

AIR QUALITY IN BENGALORE



KARNATAKA STATE POLLUTION CONTROL BOARD

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AIR QUALITY MONITORING

- **AAQM** is required to **determine**
 - Existing **quality** of air.
 - Evaluation of the effectiveness of **control** program.
 - To Identify areas in need of **restoration** and their **prioritization**

Objectives of AQM

- Background **data**.
- **Status** & **trend** Evaluation.
- Environment **exposure level** determination.
- **Scavenging** Behavior of Environment.
- Air quality **management**.

Karnataka Scenario

- **AAQM** started in the year **1983** with 2 stations.
- **30 NAMP** stations in the state (09 in Bangalore)
- **5** AQM stations under **Board** Programme
- **2 CAAQM** by KSPCB and **3 CAAQM** stations by CPCB in Bangalore.
- **17 cities** under AAQM Programme.
- Monitoring involving **PM₁₀**, **PM_{2.5}**, **NO_x**, **Sox**, **NH₃** & **Lead**.

National Ambient Air Quality Standards

Sl No.	Pollutant	Time Weighted average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural and other area	Ecologically Sensitive area (notified by Central Government)	
1	Sulphur Dioxide (SO ₂), µg/m ³	Annual 24 hours	50 80	20 80	-Improved West and Gaeke -Ultraviolet Fluorescence
2	Nitrogen Dioxide (NO ₂), µg/m ³	Annual 24 hours	40 80	30 80	-Modified Jacob and Hochheiser (Na-Arsenite) -Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM ₁₀ , µg/m ³	Annual 24 hours	60 100	60 100	-Gravimetric -TOEM -Beta attenuation
4	Particulate Matter (size less than 2.5µm) or PM _{2.5} , µg/m ³	Annual 24 hours	40 60	40 60	-Gravimetric -TOEM -Beta attenuation
5	Ozone (O ₃), µg/m ³	8 hours 1 hour	100 180	100 180	-UV Photometric -Chemiluminescence -Chemical method
6	Lead (Pb), µg/m ³	Annual 24 hours	0.5 1.0	0.5 1.0	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter

Cont.

SI No.	Pollutant	Time Weighted average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural and other area	Ecologically Sensitive area (notified by Central Government)	
7	Carbon monoxide (CO), mg/m ³	8 hours	02	02	-Non-Dispersive Infra-Red (NDIR)
		1 hour	04	04	
8	Ammonia (NH ₃), µg/m ³	Annual	100	100	-Chemiluminescence -Indophenol blue method
		24 hours	400	400	
9	Benzene (C ₆ H ₆), µg/m ³	Annual	05	05	-Gas chromatography based continuous analyzer -Adsorption and Desorption followed by GC analysis
10	Benzo(a) Pyrene (BaP)-particulate phase only, ng/m ³	Annual	01	01	-Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m ³	Annual	06	06	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m ³	Annual	20	20	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

Source: CPCB, 2009

Location of Monitoring Station



**National Air
Monitoring
Programme
(NAMP) in
Karnataka**

1	TERRI Office, Domlur, Bangalore
2	Amco Batteries (Admin Block), Mysore Rd, Bangalore
3	Victoria Hospital (On Roof top of Plastic Surgery Ward - 1st Floor)
4	Yeshwanthpur Police Station, Bangalore
5	Graphite India Ltd., Mahadevapura Main Road, Bangalore
6	Jnana Bharathi Campus, Environment Science Dept. University of Bangalore
7	RV College of Engineering, Bangalore
8	RO Building, Urban Eco Park, Peenya Industrial Area, Bangalore
9	KHB Industrial Area, Yelahanka (RR Foundries Premises), Bangalore
10	KSPCB Building, Tumkur
11	Regional Office, Kolar
12	Intake well of HPF, Harihar
13	Moti Talkies, Gandhi Circle, Davanagere
14	Regional Office, Davanagere
15	Regional Office, Dharwad
16	Gokul Road, Opp. New Bus stop, Hubli
17	KSPCB Building, Hebbal Industrial Area, Mysore
18	KSRTC Bus Stand, KR Circle, Mysore
19	Regional Office, Bagalkote
20	Regional Office, Belagaum
21	Regional Office, Bidar
22	Regional Office, Chitradurga
23	Govt. Hospital, Gulbarga
24	Regional Office, Hassan
25	Karwar Post Office, Baithkol, Karwar
26	Regional Office, Mandya
27	M/s Segment Scientific Ltd., (Bulk Drug Unit) Baikampady Industrial Area, Mangalore
28	Regional Office, Raichur
29	Visvesvaraya Iron and Steel Plant Ltd., (Oxygen Plant) Bhadravathi Shimoga
30	KSPCB Building, Bijapur

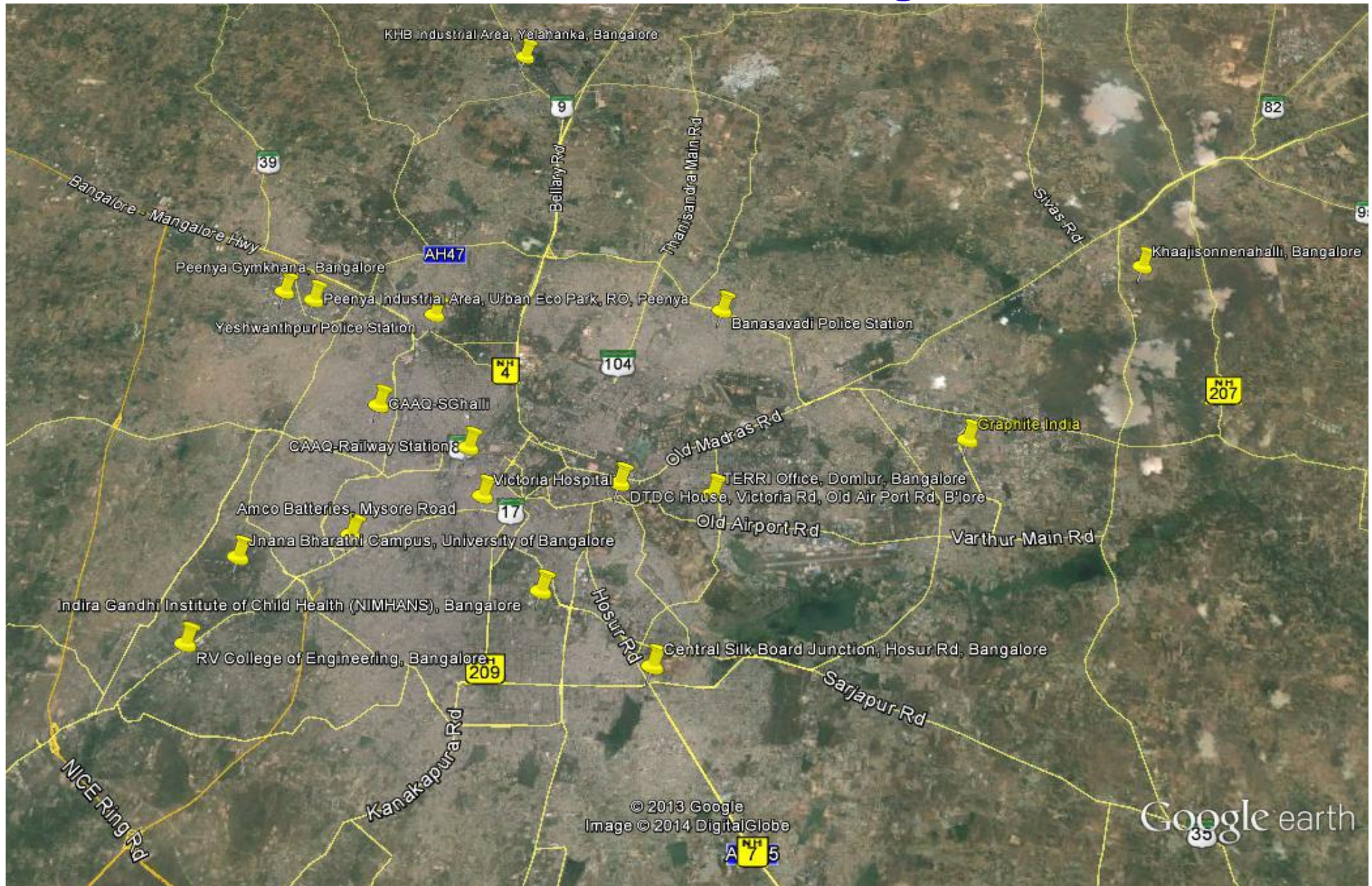
Board's Ambient Air Quality Monitoring Programme

Sl. No.	Name of the Board Station
1	Banasawadi Police Station
2	DTDC House, Victoria Road, Old Air Port Road, Bangalore
3	Central Silk Board Junction, Hosur Road, Bangalore
4	Indira Gandhi Institute of Child Health (NIMHANS), Bangalore
5	Kaji Sonnenahalli, B'lore
6	Peenya Gymkhana , Peenya, Bangalore
7	City Corporation office Building, Bellary
8	Regional Office, Bellary
9	Regional Office, Chamarajanagara

Continuous Ambient Air Quality Monitoring Stations (CAAQMS)

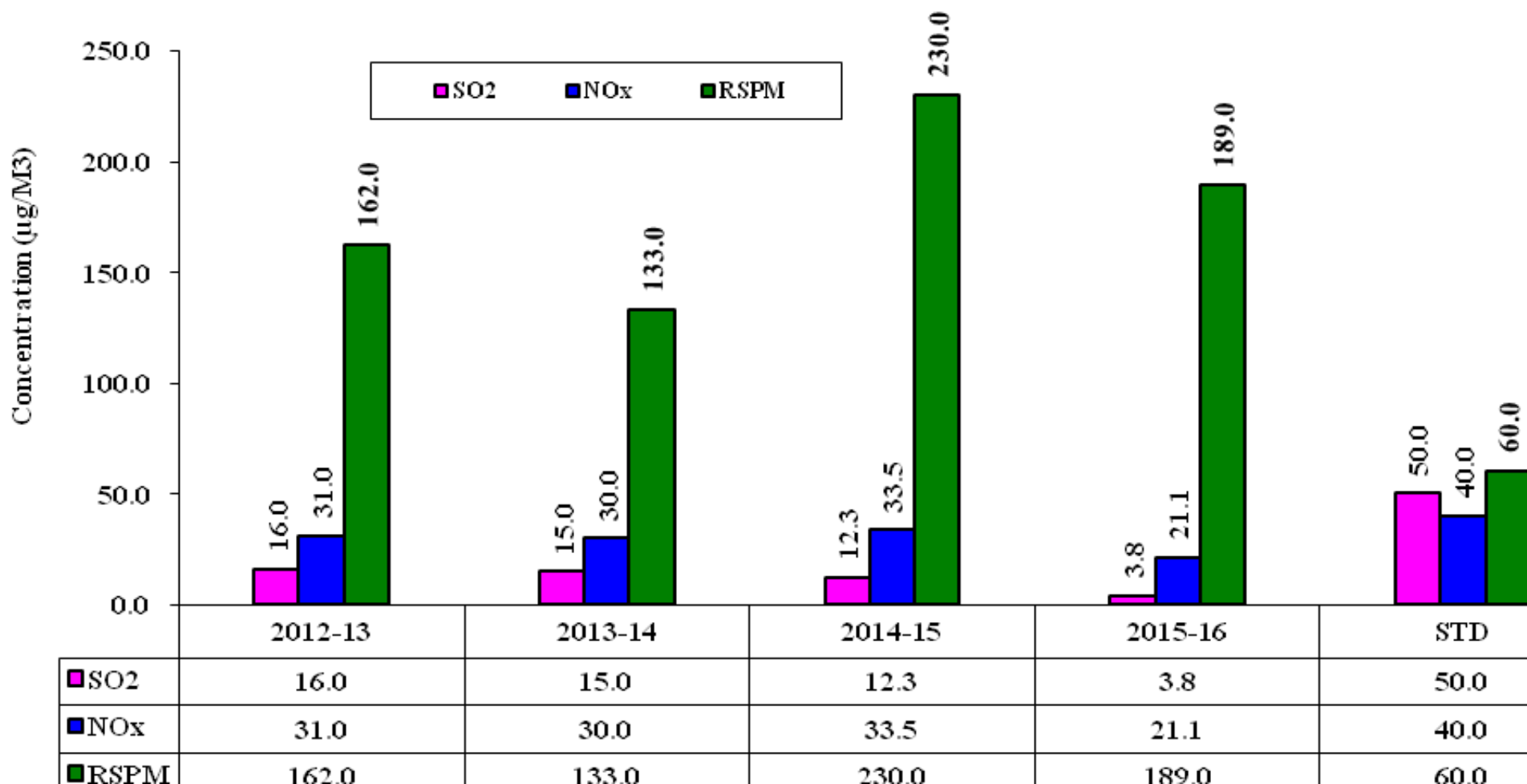
Sl. No.	Name of the CAAQM Station
1	City Railway Station, Bangalore
2	Regional Office Complex, KSPCB, SG Halli, Bangalore

Location of Stations - Bengaluru



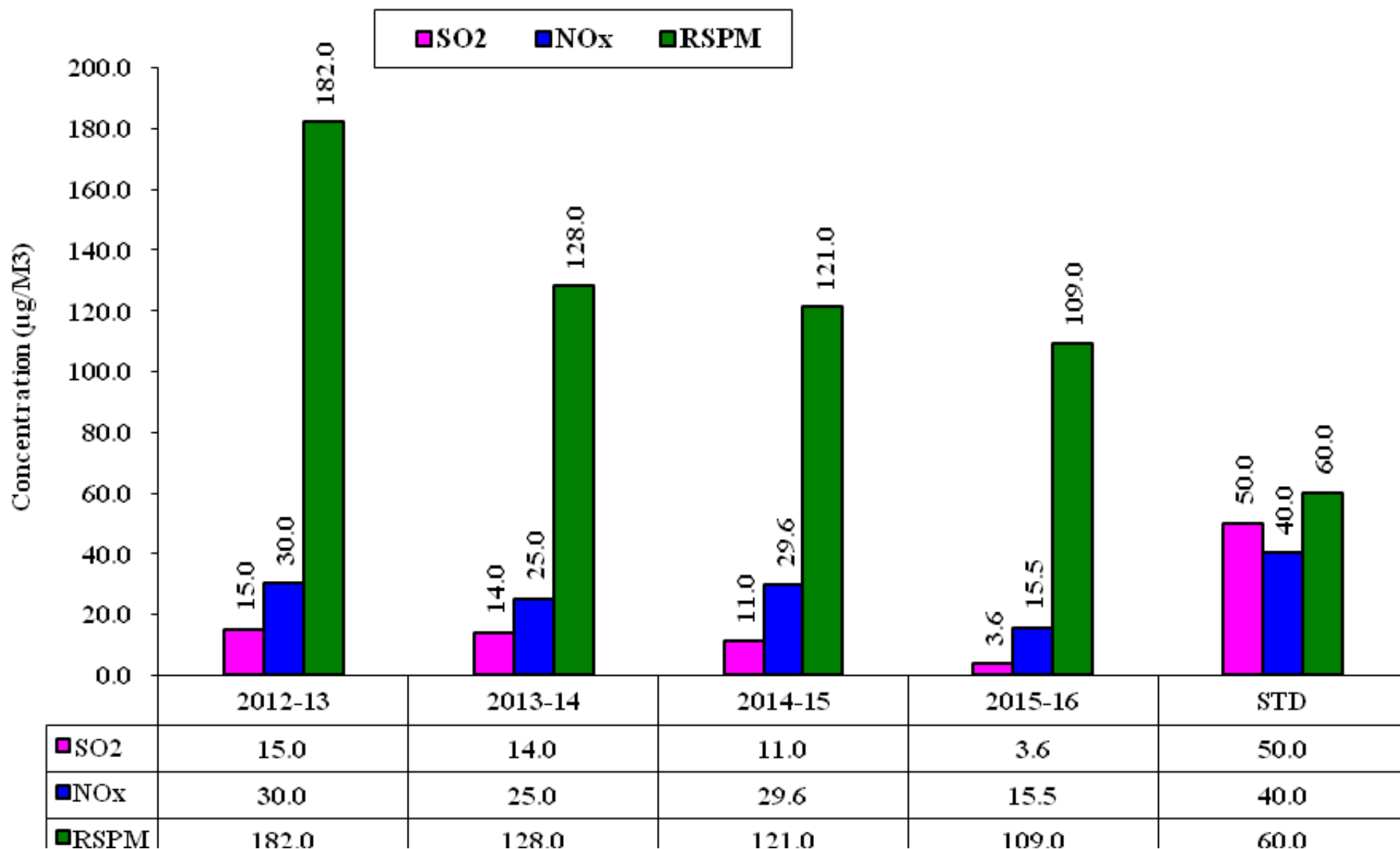
Industrial Zone of Bangalore city

Annual average values of air pollutants at Export Promotional Park ITPL , White Field Road, during the years 2012-16



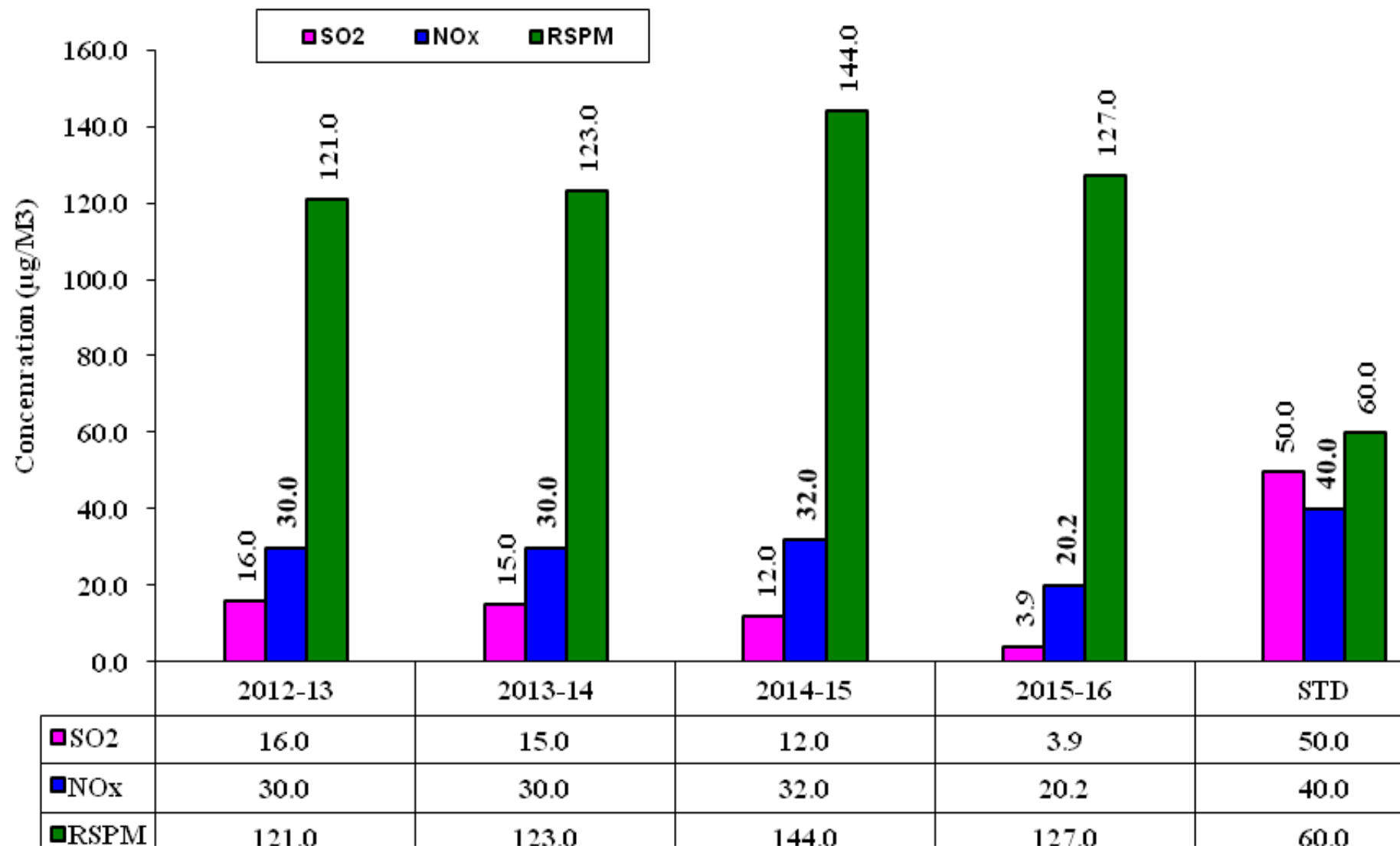
Industrial Zone of Bangalore city

Annual average values of air pollutants at KHB Indl Area, during the years 2012-16



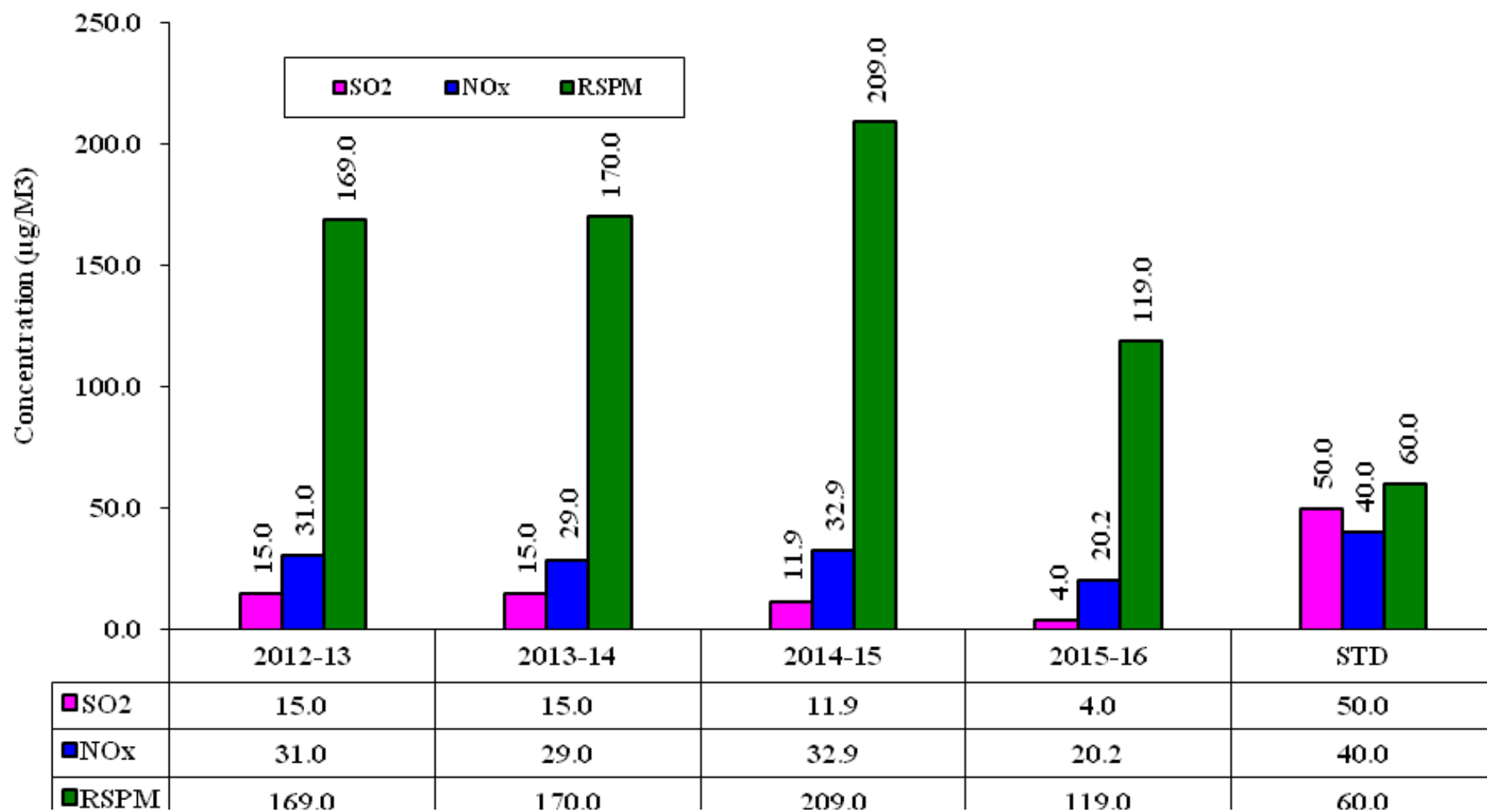
Industrial Zone of Bangalore city

Annual average values of air pollutants at Peenya Industrial Area, during the years 2012-16



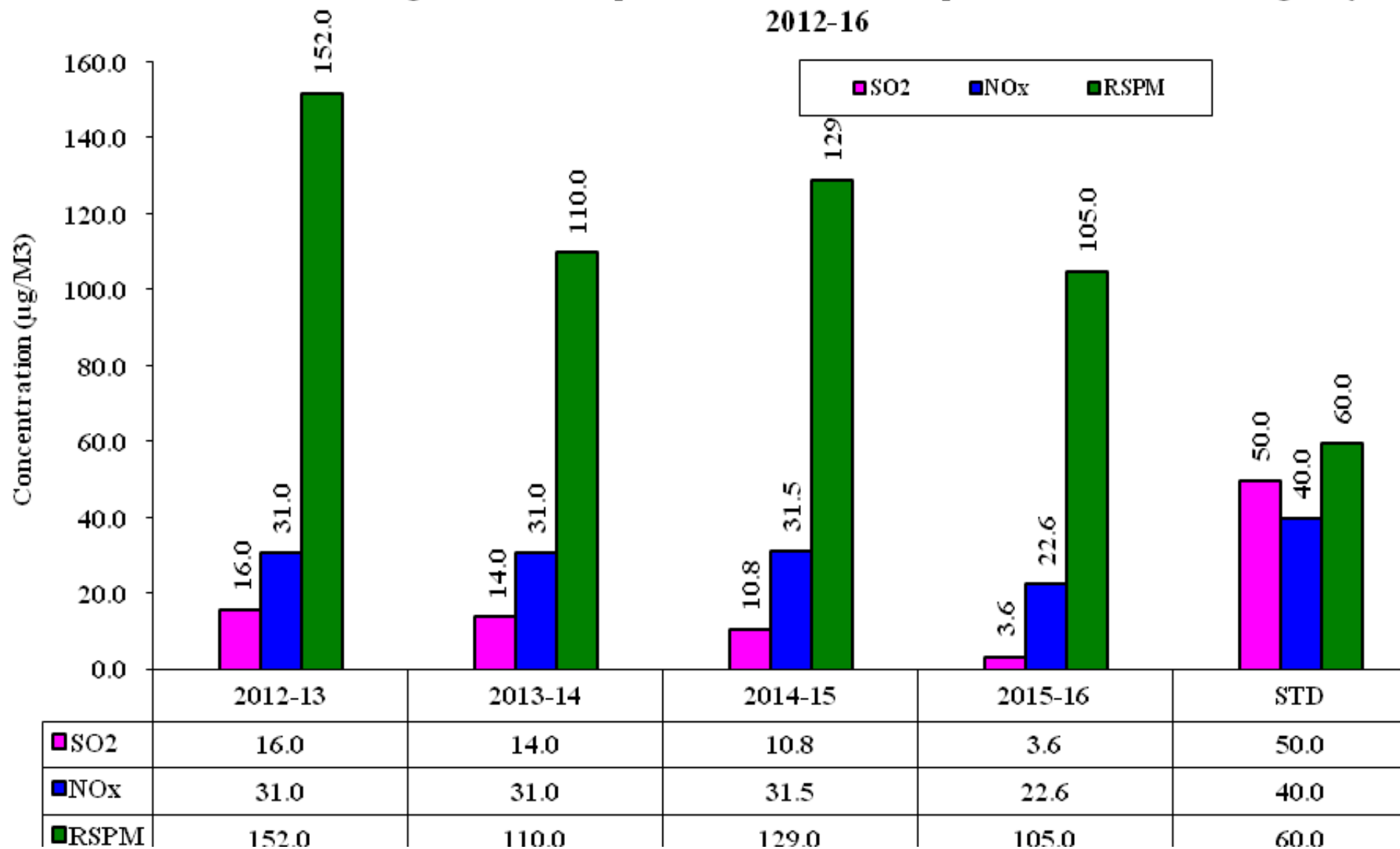
Residential, Rural & Other areas of Bangalore city

Annual average values of air pollutants at AMCO Batteries, Mysore Road, during the years 2012-16



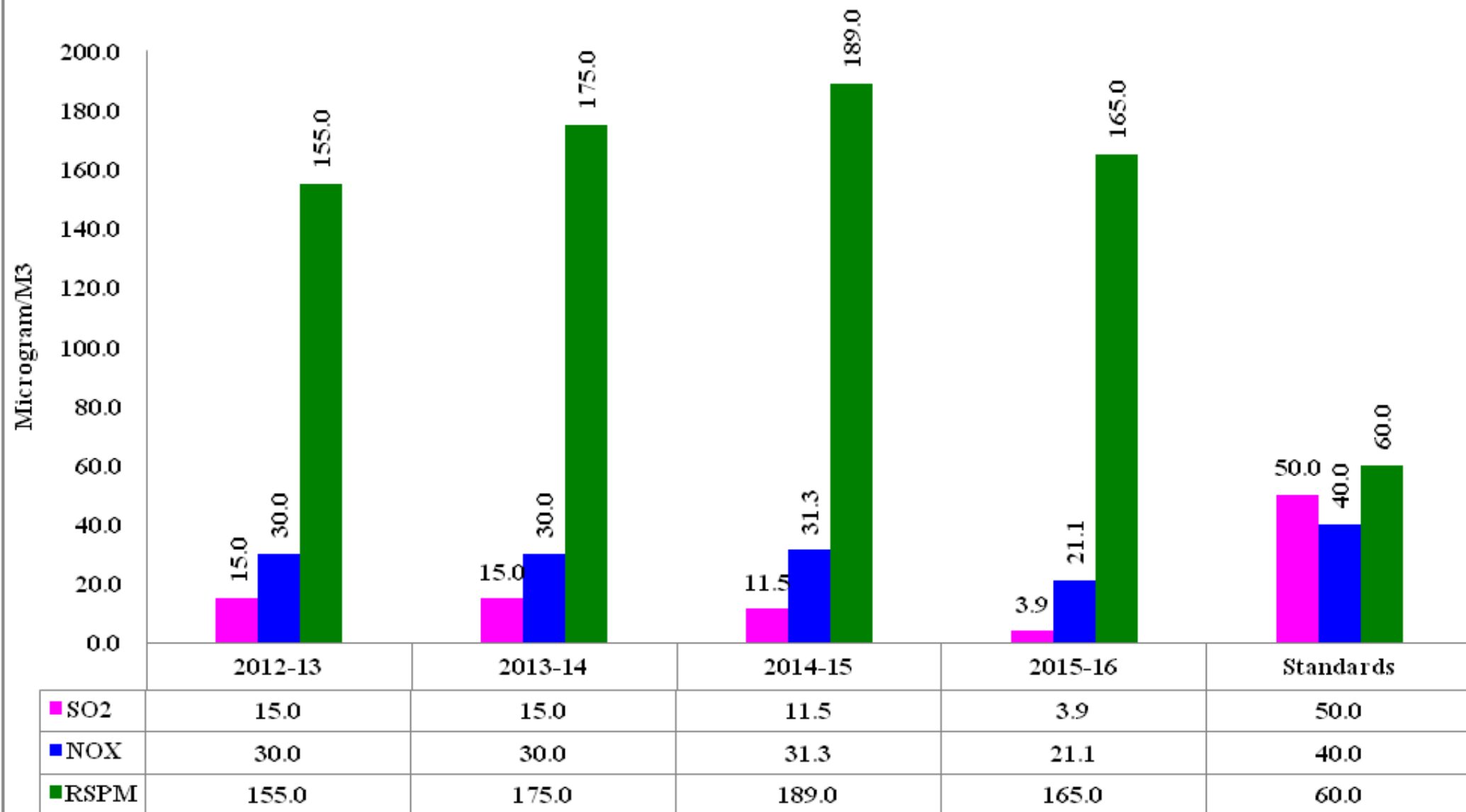
Residential, Rural & Other areas of Bangalore city

Annual average values of air pollutants at Yeshwanthpur Police Station during the year 2012-16



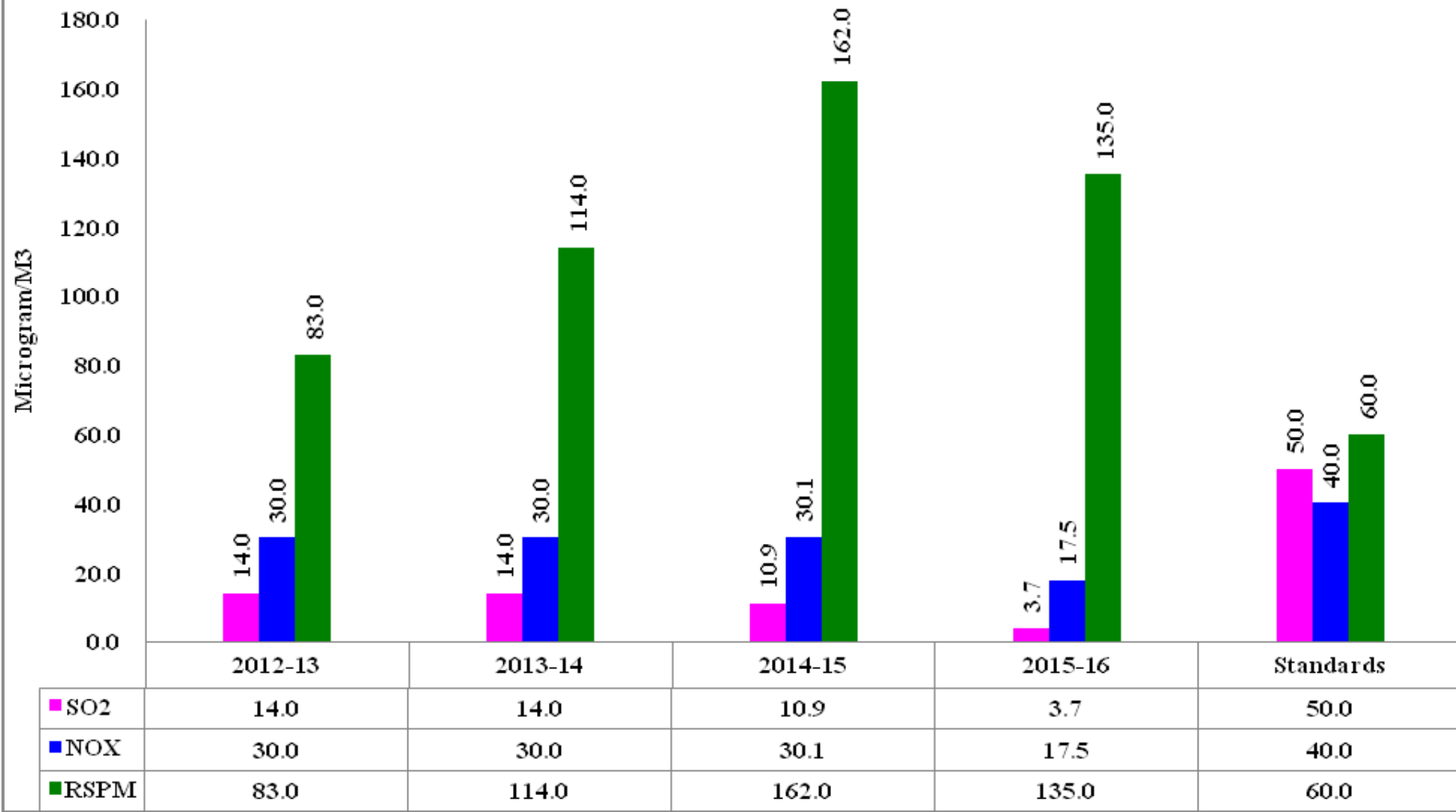
Residential, Rural & Other areas of Bangalore city

Annual average values of air pollutants at Central Silk Board for the years 2012-2016



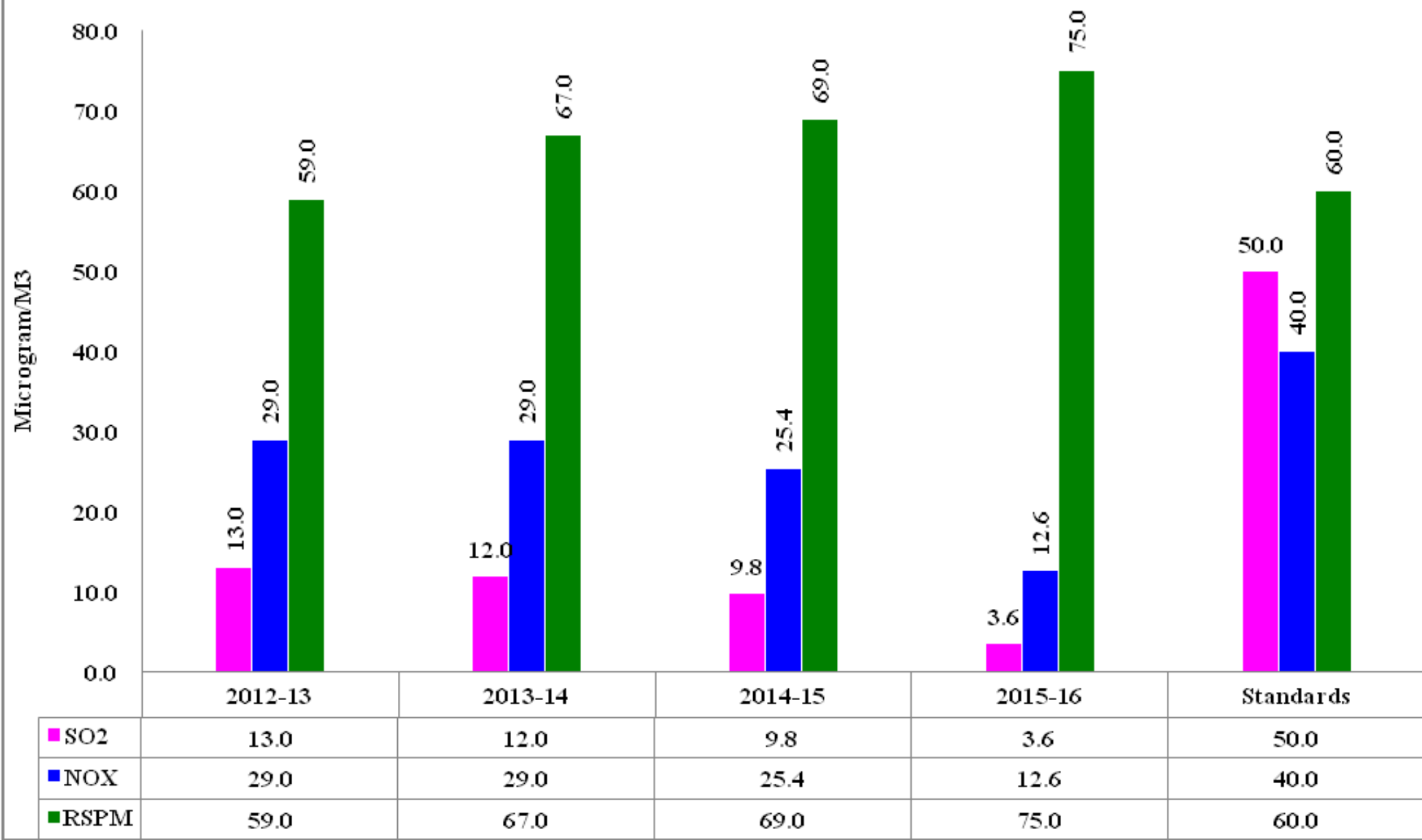
Residential, Rural & Other areas of Bangalore city

Annual Avg values of air pollutants at DTDC Vitoria Roard for the year 2012-16



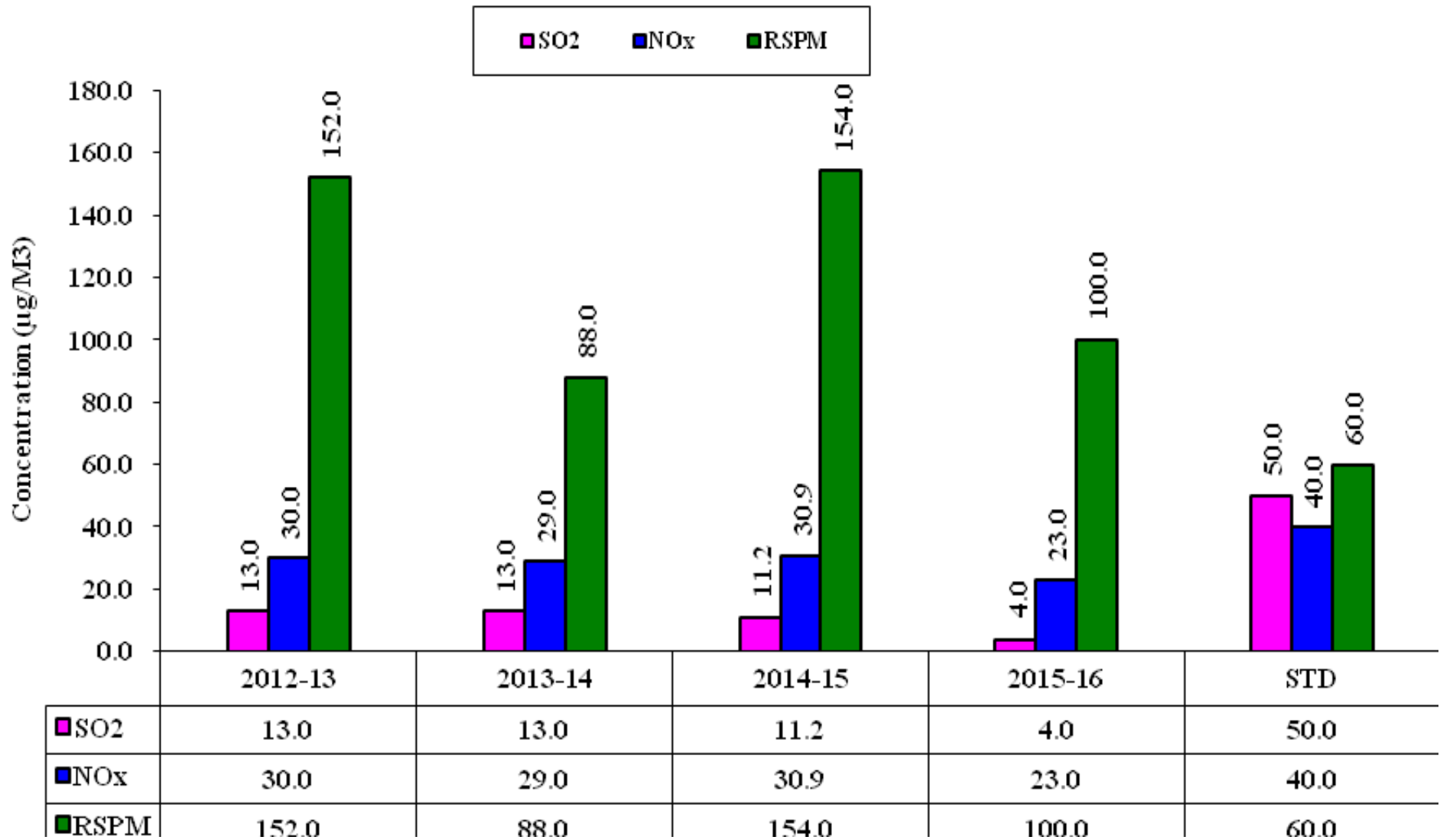
Residential, Rural & Other areas of Bangalore city

Annual avg values of of air pollutants at Kajisonnenahalli for the year 012-16



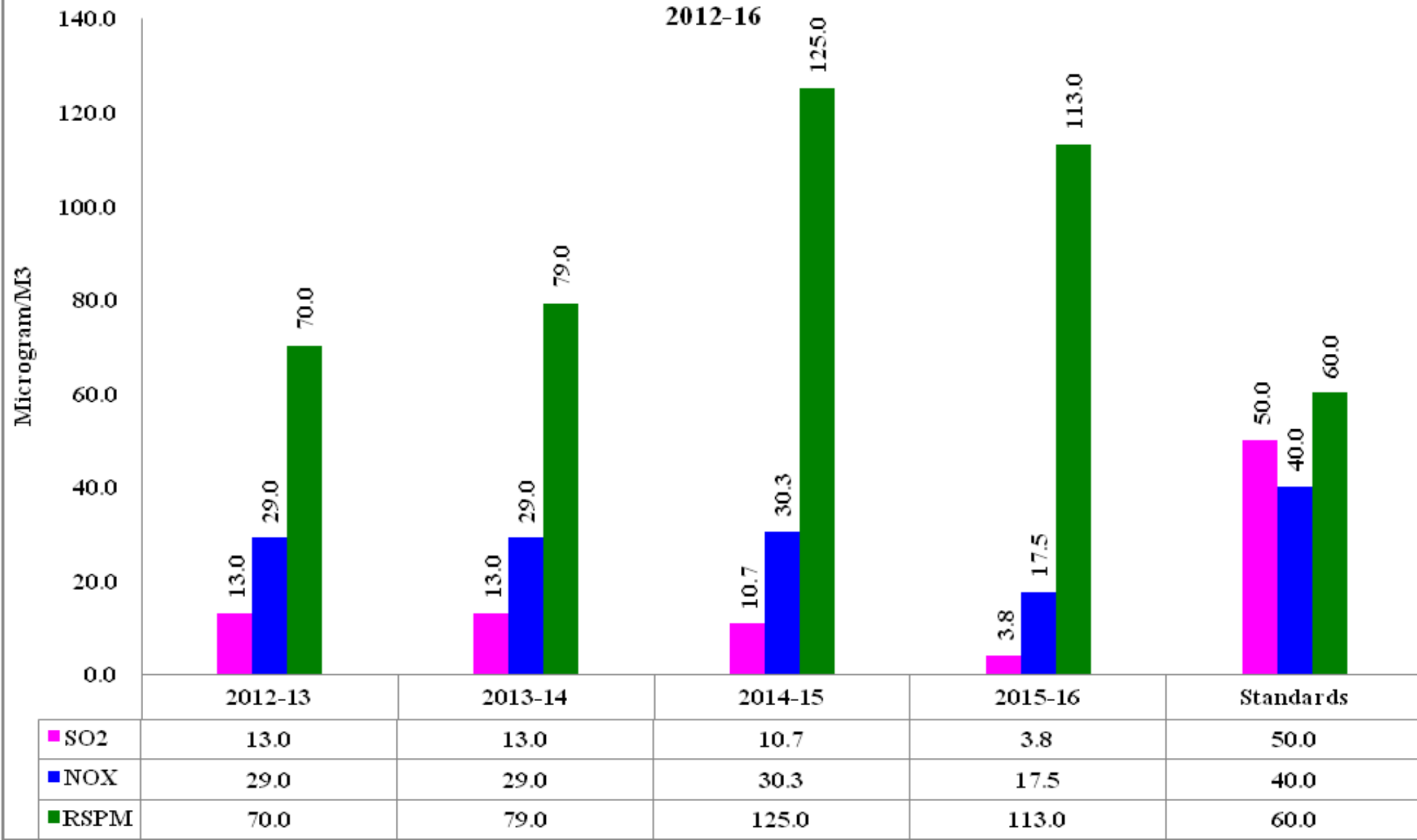
Residential, Rural & Other areas of Bangalore city

Annual average values of air pollutants at Victoria Hospital , Bangalore during the years 2012-16



Residential, Rural & Other areas of Bangalore city

Annual Average values of air pollutants at Indira Gandhi Child Health Care Center for 2012-16

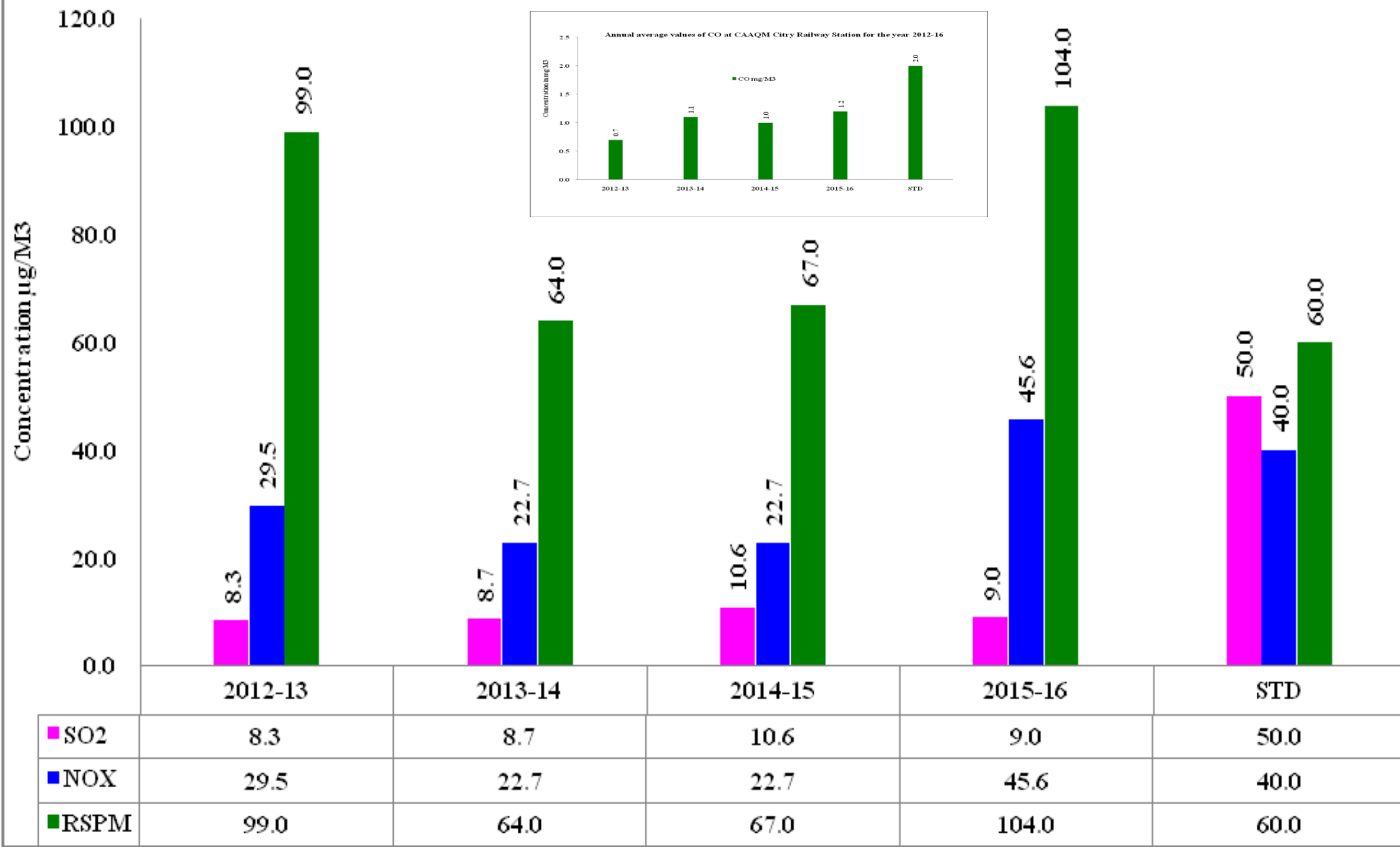


CAAQMS at City Railway station

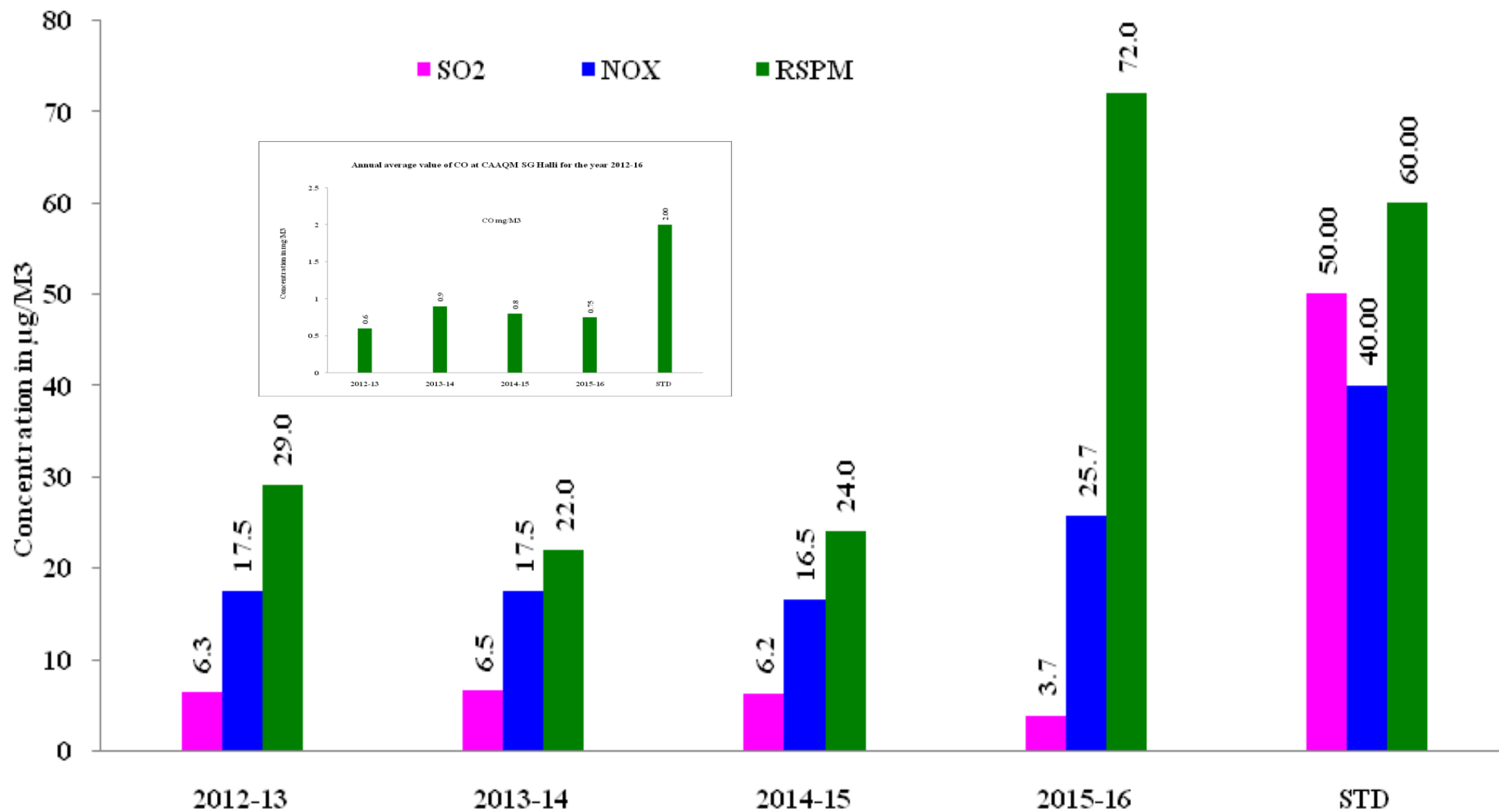
Pollutants: SO_2 , NO_x , CO and RSPM



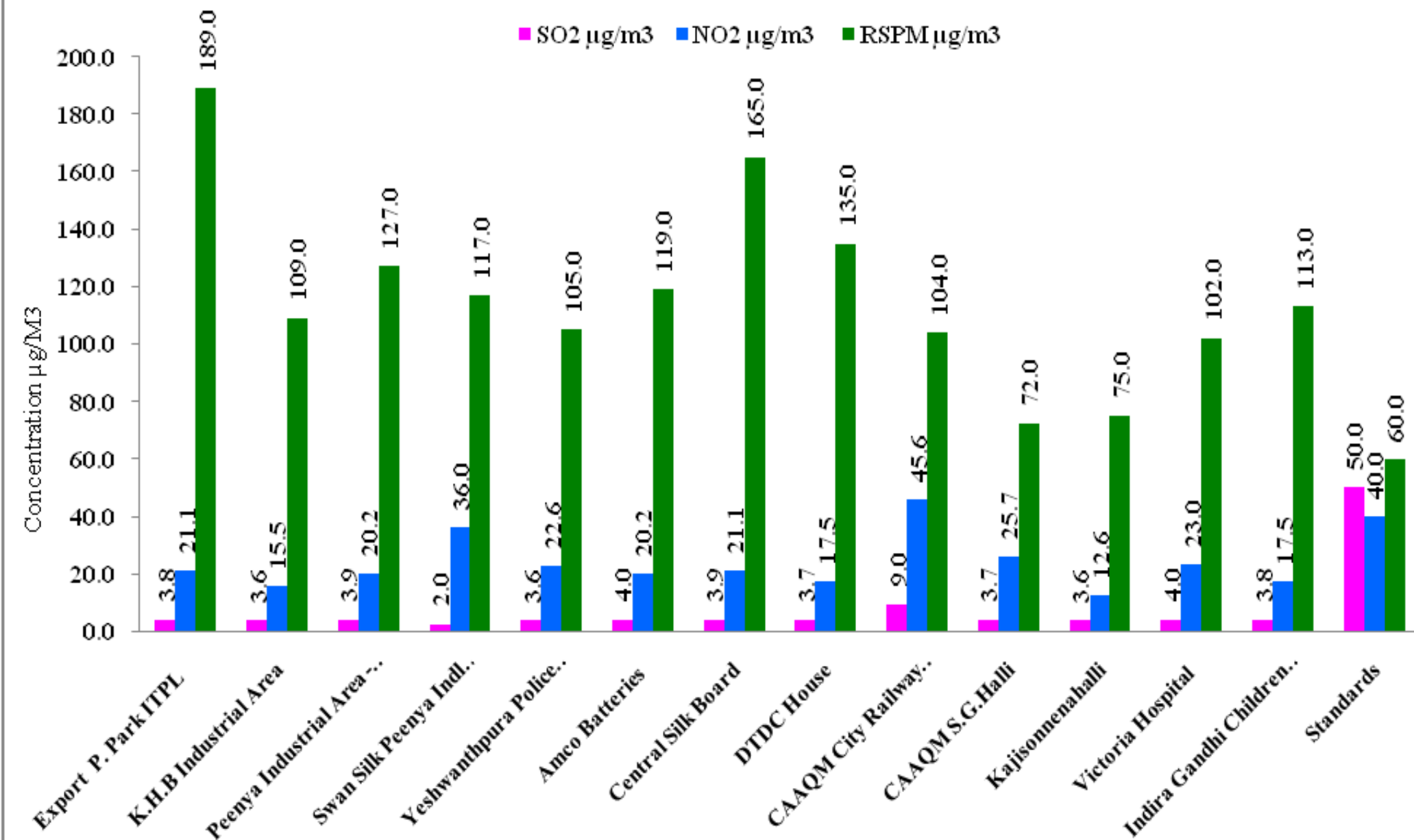
Annual average values of Air pollutants at CAAQM CRS for the year 20012- 2016



Annual average values of Air pollutants at SG Halli for the year 2012-16



Annual Average values of Air pollutants in 13 location of Bangalore city during the year 2015-16



Source Apportionment Study: Total Emission Loads (TPD)

	PM10	% Contribution	NO _x	% Contribution	SO ₂	% Contribution
Transport	22.4	42	146.4	67.4	2.31	15.8
Road dust	10.9	20	0.0	-	0.0	-
Domestic	1.8	3	2.73	1.2	0.68	4.6
DG Set	3.6	7	50.96	23.3	3.35	23.0
Industry	7.8	14	17.19	7.9	8.21	56.2
Hotel	0.1	-	0.20	0.09	0.02	0.01
Construction	7.7	14	0.0	-	0.0	-
Total	54.4	100	217.4	100	14.6	100

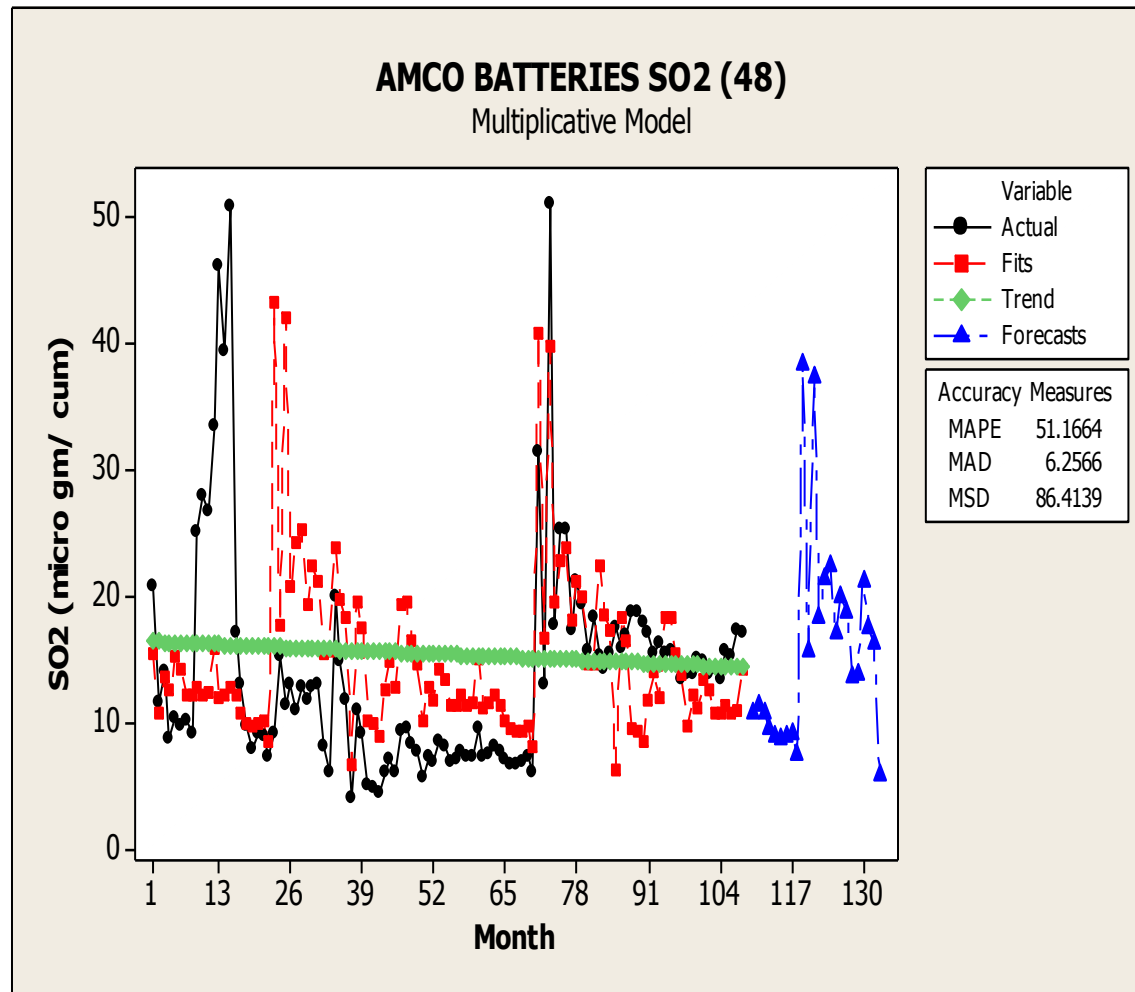
Emission Factors for Indian Vehicles

Sl. No	Type of vehicle	Emission factor : Grams/KM				
		CO	HC	NO _x	CO ₂	PM
1	Scooter	3.02	2.02	0.03	29.62	0.046
2	Three wheeler (diesel)	2.09	0.16	0.69	173.8	0.34
3	Cars	0.06	0.08	0.28	148.7	0.15
4	HCV Diesel Bus	3.97	0.26	6.77	735.5	1.075
		0.4 g*35 lakhs vehicle- 1.4 ton				

Time Series Trends : Sulphur Reduction Programme of India

Concentration of **SO₂** showing an **decreasing** trend by **15 -20 %** over 10 years due to implementation of Sulphur reduction programme of Govt of India (Green Fuel concept).

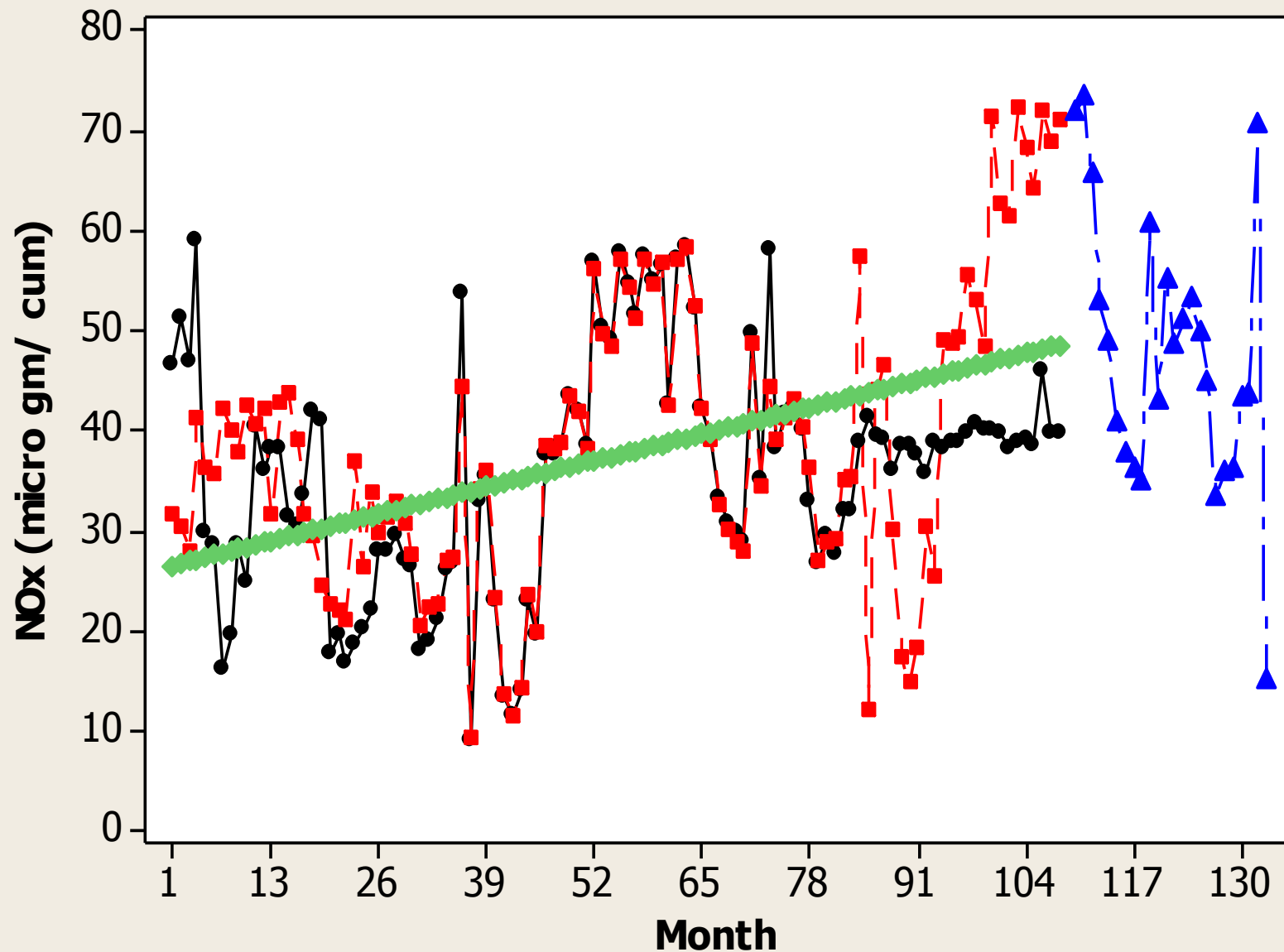
SO ₂ Concentration in µg/M ³ at AMCO Batteries , Mysore Road	
1998-99	38.0
1999-00	32.0
2000-01	26.0
2001-02	27.0
2002-03	16.0
2003-04	16.7
2004-05	17.6
2005-06	21.2
2006-07	15.3
2007-08	15.9
2008-09	14.9
2014=15	9.0
Standards	60



Aug 1997	0.25 %
1998	0.25 in Metro cities
2000	0.25 in Entire country
2000-04	0.05 % in 11 cities
2005	0.035 % in 11 cities
April 2010	0.005 % in 11 cities and 0.035 % entire country

AMCO BATTERIES NO_x (48)

Multiplicative Model



Variable

- Actual
- Fits
- Trend
- Forecasts

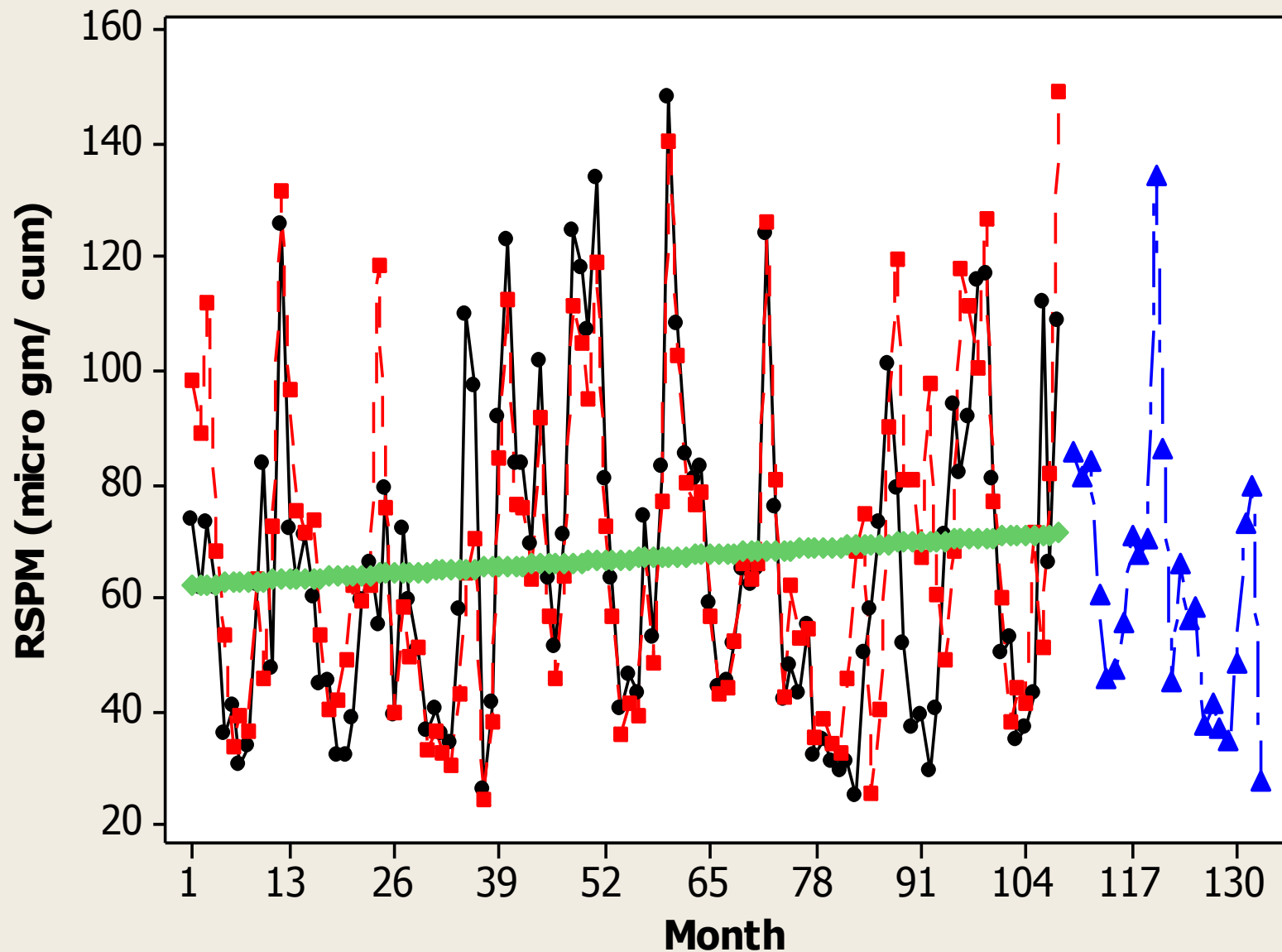
Accuracy Measures

MAPE	22.430
MAD	7.620
MSD	143.610

Concentration of NO_x are showing an increasing trend by 100 % over 10 years. The reason may be increase in vehicular population by 258 %

AMCO BATTERIES RSPM (48)

Multiplicative Model



Variable	
Actual	
Fits	
Trend	
Forecasts	
Accuracy Measures	
MAPE	24.489
MAD	13.618
MSD	390.993

Concentration of RSPM for this site is showing a moderate 16-20% increase in trend over 10 years. The reason might be resuspension of road dust, vehicular traffic, etc.

Action taken



PIL in Hon'ble High Court of Karnataka

- Suo-Moto Public Interest Litigation WP No. 39432/2013.
- Board issued direction under Section 31(A) of the Air (Prevention and Control of Pollution) Act, 1981 to BBMP, Traffic Police, Transport Commissioner and BDA to take steps to control air pollution and reduce noise levels in Bangalore

Directions to Transport Department

- To restrict registration of new vehicles
- To ban the entry of Heavy Motor Vehicles (HMTVs)
- To ban the use of two stroke vehicles within BBMP area.
- To ban auto rickshaws in central business district
- To ban use of more than 15 years old HMTVs
- No PUC – no fuel
- To impose heavy fine and confiscate shrill/ Air horns not confirming to MV Act.
- To plan for traffic regulation.
- Testing of Vehicular emission as well as emission testing centres.
- To convert to CNG
- Create mass awareness .

Directions to BBMP

- To plan comprehensive parking management programme
- To remove dust/silt accumulated on roadside, storm water drain and to transport the silt removed.
- To fill portholes and road cutting
- To evacuate non-parking activities in area earmarked for parking
- To Remove encroachments of footpaths

Directions to Police Department:

- To strictly enforce the provisions of the Noise (Regulation & Control) Rules, 2000 & the Orders issued by State Government of the No. FEE 46 ENV 2000, dated 13.8.2002.
- To plan for regulating the traffic.
- To coordinate with BBMP and Transport department
- To remove encroachment of footpaths.
- To introduce dedicated bus lanes
- To conduct awareness programmes regarding “No honking”.

Directions to BDA:

- To take up massive afforestation

Recommended Minimum Number of Stations

Pollutant	Population of evaluation Area	Minimum No. Of AAQM Station
PM	< 1,00, 000	4
	1,00,000 – 10,00,000	4 + 0.6 per 1,00,000 Population
	10,00,000 – 50,00,000	7.5 + 0.25 per 1,00,000 Population
	> 50,00,000	12 + 0.16 per 1,00,000 Population
SO₂	< 100 000	3
	100 000 – 1000 000	2.5 + 0.5 per 100 000 Population
	1000 000 – 10 000 000	6 + 0.15 per 100 000 Population
	> 10 000 000	20
NO₂	< 100 000	4
	100 000 – 1000 000	4 + 0.6 per 100 000 Population
	> 1000 000	10
CO	< 100 000	1
	100 000 – 5 000 000	1 + 0.15 per 100 000 Population
	> 5 000 000	6 + 0.05 per 100 000 Population
Oxidants	-do-	-do-

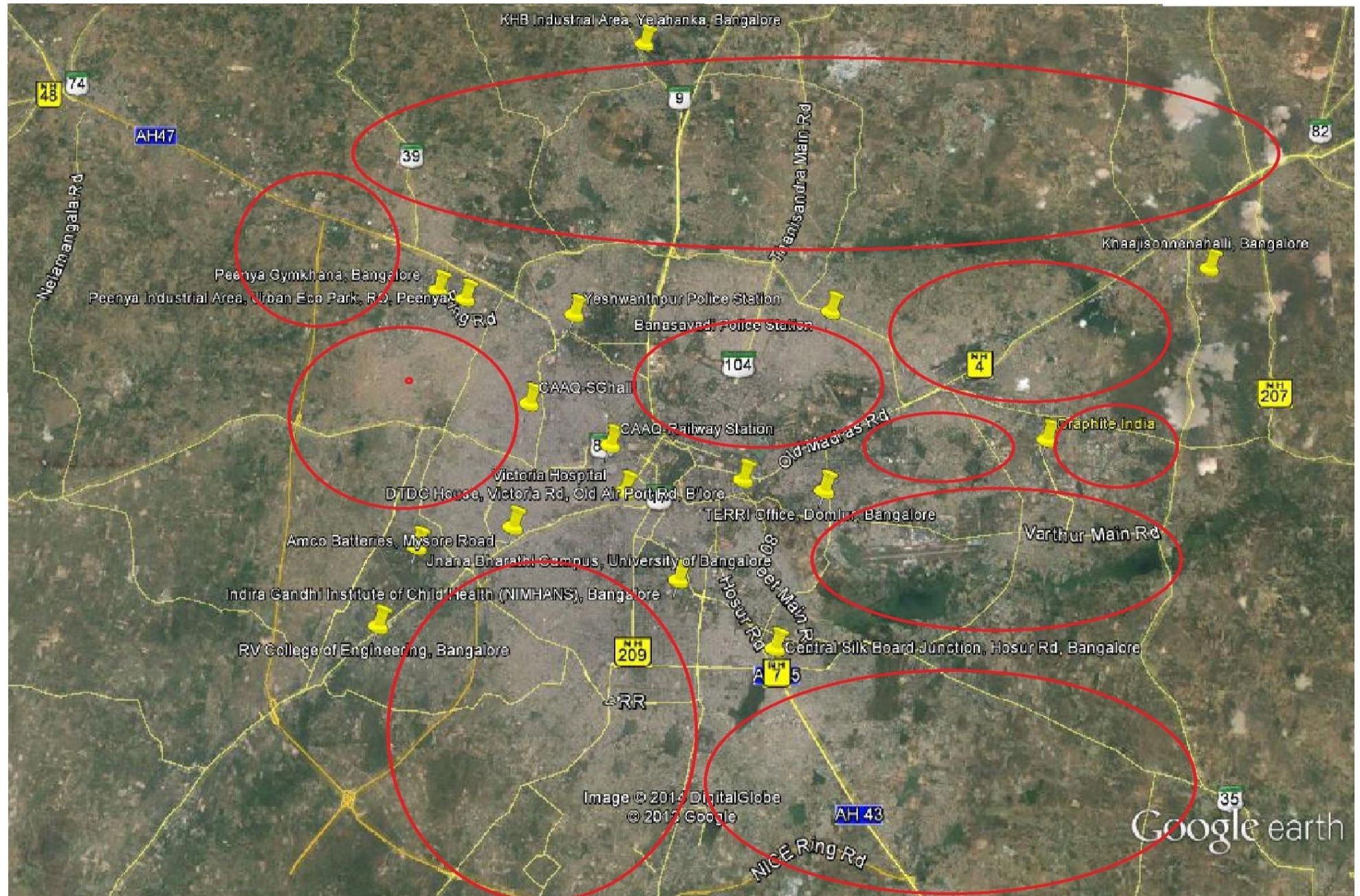
(Source: IS : 5182 (Part 14), 2000)

Distribution of Sampling Station

Total number of stations	Number of stations	
	In city centre or industrial areas	In residential areas
1	1	0
2	1	1
3	2	1
4	2	2
5	3	2
10	6	4

Source – WHO, 1977

Scope for New stations - Bengaluru



Way Forward

- Installation and Collection of Metrological DATA
- Use of Air Quality Modeling to assess the Pollutants
- Establishment of New AAQM Stations based on Population in phase manner.
- Establishment of Continuous AAQM at Mysore, Mangalore, Dharward, Bellary, Gulbarga, Shimoga, Tumkur & other cities.
- Establishment of AAQM Stations at Industrialized Towns such as Nanjanagud, Hassan, Udupi, Bhadravathi, Sandur, Hospet, Hoskote, Dabaspeth, Doddballapur, Anekal etc.,
- Strengthening of all the laboratory.
- Strengthening AAQM Cell .

THANK YOU....