Training Program and Refresher under the Malé Declaration

Country Report: Pakistan

By:

Muhammad Ahmad Khan
(Manager/DeputySecretaryMinistry of Climate Change)
Sajid Mahmood (Laboratory Technical)
Pakistan Environmental Protection Agency Islamabad
Government of Pakistan

Institutional Arrangement

- A Memorandum of Understanding (MOU) was signed between Pak-EPA and Pakistan Meteorological Department (PMD) to establish and for proper functioning of Trans-boundary Air Pollution Monitoring Station under Male′ Declaration.

- PMD Officials and staff are looking after the Laboratory and carrying out the monitoring activities.

- Punjab University was nominated to Carry out Study on ‘Crop Impact Assessment’

List of Equipments Installed:

- Ambient air monitoring equipment for Particulate Matter [PM10 and TSPM (Total Suspended Particulate Matter)]
- Bulk collector - for deposition monitoring
- Wet-only collector − for acidic gas deposition
- Diffusive samplers (for Nitrogen Dioxide, Sulfur Dioxide and Ozone) according to the monitoring protocol

All equipment were installed according to the monitoring protocol under Malé Declaration

Health Impact Assessment in Pakistan

Health End-Points	Attributed Total Cases	Total Annual Costs
Premature mortality adults	21,791	58-61
Mortality children under 5 yrs	658	0.83
Chronic Bronchitis	7,825	0.06
Hospital Admissions	81,312	0.28
Emergency room visits/ outpatient hospital visits	1,595,080	0.80
Restricted activity days	81,541,893	2.06
Lower respiratory illness in children	4,924,148	0.84
Respiratory symptoms	706,808,732	0.00
Total		**62-65**

Source: Pakistan Strategic country Environmental Assessment Report by World Bank, 2006

Status of Air Quality

Generation of Pollutants by Industry

- Carbon Monoxide: 285 tons
- Nitrogen Oxides: 162 tons
- Sulphur Oxides: 378 tons
- Particulate Matter: 4,400 tons

Source: Pakistan Strategic country Environmental Assessment Report by World Bank, 2006.

Sources of Air Pollution

- Major sources are vehicles, power plants, industries and brick kilns.
- Transport-related: Old and poorly functioning vehicles, diesel trucks, two-stroke two wheelers and Rickshaws.
- High level of sulfur in diesel.
- Burning of municipal solid waste is significant, almost 57,000 tons of solid waste is generated each day, most of which is either dumped or burnt.

Air Quality Monitoring

- Air quality monitoring network was established in 2007

- Fixed and mobile monitoring stations have been established to collect the data of ambient air in 5 major cities.

Monitoring Activities Under Male' Declaration

Monitoring Site: Bahawal Nagar

- Monitoring Station comprising a Laboratory was established at Bahawal Nagar in January 2007 for Trans-boundary Air Pollution Monitoring under Male′ Declaration.

Bahawal Nagar

Industries located around monitoring station

Haze / Fog phenomena in winter in Bahawalnagar

Onsite Laboratory

- A laboratory for the analysis of basic parameters of the field samples collected from the dry and wet-only collectors was also established at the site.

List of Equipments Installed

- High Volume Samplers
- Bulk collector - for deposition monitoring
- Wet-only collector – for acidic gas deposition
- Diffusive samplers (for Nitrogen Dioxide, Sulfur Dioxide and Ozone) according to the monitoring protocol
- UV-Spectrophotometer
- pH Meter
- Electricity Conductivity Meter
- All equipment were installed according to the monitoring protocol under Malé Declaration

Laboratory

Training on Air Sampler

Demonstration on Diffusion Samplers

Training on Bulk Collector

Training on Wet Only Collector

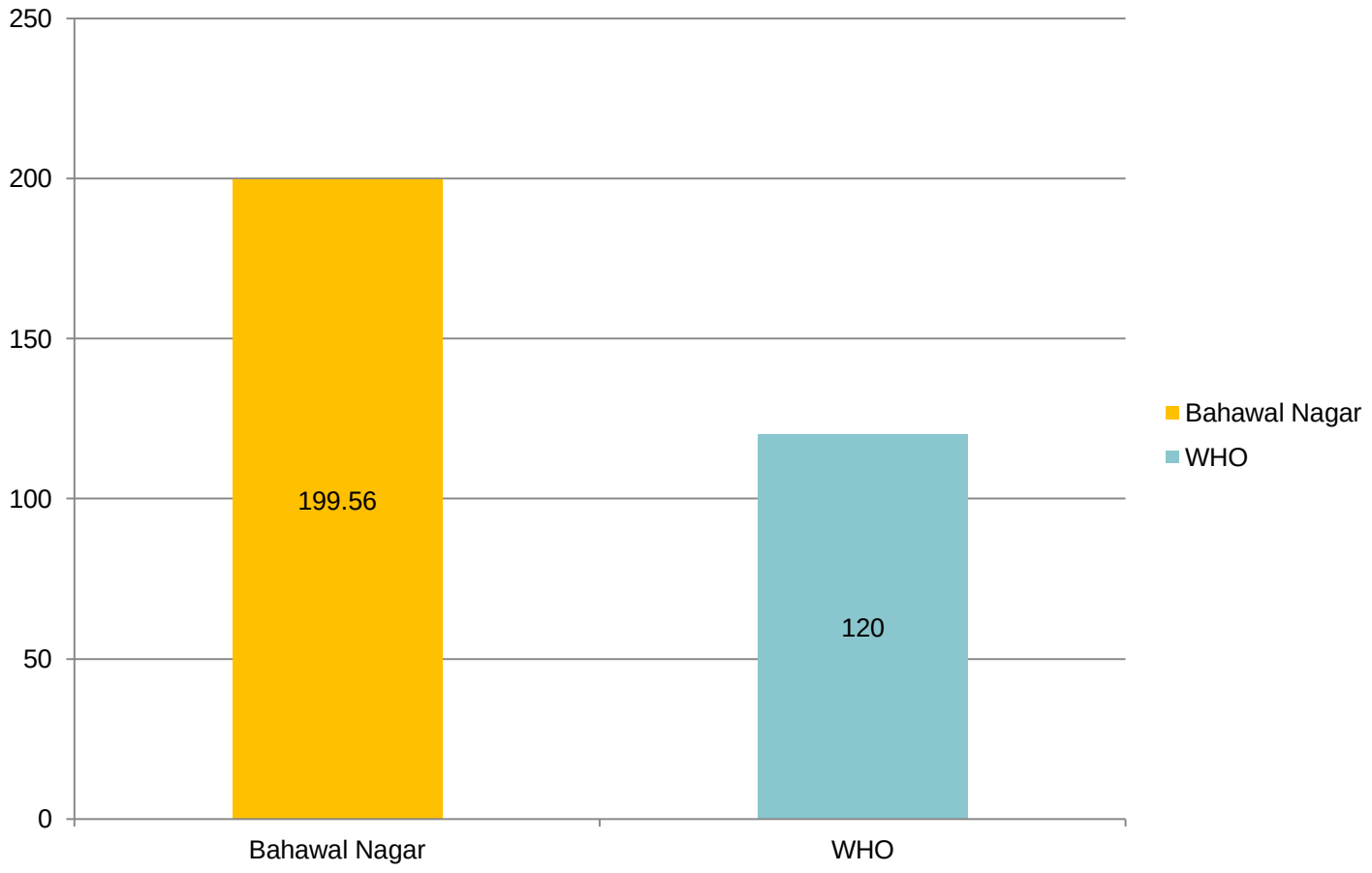
On-Site Monitoring Activities

- Samples are being collected from the Monitoring Site at Bahawal Nagar.
- PM_{10}, NRSPM & TSPM are Analyzed at the Monitoring Site.
- Samples for Analysis of SO_2 & NO_2 are being sent regularly to Swedish Environmental Research Institute, Sweden.

Monthly Average Data of HVAS from February to December, 2007

Name of month	Concentration (µg/m^3)		
	PM_{10}	**NRSPM**	**TSPM**
February, 2007	217.72	175.87	393.60
March, 2007	120.21	110.66	198.24
April, 2007	143.2	271.26	414.58
May,2007	367.52	768.63	1136.15
June , 2007	135.14	388.23	523.37
July, 2007	227.21	384.54	611.15
August, 2007	134.90	413.49	548.38
September, 2007	105.42	309.09	414.51
October, 2007	247.05	390.31	637.35
November, 2007	257.05	303.10	560.17
December, 2007	239.78	195.71	435.49

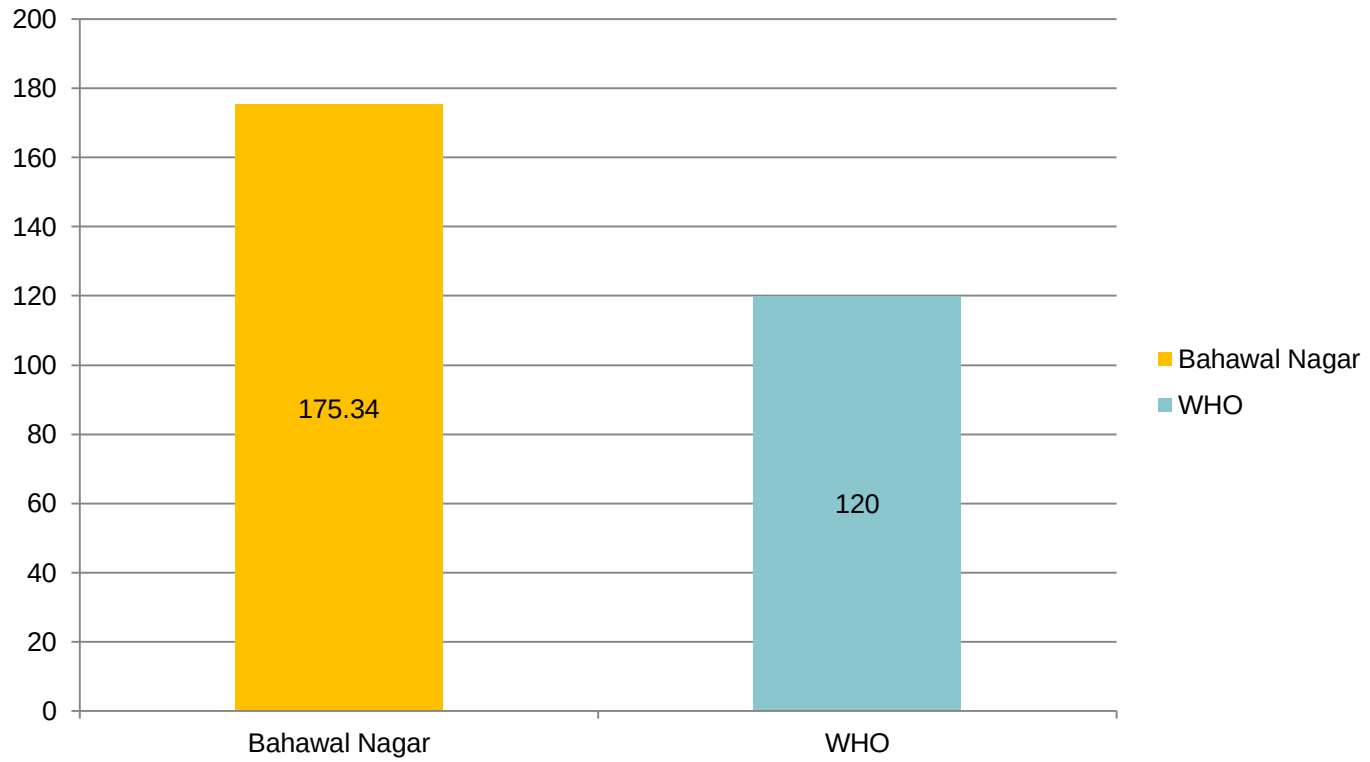
Comparison of PM_{10} ($\mu g/m^3$)at Bahawal Nagar with WHO Standards



Monthly Average Data of HVAS from January to December, 2008

Name of month	Concentration (µg/m^3)		
	PM_{10}	**NRSPM**	**TSPM**
January, 2008	169.87	165.71	335.58
February, 2008	208.78	318.44	527.21
March, 2008	173.19	294.99	468.18
April, 2008	129.98	385.30	515.27
May,2008	349.37	872.98	1222.35
June , 2008	175.84	279.99	455.83
July, 2008	161.41	300.41	461.82
August, 2008	57.58	218.03	275.61
September, 2008	91.50	250.52	342.02
October, 2008	196.63	340.43	537.07
November, 2008	200.25	369.42	569.67
December, 2008	189.69	243.35	433.04

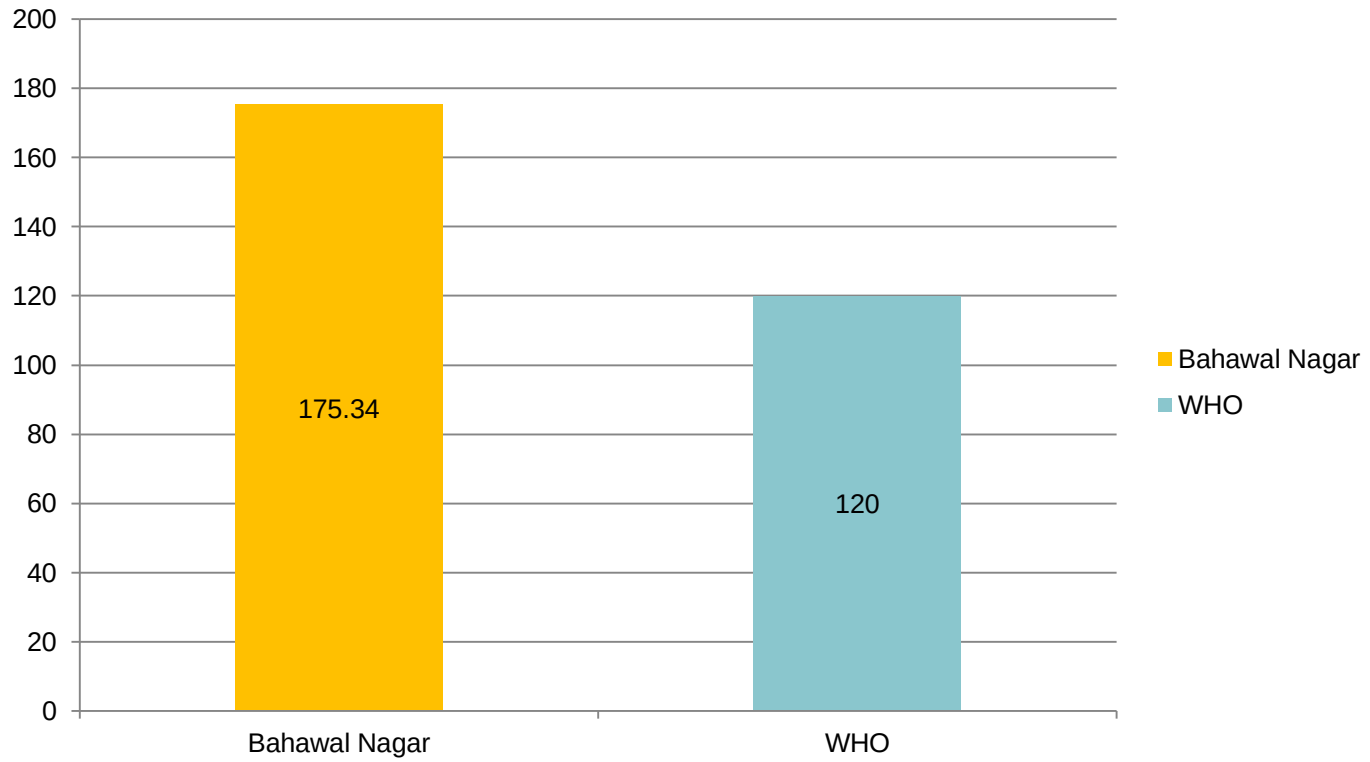
Comparison of PM_{10} ($\mu g/m^3$) at Bahawal Nagar for 2008 with WHO Standards



Monthly Average Data of HVAS from January to December, 2009

Name of month	Concentration (µg/m^3)		
	PM_{10}	**NRSPM**	**TSPM**
January, 2009	162.86	289.22	452.08
February, 2009	105.78	265.31	371.09
March, 2009	-	-	-
April, 2009	-	-	-
May,2009	-	-	-
June , 2009	-	-	-
July, 2009	-	-	-
August, 2009	-	-	-
September, 2009	-	-	-
October, 2009	-	-	-
November, 2009	-	-	-
December, 2009	312.83	353.17	666.00

Comparison of PM_{10} ($\mu g/m^3$) at Bahawal Nagar for 2009 with WHO Standards



Results of Diffusive Samplers for 2005

Month	**SO_2 (µg/m^3)**	**NO_2 (µg/m^3)**
January-February	11.7	50.6
February-March	12.4	51.5
March-April	12.9	37.5
April-May	14.4	48.3
May-June	13.4	34.3
June-July	7.8	41.1
July-August	8.7	41.8
August-September	10.9	44.7
September-October	20.9	73.5
October-November	23.5	51.0
November-December	19.9	60.2

Results of Diffusive Samplers for 2006

Month	**SO_2 (µg/m^3)**	**NO_2 (µg/m^3)**	**O_3 (µg/m^3)**
December-January	18.8	55.8	-
January-February	20.6	51.9	-
February-March	15.8	49.9	-
March-June	11.6	28.9	-
June	12.1	40.6	-
June-July	7.7	42.2	54.0
July-August	8.0	42.1	28.0
August-September	12.1	45.0	29.0
September-October	12.1	50.5	26.0
October-November	13.7	62.5	13.0
November-December	9.6	56.5	11.0

Results of Diffusive Samplers for 2007

Month	**SO_2 (µg/m^3)**	**NO_2 (µg/m^3)**	**O_3 (µg/m^3)**
December-January	8.9	60.6	11.0
January-February	9.0	20.2	55.0
March-April	9.5	12.4	61.0
April	6.8	8.8	70.0
June-July	3.7	7.7	70.0
July-August	4.7	7.1	66.0
August-September	4.8	8.8	61.0
September-October	4.4	9.7	76.0

Monthly average of weekly collected data of Wet Deposition for Year 2007

(Wet only Collector)

Name of Month	Electrical Conductivity (EC) µS/cm	pH	Total Rain (mm)
February, 2007	93.5	7.4	8.48
March, 2007	-	-	-
April, 2007	222.4	7.85	1.1
May, 2007	274.4	8	trace
June, 2007	96.5	7.84	33
July, 2007	143.95	8.13	3.6
August, 2007	56	7.7	3.8
September, 2007	275	9.6	10
October, 2007	Nil	Nil	Nil
November, 2007	Nil	Nil	trace
December, 2007	210	8	1
January, 2008	238.95	7.8	4.4

Monthly average of weekly collected data of Wet Deposition for Year 2008

(Wet only Collector)

Name of Month	Electrical Conductivity (EC) µS/cm	pH	Total Rain (mm)
January	-	-	8.8
February	-	-	o
March	-	-	o
April	-	-	8.5
May	970	8.04	16
June	-	-	28.1
July	-	-	8.6
August	-	7.65	9.0
September	-	-	Trace
October	-	-	0
November	-	-	0
December	-	-	3.0

Monthly average of weekly collected data of Wet Deposition for Year 2009

(Wet only Collector)

Name of Month	Electrical Conductivity (EC) µS/cm	pH	Total Rain (mm)
January	-	-	2.8
February	-	-	3.0
March	-	-	4.3
April	-	-	1.8
May	-	-	1.0
June	-	-	4.8
July	-	-	22.2
August	-	-	5.8
September	-	-	7.3
October	-	-	-
November	-	-	-
December	-	-	0

Monthly average of weekly collected data of Wet Deposition for Year 2008

(Bulk Collector)

Name of Month	Electrical Conductivity (EC) µS/cm	pH	Total Rain (mm)
January	238.95	7.79	8.8
February	-	-	0
March	-	-	0
April	393.0	7.87	8.5
May	168.05	7.99	17.5
June	136.3	8.0	28.1
July	155.3	8.0	8.6
August	65.015	7.65	9.0
September	-	-	-
October	-	-	-
November	-	-	-
December	555	7.37	12.0

Monthly average of weekly collected data of Wet Deposition for Year 2009

(Bulk Collector)

Name of Month	Electrical Conductivity (EC) µS/cm	pH	Total Rain (mm)
January	5020	7.83	14.0
February	4710	7.9	12.0
March	5390	7.96	17.0
April	2980	7.85	7.0
May	-	-	1.0
June	2810	7.11	4.8
July	2755.3	7.60	22.2
August	918	9.7	5.8
September	936	8.8	7.3
October	-	-	-
November	-	-	-
December	-	-	0

Inter-Comparison Study

- 8 Passive Samplers for NO_2 and SO_2 (ready for exposure) were Provided to the Malé Declaration Site.

- One Set of Four Samplers for NO_2 and SO_2 was Analyzed by the Usual Protocol Employed at Pak-EPA's Laboratory
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- Send the Second Set of 4 Samplers to NUS for Analysis, along with the Protocol Employed at Pak-EPA's Laboratory.

- This Experiment was Done Twice.

Part-1 In Country Exposure and Analysis Report
NO_2 Analysis Report

Sample ID	Exposure Time Or 14 Days	Approximate height of exposure)	Absorbance of Sample (A)	Absorbance Of Blank (A^o)	NO_2 Concentration	
					(ppb)	µg/m3
B-1	335	2.5	0.427	0.121	22.64	42.6
21	334	10	0.314	0.121	14.33	26.96
22	334	10	0.289	0.121	12.5	23.5

Part-1 In Country Exposure and Analysis Report
SO_2 Analysis Report

Sample ID	Exposure Time Or 14 Days	Approximate height of exposure (m)	Absorbance of Sample (A)	Absorbance Of Blank (A^o)	NO_2 Concentration	
					(PPb)	µg/m^3
B-1	335	2.5	0.427	0.121	22.64	42.6
21	334	10	0.314	0.121	14.33	26.96
22	334	10	0.289	0.121	12.5	23.5

Rain Water Samples

- Rain Water Samples received in March, 2007 and July, 2008 have been Analyzed at NIA.

Results of Rain Water Samples for Year 2007

Parameter	Measurement/analytical method	Manufacturer/Type of equipment	Detection limits (umol/L)	Determination limit (umol/L)	Concentration (umol/L)		Note
					Sample 1	Sample 2	
pH	Glass Electrode	WTW Germany made		4-5.5 at 25. ^{o}C	5.4	5.04	
Temp*					20.20	20.20	
EC	Conductivity cell	WTW Germany made		1-10ms/m	3ms/m	5.12ms/m	
Temp*				25. ^{o}C	25.6 ^{o}C	25.6 ^{o}C	
SO_4^{2-}	Absorption Method	Anova_Spectr-oquant (MERCK)	- 0.003A to 0.002A	5 – 100	4.06	20.6	
NO_3^-	Absorption Method	Anova_Spectr-oquant (MERCK)	-	5 - 100	7.74	69.58	
Cl^-	Absorption Method	UV-1601 Schimadzu	-	5 - 150	16.64	17.21	
NH_4^+							**
Na^+							**
K^+							**
Ca^{2+}	Absorption Method	Anova_Spectr-oquant (MERCK	-	1 - 50	179	188	
Mg^{2+}	Absorption Method	Anova_Spectr-oquant (MERCK		1 - 50	7.81	56.2	

*- Temperature reading of the pH and EC meters (recommended value ~25^{0}C)
**- Laboratory is under commissioning and most of instruments like AAS, IC are not proper functioning.

Results of Rain Water Samples for Year 2008

Parameter	Measurement/analytical method	Manufacturer/Type of equipment	Detection limits (umol/L)	Determination limit (umol/L)	Concentration (umol/L)		Note
					Sample 1	Sample 2	
pH	Glass Electrode	WTW Germany made		4-5.5 at 25. ^{o}C	4.9	5.08	
Temp*					20.20	20.20	
EC	Conductivity cell	WTW Germany made		1-10ms/m	4.42µs/m	5.12µs/m	
Temp*				25. ^{o}C	27.4 ^{o}C	27.1 ^{o}C	
SO_4^{2-}	Absorption Method	Anova_Spectr-oquant (MERCK)	- 0.003A to 0.002A	5 – 100	32.9	8.3	
NO_3^-	Absorption Method	Anova_Spectr-oquant (MERCK)	-	5 - 100	18.52	9.8	
Cl^-	Absorption Method	UV-1601 Schimadzu	-	5 - 150	67.74	14.64	
NH_4^+							**
Na^+							**
K^+							**
Ca^{2+}	Absorption Method	Anova_Spectr-oquant (MERCK	-	1 - 50	120.2	39.51	
Mg^{2+}	Absorption Method	Anova_Spectr-oquant (MERCK		1 - 50	15.73	8.1	

Results of Rain Water Samples for Year 2011

Organization name	Pakistan Environmental Protection Agency Islamabad Code
Department/Section	CLEAN Laboratory
Number of staff in charge of measurement	1 Person
Year of experience	Staff No.1: 11 1/2 years
(if more than 2 persons, a row be added)	Staff No.2:
Name of contact person	Sajid Mahmood (Chemist-Air)
Date of receiving samples	20/07/2011
Samples conditions at received	In cool box
Dates of measurement of different parameters (specify for each parameter)	pH,EC(2011/07/22) - NO3(2011/07/23) - Cl(2011/07/25) - SO4(2011/07/27) - Ca(2011/07/28) -Mg(2011/07/29)
Postal address	CLEAN Laboratory, Plot # 41, Street # 06 , H-8/2 Islamabad Pakistan
Contact address	Tel: +92519250713-8 Fax: +92519250718
	Email: searchline2001@yahoo.com
Note	

Parameter	Measurement/analytical method	Manufacturer/Type of equipment		Detection limits (µmol/l)	Determination limits (µmol/l)		
	Concentration (µmol/L) **Note**			**Sample 32 (Low)**	**Sample 31 (High)**		
	Average STD	1st analysis	2nd analysis	3rd analysis	1st 2nd 3rd Average	STD analysis	
pH	Glass electrode	pH meter		5.98	6.05	6.07	6.03
	0.05	5.69	5.61	5.69	5.66	0.05	
Temp*				25	24.9	24.9	24.933
	0.058	24.8	24.9	25	24.900	0.100	
EC	Conductivity Cell	EC meter		0.680	0.670	0.650	0.667
	0.015	2.950	2.960	3.010	2.973	0.032	
Temp*				25.900	25.000	25.100	25.333
	0.493	26.1	26.3	26.1	26.167	0.115	
SO42-	Spectrophotometry	Spectrophotometer		3.25	2.98	2.5	2.9
	0.38	33.35	32.5	35.65	33.8	1.63	
NO3-	Spectrophotometry	Spectrophotometer		2.08	1.98	1.78	1.9
	0.15	32.1	28.15	30.35	30.2	1.98	
Cl-	Argentrometric method			8.18	8.16	7.95	8
	0.13	77.73	76.68	75.98	77	0.88	
NH4+	distillation unit for NH3 is not present						
Na+	AAS not functional						
K+	AAS not functional						
Ca2+	Titrimetry			2.86	2.75	2.95	3
	0.10	29.07	27.15	25.5	27	1.79	
Mg2+	Titrimetry			2.94	2.35	1.98	2
	0.48	17.36	18.25	19.5	18	1.08	

** - Temperature readings of the pH and EC meters (recommended value ~ 25oC)*

Status of Emission Inventory

- Emission Inventory is Being Developed for Onward Submission.

Crop Impact Assessment

- Punjab University was nominated as Institute to carry out the Study on ‘Crop Impact Assessment’ which has been completed.

- Pak-EPA is not being Informed About the Developments of Experiments Being Done by the Expert Institute Designated for the Job.

Health Impact Assessment

Research Study- Level of Exposure of School Children to Air Pollutants

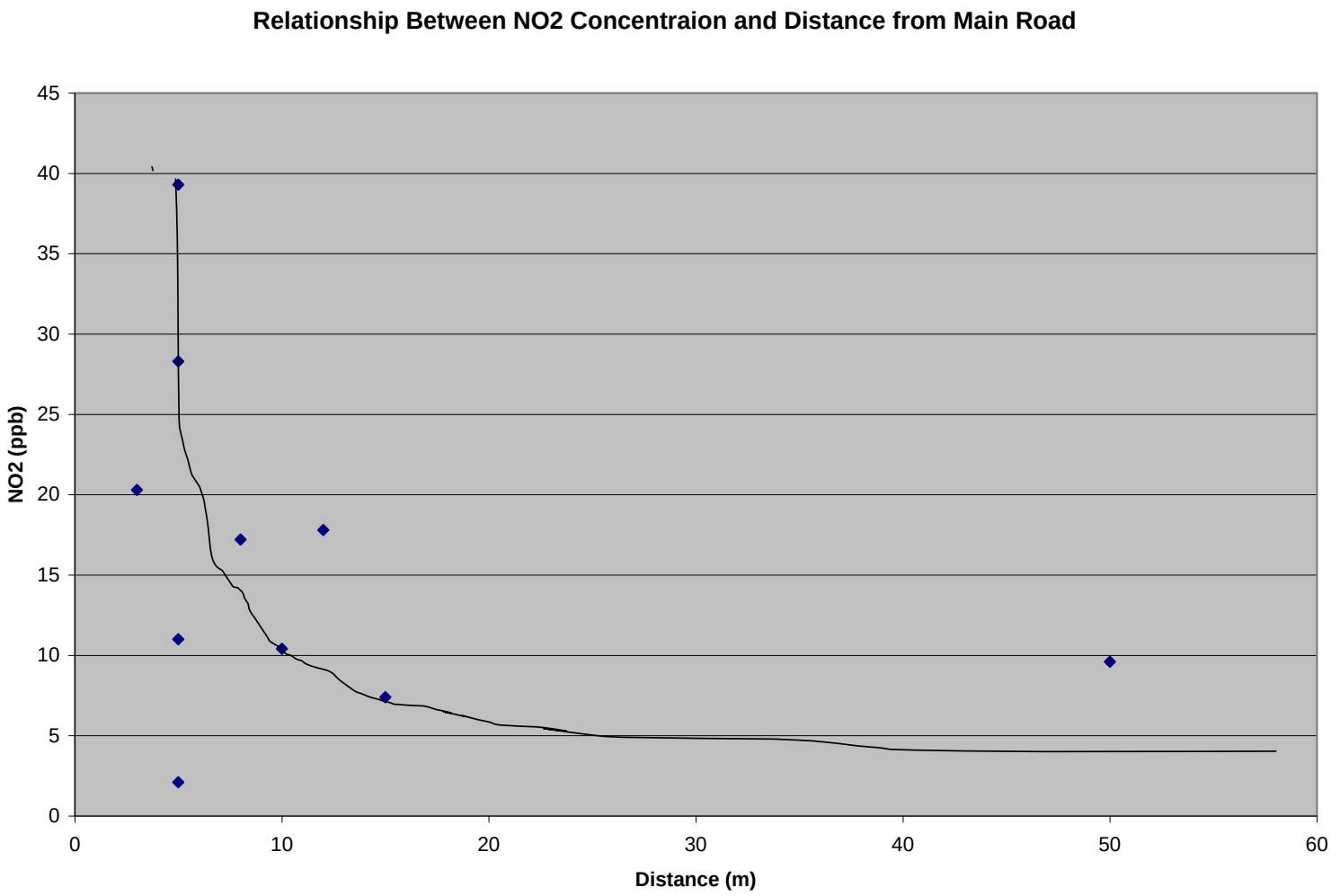
Objectives

- To Monitor the Level of NO_2 and SO_2 in Ambient Air in order to Know the Spatial Variation of this Important Traffic Related Air Pollutant.

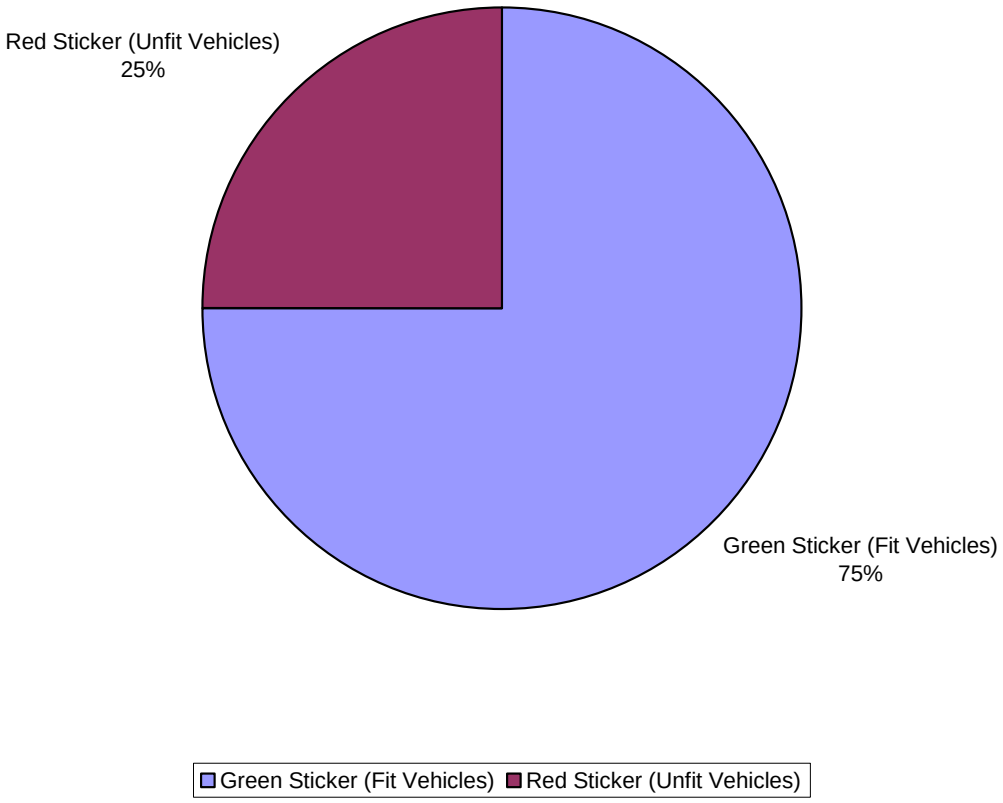
- To Determine the Level of Exposure of School Children to Air Pollutants.

Activities Undertaken

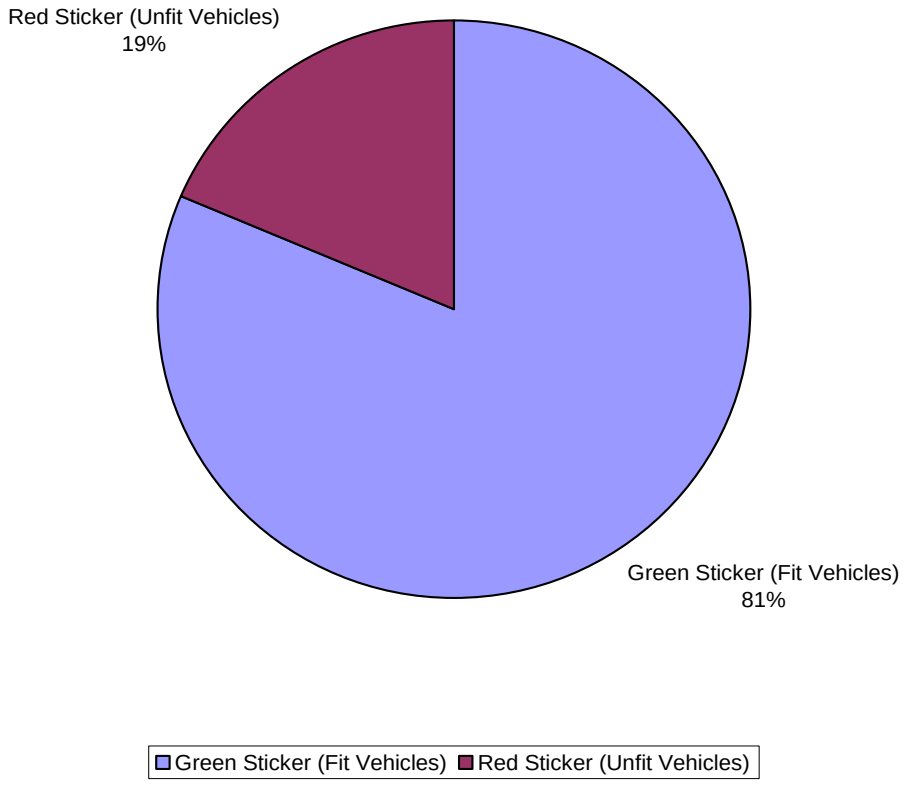
- A 5-Days Comprehensive Study has been Undertaken in Murree (Hill Resort) in September, 2007.
- 15 Locations were Selected for Ambient Air Quality Monitoring of NO_2 and SO_2.
- Vehicular Emission Testing was Also Done in that Area.
- Personal Passive Samplers were Attached to 37 Children to Monitor the Exposure Level


Relationship Between NO2 Concentraion and Distance from Main Road
NO2 (ppb)
45
40
35
30
25
20
15
10
5
0
0
10
20
30
40
50
60
Distance (m)

Testing Result of Petrol Vehices in Murree



Testing Result of Diesel Vehicles in Murree



Results

- NO_2 and SO_2 concentration decreases with Increase in distance from the road.
- The samplers installed at more than 30 meters Distance from the road have More or Less Stable Concentration of NO_2 and SO_2 .
- Children of Schools Away from the Roadside Area are Less Exposed to Air Pollutants

Challenges & Difficulties

- Administrative
  - One of the main issue is our ministry was under devolution process (2010 – end of 2011)

    i. Become part of CADD (Capital Administration and Development Department)

    ii. Then assigned to ministry of Disaster Management

    iii. Finally the ministry was renamed by Ministry of Climate Change

  - Communication and Logistical Constraints for Supervising & Monitoring the Site

Technical

- Equipments were Showing Sign of Wear – Tear and now completely non-functional.

- High Volume Sampler is not functional due to Unavailability of filter papers since 2009.

- Male’ station condition was going bad day by day due to unavailability of funds.
- Ground Staff Needs More Training
- Weak Coordination Among NIA and Expert Institute Nominated for Crop Impact Assessment
- Non-Delivery of ‘Kjeldhal Distillation System (Model UDK 142) & Titrator (Model Titroline Easy of Scott Germany)’ by M/s Modern Lab. Lahore for which Payment has already been made by UNEP

- HOW TO TACKLE CONSTRAINTS ?

Thanks