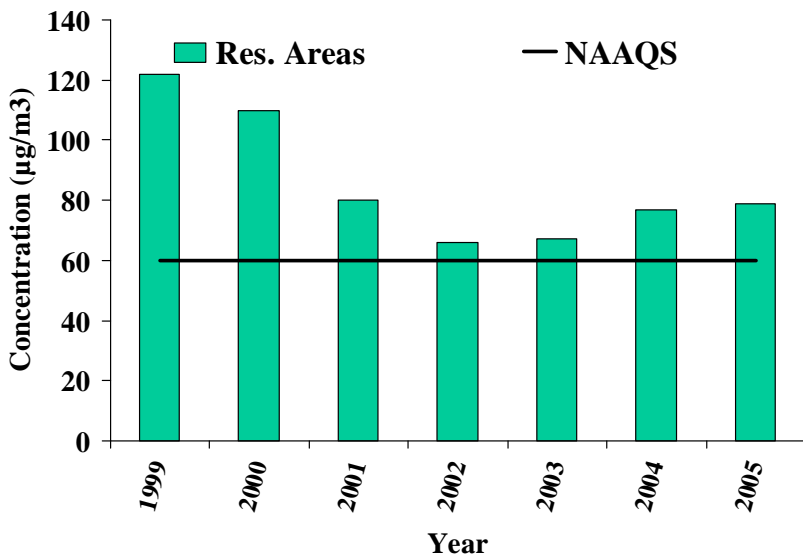


Figure 16.4: Trends in Annual Average Concentration of RSPM in Mumbai.

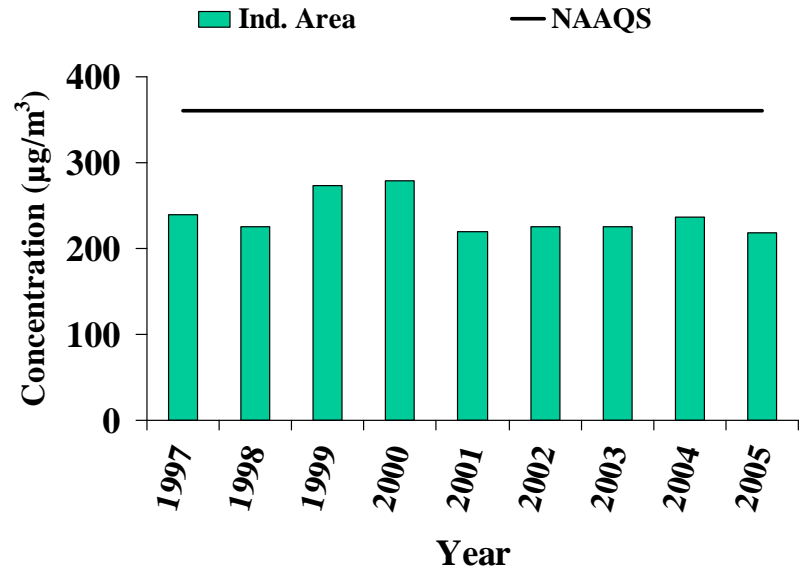
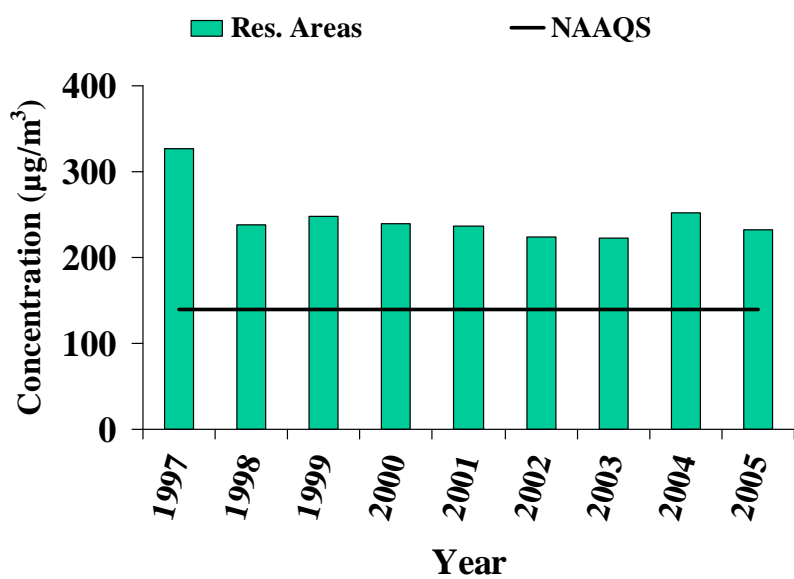


Figure 16.5: Trends in Annual Average Concentration of SPM in Mumbai.

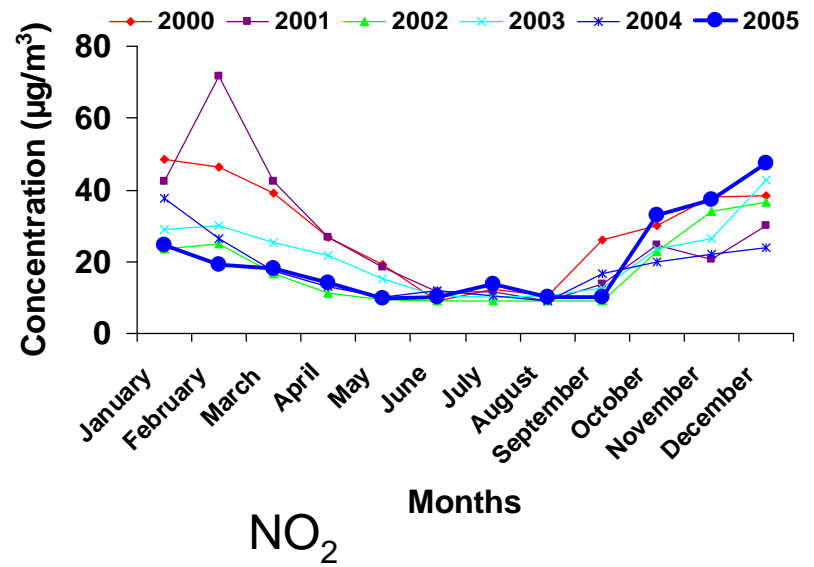
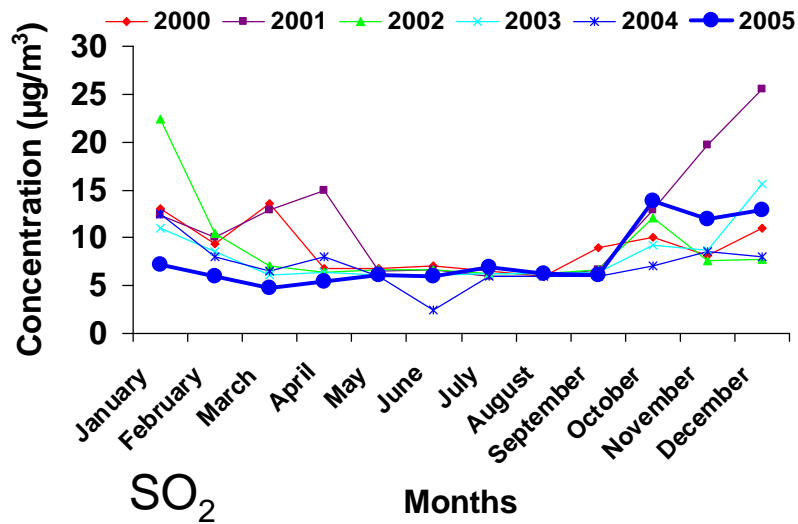


Figure 16.6: Trend in Monthly Average Concentration of SO₂ and NO₂ in Mumbai.

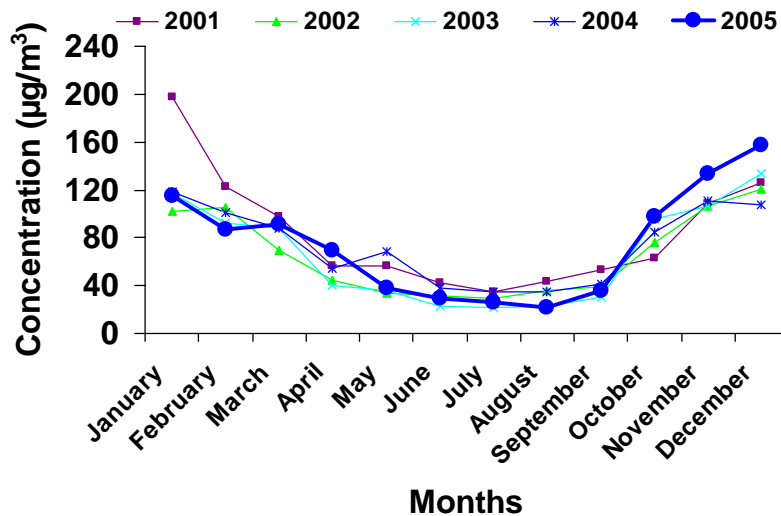


Figure 16.7: Trend in Monthly Average Concentration of RSPM in Mumbai.

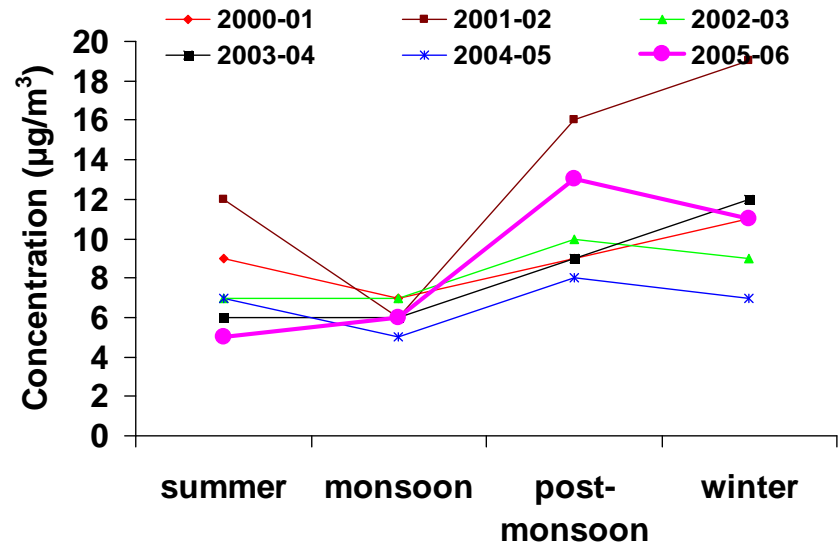


Figure 16.8: Trend in Seasonal Concentration of SO₂ in Mumbai.

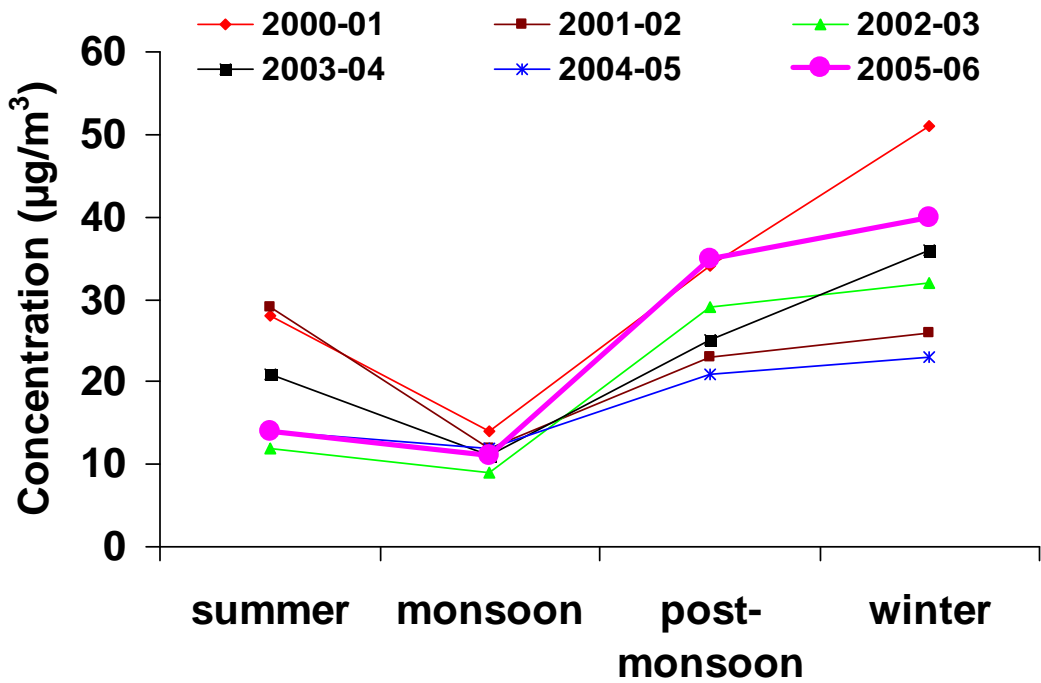


Fig 16.9: Trend in Seasonal Concentration of NO₂ in Mumbai.

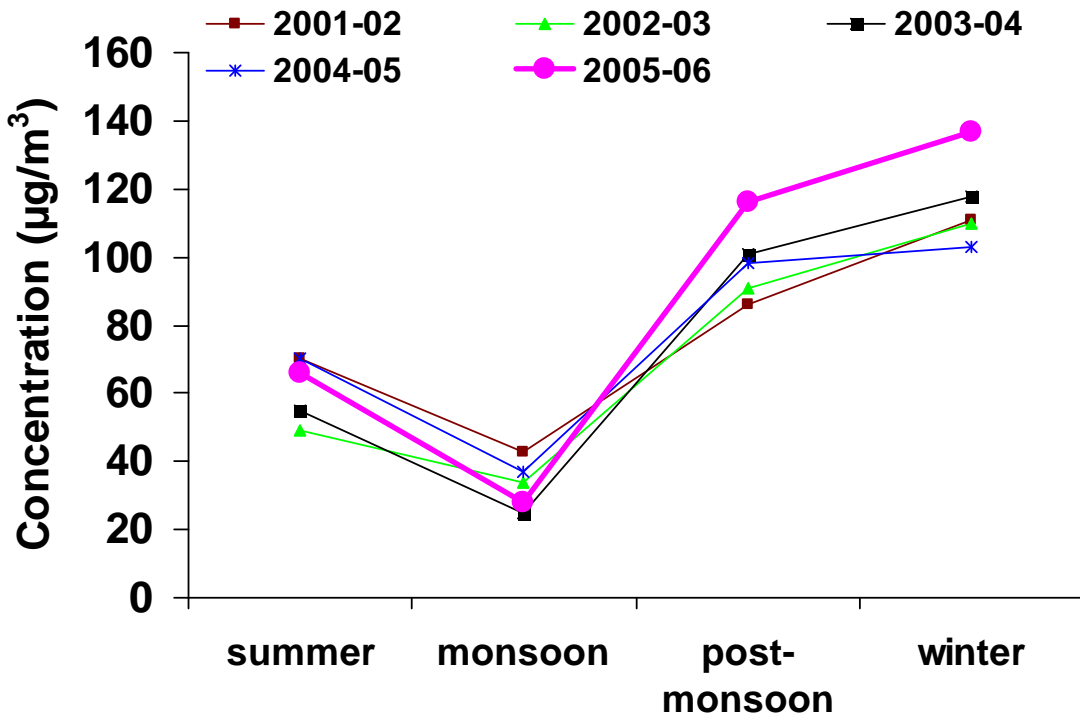


Fig 16.10: Trend in Seasonal Concentration of RSPM in Mumbai.

16.3 Action Plan for the Control of Air Pollution for the city of Mumbai (As on December 2003)

16.3.1 Action taken so far

(a) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- Government of Maharashtra implemented Industrial location policy
- Almost all the Industries have provided with Pollution control systems.
- In Kandivili there were complaints of air pollution due to existing cluster of stone crushing and hot mix plants. The Board has directed all these units to shift to the confirming zone.

(b) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- India stage 2000 emission norms (Euro –I equivalent) for all vehicles introduced in 2000
- The Honorable Bombay High Court by their order dated 17th October , 2001 directed for phasing out of old commercial vehicles unless they are converted to run on LPG /CNG. So far various categories of old commercial vehicles have been phased out in a phased manner.
- Mahanagar gas Limited is supplying CNG for vehicular application in Mumbai through its 57 filling stations.
- LPG also has been approved as automotive fuel in August 2000. LPG is a clean fuel. The oil companies have set up about 15 LPG dispensing stations in Mumbai.
- At present there are 47 retrofitting workshops for fitment of CNG kits on the in-use four wheelers light vehicles like taxis, cars and 158 workshops for three wheelers auto rickshaws.
- For the retro fitment of LPG kits on four wheeler light vehicles, there are 166 workshops in Mumbai and three wheelers auto rickshaws the number of workshops are 179.
- Bharat stage-II norms(Euro-II equivalent) have been implemented for all the new vehicles(except 2 &3 wheelers) since 2001/2002
- The low sulphur diesel (0.05%) introduced since 2001/2002.
- Leaded petrol phased out from 2000.
- Low smoke 2-T oil was made available from 1998
- Benzene content in gasoline reduced to 1 %.
- Some of the taxis have been converted to CNG mode.
- 5 % ethanol blended gasoline introduced since January 2003.

16.3.2 Proposed Action Plan

(a) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- Future action plan under Corporate responsibility for environment protection for highly polluting 18 categories of industries have been approved and will be implemented in a time bound manner.
- Emission norms for new diesel engines for genset application will be made available in a phased manner from January- July 2004

(b) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:

- Mahanagar gas Limited is supplying CNG for vehicular application in Mumbai through its 57 filling stations. Efforts are being made by the MGL to increase the CNG dispensing facilities to about 80 outlets by March 2004.
- Bharat stage-III & Bharat stage-IV emission norms will be implemented for new vehicles (except 2 & 3 wheelers) from 2005 & 2010 respectively
- For 2& 3 wheelers Bharat –II & Bharat stage-III emission norms will be introduced by 2005 & 2008/10 respectively.
- Sulphur in diesel will reduced to 0.035% & 0.005% by 2005 & 2010 respectively.
- Inspection & maintenance system for all categories of in-use vehicles will be introduced from April 2006
- New PUC checking system will be introduced for all categories of in-use vehicles by October 2004
- Augmentation of mass transport system by April 2004.
- Stricter emission norms will be made applicable for all Inter-state buses and trucks.

16.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Mumbai. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, use of cleaner fuel such as CNG etc. Other measures include implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality.

Levels of NO₂ are within the prescribed NAAQS. A decreasing trend has been observed in ambient levels of NO₂ in Mumbai which may be due to various measures taken such as implementation of stricter emission norms, phasing out

of old vehicles etc. One of the major sources of NO₂ are vehicles and number of vehicles in Mumbai have increased exponentially over the years. The most critical form of pollution in Mumbai is respirable suspended particulate matter. (RSPM) and the levels are more than prescribed National Ambient Air Quality Standard of RSPM. The reason for high respirable suspended particulate matter levels may be vehicular emissions, resuspension of traffic dust, commercial and domestic use of fuels, burning of biomass, emission from power plant, oil refinery etc.

17.0 Patna

Patna the imperial city. Patna once called Pataliputra the capital of Bihar, is among the world's oldest capital cities with unbroken history of many centuries as imperial metropolis. A very fertile arched stretch of land along the bank of the Ganga. The history and heritage of modern day Patna go back well over two millennia. Like Delhi, Patna too had been the regal seat of governance for successive kingdoms since ancient times. And to this day, it is the capital city of the state. As each ruler ascended in power and established dynastic glory, he gave his capital a new name. The beehive shaped Golghar, a granary built to store surpluses against possible famines, is the main landmark of the city. The Patna city museum exhibiting old sculptures, paintings and other archeological finds; the Har Mandir, one of the holiest Sikh shrines; Kumrahar, a small village on the south of Patna are amongst the other places of interest.

The state has a humid subtropical monsoon climate, with three well-defined seasons: the cool season, from November to February; the hot season, from March to mid-June; and the rainy season, from mid-June through October. Temperatures in December and January fall to 5°C and below, while those in May rise above 40° C. The state's mean annual rainfall is 1,270 mm. The Map of Patna is depicted in Figure 17.1.

17.1 Sources of Air Pollution

There are various sources of air pollution in the city of Patna, which can be classified under the following major sources:

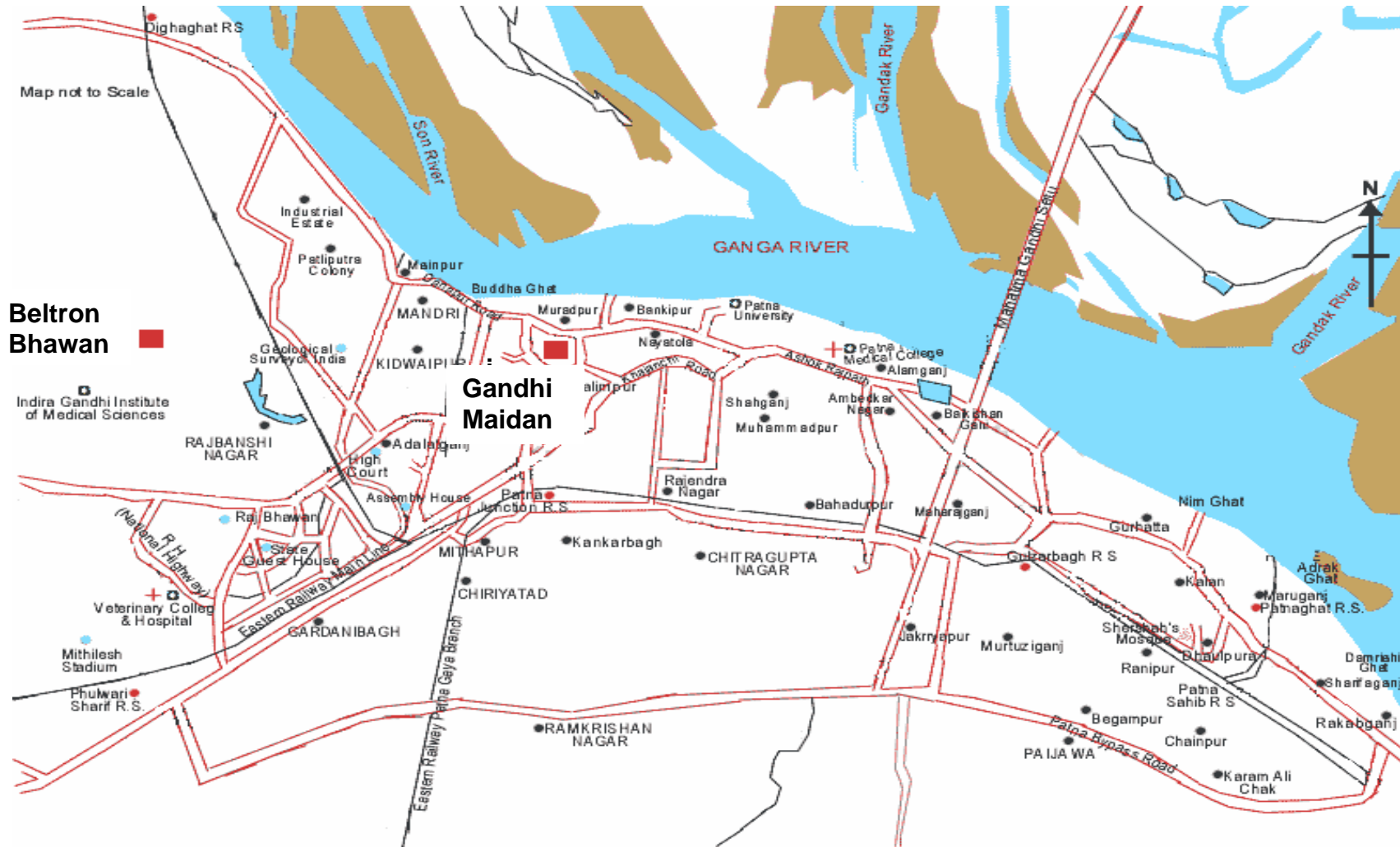
(i) Vehicular source: There are around 3 lakhs vehicles.

(ii) Industrial sources: Few medium & small scale industries, which emitting 150 kg/hr of particulate matter through their stacks; and

(ii) Coal fired hearths in slums, improper transport of sand and other construction materials, bad road conditions and traffic congestion etc. are some of the other main sources

17.2 Ambient Air Quality

Bihar State Pollution Control Board is monitoring ambient air quality at two monitoring stations in Patna located at Beltron Bhavan and Gandhi Maidan representing residential areas. The status and trends in ambient air quality is detailed in following sections.



■ - Location of Ambient Air Quality Monitoring Station

Figure 17.1: Map of Patna

17.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ are not violated. Also, it has been observed that NAAQS (24 hourly average) of NO₂ are also not violated. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated.

17.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in Patna. Also, low levels of NO₂ were observed in Patna during many years. High and critical levels of RSPM and SPM were observed in Patna.

17.2.3 Air Quality Trends in Patna

Trend in annual average concentration of SO₂, NO₂, RSPM and SPM is depicted in Fig. 17.2. SO₂ levels were lower than the NAAQS (annual average) during all the monitored years. NO₂ levels were lower than the NAAQS (annual average) during all the monitored year. RSPM levels exceeded the National Ambient Air Quality Standard (Annual Average). SPM levels in residential areas were higher than the NAAQS (annual average).

17.3 Action Plan for the Control of Air Pollution for the city of Patna (As on January 2004).

17.3.1 Proposed Action Plan

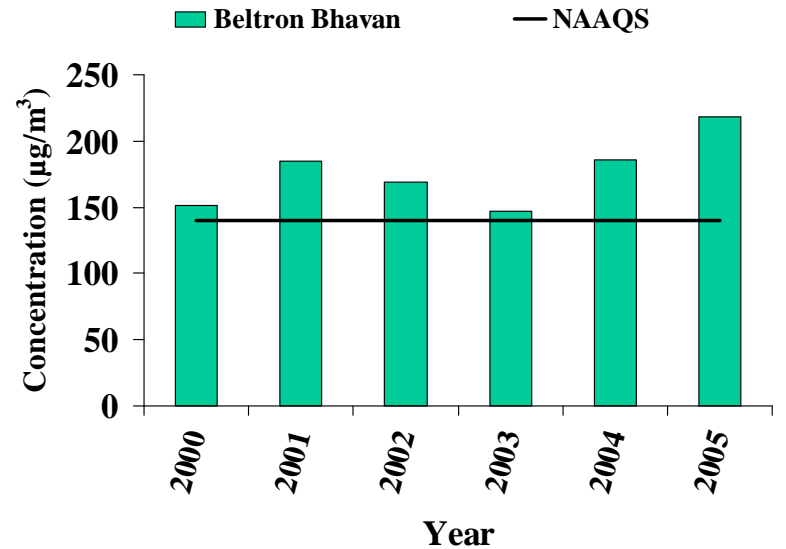
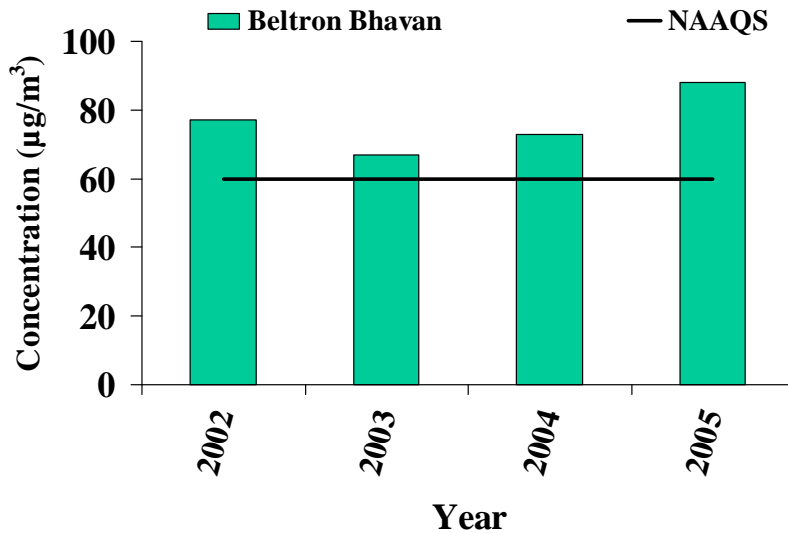
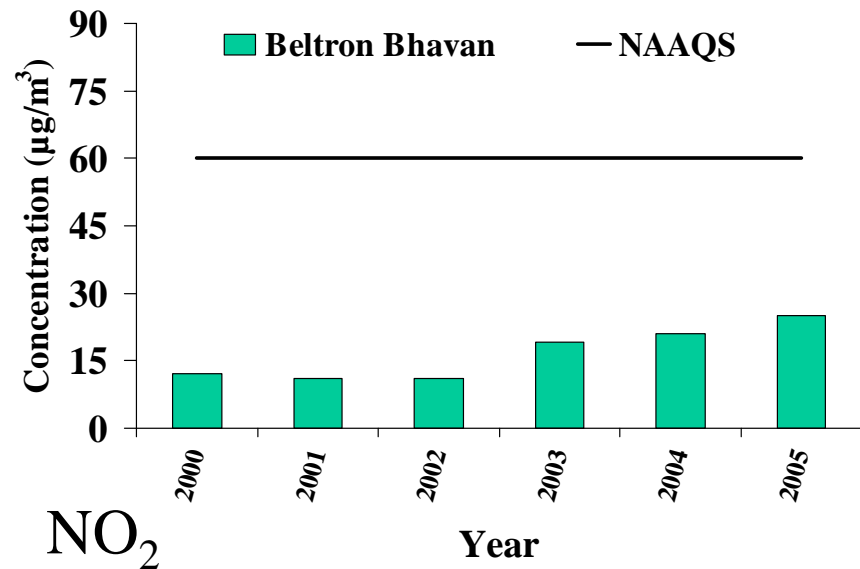
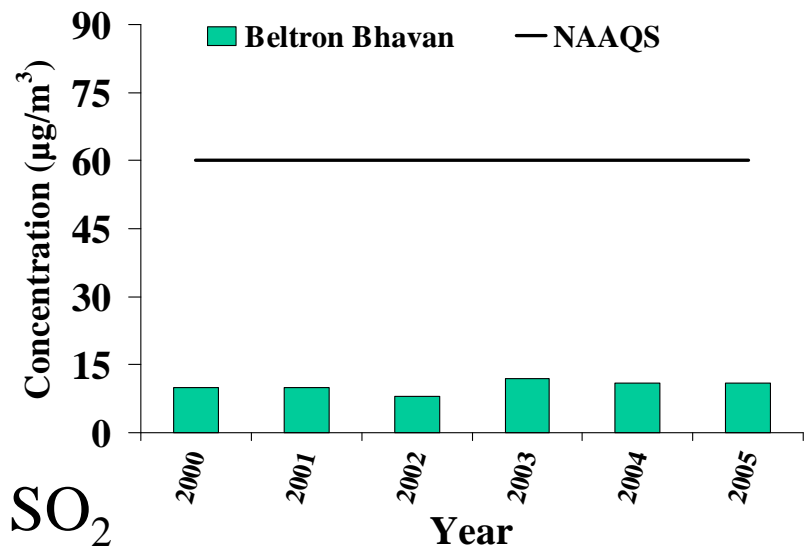
(i) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- Verification for compliance of specified norms by the industries under the Air Act, 1981 would be intensified.
- Ambient air quality monitoring at industrial area of the city to be intensified to pin point the source of pollution and take punitive action thereof.
- All the industrial units in the city to develop a green belt along their periphery.
- Verification of the compliance by industries with respect to emission norms through surprise inspections.
- Proper upkeep and regular sweeping of roads.

(ii) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:



RSPM

SPM

Figure 17.2: Trends in Annual Average Concentration of SO₂, NO₂, RSPM and SPM in Patna.

- To launch a drive to stop usage of kerosene in vehicles particularly three-wheelers and commercial vehicles on regular basis by 31.3.2004.
- To ensure no loose kerosene is sold within the vicinity of the petrol station.
- To stop the practice of removing silencers by three wheelers and no tampering with the vehicle are done by 31.03.2004.
- Necessary equipments to verify vehicular emission to be purchased to intensify drive for checking vehicular emission so as to take necessary action against the defaulters. Auto exhaust Monitoring stations to be made functional by 31.01.2004.
- Ban on supply of loose kerosene oil at petrol station/service garages; loose 2 T oil at petrol pumps and introduction of pre-mixed fuel oil & expansion of pre-mixed outlets.
- Advance fuel testing laboratories are to be established at Patna. IOC has already established one laboratory in Patna which will be utilized for checking fuel adulteration on regular basis.
- Old buses and other commercial vehicles of 15 years and above age, not complying with the emission norms, shall be allowed retrofitting within one year so as to meet the norms otherwise they will not be allowed to operate.
- All new vehicles in Patna would be registered only if they are Bharat –II complied or they run on LPG/CNG by 01.04.2005.
- Regular monitoring at critically polluted areas of the city so that plan for providing flyovers and other traffic management systems can be developed. One fly over at Chariyatand shall be functional by 30.6.2004 and another fly-over at Mithapur area by 30.6.2005.
- Removal of air pressure horns from transport buses and other vehicles.
- Control of noise pollution due to playing of loud speakers, DG sets, crackers etc.
- Transport of building materials like sand etc., garbage and other solid waste should only be done through properly covered vehicles.
- Better traffic management: Regulation of traffic during peak hours at major crossings, railway stations and bus terminals. Synchronized Traffic signals shall be made functional by 31.03.2004.

17.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. Low levels of SO₂ may be due to which may be due to various measures taken such as reduction of sulphur in diesel, implementation of stringent emission norms for new as well as in-use vehicles, improved fuel quality etc. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored year. Low levels of NO₂ are may be due to various measures taken such as implementation of stricter emission norms etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers emissions, resuspension of traffic dust, commercial and domestic use of fuels, etc.

18.0 Pune

The city, formerly spelt as Poona is located just 170-km from Mumbai at an altitude of 598m. Pune is Maharashtra's second city, which lies close to the Western Ghat Mountains (known also as the Sahyadri Hills), on the edge of the Deccan plains as they stretch away to the east. Pune is the cultural capital of the Maratha people, which is also known as the "Queen of the Deccan."

The city of Pune first gained its importance as the capital of the Marathas in the 17th century. Today Pune is one of the leading metros in India, with the Film and Television Institute of India and National Defense Academy based here. It is fast becoming one of the major hubs of industry and commerce in the country. It is also an important commercial and educational centre with distinctive features and characteristics of its own. The region surrounding Pune, now called Greater Pune, includes parts of the Sahyadri Hills, the Balaghat Range (north) and the Mahadeo Hills (south), which enclose the upper Bhima River Valley.

Pune exemplifies an indigenous Marathi culture and ethos, in which education, arts and crafts, and theatres are given due prominence. It is the birthplace of the poet-saint Tukaram (in Dehu) and Janeshvara (in Alandi), the author of the well-known commentary on the "Bhagavad Gita". It is the home of great freedom fighters like Bal Gangadhar Tilak, Agarkar and Gopal Krishna Gokhale. Jayant Narlikar, the famous contemporary scientist, is from Pune. Pune is the seat of North Indian Classical music. Pune boasts of its art galleries, museums such as the Raja Kelkar museum, which is a one-man collection of artifacts. Pune has been an example for the blending of the culture and heritage with modernisation and its side effects.

18.2 Sources of Air Pollution

The main sources of air pollutants in Pune are detailed below

a) Vehicular Sources

The emission load inventory from vehicular sources have been done by Central Institute of Road Transport (CIRT) which reveals that approximately 182 tonnes of pollutants are emitted from vehicles per day in Pune. Vehicular emission inventory shows that 78 % of total vehicular pollution is contributed by 2 wheelers, after this cars & 3 wheelers contributes 12 & 5 % respectively in total vehicular emissions. The key traffic & transportation problems in Pune are like disproportionate rise in number of vehicles; insufficient road area, severely impaired mass transport system etc.

b) Industrial Sources

The large & medium scale industries are very few in Pune & these industries do not have high pollution potential. The small-scale industries are mainly in service category. However more frequent power failure in recent years have given rise to higher needs to D.G sets.

c) Domestic Sources

Slum dwellers in Pune having population of approximately 10,50,00 covering declared slum area of 659 hectares. The slum dwellers are chiefly responsible for contributing pollution from domestic sources as these people mainly uses polluting domestic fuels like wood, bagasse, saw dust, waste paper /or any sundry waste thus contributing to air pollution.

The other sources include agricultural burning, paved and unpaved road dust, construction activities etc.

18.2 Ambient Air Quality

Maharashtra State Pollution Control Board is operating three ambient air quality monitoring stations under National Air Quality Monitoring Programme (NAMP) in Pune. These air quality stations are located at Nalstop and Swargate representing residential areas and Bhosari representing industrial area. The status and trends in ambient air quality is detailed in following sections.

18.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ are not violated. NAAQS (24 hourly average) of NO₂ are violated at some stations like Swargate and Nalstop during some years. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated.

18.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low and Moderate levels of SO₂ and NO₂ were observed during many years. Critical levels of RSPM were observed in residential areas of Pune. Critical levels of SPM were also observed in residential areas of Pune.

18.2.3 Air Quality Trends in Pune

Trend in annual average concentration of SO₂ is depicted in Fig. 18.1. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Pune which may be due to various measures taken such as reduction of sulphur in diesel etc. Trend in annual average concentration of NO₂ is depicted in Fig. 18.2. NO₂ levels in industrial areas were lower than the NAAQS (annual average) during all the monitored year. A decreasing trend has been observed in ambient NO₂ levels in Pune which may be due to various measures taken such as introduction of Euro III norms etc.

Annual average concentration of RSPM is depicted in Figure 18.3. RSPM levels exceeded the National Ambient Air Quality Standard (Annual Average) in residential areas whereas in industrial areas they were within the NAAQS (Annual Average). Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 18.4. SPM levels exceeded the NAAQS (Annual Average) in residential areas whereas in industrial areas they were within the NAAQS (Annual Average).

18.2.4 Meteorological Issues

Seasonal variation in RSPM levels at Nalstop, Pune is depicted in Figure 18.5. The concentrations are higher in winter months and are lower during monsoon months. A plausible explanation for these results may be found by examining meteorological conditions. During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher concentrations.

The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources, increase mixing processes.

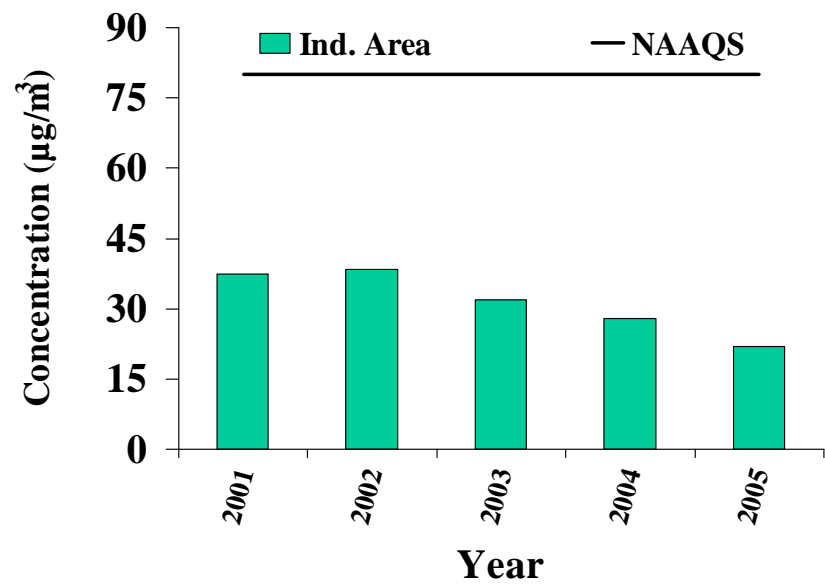
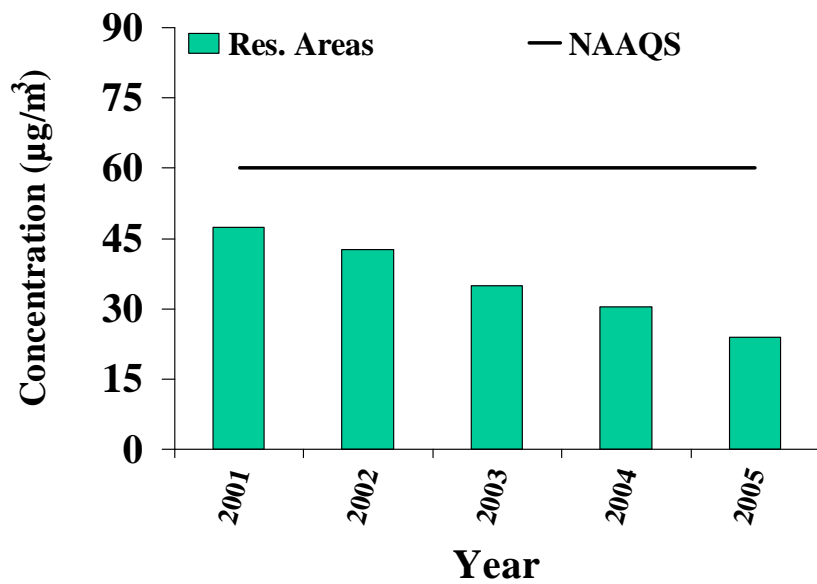


Figure 18.1: Trends in Annual Average Concentration of SO₂ in Pune.

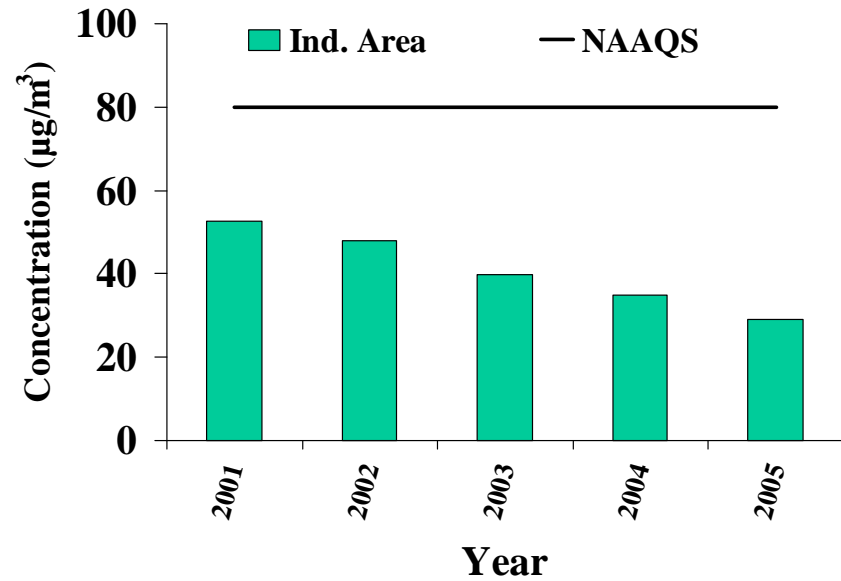
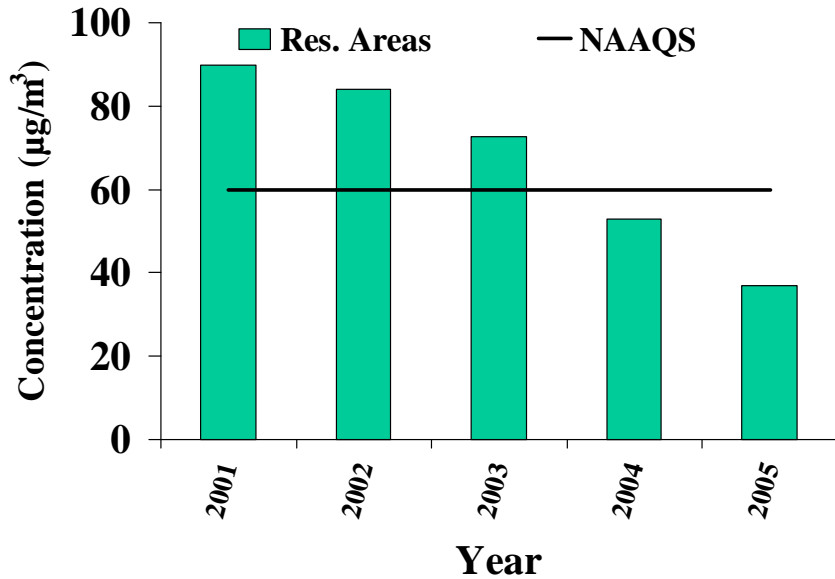


Figure 18.2: Trends in Annual Average Concentration of NO₂ in Pune.

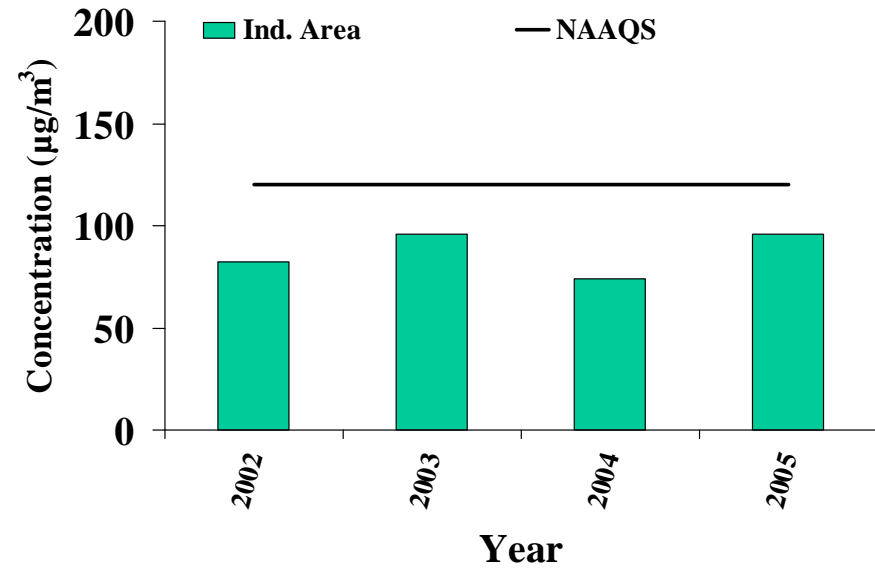
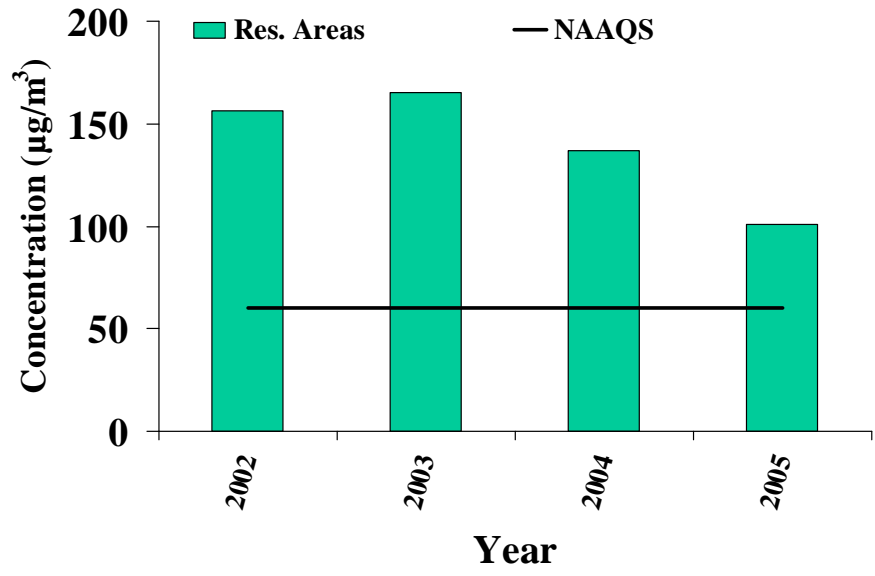


Figure 18.3: Trends in Annual Average Concentration of RSPM in Pune.

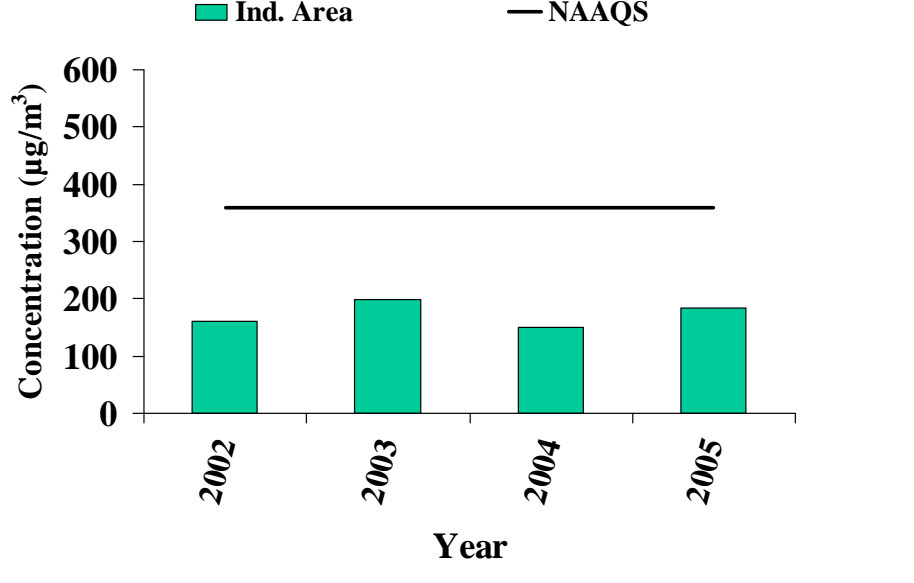
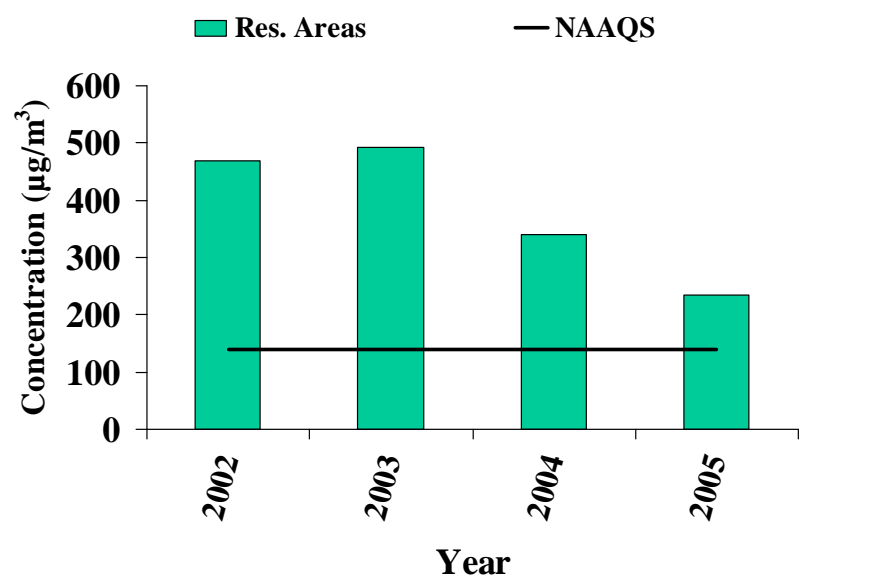


Figure 18.: Trends in Annual Average Concentration of SPM in Pune.

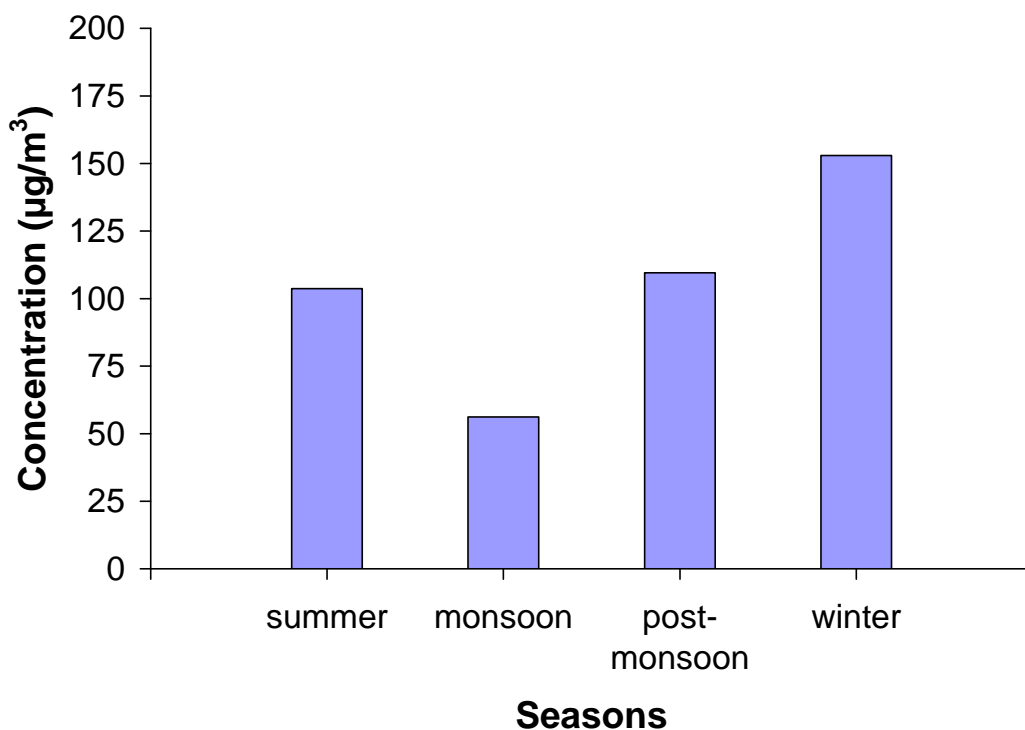


Figure 18.5 Seasonal variation in RSPM levels at Nalstop, Pune during 2005-06.

18.3 Action Plan for the Control of Air Pollution for the city of Pune (As on February 2005).

A Task Force is formed on 2nd June 2004 to draw an Action Plan for controlling air pollution in Pune. The agencies involved are Transport Dept, Public Sector Oil Companies, Maharashtra Pollution Control Board (MPCB), Pune Municipal Corporation (PMC), Pimpri Chinchwad Municipal Corporation (PCMC), District Supply Office, MoRTH, and Ministry of Petroleum and Natural gas, Regional Transport offices, PMT. MPCB has been appointed as a Convener to prepare the action plan.

18.3.1 Action taken so far

(a) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- Maharashtra Pollution Control Board has taken step to shift the industries located in the non conforming zones to the designated industrial areas. Besides, the Regional Planning Authority is in the process of preparing a

Development plan identifying a proper industrial area where the unauthorized industries can be shifted.

- Maharashtra Pollution Control Board has adopted River Regulation Zone (RRZ) policy for siting of industries as declared by Government of Maharashtra, vide Govt. Resolution No. MMV-2000/326/22/TB-3 dated 15-07-2000. Accordingly the river catchments have been categorized in 4 categories.
- The Board has laid down the distance criteria for the existing and new stone crushers. It was then accordingly decided that No stone crushers should be allowed within 500 mtrs. from National Highway, 200 mtrs from State Highway and 100 mtrs. from other Roads whether it is MDR, ODR or V.R. The distance criteria of 500 mtrs. from human habitation shall be maintained.
- The Gensets are regulated under the provisions of the Air (Prevention and Control of Pollution) Act, 1981 and the conditions about the emission standards as per the EP Rules are imposed in the consents granted to the industries for establishing the D.G.sets. MPCB regularly monitors the emissions from this power generating source. The total number of D.G.sets established by the industries in Pune and PCMC area is about 120.
- Adequate air pollution control equipments like dust collectors and scrubbers are provided by the industries.

(b) Domestic Pollution

The salient features of actions taken to control domestic pollution are as follows:

- Open burning is banned by PMC. Citizens are sensitized by PMC to carry out vermi-composting in their housing societies, institutions and hospitals. Presently construction of vermi-compost pits is mandatory in the newly constructed housing societies. The completion certificate is held up in case of non-compliance.

(c) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Bharat Stage - II emission norms has been implemented in Pune from 01.04.2003 for 4 wheeled vehicles with GVW equal to or less than 3500 Kgs.
- Unleaded petrol has already been made available.

- Supply of gasoline with 1 % benzene has already been started from April 2003.
- Supply of low sulphur diesel (0.05%) has been started.
- Ban on supply of loose 2 T oil.
- Vehicles are regularly checked for PUC certificates and if found exceeding the limits, the registration is suspended till satisfactory repair. Around 50% vehicle comes for inspection & approximately 05% is failure rate. Periodical & surprised check of PUC center by Dept. In Pune, there are 99 nos. of PUC centers for Petrol, 15 nos. for diesel & 53 nos. for petrol & diesel. In Pimpri Chinchwad, there are total 57nos. of PUC centers.
- Emission norms for CO & HC have been tightened from 01.10.2004 for in-used vehicle based on the year of manufacturing. The new procedure to measure PUC norms has been laid down from 01.10.2004.
- PMT operates 800 buses in Pune Municipal Corporation area. They have phased out 100 buses in 2002-2003 out of the 114. The Pune Municipal Corporation is planning to replace 100 buses during 2003-2004 which are fifteen years old, 83 buses during 2004-2005 and 111 buses during 2005-2006.
- PMT is in the process of hiring 135 buses & purchasing 200 buses. Out of 135 private buses, 85 medium buses & 50 mini buses of Euro II norms are being made available by the selected bidders. Accordingly, supply order has been given to them. These were expected to be made available by March 2004.
- Switch over of two wheelers from 2 strokes to 4 strokes is being done in phases. It is considered not to permit new two wheelers with 2S engines.
- RTO has banned six seaters within Pune Municipal Corporation area.
- Banning on registration of all new diesel public vehicles.
- Only petrol driven rickshaws are permitted in PMC area.
- Restriction is put on goods Vehicle and passenger buses entering the city by PMC and Police Commission orate.
- No new rickshaw permits are being granted from 26-11- 1997.
- All intent letters for the rickshaw permits have been cancelled from 29-04-1999.
- 10 river bridges have been constructed while other are in different stages of construction.
- Introduced synchronized traffic signals.
- Better traffic management through bicycle pathways, bye passing of inter city/inter state buses etc.
- Inventory of emissions load from vehicles is done in Pune city & PCMC and is reported by Central Institute of Road transport (CIT), Pune .
- **Scheme for switching over to LPG/CNG**

In Pune city, there are 5 LPG outlets. Pune RTO has authorized 80 LPG Retrofitters. The No. of vehicles converted to LPG fuel are 3,576. .The only new

A/R or old A/R converted into LPG fuel are accepted for replacement on permit in Pune city.

18.3.2 Proposed Action Plan

(a) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- Organization and review of the inventories of the polluting industries.
- Control of industrial emissions and ensuring compliance of the standards.
- Identification and closure of clandestine /unauthorized industrial operations or shifting. Within 18 months, 3 units are identified which requires shifting.
- Compliance to standards in D.G sets. Three industries have been identifies and instructed for compliance.
- Implementation of industrial location policy for shifting of industries from non- confirming zones.
- Implementation of Common responsibility for environmental protection (CREP) for 17 categories of industries having more pollution potential.

(b) Domestic Pollution

The salient features of actions plan to control domestic pollution are as follows:

- Notification for banning of open garbage burning. It is prescribed by MPCB through authorization under MSW (M&H) Rules, 2000.
- Promotion of use of LPG as domestic fuel instead of burning coal , wood & Cow dung etc.

(c) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:

- Notify & Implement vehicular emission norms as per road map recommended by Expert committee on Auto Fuel Policy.
- Performance checking for cat. Conversion kits to be put in place by 01.04.2005. At present there are 68 conversion centers in Pune city.
- Pre-mixed 2-T oil to be made compulsory as of April 2005.
- Improvement of the existing PUC centers. Defaulter has to pay Rs. 100/- at a time. Proposed as per Mumbai High court orders first time defaulter, there should be imposition of fine. Second time defaulter, cancellation of driving license and further defaulters, vehicle is to be banned to ply.

- Phasing out of grossly polluting vehicles. Government of Maharashtra has framed the phase out programme for different categories of vehicles.
- Ban on alteration of petroleum vehicles to diesel vehicles.
- Stricter drive to check the adulteration of the fuels. Periodical surprise checking is being performed.
- City government to submit a comprehensive plan for public transportation to EPCA by April 30,2006.
- Planning and construction of by-pass roads is under the preview of MSRDC.
- RTA has instructed PMT, PCMC to provide an efficient adequate, economical and properly coordinated bus service in Pune city, which will help to reduce the use of personalized vehicles. PMT to augment its public transport system and 150 buses more by March 2005.
- Proposed various flyovers/bridges to reduce the congestion and these are under various stages of completion while few have already been completed
- To finalize and implement parking policy by April 30, 2006.
- Increasing road length and improvement in road surface.
- Augmentation in the ambient air quality network by April 2005.
- To review inventory of emission load from all categories of vehicles.

- **Scheme for switching over to LPG/CNG**
 - The Ministry of Petroleum and Natural Gas (MoPNG) in early January 2004 has allocated 0.4 MMSCMD of gas for the Pune city has been allocated an Administered Price Mechanism (APM) gas which would be cheaper than the gas bought from the private players.
 - GAIL has already signed joint venture agreements with the BPCL for implementing the city gas project in the city of Pune. For the City, GAIL's proposed Dahej-Uran Pipeline (DUPL) will be extended up to Pune and the project is to be implemented in 2006-07. Mahanagar Gas Limited (MGL), which is managing city gas business in Mumbai shall also be a partner in the Joint Venture Company of Pune.
 - City government to convert 20,000 autos which are pre-1991 to LPG by June 31, 2005.
 - GAIL to ensure that it meets its deadline of December 2005 for supply of CNG to city;

18.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Pune. Decreasing trend may be due to various interventions that have taken place in recent years

such as reduction of sulphur in diesel, implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality etc.

Levels of NO₂ are within the prescribed NAAQS. A decreasing trend has been observed in ambient levels of NO₂ in Pune which may be due to various measures taken such as implementation of stricter emission norms, phasing out of old vehicles etc. The most critical form of pollution in Pune is respirable suspended particulate matter. (RSPM) and the levels are more than prescribed National Ambient Air Quality Standard of RSPM. Although RSPM levels have started to decrease in Pune in recent years. The reason for high respirable suspended particulate matter levels may be vehicular emissions, resuspension of traffic dust, commercial and domestic use of fuels, burning of biomass, emission from power plant, oil refinery etc.

19.0 Solapur

Solapur is one of the important district of Maharashtra State of India. It is located in the southern part of Maharashtra. The district consist of eleven Talukas. The headquarter of North Solapur and South Solapur Taluka is the Solapur city itself. The famous religious places like Pandharpur and Akkalkot are in Solapur district only. Solapur has its own history and once it was known as Textile Capital. Solapur is transport hub connecting Maharashtra, Karnataka and Andhra Pradesh. It is well connected by Road and Rail to major districts and cities. The national highways 9, 13 and 211 pass through Solapur city. Solapur district, famous for its Chadder, Handloom, Powerloom and Beedi Industries, covering an area of 14844.6 sq.kms. The district is having 11 Talukas and is surrounded by Ahmednagar and Osmanabad districts in the north, Osmanabad and Gulbarga (Karnataka State) in the East, Sangli and Bijapur (Karnataka State) in the South and Pune, Satara districts in the West.

Geographically Solapur is located between 17.10 to 18.32 degrees North latitude and 74.42 to 76.15 degrees East longitude. The district is situated on the south east fringe of Maharashtra State and lies entirely in the Bhima and Seena basins. The district covers geographical area of 14844.6 sq.kms. which is 4.82% of the total area of Maharashtra State. Out of the total area of the district 338.8 sq.kms (2.28%) is Urban area whereas remaining 14505.8 sq.kms. (97.72%) is Rural area. Area wise Karmala taluka is biggest covering an area of 1609.7 sq.kms and North Solapur is smallest covering an area of 736..3 sq.kms. Solapur is the home of Handloom and Powerloom weaving industry which provides employment to a large number of workers. There are around 6000 powerloom industries operational in the district. Out of these 300 establishments are registered under Mumbai Shops and Societies Act 1948 and the other 3000 are registered under Factories Act 1948. There are about 25000 Powerloom and about 30000 workers are employed. On the Jackard powerloom the main production is Chadders, Towels and Napkins. These products are exported to various countries in the world

19.1 Source of Air Pollution

The main sources of air pollution are vehicles, natural dust and industries. Number of vehicles have increased over the last few years. These vehicles are one of the major sources of air pollution. Out of these vehicles, 2-stroke two wheelers dominate in number. Due to power shortage, there are generators that are being used which also contribute to ambient air pollution. Other sources include natural dust, resuspension of dust from unpaved roads etc.

The total industries in Solapur city are 633 out of that 7 are large scale, 4 are medium scale and 622 are small scale industries, respectively. Besides, category wise 157 industries belong to Red category (highly polluting), 74 are Orange

category (medium polluting) and 402 are Green category industries (Non-polluting). There are about 17 air polluting industries in Solapur city.

19.2 Ambient Air Quality

Walchand Institute of Technology, Solapur is measuring ambient air quality at two monitoring stations in Solapur under National Air Quality Monitoring programme (NAMP). These monitoring stations are located at WIT Campus and Chitale Clinic. The status and trends in ambient air quality is detailed in following sections.

19.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated in residential areas.

19.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in residential areas and industrial areas of Solapur. Moderate levels of NO₂ were observed in Solapur. High levels of RSPM are observed in industrial areas and critical levels of RSPM are observed in residential areas. Critical levels SPM were observed in residential areas of Solapur.

19.2.3 Air Quality Trends in Solapur

Trend in annual average concentration of SO₂ is depicted in Fig. 19.1. SO₂ levels in residential area and industrial area were lower than the NAAQS (annual average) during all the monitored years. Trend in annual average concentration of NO₂ is depicted in Fig. 19.2. NO₂ levels in residential area and industrial area were lower than the NAAQS (annual average) during all the monitored year

Annual average concentration of RSPM is depicted in Figure 19.3. RSPM levels are exceeding the National Ambient Air Quality Standard (Annual Average) in residential area. A decreasing trend has been observed in residential area which may be due to various measures taken such as reduction of sulphur in diesel etc. Trend in annual average concentration of SPM in residential areas and industrial areas is depicted in Fig. 19.4. SPM levels in residential areas exceeded the NAAQS (annual average) in residential area.

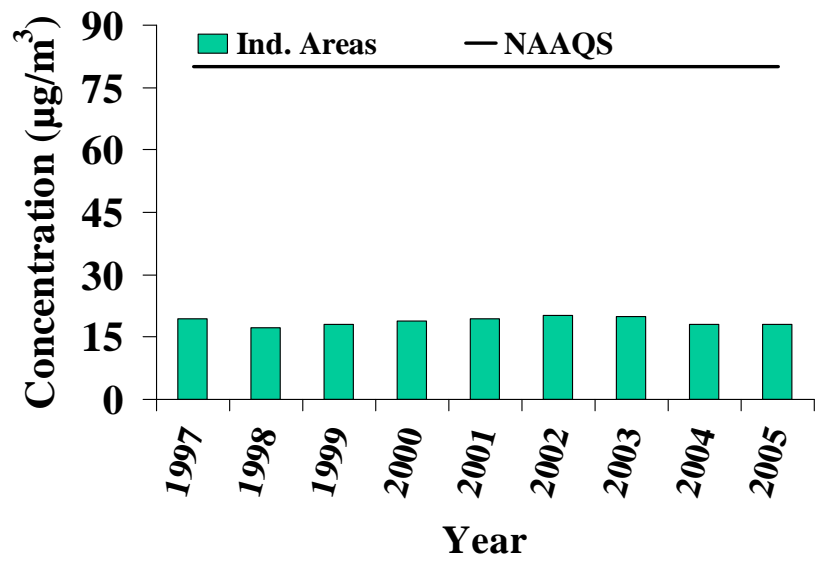
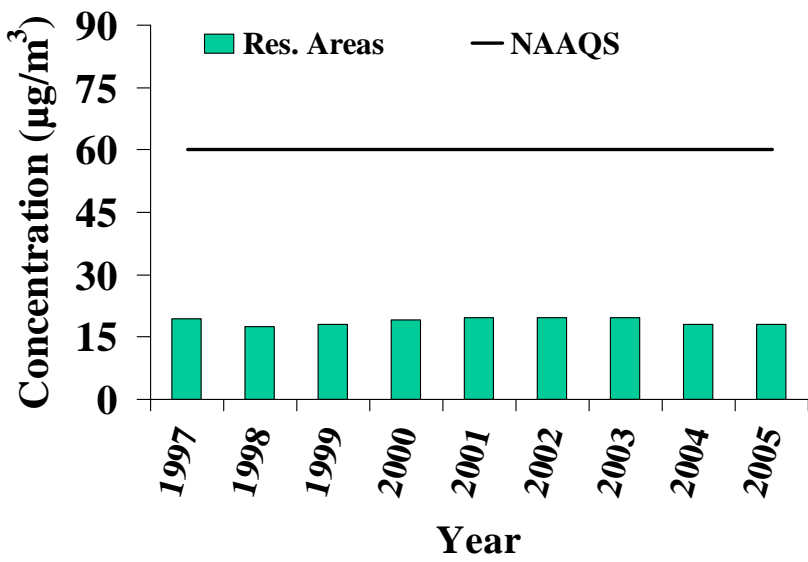


Figure 19.1: Trends in Annual Average Concentration of SO₂ in Solapur.

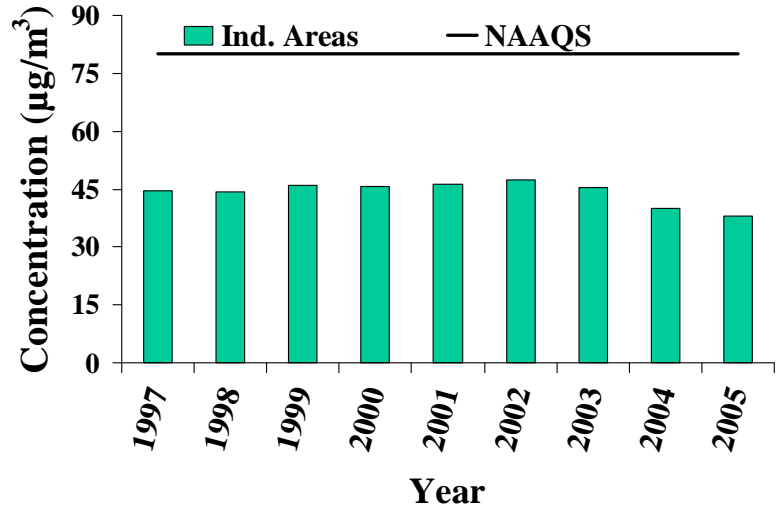
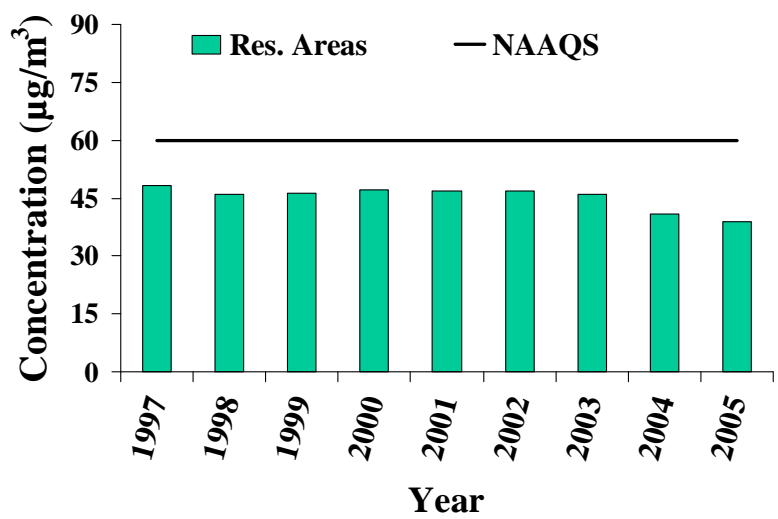


Figure 19.2: Trends in Annual Average Concentration of NO₂ in Solapur.

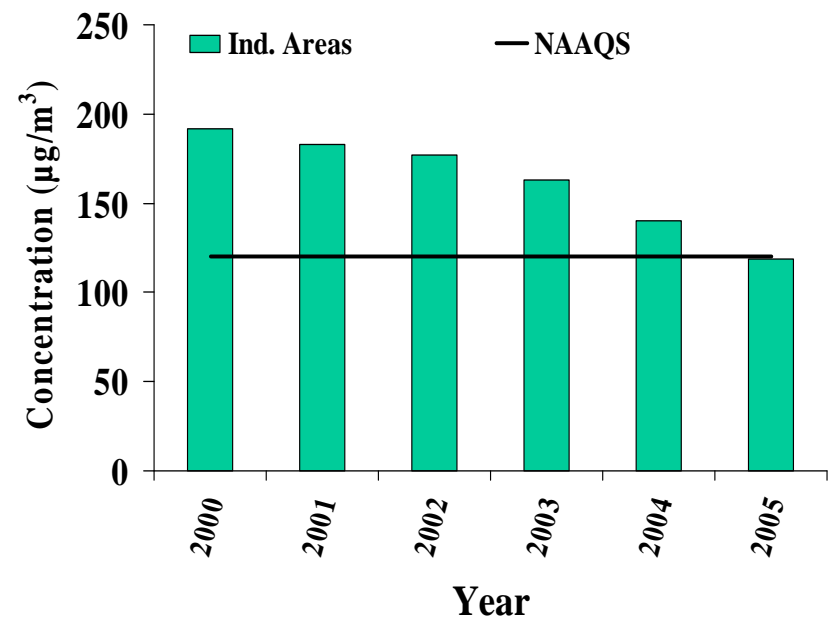
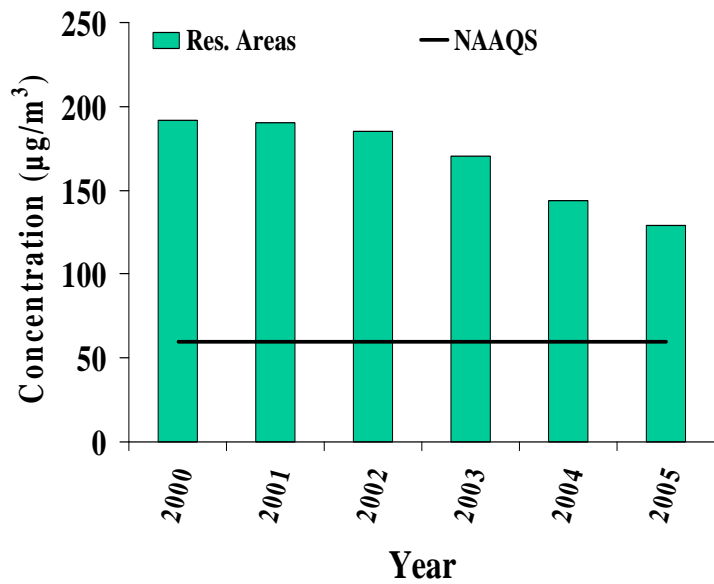


Figure 19.3: Trends in Annual Average Concentration of RSPM in Solapur.

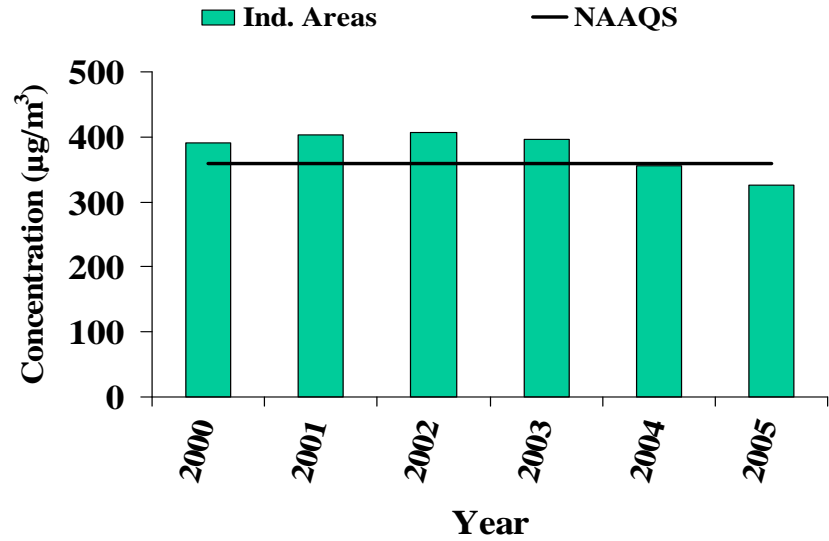
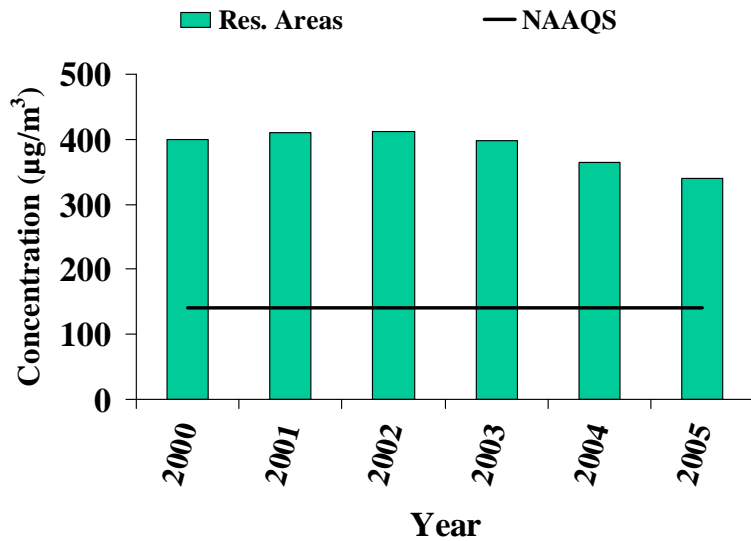


Figure 19.4: Trends in Annual Average Concentration of SPM in Solapur.

19.2.4 Meteorological Issues

Seasonal variation in RSPM levels at Chitale Clinic, Solapur is depicted in Figure 19.5. The concentrations are higher in summer and winter months and are lower during monsoon months. A plausible explanation for these results may be found by examining meteorological conditions. During the winter, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher concentrations. Dust generated from strong and turbulent winds during summer months results in particulate matter being airborne resulting in high levels.

The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources, increase mixing processes.

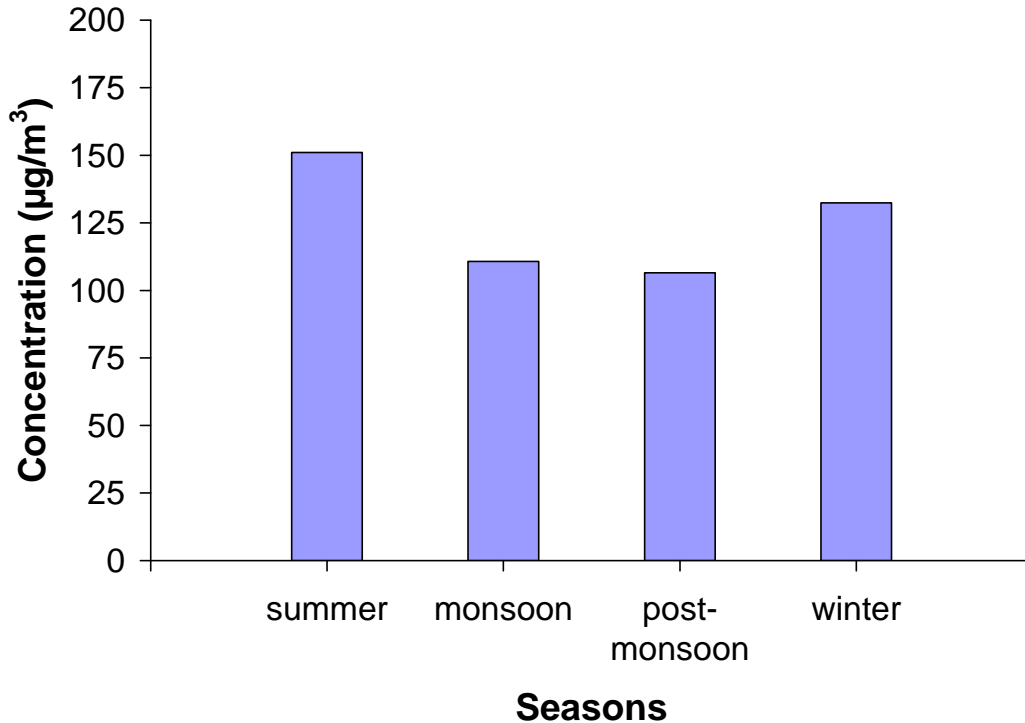


Figure 19.5: Seasonal variation in RSPM levels at Chitale Clinic, Solapur during 2005-06.

19.3 Action Plan for the Control of Air Pollution for the city of Solapur (As on February 2005)

19.3.1 Action taken so far

(a) Industrial Pollution

The salient features of actions taken to control industrial pollution are as follows:

- The total industries in Solapur city are 633 out of that 7 are large scale, 4 are medium scale and 622 are small scale industries, respectively. Besides, category wise 157 industries belong to Red category (highly polluting), 74 are Orange category (medium polluting) and 402 are Green category industries (Non-polluting).
- There are about 17 air polluting industries in Solapur city. Continuous efforts are being made to enforce the installation of pollution control systems in the industries and the D.G.Sets. To minimize the pollution load from industrial sources, MPCB has already started implementing CREP for 17 categories of industries having more pollution potential with a specific time frame.
- The compliance is kept under observation through regular inspection & vigilance.
- MPCB has adopted river regulation zone (RRZ) policy for sitting of industries as declared by Government of Maharashtra dated 15-7-2000.
- MPCB has also adopted sitting criteria for stone crushers. The Board has laid down the distance criteria for the existing and new stone crushers. It was then accordingly decided that No stone crushers should be allowed within 500 mtrs from National Highway, 200 mtrs from State Highway and 100 mtrs from other Roads viz. MDR, ODR or V.R.
- There are about 29 units (industrial as well as commercial) in the Solapur city who are using the D.G.Sets as alternative source of power. MPCB has already imposed very elaborate conditions for controlling the pollution from the usage of D.G. sets in accordance with Environment (P) Rules and has been monitoring the emissions from this source.

(b) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Bharat stage-II emission norms implemented from April 2004
- Inventory of emission load from vehicles in Solapur city reveals emission of 27 tonnes of pollutants per day.
- Six seater Auto rickshaws primarily running on diesel have been banned from 15.07.2002 in Solapur Municipal Corporation Area
- Only petrol run auto rickshaws are currently permitted and no diesel run autorickshaw is permitted as replacer vehicle (for permit holder by RTO).

- Ban on supply of loose 2-T oil.
- Checking of fuel adulteration.
- Banning on registration of all new diesel public vehicles like Six Seaters.
- Only petrol three seaters are running in the city.
- Vehicles are checked regularly for PUC certificate and if found exceeding the limits the registration is suspended till satisfactory repairs. Renewal of certificate is granted after observing satisfactory performance.
- Vehicles are inspected regularly for renewal of fitness certificates. Special checking drives are organized in all parts of the city to check and report Motor vehicles defaulting in renewal of fitness certificate. Penal action is taken against erring vehicles as per provision of Motor Vehicle Act 1988. Similarly, for the convenience of public, motor vehicle (MV) inspector tours the city & organizes camps so as to facilitate Motor Vehicle owners from far away places for producing their motor vehicles for Inspection for renewal of fitness certificate. Such programme is declared in news papers well in advance.
- There are 8 PUC centers for checking petrol vehicles, 5 for diesel vehicles & 4 PUC centers for checking both petrol & diesel vehicles. There is no restriction on opening of new PUC centre. During every renewal of permission of PUC centre thorough inspection of the centre is carried out by RTO. The enforcement squads carry out checking of vehicles for pollution and a fine of Rs. 100/- is recovered for non-production of PUC certificate or non-compliance. Also defaulter who does not rectify pollution level within 7 days from checking is prosecuted in the court of Law or has to pay a fine of Rs. 500/- each (Owner/Driver). Similarly registration of MV stands suspended till PUC level is brought within norms. Also new and in use vehicles are strictly inspected at the time of registration, during renewal of certificate of fitness & renewal of registration of compliance of PUC norms.
- National Highway Nos. 13 & No. 9 were earlier passing through Solapur city. However, a bypass has been construction on NH 13 at Mohol- Kamti-Mandrup. Therefore, majority of the traffic is using this by-pass. This has resulted in the direct traffic not entering the city and consequent reduction in air pollution.
- The program on the introduction of LPG as a vehicular fuel in Solapur by the Petroleum companies is in the advanced stages of implementation. However currently there is no LPG outlet in the city for vehicles. The fuel supplied by the two oil companies viz. Indian Oil Corp Ltd and Hindustan Petroleum corp. Ltd includes Diesel(0.05 % sulphur) and petrol (3 % Benzene, unleaded and 0.05% sulphur) Oil companies are preparing plans to set up of infrastructure facility for dispensing of gas fuels to the vehicles based on the demand in Solapur.

19.3.2 Proposed Action Plan

(a) Industrial Pollution

The salient features of action plan to control industrial pollution are as follows:

- Organisation of inventories of polluting industries
- Control of emissions and ensuring compliance of standards.
- Identification and closure of clandestine / unauthorized industrial operations.
- Compliance to standards in DG sets.
- Identification of areas where industries from non- confirming zones shall be shifted.
- Notification for banning of open burning of garbage.
- Promotion of LPG as domestic fuel instead of burning coal & wood.

(b) Vehicular Pollution

The salient features of action plan to control vehicular pollution are as follows:

- Bharat stage-III emission norms to be implemented from 2005.
- Performance checking for catalytic converters and conversion kits to be put in place by 01.04.2005.
- To supply gasoline with 3 % and 1% benzene contents by 2004 and 2010 respectively.
- To supply low sulphur diesel (0.05 %) by January 2004.
- Ban on supply of loose 2 T oil.
- Introduction of alternate fuels like CNG/LPG. IOC proposed to plan one RO to supply auto LPG.
- Improvement of public transport system for discouraging of private vehicles.
- Improvement of existing PUC system.
- Phasing out of grossly polluting vehicles like 15 years old commercial vehicles etc.
- Ban on conversion of petrol vehicles to diesel vehicles.
- Better traffic management to avoid congestions through introduction of synchronized signals with timers, bye passing of inter city interstate traffic, increased road length, augmentation of railway network and fiscal incentives

19.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. Low levels of SO₂ are may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, implementation of stricter vehicle emission norms etc. NO₂ levels are also within the prescribed NAAQS during all the monitored years. The reason for low levels of NO₂ may be various measures taken such as implementation of stricter emission norms etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS. Although during recent years RSPM levels have started to decrease which may be due to various measures such as implementation of stricter vehicle emission norms, banning of six seater diesel rickshaws etc. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers, resuspension of traffic dust, commercial and domestic use of fuels, etc.

20.0 Varanasi

Varanasi, or Benaras, (also known as Kashi) is one of the oldest living cities in the world. According to 'Vaman Puran' the Varuna and Assi rivers originated from the body of the primordial person at the beginning of the time itself. The tract of the land lying between them is called Varanasi and believed to be the holiest of all pilgrimages. The Pali version of Varanasi is 'Banarsi' which ultimately give birth to the name Banaras. The city is also famous as Kashi (derived from the root Kash means to shine) -the city of spiritual light. Steeped in tradition and mythological legacy, Kashi is the original ground created by Lord Shiva and Parvati, upon which they stood at the beginning of time.

According to the historians, the city was founded some ten centuries before the birth of Christ. The city is mentioned in the Holy Scriptures like Vaman Puran, Buddhist texts and in the epic 'Mahabharata'. Puranic literature relates its existence to at least three millennia. Varanasi proudly tells that it was the birth place of St. Kabir, worship place of Bhakta Ravidas and composing place of Mahakavya Shri Ramcharitmanas by Goswami Tulsidas. Varanasi is also renowned for its rich Tapestry of music, arts, crafts and education.

The district Varanasi is located in the south-west portion of the Uttar Pradesh and having the geographical coordinates as 82⁰15' to 83⁰30' East longitude and 24⁰25' to 25⁰30' North latitude. Other districts namely Jaunpur and Ghazipur surround it on North, Bihar state on East, Mirzapur and Bhadohi in west. The geographical area of the district is 4035 sq.km (1.37% of entire Uttar Pradesh of 294411sq.km.). It is divided into four tehsils for administrative purposes. Geographically, it can be divided into two parts, first portion comes under Gangetic plain and another is Naugarh's hilly terrain. The holy river Ganga divides the district into almost two equal parts and other rivers flowing through the district area are Gomti, Karmnasha, and Chandra Prabha & Varuna. Karmnasha practically separates the district from the surrounding Bihar State.

Climate of Varanasi District is more or less dry. May and June are the hottest months of the year Dust storms and hot waves are common during summers rains start mostly from the third week of the June and continue till October. The most chilling months are December and January. Varanasi district enjoys the extremes of winter and summer alternatively in a year. Varanasi is a fast growing commercial, industrial and trading centre of eastern Uttar Pradesh and Central India. The city is connected with most of the important Indian places through express highways. The major roads passing through the city are GT road, NH56, NH29, a MDR to Azamgarh and an ODR to Sindora. Besides the above, there are other minor categories of roads also, which connect the city with nearby places e.g. Chunar, Mirzapur and far and near villages.

20.1 Sources of Air Pollution

The State Environment report of Varanasi city prepared by CPCB in association with UPPCB shows that on an average the daily consumption of coal, Kerosene & LPG is 30T, 50 KI & 125 T respectively.

(a) Vehicular Air Pollution

Like other ancient city of India, the traffic pattern is characterized by intermixing of slow and fast moving vehicles, passing of inter and intra city traffic through the busy portions of city erratic driving and violation of the traffic rules and regulations. Typical characteristics of the roads are improper roads geometries, encroachments, inadequate road widths and road networks. These factors either singularly or in combinations are responsible for frequent and hours lasting traffic jams in the city. The areas which are very sensitive from the point of view are in around of Godolia, Maidagain, Bhelupur, Sonarpura, Nadesar, Cantt. Sigra etc.

(b) Industrial Air Pollution

Varanasi basically being a place of religious, historical and tourist importance, also enjoys the status of an important place in India in the production of various handicraft items like silk sarees, carpets, jari jamdani, rags, customary knitting of jamavars etc. The real industrial development started taking place in the city after the year 1950. The major portion of the SSI units belong to the categories of Gen. Engg., Metal Processing and Products, Machinery Parts followed by Textile Products including wool, silk, cotton and jute. During the recent years, more and more textile related units are coming up in the city. The large scale industry of national and international importance is M/s Diesel Locomotive Works, producing 160 odd nos. diesel locomotives per annum. Other large and medium industries in and around Varanasi belong to the categories of Gen. Engg. and food and food stuffs. There is only one recognized industrial area in the city i.e. Lahartara industrial area and most of the industries are operating inside the city

20.2 Ambient Air Quality

Uttar Pradesh State Pollution Control Board is monitoring ambient air quality at two monitoring stations in Varanasi under National Air Quality Monitoring Programme (NAMP). These monitoring stations are located at Regional Office of Uttar Pradesh State Pollution Control Board and Shivpuri. The status and trends in ambient air quality is detailed in following sections.

20.2.1 Violation of NAAQS (24-hourly avg.)

In general it has been observed that NAAQS (24 hourly average) of SO₂ and NO₂ are not violated. NAAQS (24 hourly average) of RSPM are violated. NAAQS (24 hourly average) of SPM are also violated.

20.2.2 Air Quality in terms of Low, Moderate, High and Critical Levels

Air quality with respect to SO₂, NO₂, SPM and RSPM has been determined in terms of low, moderate, high and critical levels. Low levels of SO₂ were observed in Varanasi. Low levels of NO₂ were observed in Varanasi during many years. Critical levels of RSPM and SPM were observed in Varanasi.

20.2.3 Air Quality Trends in Varanasi

Trend in annual average concentration of SO₂, NO₂, SPM and RSPM is depicted in Figure 20.1. SO₂ levels in residential area were lower than the NAAQS (annual average) during all the monitored years. NO₂ levels in residential area were lower than the NAAQS (annual average) during all the monitored year. RSPM levels exceeded the National Ambient Air Quality Standard (Annual Average). SPM levels in residential areas also exceeded the NAAQS (annual average).

20.0 Action Plan for the Control of Air Pollution for the city of Varanasi (As on October 2003)

20.3.1 Action taken so far

(a) Industrial Pollution

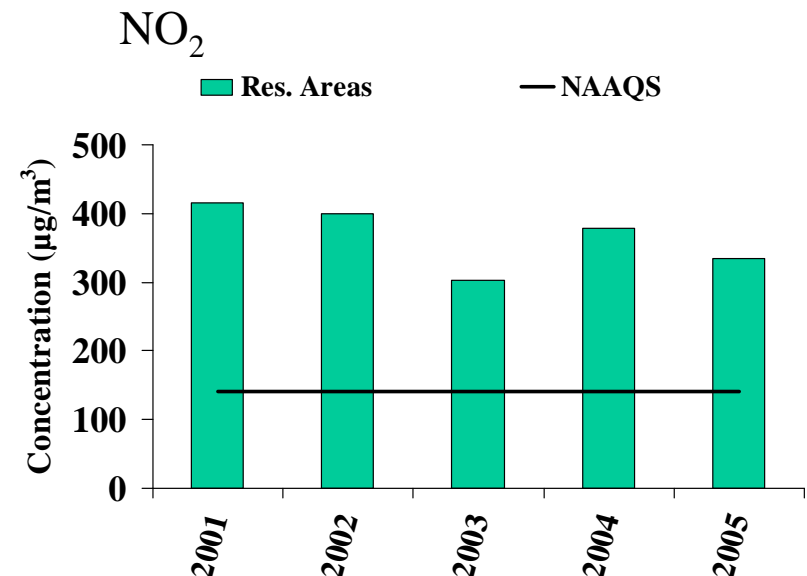
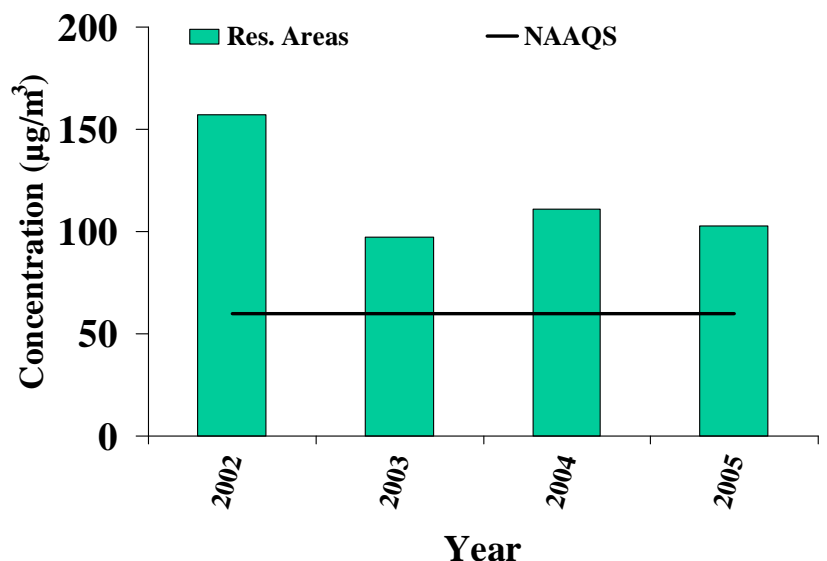
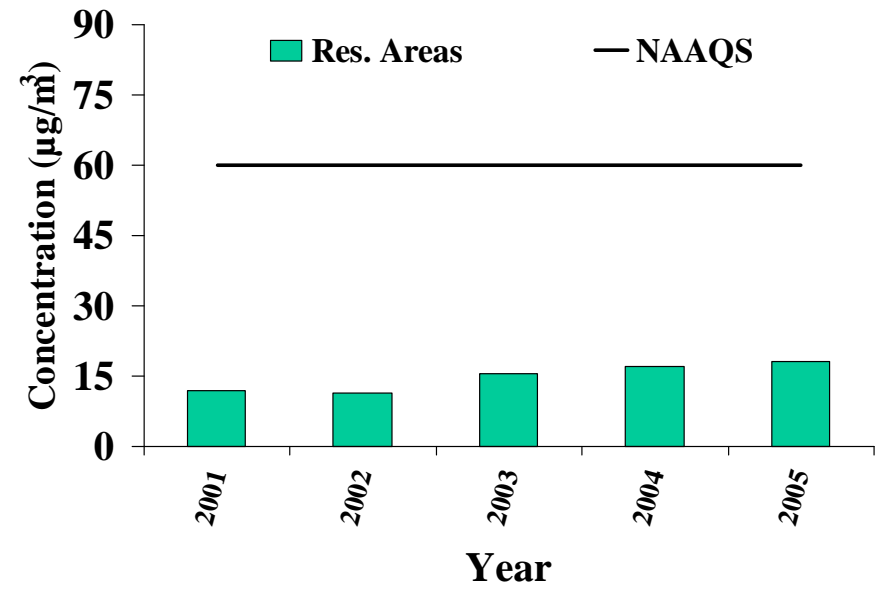
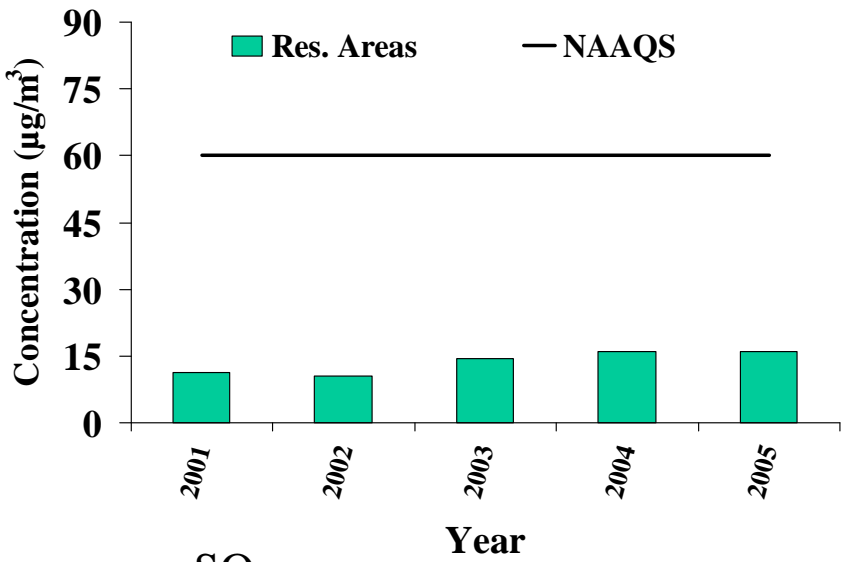
The salient features of actions taken to control industrial pollution are as follows:

- Organized inventories of all the polluting industries .
- Control of Industrial emissions and ensuring compliance to standards.
- Identification and closure of clandestine /unauthorized industrial operations.

(b) Domestic Pollution

The salient features of actions taken to control domestic pollution are as follows:

- Notification for banning of open burning of garbage.
- Promotion of use of LPG as domestic fuel instead of burning coal wood etc.



RSPM

SPM

Figure 20.1: Trends in Annual Average Concentration of SO₂, NO₂, RSPM and SPM in Varanasi.

(c) Vehicular Pollution

The salient features of actions taken to control vehicular pollution are as follows:

- Vehicular emission inventory has already been done.
- Notification & Implementation of vehicular emission norms as per road map notified by the Govt. of India.
- PUC for checking compliance of emission norms for In-use Vehicles.
- Retrofitment of after combustion technology like catalytic converters.
- Improvement in the fuel quality to match with the prescribed emission norms.
- Introduced of low Benzene (5%) gasoline
- Introduced low sulphur (0.25%) diesel.
- Introduced pre-mixed 2-T oil and expanded the pre-mixed outlets.
- Introduced ethanol(5%) blended gasoline.
- Ban on re-registration of vehicles converted from petrol to diesel .
- Stricter drives to check adulteration of fuel.
- Restriction of movement of goods carriers in urban areas.
- Imposed restrictions on movement of local goods carriers during peak hours.
- Better traffic management through bypassing inter state/inter city traffic, Bus terminal shifted in the outskirts etc.

(d) Inter Agency Task Force:

It is proposed to form “ Pollution Prevention Authority” exclusively under the chairmanship of Divisional Commissioner for the implementation of the action plan as per specified frame work in the action plan.

20.3.2 Proposed Action Plan

(c) Industrial Pollution

The salient features of actions plan to control industrial pollution are as follows:

- Inventorisation of emissions from industrial sources. Though the city is devoid of any industry that is air polluting still the inventory will be carried out to strengthen the data.
- Monitoring & closure of clandestine industrial operations.
- Vigilance of industries.

(b) Domestic Pollution

The salient features of actions plan to control domestic pollution are as follows:

- Notification for banning of open burning of garbage.
- Promotion of use of LPG as domestic fuel instead of burning coal wood etc.

(c) Vehicular Pollution

The salient features of actions plan to control vehicular pollution are as follows:

- Inventory of emission load from all categories of vehicles.
- Implementation vehicular emission norms in accordance with the road map laid by the Expert Committee on Auto Fuel Policy.
- Retrofitment of after combustion technologies like cat. converters and particulate trap by March 2005.
- Supply fuel compatible with emission norms.
- Phasing out of old vehicles.
- Implement new emission norms for In-use vehicles from October 2004.
- Introduction of low Benzene(3%) gasoline with effect from April 2005.
- Introduction of low sulphur diesel (0.05%) with effect from 2005.
- Ban on registration of vehicles converted from petrol to diesel.
- Better traffic management, Bye passing of Inter state/inter city traffic.
- Wherever possible widening of roads and removal of encroachments.
- Development & improvement in road & railway infra structure.
- Fiscal Measures like higher road tax for old vehicles, restructuring of parking fees & road tolls and fiscal incentives for alternate fuels.

20.4 Findings

SO₂ levels are within the prescribed NAAQS during all the monitored years. The reason for low levels of SO₂ may be various measures taken such as reduction of sulphur in diesel, implementation of stricter emission norms and commensurate fuel quality. NO₂ levels also within the prescribed NAAQS during all the monitored years. RSPM and SPM levels exceed the prescribed NAAQS. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers, resuspension of traffic dust, commercial and domestic use of fuels, etc.

21.0 Findings and Recommendations

The findings and recommendations are detailed below

21.1 Findings

(i) The findings are as follows

(a) SO₂

Low levels of SO₂ were observed in all the seventeen cities. A decreasing trend was observed in Bangalore, Delhi, Faridabad, Hyderabad, Kanpur, Kolkata, Lucknow, Mumbai and Pune. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, use of cleaner fuel such as CNG in Delhi and Mumbai etc. Other measures include implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality. Also there has been a change in domestic fuel used from coal to LPG which may have contributed to reduction in ambient levels of SO₂.

(b) NO₂

NO₂ levels were within the prescribed NAAQS in the cities except Agra during most of the years. Agra being a sensitive city, the standards are stricter. A decreasing trend has been observed in Ahmedabad, residential areas of Faridabad, Kolkata, Mumbai and Pune. Fluctuating trends in NO₂ were observed in cities like Bangalore. Vehicles are one of the major sources of NO₂ and their number is increasing exponentially. The reasons for low levels of NO₂ may be various measures taken such as banning of old vehicles, better traffic management etc. The reasons behind reduction in NO₂ may be introduction of improved vehicular technology in the form of Bharat Stage –III vehicles, banning of old vehicles in some cities, improved traffic management etc.

(c) RSPM

RSPM levels exceed the prescribed NAAQS in most of the cities but a decreasing trend has been observed in cities namely Ahmedabad, Hyderabad, Solapur, residential areas of Bangalore and Faridabad. The reason of decrease in RSPM levels may be implementation of stricter vehicle emission norms and commensurate fuel quality, use of cleaner fuels, banning of diesel driven vehicles in some cities etc. Vehicles are one of the major sources of RSPM and their number is increasing exponentially. Fluctuating trends have been observed in cities like Chennai. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, resuspension of traffic dust, commercial and domestic use of fuels, etc.

(d) SPM

SPM levels exceed the prescribed NAAQS in many cities especially in residential areas. Northern cities like Delhi, Jodhpur, Varanasi, Lucknow experience dust storms and hazy conditions during summer months. These dust storms build up particulate matter in ambient levels resulting in high SPM levels. Trend in SPM is fluctuating in many cities like Patna, Varanasi. The reason for high SPM levels may be natural dust, resuspension of dust, vehicles, commercial and domestic use of fuel etc.

(ii) The city-wise findings are as follows

(a) Agra

SO₂ levels are within the prescribed National Ambient Air Quality Standards for sensitive areas. The reason for low levels of SO₂ may be various measures taken such as reduction of sulphur in diesel, implementation of stricter emission norms and commensurate fuel quality. NO₂, RSPM and SPM levels exceed the prescribed National Ambient Air Quality Standards for sensitive areas. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers, resuspension of traffic dust, commercial and domestic use of fuels, etc.

(b) Ahmedabad

The levels of SO₂ are well within the NAAQS in both the residential as well industrial areas in the city of Ahmedabad. The interventions behind reduction in SO₂ levels are many such as implementation of the road map proposed by Auto Fuel Policy etc. Only Bharat Stage-III new vehicles have been registered in Ahmedabad. Other measures include introduction of alternate fuel like CNG, reduction in percentage of sulphur in coal used in thermal power plants. Many industrial units have switched over to Natural Gas,

The ambient air quality levels of NO₂ are also within the prescribed standard and a decreasing trend has been observed in the levels of NO₂ in both the residential as well as industrial area during past few years. The reasons behind reduction in NO₂ may be introduction of improved vehicular technology in the form of Bharat Stage –III vehicles, improvement in traffic management has also caused smooth traffic flow thereby reduction in idling emissions. Banning of diesel driven auto rickshaws in the city and diversion of heavy diesel driven vehicles out of the city can also cause considerable reduction in NO₂ levels in the ambient air.

The levels of RSPM in are although exceeding the NAAQS, but decreasing trend has been observed during past few years. Reduced RSPM levels may be because of introduction of improved vehicular technology as well as better fuel quality, Further alternate fuel like natural gas in both vehicles as well industrial units also causes reduction in particulate emissions. Implementation of pollution control devices like wet scrubbers and ESP's in industrial units and thermal power plants, implementation of CREP in highly polluting industrial units, improvement in traffic management has caused smooth traffic flow thereby reduction in idling emissions. Banning of diesel driven auto rickshaws in the city and diversion of heavy diesel driven vehicles out of the city etc. Utilisation of approx 70% of the fly ash generated in the thermal power plants may also cause reduction in RSPM levels.

(c) Bangalore

The levels of SO₂ in the ambient air are very well within the prescribed NAAQS. A decreasing trend has been observed in ambient levels of SO₂. The reasons for decreasing trend may be implementation of Bharat Stage-III norms for all the new vehicles in the city and use of commensurate fuel (Diesel with 0.035% S and petrol with 0.015% S).

RSPM levels in residential areas are exceeding the prescribed NAAQS but have shown a decreasing trend in residential areas. SPM levels in residential areas are also exceeding the prescribed NAAQS. Reduction in RSPM and SPM levels in residential areas may have been caused by combination of many interventions such as implementation of stringent emission norms for both new as well as in-use vehicles, improvement in the fuel quality, switching over to LPG as automotive fuel, better traffic management through by-passing of heavy vehicles and development of better traffic infrastructure, stricter drive for checking adulteration, augmentation in public transport system, imposing green tax on old vehicles etc. The RSPM and SPM levels in industrial areas are within the prescribed NAAQS.

(d) Chennai

Levels of SO₂ and NO₂ in Chennai are well within the NAAQS (Annual avg.). NAAQS (24-hourly avg.) wrt to SO₂ and NO₂ were also not violated. RSPM levels have also not violated prescribed NAAQS during many years. One of the reason for low levels of pollution in coastal cities like Chennai is that it has excellent ventilation effects due to sea and land breezes which reduces pollution levels. During some years NAAQS (24 hourly avg.) wrt RSPM was violated in residential areas which may be due to emission from vehicles, resuspension of traffic dust, emission from industries etc.

(e) Delhi

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Delhi. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, use of cleaner fuel such as CNG etc. Other measures include implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality. Also there has been a change in domestic fuel used from coal to LPG which may have contributed to reduction in ambient levels of SO₂.

Levels of NO₂ are within the prescribed NAAQS. One of the major sources of NO₂ are vehicles and number of vehicles in Delhi have increased exponentially over the years. Various measures have been taken such as implementation of stricter vehicle emission norms, measures taken to reduce traffic congestion such as non-destined heavy vehicles have been prohibited entry, other heavy vehicles are allowed to enter during night-time and many flyovers have been constructed. RSPM levels have also started to decrease despite exponential increase in number of vehicles. Measures that have been taken to reduce RSPM include conversion of diesel buses to CNG mode, implementation of Bharat Stage-III norms etc. SPM levels have been fluctuating. SPM is contributed by natural sources, resuspension of dust, vehicles etc. A reduction in CO levels has been observed despite increase in number of vehicles which may be attributed to measures such as conversion of three wheelers of CNG in Delhi.

(f) Faridabad

A decreasing trend has been observed in ambient SO₂ levels in Faridabad which may be due to various measures taken such as reduction of sulphur in diesel, implementation of stringent emission norms for new as well as in-use vehicles, improved fuel quality, use of better fuels like CNG in industries etc. SO₂ levels in residential areas and industrial areas were lower than the NAAQS (annual average) during all the monitored years. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored year. A decreasing trend has been observed in ambient NO₂ levels in residential areas of Faridabad despite increase in number of vehicles. The decreasing trend may be due to various measures taken such as introduction of Bharat Stage III norms for new vehicles etc. In residential area, decreasing trend has been observed in SPM and RSPM levels which may be due to measures such as implementation of stringent emission norms for new as well as in-use vehicles, improved fuel quality etc.

(g)Hyderabad

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Hyderabad.

Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, implementation of stringent emission norms for both new as well as in-use vehicles along with improved fuel quality. NO₂ levels are also within the prescribed NAAQS (Annual average) during all the monitored years despite increase in number of vehicles. RSPM levels have shown a decreasing trend in Hyderabad which may be due to measures taken such as implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality Implementation of CREP (Common Responsibility for Environment Protection) in 17 categories of highly polluting Industries, implementation of urban greening project and measures like introduction of pre-mixed 2-T oil, checking adulteration traffic management, etc.

(h) Jharia

SO₂ levels at Jharia were within the prescribed NAAQS during all the monitored years. The reasons for low levels of SO₂ may be measures taken such as reduction of sulphur in diesel. NO₂ levels were also within the prescribed NAAQS (Annual average) although NAAQS (24 hourly avg) of NO₂ was exceeded during some years. RSPM levels were above the prescribed NAAQS and SPM levels also exceeded prescribed NAAQS during many years. The reason for high RSPM and SPM levels may be widespread coal mining in the areas.

(i) Jodhpur

SO₂ levels were within the prescribed NAAQS during all the monitored years. The reason for low levels of SO₂ may be various measures taken such as reduction of sulphur in diesel, banning of old vehicles etc. NO₂ levels are also within the prescribed NAAQS during all the monitored years. The reasons for low levels of NO₂ may be various measures taken such as banning of old vehicles, better traffic management etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS in residential areas. The reason for high particulate matter may be natural dust esp dust storms, resuspension of dust, vehicles etc.

(j) Kanpur

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Kanpur. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, etc. Other measures include implementation of implementation of stricter emission norms for new vehicles, and commensurate fuel quality. NO₂ levels are also within the prescribed NAAQS during all the monitored years. The reason for low levels of NO₂ may be various measures taken such as implementation of stricter emission norms, better traffic management etc. RSPM levels exceed prescribed NAAQS and SPM levels also exceed prescribed NAAQS. The reason for high particulate matter levels may be

vehicles, engine gensets, small scale industries, biomass incineration, resuspension of traffic dust, commercial and domestic use of fuels, etc.

(k) Kolkata

SO₂ levels were within the prescribed NAAQS in Kolkata. A decreasing trend has been observed in ambient SO₂ levels which may be due to various measures taken such as implementation of stricter vehicles emission norms and commensurate fuel quality, conversion of the coal fired boilers and coal fired ceramic kilns to oil fired ones etc. Decreasing trend has also been observed in ambient NO₂ levels which may be due to various measures taken such as implementation of stricter emission norms etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS in residential areas. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers and emission from power plants, resuspension of traffic dust, commercial and domestic use of fuels, etc.

(l) Lucknow

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Lucknow. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, use of cleaner fuel such as LPG etc. Other measures include implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality. NO₂ levels are also within the prescribed NAAQS during all the monitored years. The reason for low levels of NO₂ may be various measures taken such as implementation of stricter emission norms, phasing out of old polluting vehicles, better traffic management etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers, resuspension of traffic dust, commercial and domestic use of fuels, etc.

(m) Mumbai

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Mumbai. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, use of cleaner fuel such as CNG etc. Other measures include implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality.

Levels of NO₂ are within the prescribed NAAQS. A decreasing trend has been observed in ambient levels of NO₂ in Mumbai which may be due to various measures taken such as implementation of stricter emission norms, phasing out

of old vehicles etc. One of the major sources of NO₂ are vehicles and number of vehicles in Mumbai have increased exponentially over the years. The most critical form of pollution in Mumbai is respirable suspended particulate matter. (RSPM) and the levels are more than prescribed National Ambient Air Quality Standard of RSPM. The reason for high respirable suspended particulate matter levels may be vehicular emissions, resuspension of traffic dust, commercial and domestic use of fuels, burning of biomass, emission from power plant, oil refinery etc.

(n) Patna

SO₂ levels are within the prescribed NAAQS during all the monitored years. Low levels of SO₂ may be due to which may be due to various measures taken such as reduction of sulphur in diesel, implementation of stringent emission norms for new as well as in-use vehicles, improved fuel quality etc. NO₂ levels in residential area and industrial areas were lower than the NAAQS (annual average) during all the monitored year. Low levels of NO₂ are may be due to various measures taken such as implementation of stricter emission norms etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers emissions, resuspension of traffic dust, commercial and domestic use of fuels, etc.

(o) Pune

SO₂ levels are within the prescribed NAAQS during all the monitored years. A decreasing trend has been observed in ambient SO₂ levels in Pune. Decreasing trend may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, implementation of Bharat Stage-III emission norms for new vehicles and commensurate fuel quality etc.

Levels of NO₂ are within the prescribed NAAQS. A decreasing trend has been observed in ambient levels of NO₂ in Pune which may be due to various measures taken such as implementation of stricter emission norms, phasing out of old vehicles etc. The most critical form of pollution in Pune is respirable suspended particulate matter. (RSPM) and the levels are more than prescribed National Ambient Air Quality Standard of RSPM. Although RSPM levels have started to decrease in Pune in recent years. The reason for high respirable suspended particulate matter levels may be vehicular emissions, resuspension of traffic dust, commercial and domestic use of fuels, burning of biomass, emission from power plant, oil refinery etc.

(p) Solapur

SO₂ levels are within the prescribed NAAQS during all the monitored years. Low levels of SO₂ are may be due to various interventions that have taken place in recent years such as reduction of sulphur in diesel, implementation of stricter vehicle emission norms etc. NO₂ levels are also within the prescribed NAAQS during all the monitored years. The reason for low levels of NO₂ may be various measures taken such as implementation of stricter emission norms etc. RSPM levels exceed the prescribed NAAQS and SPM levels also exceed prescribed NAAQS. Although during recent years RSPM levels have started to decrease which may be due to various measures such as implementation of stricter vehicle emission norms, banning of six seater diesel rickshaws etc. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers, resuspension of traffic dust, commercial and domestic use of fuels, etc.

(q) Varanasi

SO₂ levels are within the prescribed NAAQS during all the monitored years. The reason for low levels of SO₂ may be various measures taken such as reduction of sulphur in diesel, implementation of stricter emission norms and commensurate fuel quality. NO₂ levels also within the prescribed NAAQS during all the monitored years. RSPM and SPM levels exceed the prescribed NAAQS. The reason for high particulate matter levels may be vehicles, engine gensets, small scale industries, biomass incineration, boilers, resuspension of traffic dust, commercial and domestic use of fuels, etc.

21.2 Recommendations

The recommendations are as follows:

- (i) Background stations may be included in the network to assess the anthropogenic impact
- (ii) Calibration of air quality monitoring instruments may be carried out regularly.
- (iii) Analytical quality control exercises may be carried out regularly to improve quality of data.
- (iv) A comprehensive urban air quality management strategy should be formulated using information related to urban planning, ambient air quality, an emission inventory, and air quality dispersion models. Action plan should be regularly reviewed keeping into view the results of implementation.

(v) Studies on inventory of air polluting sources and source apportionment studies may be undertaken to improve upon the action plan to control air pollution.

(vi) Epidemiological studies should be undertaken to develop dose-response relationships.

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

(viii) Monitoring of hazardous air pollutants may be undertaken as they are well known to have marked effect on human health and environment.

(ix) Concept of "Public Participation" should be always considered for successful completion of any project. As local experience of public can result in development of more efficient and socially acceptable action plan and further getting public involved will make public more concerned towards achieving the objective of clean air.

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Pollutant	Time Weighted Average	Concentration in Ambient Air			Method of Measurement
		Industrial Area	Residential, Rural and other Areas	Sensitive Area	
Sulphur Dioxide (SO ₂)	Annual Average*	80 µg/m ³	60 µg/m ³	15 µg/m ³	1. Improved West and Gaeke Method 2. Ultraviolet Fluorescence
	24 Hours Average**	120 µg/m ³	80 µg/m ³	30 µg/m ³	
Oxides of Nitrogen as NO ₂	Annual Average*	80 µg/m ³	60 µg/m ³	15 µg/m ³	1. Jacob & Hochheiser modified (NaOH-NaAsO ₂) Method 2. Gas Phase Chemiluminescence
	24 Hours Average**	120 µg/m ³	80 µg/m ³	30 µg/m ³	
Suspended Particulate Matter (SPM)	Annual Average*	360 µg/m ³	140 µg/m ³	70 µg/m ³	High Volume Sampling (Average flow rate not less than 1.1m ³ /minute)
	24 Hours Average**	500 µg/m ³	200 µg/m ³	100 µg/m ³	
Respirable Particulate Matter (Size less than 10µm) (RPM)	Annual Average*	120 µg/m ³	60 µg/m ³	50 µg/m ³	Respirable Particulate Matter Sampler
	24 Hours Average**	150 µg/m ³	100 µg/m ³	75 µg/m ³	
Lead (Pb)	Annual Average*	1.0 µg/m ³	0.75 µg/m ³	0.50 µg/m ³	AAS Method after sampling using EPM 2000 or equivalent filter paper
	24 Hour Average**	1.5 µg/m ³	1.0 µg/m ³	0.75 µg/m ³	
Carbon Monoxide (CO)	8 Hours Average**	5.0 mg/m ³	2.0 mg/m ³	1.0 mg/m ³	Non dispersive Infrared Spectroscopy
	1 Hour Average	10.0mg/m ³	4.0 mg/m ³	2.0 mg/m ³	
Ammonia (NH ₃)	Annual Average*	0.1 mg/m ³			-
	24 Hour Average**	0.4 mg/m ³			

* Annual Arithmetic mean of minimum 104 measurements in a year twice a week 24 hourly at uniform interval.

** 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

NOTE

1. National Ambient Air Quality Standard : The levels of air quality necessary with an adequate margin of safety, to protect the public health, vegetation and property.
2. Whenever and wherever two consecutive values exceed the limit specified above for the respective category, it would be considered adequate reason to institute regular/continuous monitoring and further investigations.
3. The State Government / State Board shall notify the sensitive and other areas in the respective states within a period of six months from the date of notification of National Ambient Air Quality Standards

Annexure II

Details of Ambient Air Quality Monitoring Stations under National Air Quality Monitoring Programme (NAMP) in Seventeen Cities.

S.No.	STATE/UT	CITY	LOCATION	Type of Area
1	Andhra Pradesh	Hyderabad	Nacharam	I
			CITD Balanagar	I
			Uppal	I
			Jubilee Hills	R
			Charminar	R
			Paradise	R
			Tarnaka	R
			ABIDS Circle	R
			Zoo Park	S
2	Bihar	Patna	Beltron Bhavan	R
			Gandhi Maidan	R
3	Delhi	Delhi	Shahzada Bagh	I
			Shahdara	I
			Nizamuddin	R
			Ashok Vihar	R
			Siri Fort	R
4	Gujarat	Ahmedabad	Janakpuri	R
			Naroda GIDC	I
			Shardaben Hospital	I
			Naroda Industries Association	I
			Odhav GIDC	I
			Mirzapur	R
			Berhampura	R
			Cadilla Bridge, Narol	R
L. D. Engineering College	R			
5	Haryana	Faridabad	Shivalic Global Industries	I
			Regional Office	R

S.no.	State	City	Location	Type of Area
6	Jharhand	Jharia	MADA	I
7	Karnataka	Bangalore	Graphite India Limited	I
			KHB Industrial Area	I
			Peenya Industrial Area	I
			Yeshwanthpura	R
			Amco Batteries	R
			Victoria Hospital	S
8	Maharashtra	Mumbai	Parel	I
			Worli	R
			Kalbadevi	R
		Solapur	WIT Campus	I
			Chitale Clinic	R
		Pune	Bhosari	I
			Swargate	R
Nalstop	R			
9	Rajasthan	Jodhpur	RIICO Office	I
			Sojati Gate	R
			Maha Mandir Police Thana	R
10	Tamil Nadu	Chennai	Thiruvottiyur Municipal Office	I
			Kathivakkam	I
			Manali	I
			Thiruvottiyur	I
			Madras Medical College	R
			NEERI CSIR Campus	R
11	Uttar Pradesh	Lucknow	Talkatora	I
			Kapoor Hotel	R
			Mahanagar	R
			Aminabad	R
			Chandganj	R
		Kanpur	Fazalganj	I
			Jajmau	I
			Deputy ka Padao	R
			Kidwai Nagar	R
			Sharda Nagar	R
		Varanasi	Regional Office	R
			Shivpuri	R

S.No.	STATE/UT	CITY	LOCATION	Type of Area
	Uttar Pradesh	Agra	TajMahal	S
			Itmad-ud-daulah	S
			Rambagh	S
			Nunhai	S
12	West Bengal	Kolkata	Cossipore	I
			Dunlop Bridge	I
			Behala Chowrasta	I
			Lal Bazaar	R
			Kasba	R
			Salt lake	R
			Minto Park	R
			Baishnabghata	R
Moulali	R			

Note:- R – Residential and other areas, I – Industrial area, S- Sensitive Areas

Annexure III

Format For Preparation of Proposed Action Plan and Reporting Progress.

S.No	Issue	Proposed action (Pl. note: The following are some of the action points that have been listed by some of the state governments, or discussed in the consultation meetings or EPCA has considered. This is not an exhaustive list. All proposed action points must be detailed out as much as possible.)	Implementing Agency	Target date for completion of on going activity and planned improvements	Status of on going activity as on May 2004
VEHICULAR POLLUTION					
1.	New vehicles Roadmaps for improving vehicle technology (Vehicle-category-wise: cars(diesel and petrol), two-wheelers, three-wheelers, medium duty vehicles, heavy duty vehicles-truck and buses any other)	The current status: Status of implementation of Bharat-II norms Proposed plan and deadline <ol style="list-style-type: none"> i. Introduction of Bharat-III norms ii. Introduction of Euro-IV norms iii. Implementation of Bharat stage-II iv. Introduction of emission warranty for vehicles 			
2.	Improvement in Fuel quality	Current status: <ol style="list-style-type: none"> a. Reduction of sulphur content in diesel and petrol to 0.05% and lower levels immediately b. Reduction in benzene content to 1% in petrol Proposed <ol style="list-style-type: none"> c. plan for introduction of Euro-III and Euro-IV fuels 			
3.	In-use vehicles				
I.	Phasing out of old vehicles	<ol style="list-style-type: none"> a. Phasing out of 15-year-old commercial vehicles and all diesel three wheelers vehicle b. Plans to lower the age cap further 			
II.	Vehicle inspection Upgradation planned for PUC System (Petrol/CNG, and diesel vehicles)	Level of compliance. How many vehicles come for inspection currently and failure rate for different categories of vehicles. Policy measures to ensure that all vehicles come for tests.			

S.No	Issue	Proposed action (Pl. note: The following are some of the action points that have been listed by some of the state governments, or discussed in the consultation meetings or EPCA has considered. This is not an exhaustive list. All proposed action points must be detailed out as much as possible.)	Implementing Agency	Target date for completion of on going activity and planned improvements	Status of on going activity as on May 2004
		<p>Modification in test procedures and standards and additional pollutants to be introduced for testing in all categories of vehicles planned</p> <p>Institutional systems put in place or planned for rigorous auditing and inspection of these centers</p> <p>On road inspection of vehicles planned and periodically coverage</p>			
III.	Centralized inspection & maintenance system	a. provide a phase-in plan of improved centralized inspection and maintenance programme to replace the current PUC system. Priorities the vehicle segments like commercial vehicles that would be first brought under the advanced inspection system.			
IV.	Bypassing transit traffic	<p>Plans for the following :</p> <p>a. Restriction on plying of interstate/intercity buses in city</p> <p>b. Restriction of entry of non-destined commercial vehicles in city</p>			
V.	Proportioning of 2T oil for two stroke engines	<p>a. installation of premix oil dispensers for 2-stroke 2 and 3 wheelers</p> <p>b. measures to ban sale of loose 2T oil</p>			
4.	Adulteration of fuels	<p>a. setting up of facility for independent fuel testing in city</p> <p>b. improvements planned for more effective monitoring of retail outlets, depots and tankers etc.</p> <p>c. status of implementation of naphtha, kerosene and solvents control order. Propose how to make the implementation effective.</p> <p>d. Any plans for public broadcast of defaulting petrol pump</p> <p>e. Plans to make penalty more stringent to act as strong</p>			

S.No	Issue	Proposed action (Pl. note: The following are some of the action points that have been listed by some of the state governments, or discussed in the consultation meetings or EPCA has considered. This is not an exhaustive list. All proposed action points must be detailed out as much as possible.)	Implementing Agency	Target date for completion of on going activity and planned improvements	Status of on going activity as on May 2004
		<p>deterrent</p> <p>f. Rationalization of state taxes on imported kerosene and other solvents/fuels etc to narrow the price gap</p> <p>g. Any other measure like electronic marker system etc.</p>			
5.	Alternative fuels				
i.	Introduction of cleaner fuel(s) LPG/CNG	<p>Indicate the priority vehicles segments like three wheelers, small commercial vehicles, buses etc that would be targeted for phased introduction of alternative fuels. Give a schedule of implementation.</p> <p>Based on this plan estimate the demand for cleaner fuel over the time frame for implementation</p> <p>Provide plan and schedule for setting up of infrastructure facility dispensing and (compressing) of gas</p> <p>Number of stations with capacities planned. If feasibility plans are under preparation report its results and indicate a tight time frame for its completion.</p>			
ii.	Institutional plans for implementation of gaseous fuel programme	<p>Provide the institutional plans for specially designed safety inspection programme for CNG and LPG vehicles and frequency of inspection. How capacity and skills will be created in the inspection centers for safety inspection? Independent auditing and supervision of these centers.</p> <p>Authorization of conversion workshop and fitment of kits etc.</p> <p>Fiscal measures to encourage replacement of old vehicles on gaseous fuels.</p>			

S.No	Issue	Proposed action (Pl. note: The following are some of the action points that have been listed by some of the state governments, or discussed in the consultation meetings or EPCA has considered. This is not an exhaustive list. All proposed action points must be detailed out as much as possible.)	Implementing Agency	Target date for completion of on going activity and planned improvements	Status of on going activity as on May 2004
		<p>Regulatory and fiscal approach to stop fitment to unauthorized conversion kits.</p> <p>(Pl. note: Simple conversion of old diesel engines to gaseous fuels should not be allowed. Diesel vehicles should be replaced with new dedicated gaseous fuel vehicles)</p>			
iii.	Ethanol blend petrol and bio fuel programme if any				
6.	Traffic and transport management	<p>Public transport</p> <p>Current status of public transport in terms of number of buses, load factor etc and proposed plans to augment the fleet.</p> <p>Plans to move public transport to run on clean fuels.</p> <p>Any other form of public transport planned: Metro, bus rapid transit or any other. Plan, scale and schedule of implementation.</p> <p>Transport Policy</p> <p>Formulation of transport policy to induce a modal shift from private to public modes of transport and implementation including fiscal measures.</p> <p>Formulation and implementation of parking policy</p> <p>Other measures to reduce traffic congestion: Eg:</p> <p>Planning and construction of bypass roads</p>			

S.No	Issue	Proposed action (Pl. note: The following are some of the action points that have been listed by some of the state governments, or discussed in the consultation meetings or EPCA has considered. This is not an exhaustive list. All proposed action points must be detailed out as much as possible.)	Implementing Agency	Target date for completion of on going activity and planned improvements	Status of on going activity as on May 2004
		<p>Removal of encroachment on roads, promote non-motorised transport, pedestrianisation etc</p> <p>Traffic signaling system</p> <p>Penalties for traffic violations</p> <p>Any other</p>			
7.	Fiscal measures	<p>Fiscal measures to discourage use of older and polluting vehicles (Eg. Banglore has imposed green tax on old vehicles etc.)</p> <p>Any other fiscal measures to control traffic congestion</p>			
8.	Industrial pollution control	<p>Installation of adequate pollution control measures in industries</p> <p>Feasibility of alternate cleaner fuels and implementation.</p> <p>Monitoring programmer of industries</p>			
9.	Thermal power plants	<p>a. Use of wash beneficiated coals for coal based TPP</p> <p>b. Installation of big filter with ESP</p> <p>c. Schemes for utilization of fly ash</p> <p>d. Identification of new sites for fly ash methods and methods of utilization</p>			
10.	Strengthening of air quality network				
i.		<p>Plans to strengthen the air quality monitoring. Eg.</p> <p>a. Plans to increase number of monitoring stations, improving frequency of monitoring etc.</p> <p>b. Quality control of air quality data</p> <p>c. Monitoring of additional pollutants</p> <p>d. Installation of automatic monitoring stations.</p>			

S.No	Issue	Proposed action (Pl. note: The following are some of the action points that have been listed by some of the state governments, or discussed in the consultation meetings or EPCA has considered. This is not an exhaustive list. All proposed action points must be detailed out as much as possible.)	Implementing Agency	Target date for completion of on going activity and planned improvements	Status of on going activity as on May 2004
ii.		Plans to develop air pollution inventory for the city Indicate current efforts and new studies planned with tight deadline.			
iii.		Plans to sponsor studies on health impact of air pollution in the city			
11.	Other sources of Pollution				
i.	Hospital incinerators				
ii.	Generators sets	a. Plan to control numbers b. Monitoring the use of cleaner fuel c. Enforcement of emission standards for generator sets			
iii.	Biomass burning	Ban open burning of biomass and plan for effective control and finding alternative ways like composting etc			
12.	Supervisory powers and coordination	Single modal agency to supervise, monitor, and coordinate and report on the progress of implementation of the action plan when it is finalized			
13.	Plantations	Target and implementation plan for a. Tree plantation (to ensure high survival rate) b. Green area development- give targets			

References

1. <http://www.mapsofindia.com/maps/agra/agra-city-map.htm>
2. <http://www.mapsofindia.com/maps/maharashtra/mumbai-map.htm>
3. <http://www.mapsofindia.com/maps/bihar/patna-city-map.htm>
4. <http://jodhpur.nic.in/sinfo.htm>
5. <http://kanpurnagar.nic.in/>
6. <http://www.jetairtours.com/lko.htm>
7. <http://www.bharatheritage.in/bihar/patna.htm>
8. <http://www.jetairtours.com/pat.htm>
9. <http://www.bharatheritage.in/bihar/weather.htm>
10. <http://www.punecitymag.com/history.html>
11. <http://www.indiantravelportal.com/pune/>
12. <http://solapur.nic.in/>
13. <http://varanasi.nic.in/>
14. <http://www.templenet.com/Ganga/varanasi.html>
15. <http://www.jetairtours.com/amd.htm>
16. <http://www.jetairtours.com/>
17. <http://www.bcp.gov.in/english/trafficpolice/aboutus/aboutus.htm>
18. Ministry of Road Transport and Highways, Govt. of India, website <http://morth.nic.in/motorstat/mt2.pd> (Accessed on 24/7/2004)
19. Transport Department, Govt. of Delhi website <http://transport.delhigovt.nic.in/> (Accessed on 22/7/2004)
20. Jitendra J. Shah, Tanvi Nagpal, Carter J. Brandon, Urban Air quality management in Asia, The World bank Publication, 1997.

21. Guidelines for air quality, World health organization publication, Geneva
22. The current state of air pollution in Asian Megacities, <http://www.asiaairnet.org>.
23. Air quality Status & trends in India, <http://www.whoindia.org/>.
24. Urban air quality management, <http://www.worldbank.org>.
25. CPCB, Air quality status & trends in India, CPCB publication NAAQMS/14/1999-2000.
26. Final report of the expert committee on auto fuel policy, Govt. of India, August 2002.
27. MN Rao & HVN Rao, Air Pollution, Tata Mc Graw Hill Publishing company Ltd. 2000.
28. Website of USEPA [www.epa.gov]
29. Website of Florida's Air Resource Management Division.
30. Website of US energy Information Agency.
31. Looking back to think ahead, Tata Energy Research Institute (TERI) Publication 1998
32. Website of Centre for Science & Environment [www.cseindia.org]
33. CPCB, Transport fuel quality, CPCB publication PROBES/78/2000-01.
34. CPCB, Air Pollution & its control, CPCB Newsletter "Parivesh" June 1995.
35. CPCB, Guidelines for Ambient Air Quality Monitoring, CPCB Publication, National Ambient Air Quality Monitoring Series : NAAQMS/25/2003-04.
36. Masami Kojima, Magda Lovei, Urban Air Quality Management, Coordinating Transport, Environment, and Energy Policies in Developing Countries, World Bank Technical Paper No. 508.