

Fig. :5.9

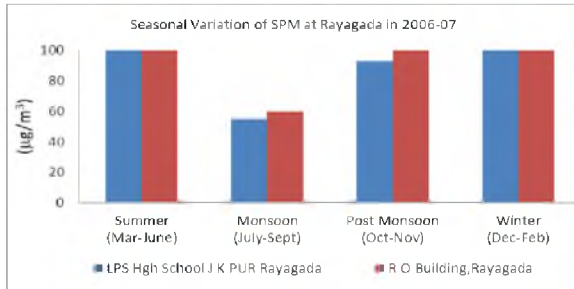


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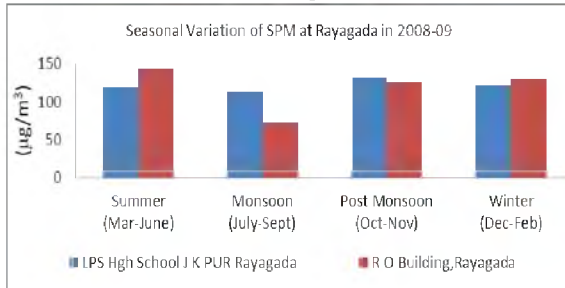


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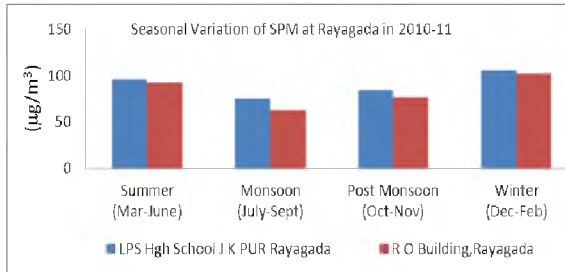


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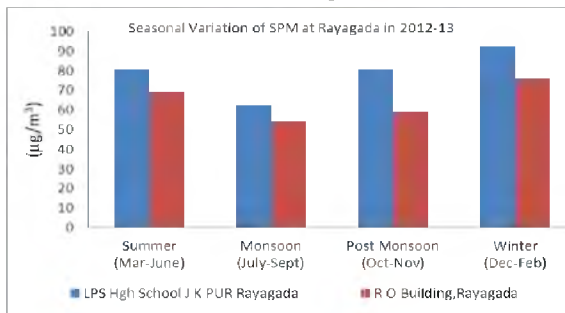


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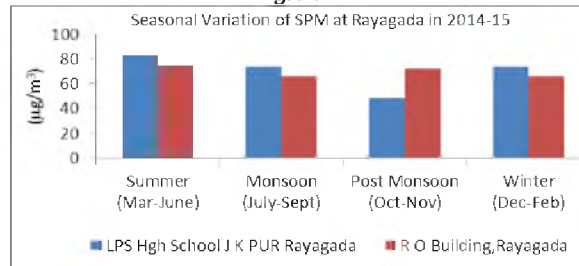


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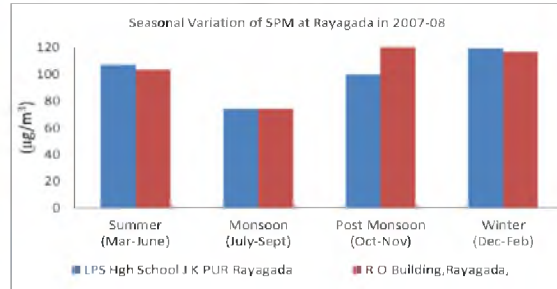


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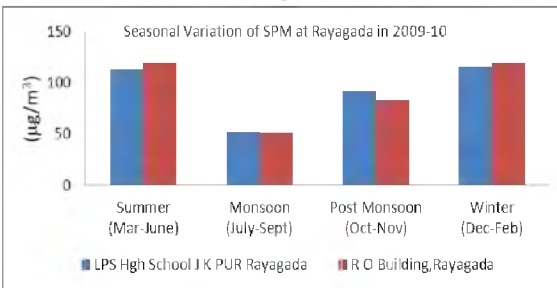


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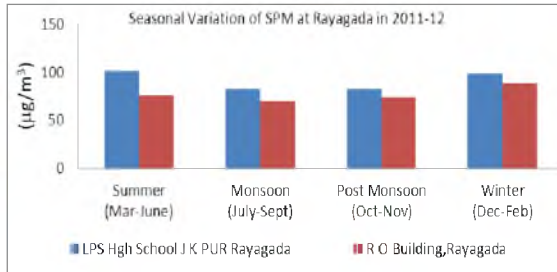


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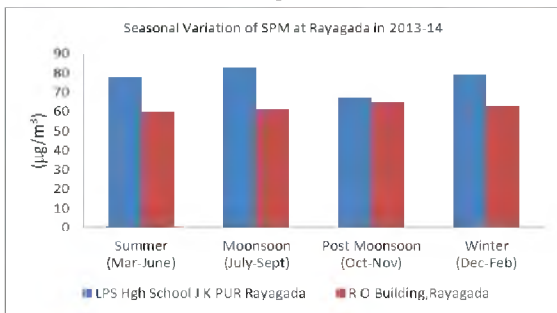


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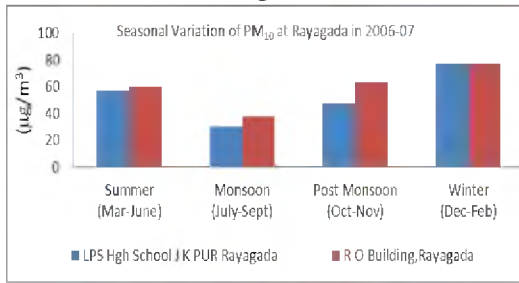


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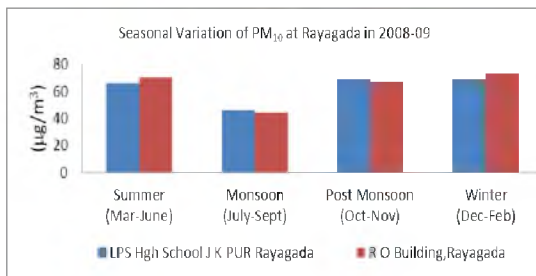


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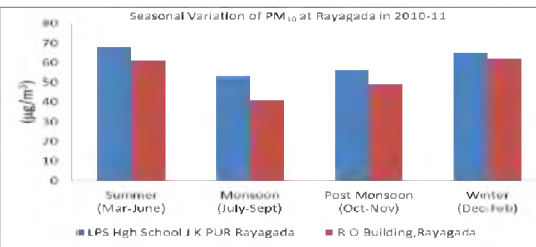


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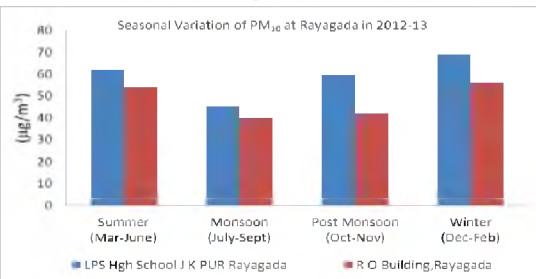


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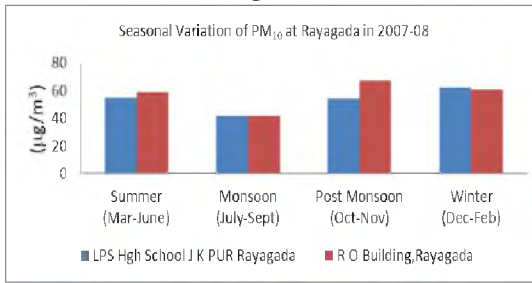


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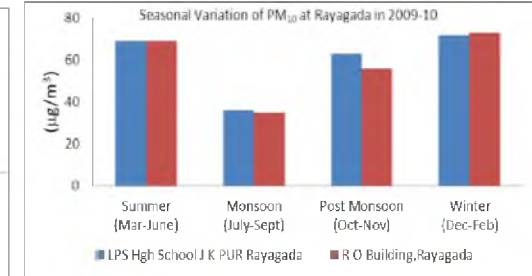


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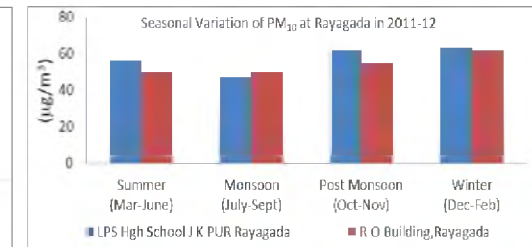


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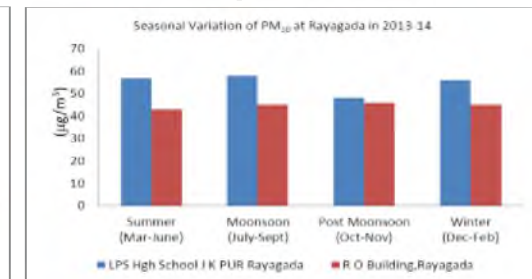


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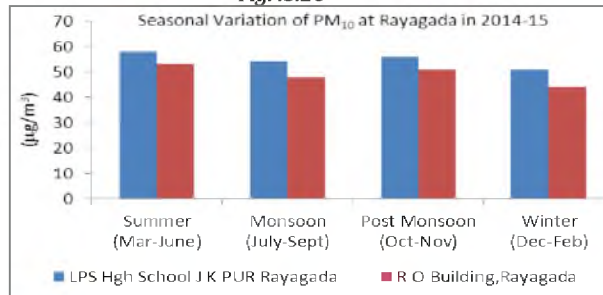


Table: 5.3 **Categorisation of Ambient Air Quality on the basis of Exceedence Factor of Rayagada**

Location	Categorisation of Rayagada, (2006 to 2014)								
	SO ₂								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
RO, Building, Indiranagar	L	L	L	L	L	L	L	L	L
Jaykaypur	L	L	L	L	L	L	L	L	L

	NO _x								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
RO, Building, Indiranagar	L	L	L	L	L	M	M	M	L
Jaykaypur	L	L	L	L	M	M	M	M	M

	SPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
RO, Building, Indiranagar	M	M	M	M	M	M	L	L	M
Jaykaypur	L	L	M	L	L	L	L	L	M

	RSPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
RO, Building, Indiranagar	M	M	H	M	M	M	M	M	M
Jaykaypur	M	M	M	M	H	M	M	M	M

NB:- L: Low, M: Moderate, H: High, C: Critical

6.0 AMBIENT AIR QUALITY STATUS AND TRENDS AT ROURKELA & RAJGANGPUR

The State Pollution Control Board, Odisha monitors the ambient air quality of Rourkela and Rajgangpur at three locations. The details are presented in Table.6.0. The locations of monitoring stations are selected as per the guideline of CPCB and are indicated in Fig. 6.0.

Table: 6.0 Ambient Air Quality Monitoring Locations

Place	Location	Latitude / Longitude	Category of Area
Rourkela	1. Regional Office Building, Sector-5	22 ^o 14'.578'' N 84 ^o 54'.245'' E	Residential
	2. IDL Outpost, Sonaparbat	22 ^o 11'.263'' N 84 ^o 52'.409'' E	Residential
	3. DISIR, Rajgangpur	22 ^o 13'.442'' N 84 ^o 36'.274'' E	Residential

6.1 Description of the locations

6.1.1 Regional Office Building, Sector-5

The station is located within the premises of Regional Office of SPC Board, Odisha, at Sector-5 of Rourkela Steel Plant Township. It is located at about 3.5 km. away from Rourkela Steel Plant. Though the immediate surroundings of the station is housed in the office complex, but it is residential in nature having less commercial activities. The station is about 4 m. above the ground level.

6.1.2 IDL Outpost

This station is located inside the police outpost premises at IDL colony, Sonaparbat at Rourkela township. The distance of the station is about 1 km from the boundary of Rourkela Steel Plant towards the east. The immediate surrounding area is residential in nature. The station is about 4 m. above the ground level. There is no other large scale industry operating within 5 Km. radius except Gulf Oil Corporation (formerly known as IDL Chemicals Ltd.).

6.1.3 DISIR, Rajgangpur

The station is operating on the roof of the Staff Quarters of M/S OCL Cement plant. The station is about 4m above the ground level. The station is located inside the residential colony. The State Highway, Sambalpur to Rourkela road, is passing nearby. M/S OCL Cement plant is about 1km away from the site.

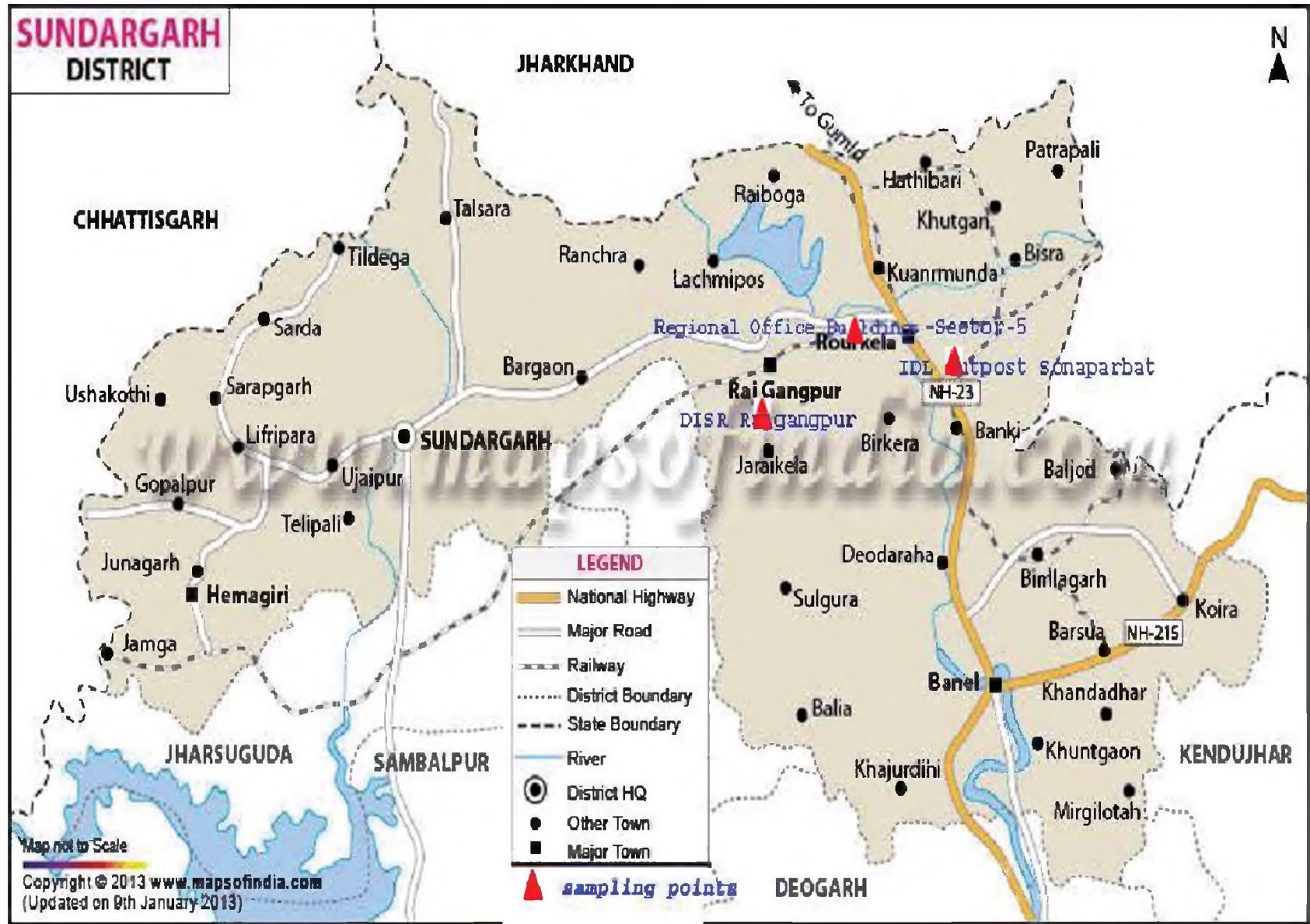


Fig.6.0 Map Showing Sampling Locations in Rourkela & Rajgangpur

6.2 Ambient Air Quality of Rourkela and Rajgangpur

Ambient Air Quality status of Rourkela area from the year 2006-2014 at Regional Office, Sector-5, & IDL outpost for the year 2006 to 2014 and DISIR, Rajgangpur for the year 2013 & 2014 with respect to annual average value, range value of 24hrly average and frequency of violation of parameters like SPM, RSPM (PM_{10}), SO_2 & NO_x are presented in Table 6.1 to 6.3 and trend analysis of the parameters during the study period are shown in Fig. 6.1 to 6.8. Seasonal variation of SPM & PM_{10} are shown in Fig. 6.9-6.25. Categorisation on the basis of exceedence factor of each location is shown in Table-6.4.

6.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at Regional Office, & IDL outpost for the year 2006 to 2014 and at DISIR, Rajgangpur for the year 2013 & 2014 were below their respective limit i.e., $50 \mu\text{g}/\text{m}^3$ for SO_2 & $40 \mu\text{g}/\text{m}^3$ for NO_x . The annual average value of SO_2 was maximum i.e., $6.0 \mu\text{g}/\text{m}^3$ in the year 2014 at Regional Office, Sector-5 & minimum i.e., $5.0 \mu\text{g}/\text{m}^3$ in the year 2007. Maximum annual average of SO_2 at IDL outpost was $5.4 \mu\text{g}/\text{m}^3$ in the year 2008 & minimum $4.9 \mu\text{g}/\text{m}^3$ in the year 2010 & 2014 and maximum annual average of SO_2 at DISIR, Rajgangpur was $5.5 \mu\text{g}/\text{m}^3$ in the year 2014 & minimum $5.2 \mu\text{g}/\text{m}^3$ in the year 2013. The maximum annual average value for NO_x at Regional Office, was $12.0 \mu\text{g}/\text{m}^3$ in the year 2014, at IDL outpost was $10.7 \mu\text{g}/\text{m}^3$ in the year 2010 & 2011 and at DISIR, Rajgangpur was $12.0 \mu\text{g}/\text{m}^3$ in the year 2013. NO_x at Regional Office, was in increasing trend from 2007 to 2009 and then it shows decreasing trend. NO_x at IDL outpost was in increasing trend from the year 2007 to 2011 & decreases from 2012 to 2014 and NO_x at DISIR, Rajgangpur increased from $5.2 \mu\text{g}/\text{m}^3$ in the year 2013 to $5.5 \mu\text{g}/\text{m}^3$ in 2014. On the basis of exceedence factor, both SO_2 & NO_x are fell under Low category at all locations throughout the study period.

6.2.2 SPM & RSPM (PM_{10})

The annual average of SPM value in all three locations were above the limit i.e., $140 \mu\text{g}/\text{m}^3$. Maximum frequency of violation for SPM on 24 hrly average was 80 % in the year 2010 at Regional Office was 75 % at IDL outpost in the year 2008 and was 98 % at DISIR, Rajgangpur in the year 2013.

The maximum annual average value for SPM at Regional Office was $213 \mu\text{g}/\text{m}^3$ in the year 2010, at IDL outpost was $215 \mu\text{g}/\text{m}^3$ in the year 2008 and at DISIR, Rajgangpur was $222 \mu\text{g}/\text{m}^3$ in the year 2014. The trend of SPM at all three locations were in increasing throughout the study period. The exceedence factor showed High at Regional Office, from the year 2006 to 2009 & 2011 to 2014 and Critical in 2010. At IDL outpost it showed High in 2006 & 2007, 2009 & 2010, 2012 to 2014 and Critical in 2008 & 2011 and at DISIR, Rajgangpur showed Critical both in the year 2013 & 2014.

The annual average of RSPM (PM_{10}) at all three locations were above the limit i.e., $60 \mu\text{g}/\text{m}^3$ throughout the study period. The maximum annual average value for RSPM at Regional Office, was $115 \mu\text{g}/\text{m}^3$ in the year 2009, at IDL outpost was $106 \mu\text{g}/\text{m}^3$ in the year 2006 and at DISIR, Rajgangpur was $109 \mu\text{g}/\text{m}^3$ in the year 2014. Maximum frequency of violation i.e., 91.5 % was at Regional Office, in the year 2009 was 59 % at IDL outpost in the year 2008 and 68.2% at DISIR,

Rajgangpur in the year 2014. The trend of RSPM at Regional Office, increased from the year 2006 to 2009 and decreases from the year 2010 to 2014. The trend at IDL outpost was mostly decreasing. Trend at DISIR, Rajgangpur increased from the year 2013 to 2014. The exceedence factor showed Critical at Regional Office, & IDL outpost from the year 2006 to 2013 & High in 2014 at both locations and DISIR, Rajgangpur showed Critical in both the year 2013 & 2014.

From seasonal variation it was observed that SPM & RSPM (PM₁₀) showed high value during winter and low value during monsoon in most of the years at all locations. However maximum value of SPM was observed i.e., 208 µg/m³ in 2007-08 at IDL outpost 239 µg/m³ in 2012-13 at Regional Office, during post monsoon season and 225 µg/m³ in the year 2011-12. Similarly maximum seasonal value of RSPM (PM₁₀) was 117 µg/m³ in the year 2010-11 at Regional Office, 111 µg/m³ at IDL outpost in summer season and 115 µg/m³ in 2008-09 at Regional Office, in the post monsoon season.

Status of Ambient Air Quality at Rourkela

Table: 6.1 Regional Office Building, Sector-5

Year	No. of Obs. (24 hrs.)	Parameters (µg/m ³) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2006	110	182 (102-289)	97 (35-160)	5.3 (BDL-5.5)	11 (BDL-15)	33.6%	37.2%	-	-
2007	106	188 (129-239)	107 (65-137)	5 (BDL-5.9)	10.0 (BDL-11)	29.2%	67%	-	-
2008	105	188 (137-229)	99 (62-137)	5.3 (4.4-6.3)	10.4 (BDL-11.5)	26%	49%	-	-
2009	106	206 (171-245)	115 (93-145)	5.5 (4.7-6.1)	10.6 (9.2-11.5)	58.5%	91.5%	-	-
2010	104	213 (174-274)	112 (87-140)	5.2 (4.3-6.3)	10.2 (9.2-11.1)	80%	85%	-	-
2011	104	208 (159-284)	109 (84-135)	5.1 (4.6-5.7)	10.0 (9.5-10.5)	61.5%	73%	-	-
2012	105	195 (158-265)	99 (78-152)	5.1 (4.1-6.7)	10.5 (9.4-14.4)	50.5%	48.5%	-	-
2013	104	197 (158-244)	93 (65-1144)	5.1 (4.6-6.0)	10.3 (9.6-12.4)	37.5%	20.2%	-	-
2014	104	203 (55-308)	89 (37-180)	6.0 (BDL-14.6)	12.0 (BDL-24.7)	74%	8.6%	-	-
Prescribed standard (R)	24 hrly/ Annual avg.	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

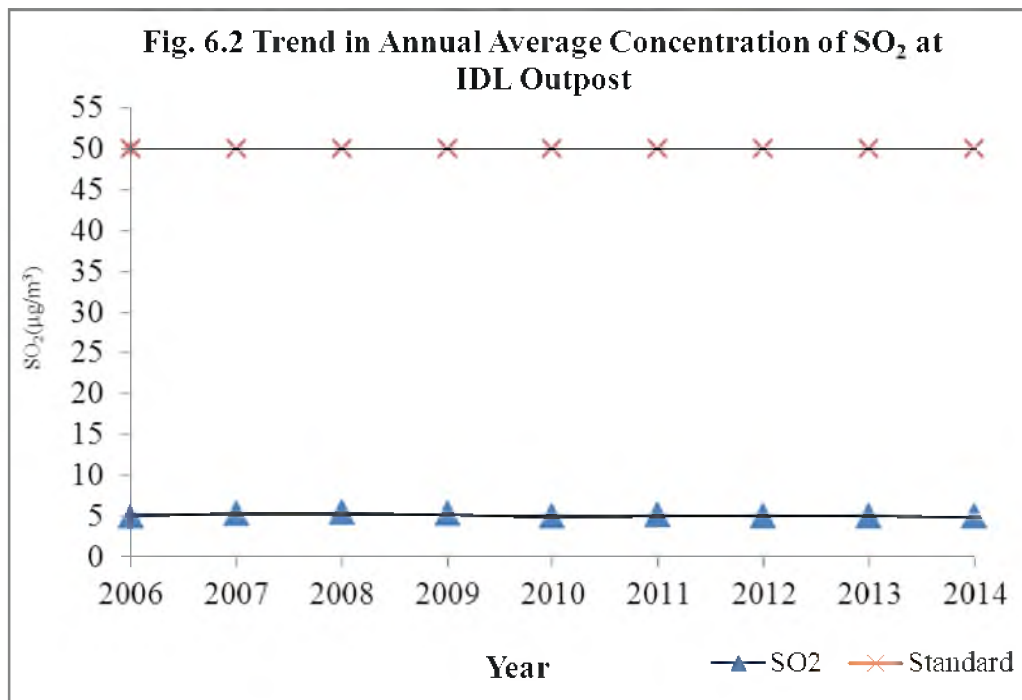
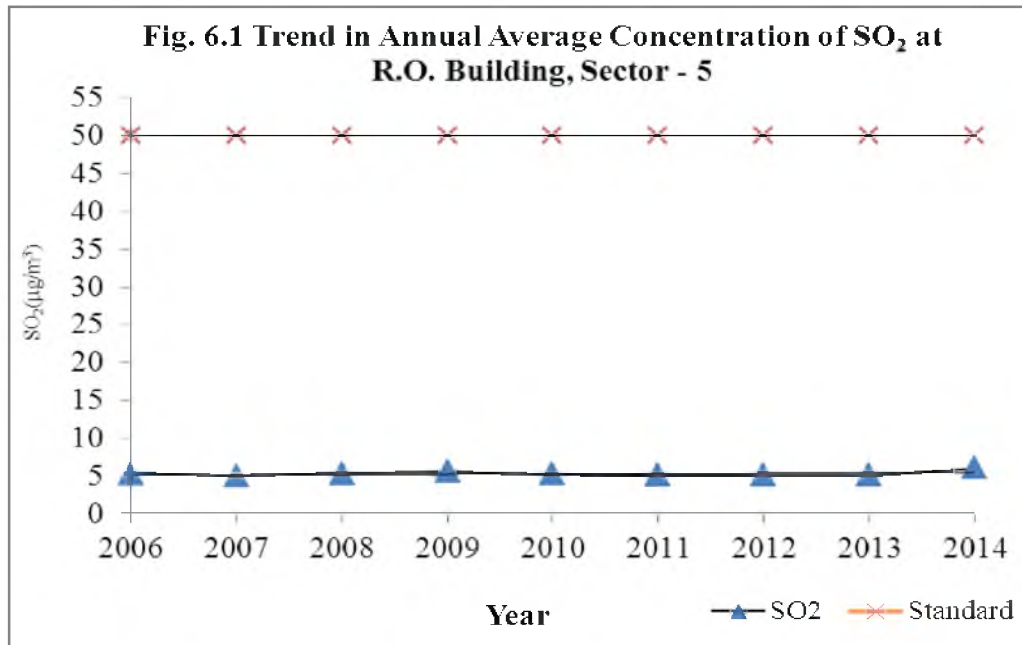
N.B.: BDL - Below Detectable Limit, R – Residential BDL Value for SO₂ - ≤4, BDL Value for NO_x - ≤9, BDL Value for RSPM - ≤ 5

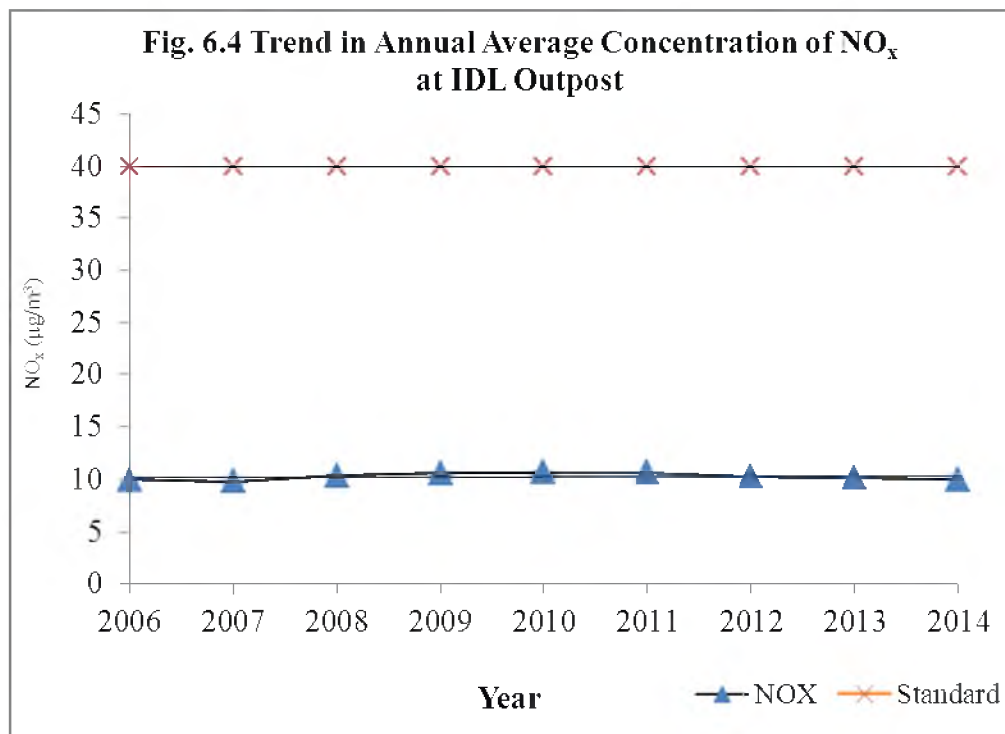
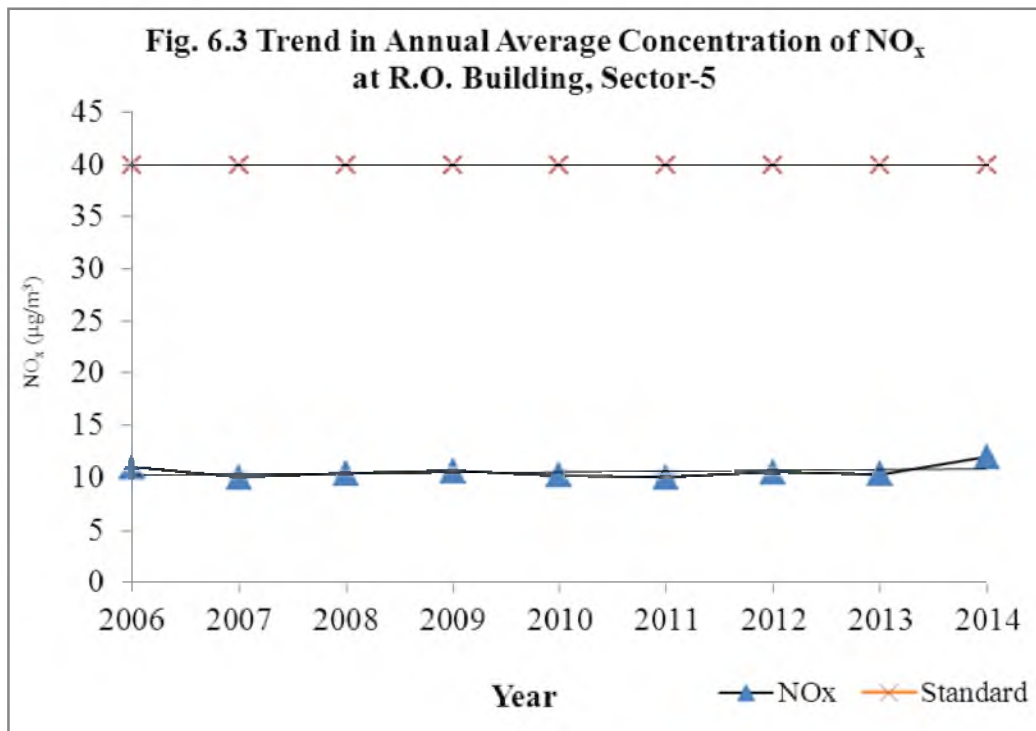
Table: 6.2 IDL Outpost

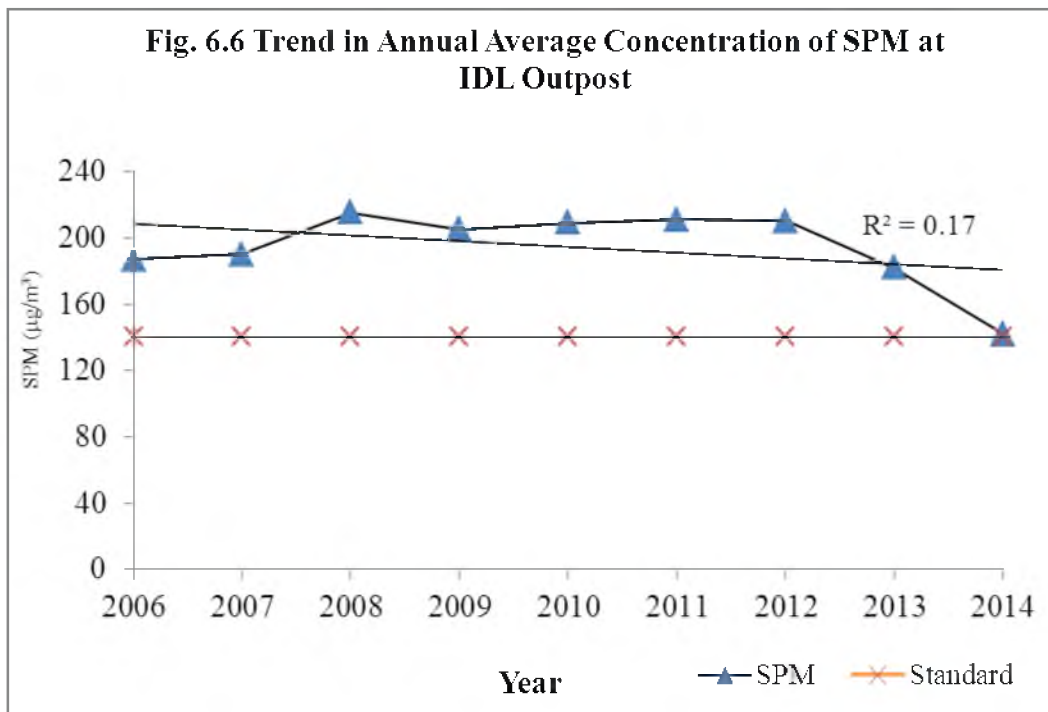
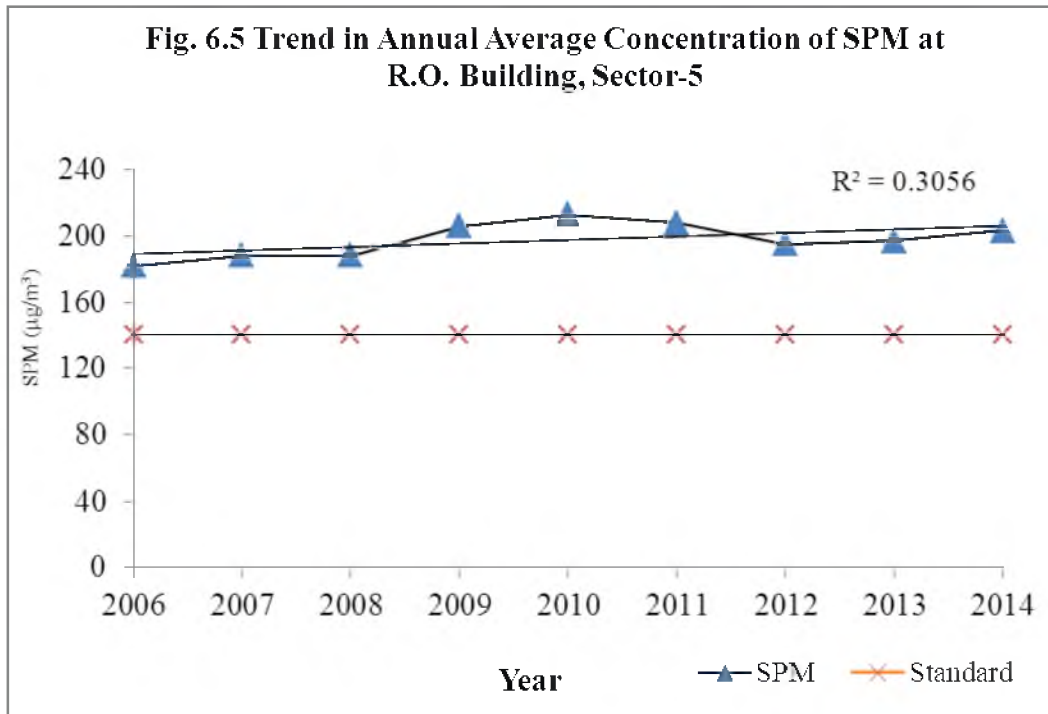
Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2006	110	187 94-275	106 52-152	5.0 BDL-6.7	10.0 BDL-12	34.5%	58.2%	-	-
2007	106	190 (146-240)	94 (61-127)	5.3 (4-6.4)	9.8 (BDL-11.8)	35%	34%	-	-
2008	104	215 (174-269)	104 (70-150)	5.4 (4.0-6.8)	10.4 (BDL-12.5)	73 %	59 %	-	-
2009	106	205 (96-292)	99 (73-167)	5.2 (BDL-6.9)	10.6 (BDL-12.7)	43.4 %	40%	-	-
2010	104	209 (172-247)	99 (80-117)	4.9 (3.7-7.3)	10.7 (9.2-12.7)	75%	53 %	-	-
2011	104	211 (181-277)	99 (77-129)	5.1 (BDL-6.4)	10.7 (9.8-11.7)	63.4%	47.1%	-	-
2012	105	210 (144-246)	97 (42-124)	5.0 (4.4-6.3)	10.3 (9.5-12.8)	70.4%	58%	-	-
2013	104	182 (118-245)	95 (58-199)	5.0 (4.0-5.9)	10.2 (9.5-11.6)	30.8%	31.7%	-	-
2014	104	142 (119-230)	71 (61-106)	4.9 (4.4-6.3)	10 (9.4-11.1)	2.8%	0.9%	-	-
Prescribed standard (R)	24 hrly/ Annual avg	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

Table: 6.3 DISIR, Rajgangpur

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2013	95	221 (195-247)	100 (80-160)	5.2 (4.4-6.2)	11.6 (9.4-14.3)	98%	41%	-	-
2014	104	222 (25-354)	109 (12-199)	5.5 (BDL-11.9)	12.0 (BDL-16.6)	67.3%	68.2%	-	-
Prescribed standard (R)	24 hrly/ Annual avg.	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual avg.	-	100/60	80/50	80/40	As Per 2009 Standard			







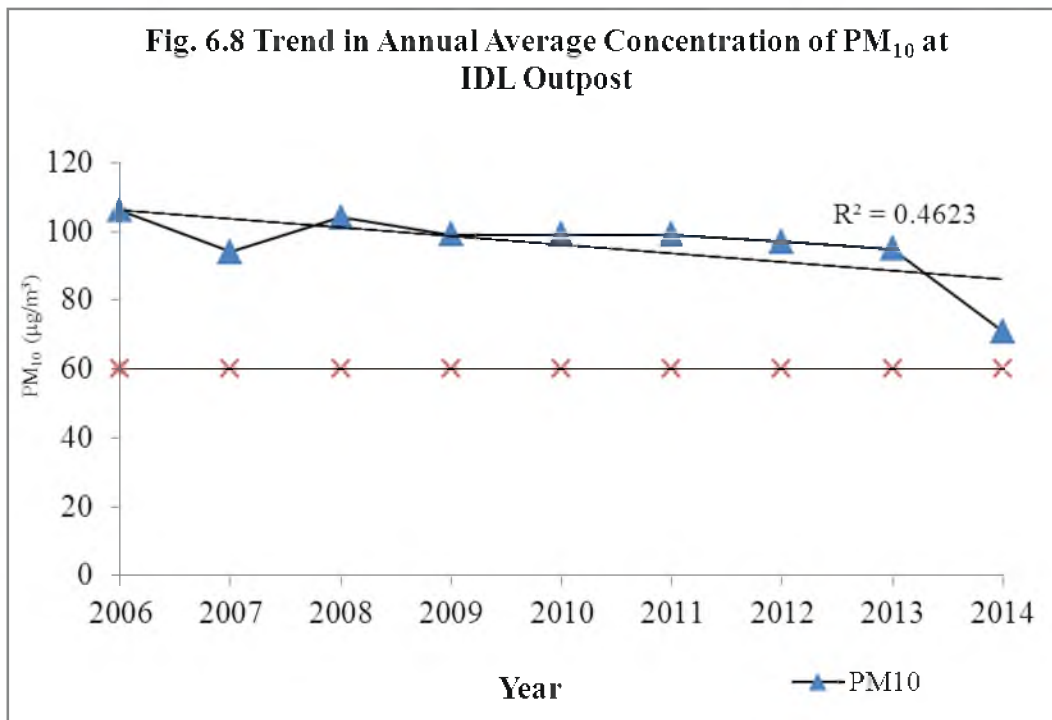
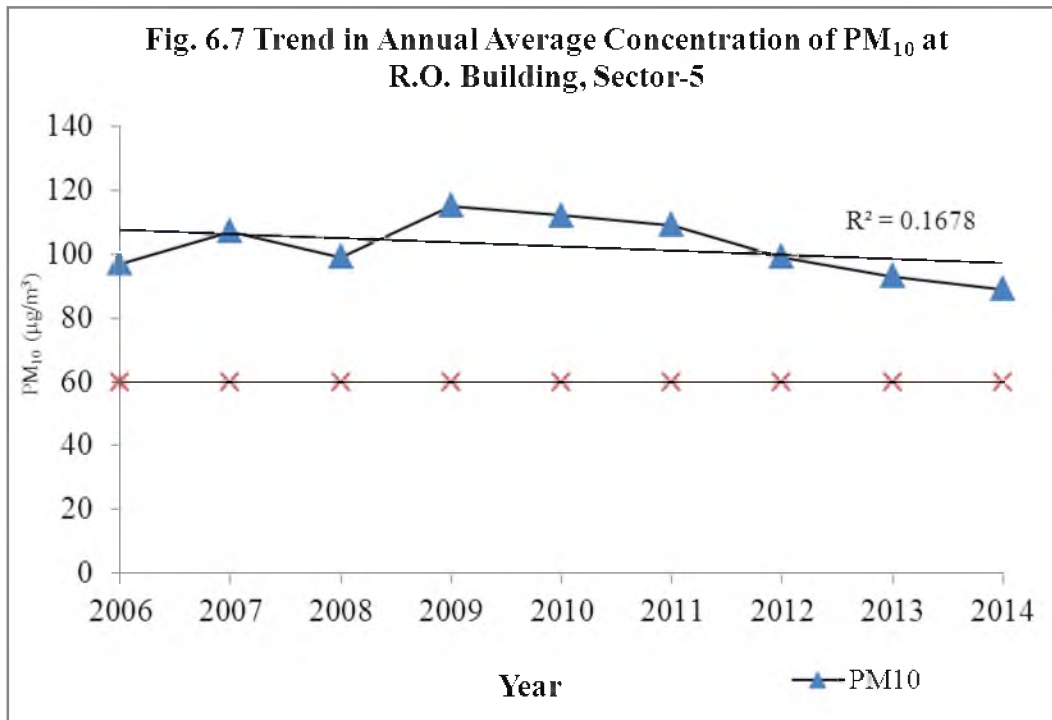


Fig.6.9

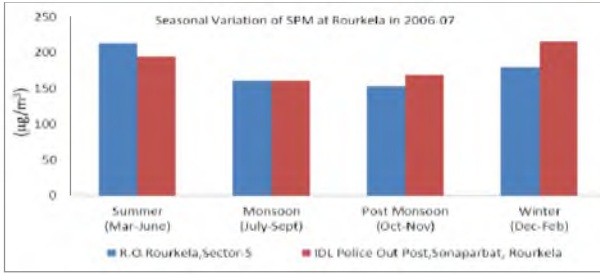


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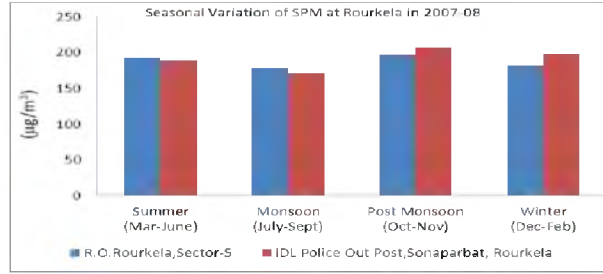


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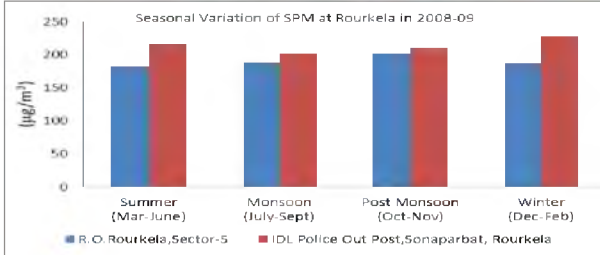


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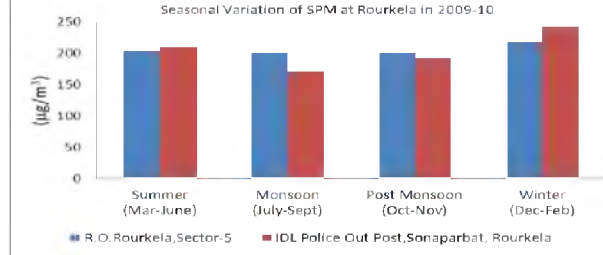


Fig.6.13

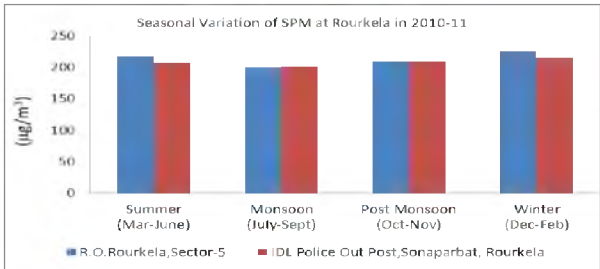


Fig.6.14

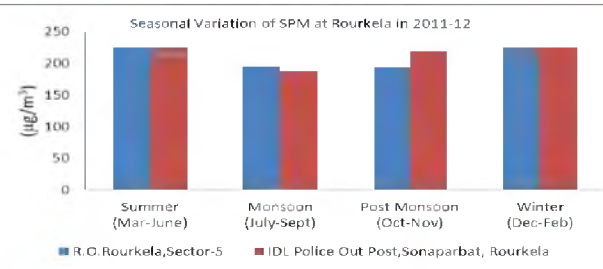


Fig.6.15

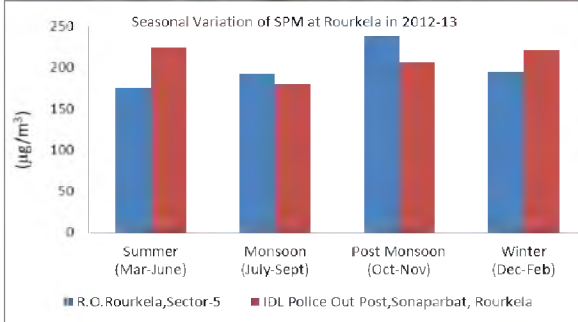


Fig.6.16

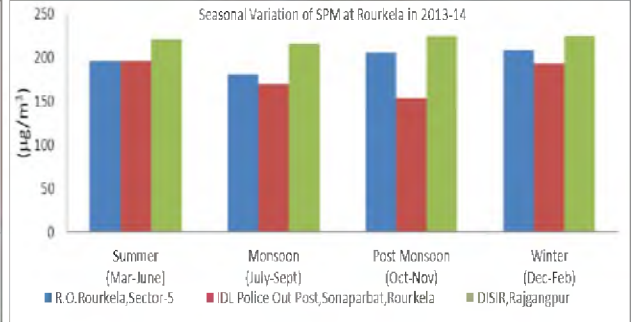


Fig.6.17

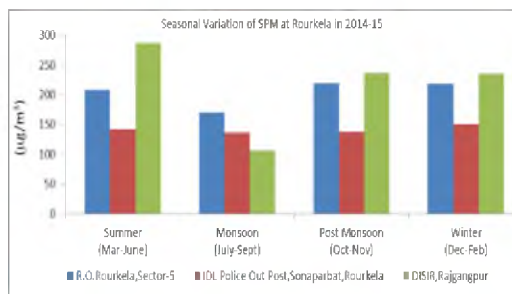


Fig.6.18

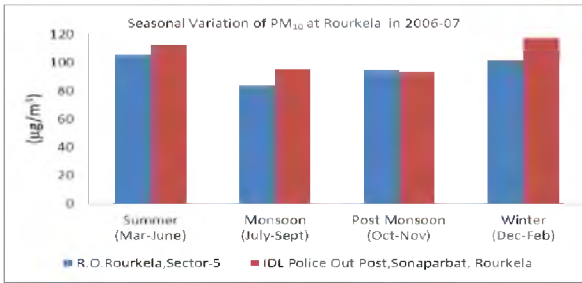


Fig.6.19

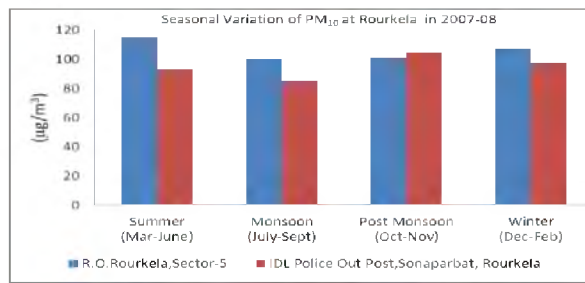


Fig.6.20

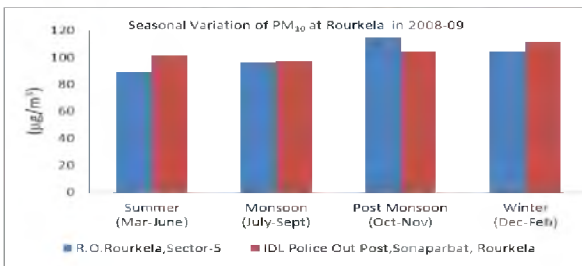


Fig.6.21

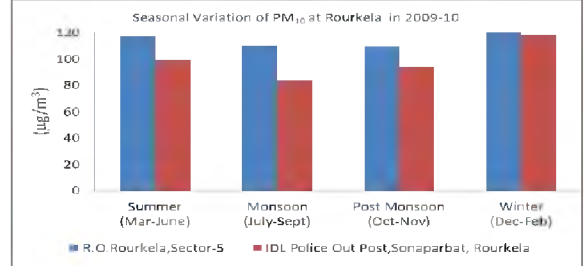


Fig.6.22

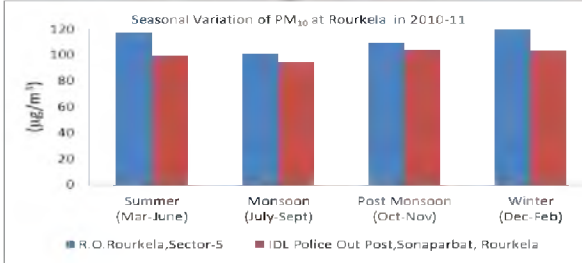


Fig.6.23

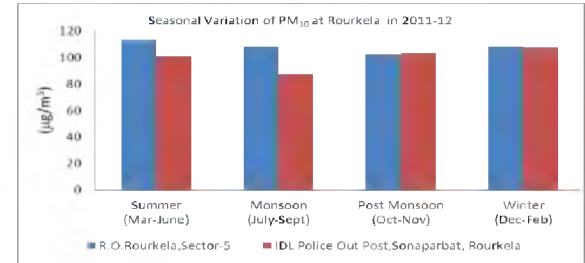


Fig.6.24

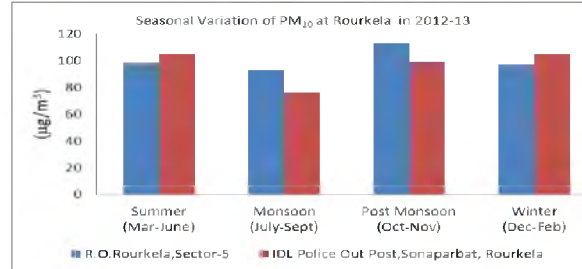


Fig.6.25

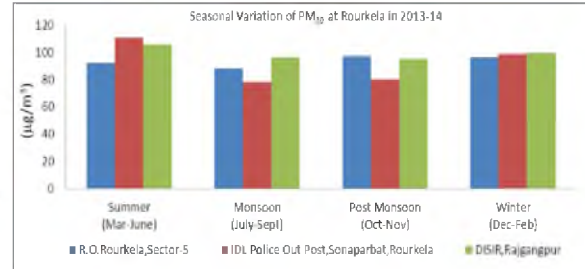


Fig.6.26

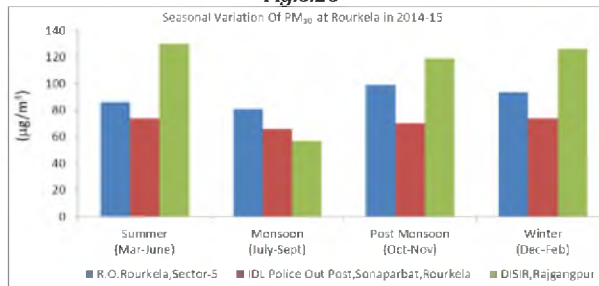


Table 6.4 **Categorisation of Ambient Air Quality on the basis of exceedence factor of Rourkela**

Location	Categorisation of Rourkela, (2006 to 2014)								
	SO ₂								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional Office Building, Premises, Sector-5	L	L	L	L	L	L	L	L	L
IDL Outpost, Sonaparbat	L	L	L	L	L	L	L	L	L
DISIR, Rajgangpur								L	L

Location	NO _x								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional Office Building, Premises, Sector-5	L	L	L	L	L	L	L	L	L
IDL Outpost, Sonaparbat	L	L	L	L	L	L	L	L	L
DISIR, Rajgangpur								L	L

Location	SPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional Office Building, Premises, Sector-5	H	H	H	H	C	H	H	H	H
IDL Outpost, Sonaparbat	H	H	C	H	H	C	H	H	H
DISIR, Rajgangpur								C	C

Location	RSPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional Office Building, Premises, Sector-5	C	C	C	C	C	C	C	C	H
IDL Outpost, Sonaparbat	C	C	C	C	C	C	C	C	H
DISIR, Rajgangpur								C	C

7.0 AMBIENT AIR QUALITY STATUS AND TRENDS OF SAMBALPUR CITY

The State Pollution Control Board, Odisha monitors the ambient air quality of Sambalpur city at One location. The details are presented in Table 7.0. The location of monitoring stations are selected as per the guideline of CPCB and are indicated in Fig.7.0

Table 7.0 Ambient Air Quality Monitoring Location

Place	Location	Latitude / Longitude	Category of Area
Sambalpur	PHED Office, Modipada	20 ⁰ 43'N / 82 ⁰ 39' E	Residential

7.1 Description of the locations

7.1.1 Pump House, PHED, Modipada

The station is operating over the pump house of PHED Office at Modipara. It is a major commercial area of Sambalpur town. It is about 3 m above the ground level.



Fig.7.0 Map Showing Sampling Locations in Sambalpur Town

7.2 Ambient Air Quality of Sambalpur

Ambient Air Quality status of Sambalpur area at Modipada from the year 2006-2014 with respect to annual average value, range value of 24hrly average and frequency of violation of parameters like SPM, RSPM (PM_{10}), SO_2 & NO_x are presented in Table 7.2 and trend of the parameters are shown in Fig. 7.1 to 7.4 Seasonal variation of SPM & PM_{10} are shown in Fig. 7.5 to 7.22. Categorisation on the basis of exceedence factor of the area was shown in Table-7.2

7.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at Modipada for the year 2006 to 2014 were below their respective limits i.e., $50 \mu\text{g}/\text{m}^3$ for SO_2 & $40 \mu\text{g}/\text{m}^3$ for NO_x . NO_x was in increasing trend from the year 2006 to 2009, then decreased upto the year 2011 and again increased thereafter. The exceedence factor of SO_2 & NO_x showed Low throughout the study period. The maximum annual average value of NO_x was $16 \mu\text{g}/\text{m}^3$ observed in the year 2009.

7.2.2 SPM & RSPM (PM_{10})

The annual average of SPM value was below the limit i.e., $140 \mu\text{g}/\text{m}^3$ during the study period and maximum annual average as shown in the year 2009 was $136 \mu\text{g}/\text{m}^3$. The trend of SPM was in increasing trend from the year 2006 to 2009 and decreased slowly thereafter. The exceedence factor of SPM showed moderate throughout the study period.

The annual average of RSPM (PM_{10}) was below the limit i.e., $60 \mu\text{g}/\text{m}^3$ from the year 2006 to 2014 and maximum annual average as shown in the year 2014 i.e., $55 \mu\text{g}/\text{m}^3$. The trend of RSPM (PM_{10}) at Modipada was in increasing trend at the beginning of the year from 2006 to 2009. The trend then decreased from the year 2009 onwards. The exceedence factor of RSPM showed Moderate throughout the study period.

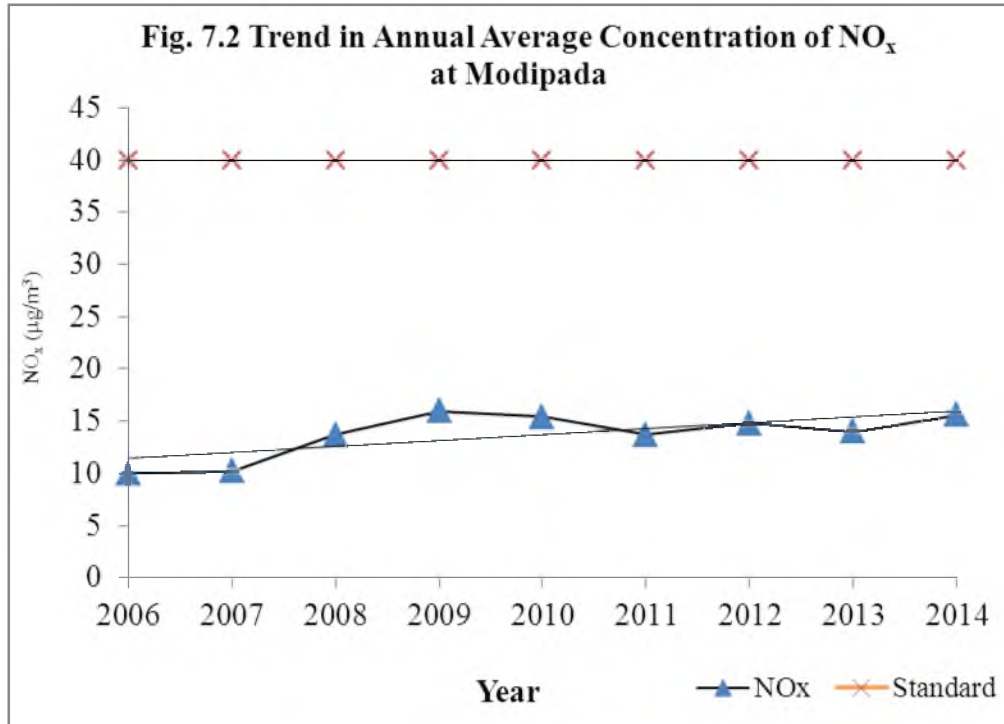
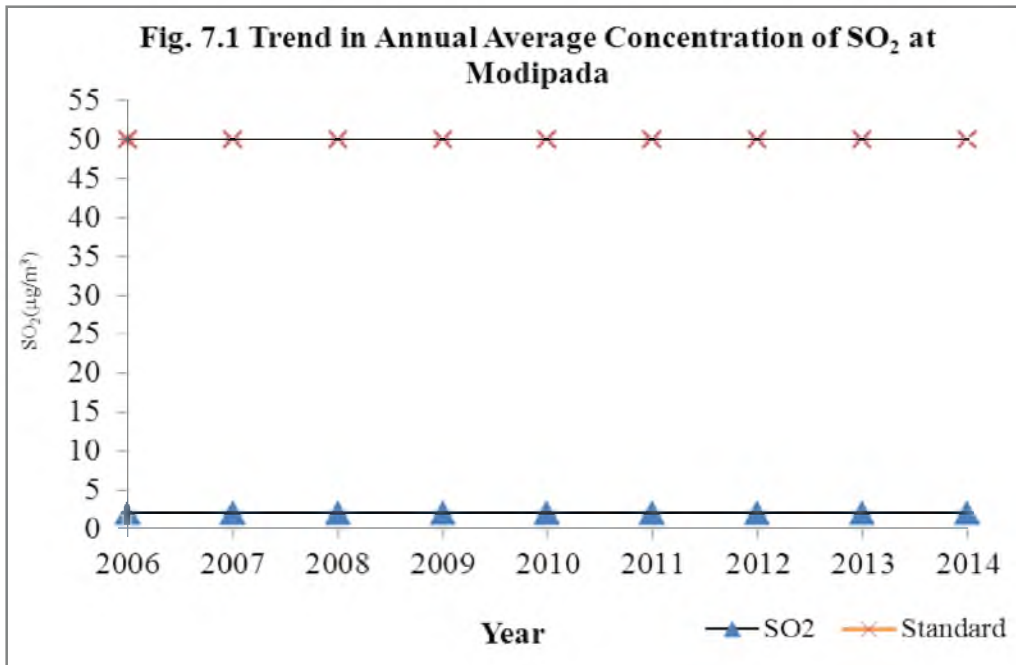
From seasonal variation it was observed that SPM & RSPM (PM_{10}) during winter season showed maximum and during monsoon showed minimum value during the study period. However, maximum seasonal average of SPM was $141 \mu\text{g}/\text{m}^3$ in the year 2013-14 during summer, $156 \mu\text{g}/\text{m}^3$ during post-monsoon and RSPM showed maximum $368 \mu\text{g}/\text{m}^3$ in 2014 during post-monsoon, $57 \mu\text{g}/\text{m}^3$ in the year 2013-14 during summer.

Status of Ambient Air Quality at Sambalpur

Table: 7.1 PHED Office, Modipada

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2006	111	114 (59-170)	45 (21-76)	BDL (BDL- BDL)	10 (BDL- 32)	-	-	-	-
2007	115	121 (57-177)	46 (22-73)	BDL (BDL-5.5)	10.2 (BDL-18.1)	-	-	-	-
2008	111	129 (59-192)	49 (28-81)	BDL (BDL-5.3)	13.7 (BDL-24)	-	-	-	-
2009	125	136 (86-168)	54 (26-75)	BDL (BDL-6.0)	16.0 (10.7-21.3)	-	-	-	-
2010	92	132 (95-165)	52 (27-68)	BDL (BDL-6.0)	15.4 (9.8-23)	-	-	-	-
2011	110	130 (99-168)	51 (29-71)	BDL (BDL-4.8)	13.7 (9.8-20.0)	-	-	-	-
2012	112	134 (96-160)	49 (38-71)	BDL (BDL-6)	14.8 (11-18.1)	-	-	-	-
2013	106	127 (87-162)	51 (33-69)	BDL (BDL-5.2)	14.0 (9.0-19.3)	-	-	-	-
2014	110	135 (116-181)	55 (46-77)	BDL (BDL-4.7)	15.6 (11.7-19.2)	-	-	-	-
Prescribed standard (R)	24 hrly / Annual avg	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

N.B.: BDL - Below Detectable Limit, R - Residential BDL Value for SO₂ - ≤ 4 , BDL Value for NO_x - ≤ 9 , BDL Value for RSPM - ≤ 5



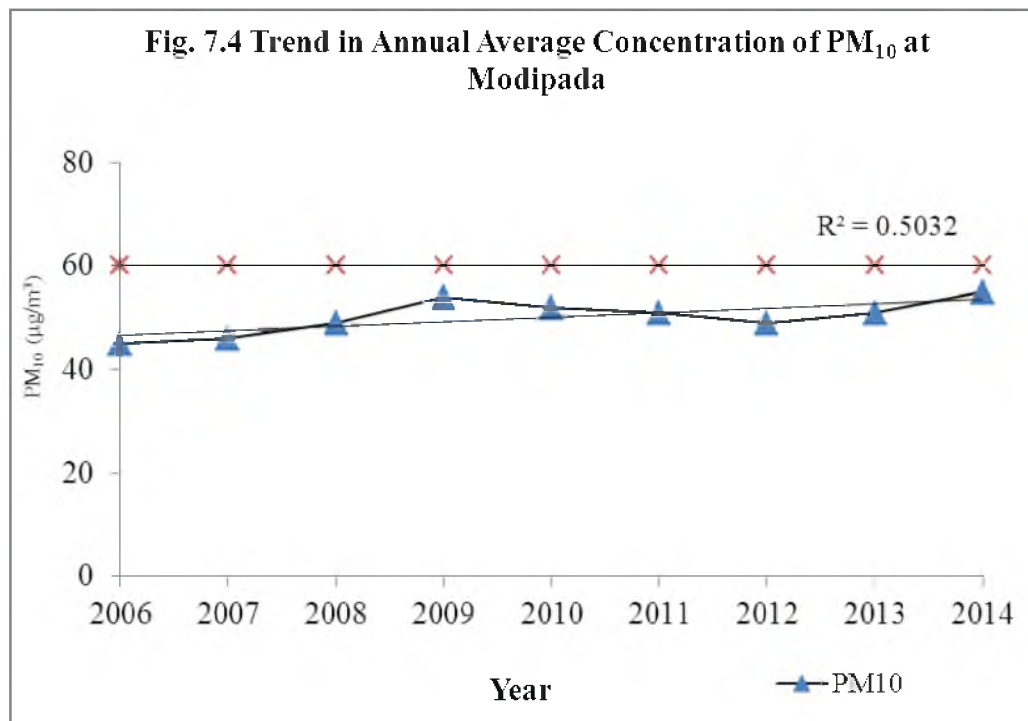
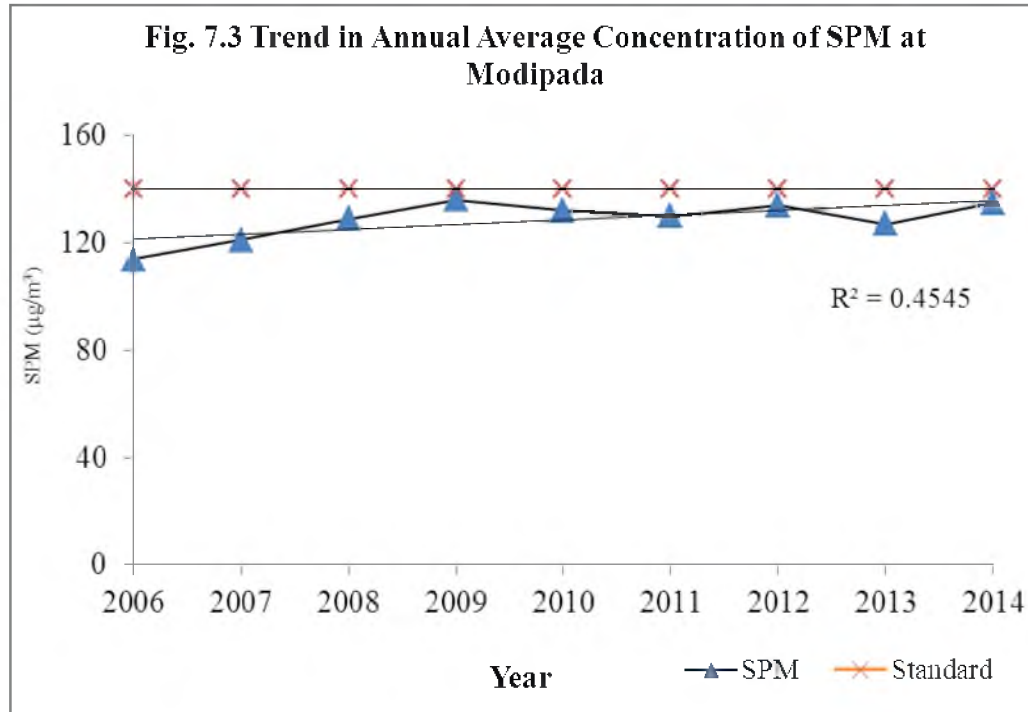


Fig.7.5

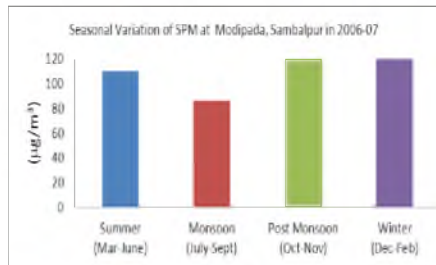


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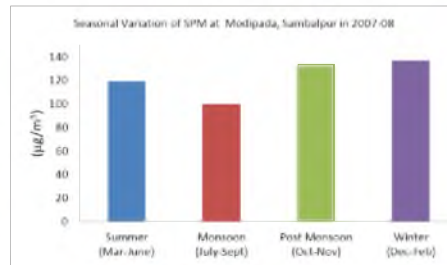


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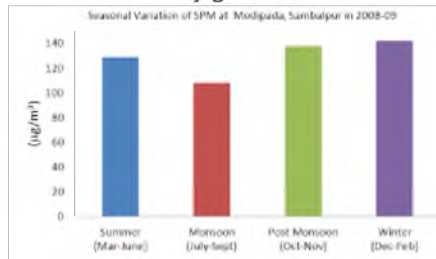


Fig.7.8

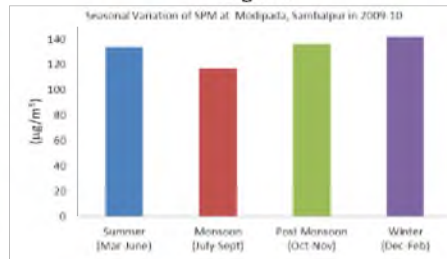


Fig.7.9

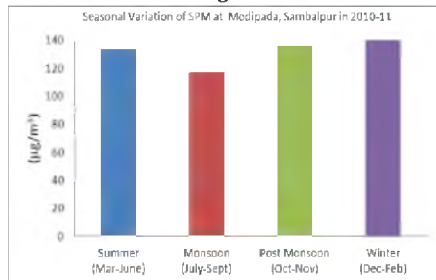


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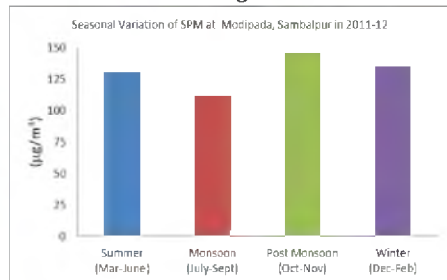


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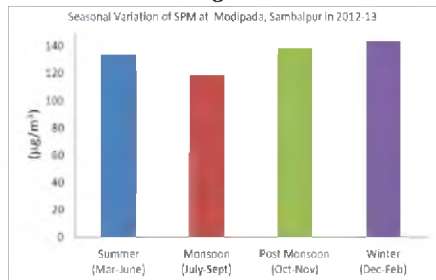


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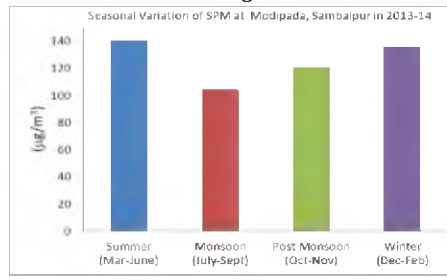


Fig.7.13

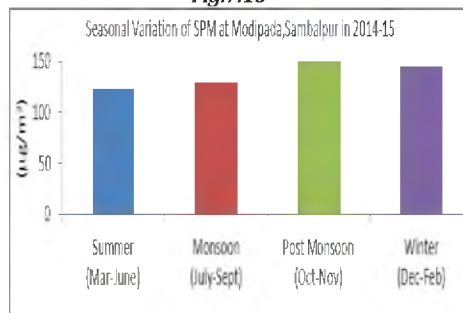


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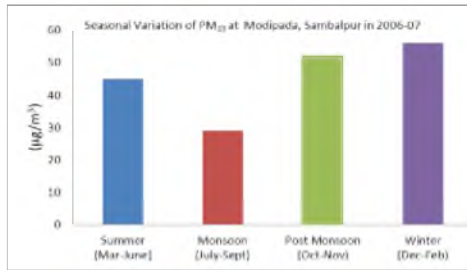


Fig.7.15

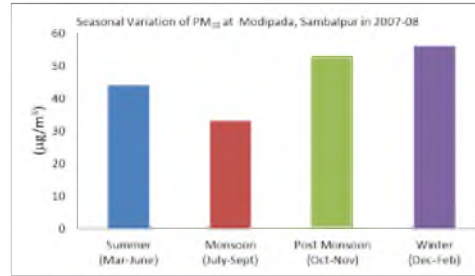


Fig.7.16

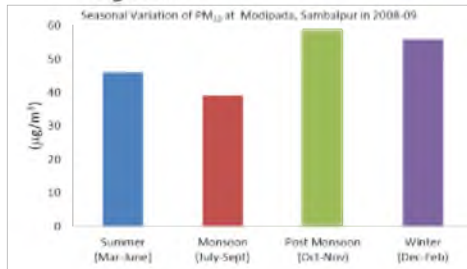


Fig.7.17

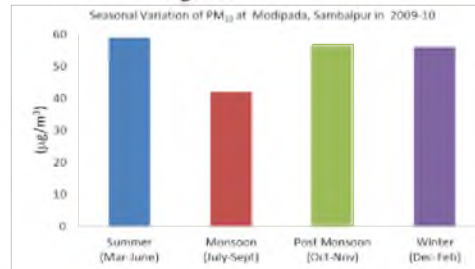


Fig.7.18

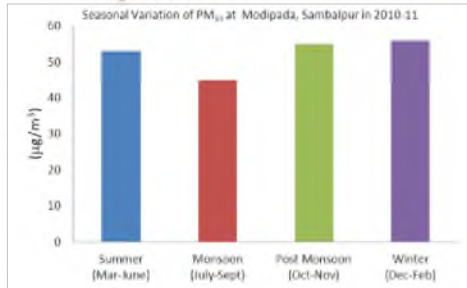


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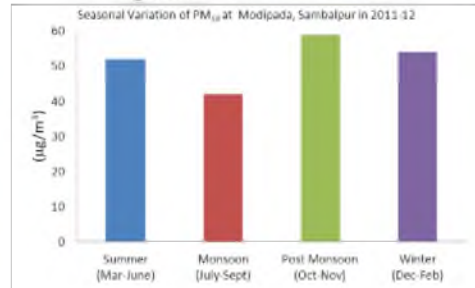


Fig.7.20

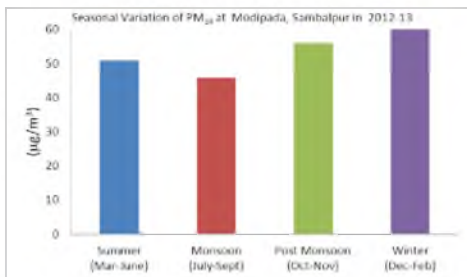


Fig.7.21

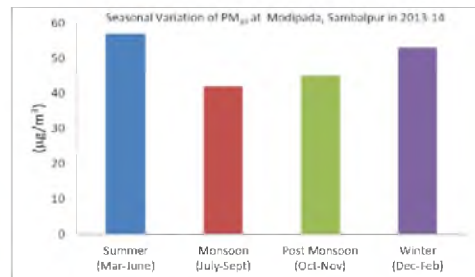


Fig.7.22

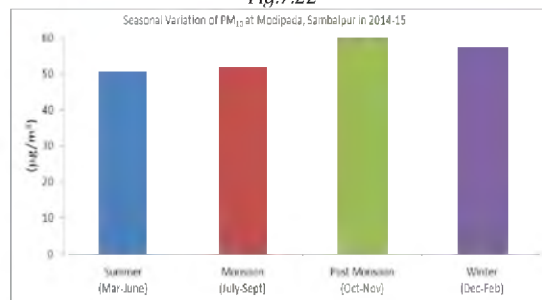


Table: 7.2 Categorisation of Ambient Air Quality on the basis of exceedence factor of Sambalpur

Location	Categorisation of Sambalpur, (2006 to 2014)								
	SO ₂								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Modipada	L	L	L	L	L	L	L	L	L

Location	NO _x								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Modipada	L	L	L	L	L	L	L	L	L

Location	SPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Modipada	M	M	M	M	M	M	M	M	M

Location	RSPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Modipada	M	M	M	M	M	M	M	M	M

NB:- L: Low, M: Moderate

8.0 AMBIENT AIR QUALITY STATUS AND TRENDS OF BALASORE TOWN

The State Pollution Control Board, Odisha monitors the ambient air quality of Balasore town at three locations. The details are presented in Table 8.0. The location of monitoring stations are selected as per the guideline of CPCB and are indicated in Fig.8.0.

Table- 8.0 Ambient Air Quality Monitoring Locations

Place	Location	Latitude / Longitude	Category of Area
Balasore	1. R.O, SPCB Sahadevkhunta	21 ⁰ 30'22.3'' N / 86 ⁰ 55'8.8'' E	Residential
	2. DIC Office, Angaragadia	21 ⁰ 29'18.2'' N / 86 ⁰ 55'1.7'' E	Residential
	3. Rasalpur, Industrial Estate	21 ⁰ 32'6.0'' N / 86 ⁰ 49'43.9'' E	Industrial

8.1 Description of the Locations

8.1.1 R.O, SPCB Sahadevkhunta

Ambient Air Quality monitoring station is operating on the roof of Regional Office SPC Board at a height of 6m above the ground level. It is located in the residential area and the station is 300m away from bus stand.

8.1.2 DIC Office, Angaragadia

The monitoring station is operating on the roof of DIC office, Angaragadia at a height of 6 m. above the ground level. The station is in Residential area.

8.1.3 Rasalpur, Industrial Estate

The monitoring station is operating on the roof of the guest house of M/S Emami Paper Mill at a height of 3m above the ground level. The station is located in industrial area. M/s Emami Paper Mill and M/s Balasore Alloy Ltd are located near the station.

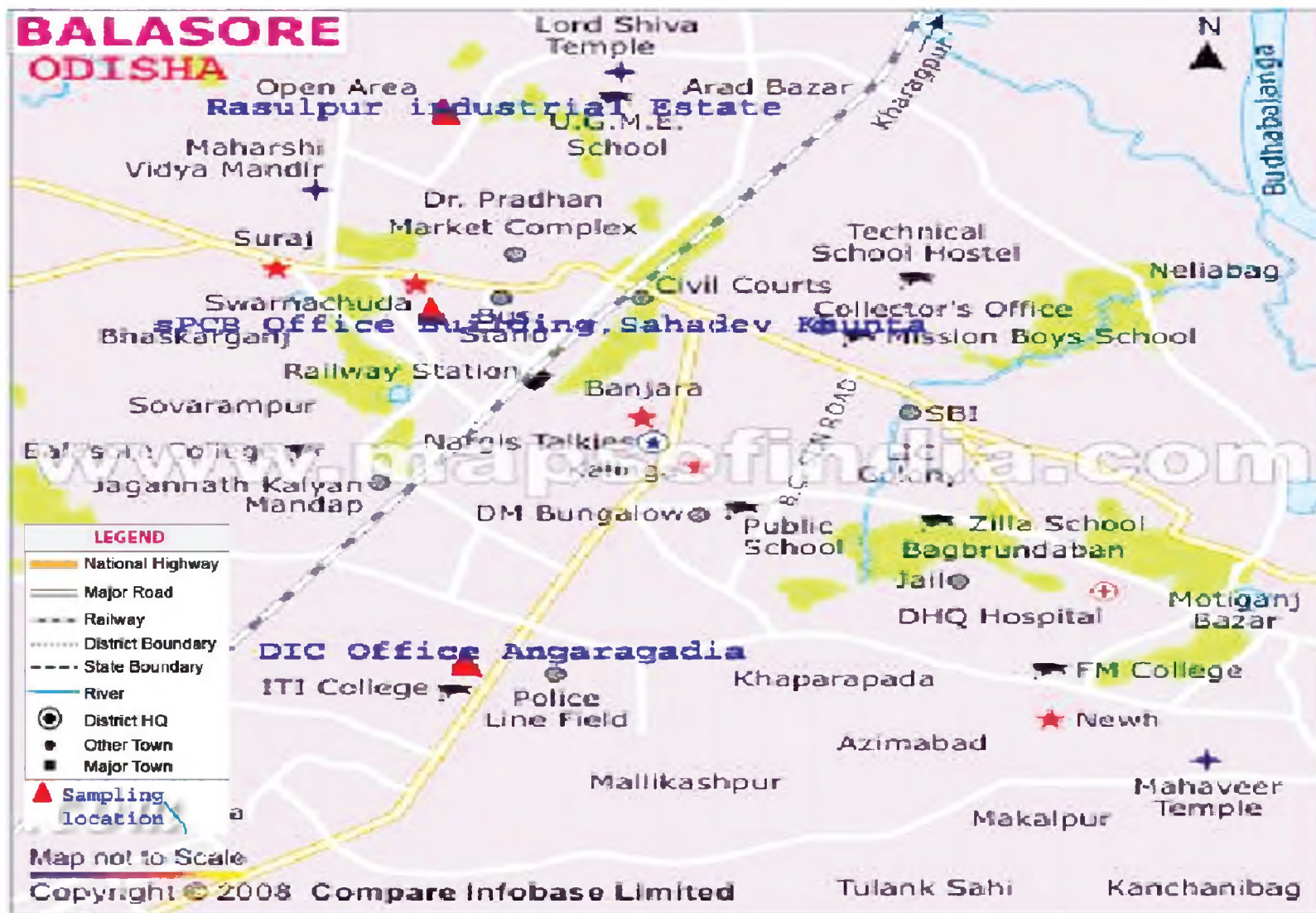


Fig.8.0 Map Showing Sampling Locations in Balasore Town

8.2 Ambient Air Quality of Balasore

Ambient air quality status of Balasore town from the year 2006 to 2014 with respect to annual average value, range value of 24hourly average and frequency of violation for parameters like SPM, RSPM (PM_{10}), SO_2 & NO_x at RO, SPCB, Sahadevkhunta for the year 2006-2014, DIC office, Angaragadia for the year 2013 to 2014 and at Rasalpur, industrial area for the year 2013 and 2014 are presented in Table 8.1 to 8.3 and trend analysis of the parameters are shown in Fig. 8.1 to 8.12. Seasonal variation of SPM & RSPM are shown in Fig. 8.13 to 8.30. categorisation on the basis of exceedence factor of the area is shown in Table 8.4.

8.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at RO, SPCB, Sahadevkhunta for the year 2006-2014, DIC office, Angaragadia from the year 2012 to 2014 and Rasalpur industrial area for the year 2013 & 2014 were below their respective limits i.e., $50 \mu\text{g}/\text{m}^3$ for SO_2 & $40 \mu\text{g}/\text{m}^3$ for NO_x . The SO_2 values were mostly remained below detectable limit throughout the study period except at Rasalpur, Industrial Estate. The maximum annual average of NO_x was $11.8 \mu\text{g}/\text{m}^3$ in the year 2012 at Sahadevkhunta, $11.8 \mu\text{g}/\text{m}^3$ in the year 2013 at DIC office Angaragadia and $14.5 \mu\text{g}/\text{m}^3$ in the year 2013 at Rasalpur industrial area. NO_x at Sahadevkhunta was in increasing trend for the year 2006 to 2012 and decreasing trend from the year 2013 to 2014; at DIC office, Angaragadia the NO_x values almost remained same for the year 2013 to 2014. Whereas NO_x value at Rasalpur, Industrial Estate was decreases from $14.5 \mu\text{g}/\text{m}^3$ in the year 2013 to $12.8 \mu\text{g}/\text{m}^3$ in the year 2014. On the basis of exceedence factor SO_2 & NO_x remained under Low category at all locations throughout the study period.

8.2.2 SPM & RSPM (PM_{10})

The annual average value for SPM at Sahadevkhunta & at DIC office Angaragadia were remained above the limit i.e., $140 \mu\text{g}/\text{m}^3$ throughout the study period except for the year 2006 to 2008 at Sahadevkhunta; whereas at Rasalpur industrial area the values remained well within the prescribed limit i.e., $360 \mu\text{g}/\text{m}^3$. The maximum annual average of SPM at Sahadevkhunta was $180 \mu\text{g}/\text{m}^3$ in the year 2014, $180 \mu\text{g}/\text{m}^3$ in the year 2013 at DIC office Angaragadia and $199 \mu\text{g}/\text{m}^3$ in the year 2013 at Rasalpur industrial area. The maximum frequency of violation for SPM in residential area on 24 hourly average was 8.8 % in the year 2009 at Sahadevkhunta. There was no violation in the Industrial area at Rasalpur. The trend for SPM was in increasing trend during the study period at Sahadevkhunta and at DIC office, Angaragadia. In Rasalpur industrial area the SPM value slightly decreased from the year 2013 to 2014. The exceedence factor showed Moderate level from the year 2006 to 2008 and High from 2009 to 2014 at Sahadevkhunta while at DIC Office, Angaragadia showed High in the year 2013 & 2014. Rasalpur showed Moderate for the year 2013 & 2014.



The annual average value of RSPM at all three stations were remained above the limit i.e., $60 \mu\text{g}/\text{m}^3$ throughout the study period . The maximum annual average of RSPM at Sahadevkhunta was $82 \mu\text{g}/\text{m}^3$ in the year 2014, $82 \mu\text{g}/\text{m}^3$ in the year 2013 at DIC office Angaragadia and $96 \mu\text{g}/\text{m}^3$ in the year 2013 at Rasalpur industrial area. The maximum frequency of violation on 24 hourly average was 31.6 % at Rasalpur industrial area in the year 2013. 9.8 % in the year 2009, at Sahadevkhunta & 4.8 % in the year 2013 at DIC office, Angaragadia. The trend of RSPM remained same for 2006 & 2007 and it was in increasing and decreasing manner at Sahadevkhunta station; at DIC Angaragadia the trend was in increasing trend whereas the Rasalpur showed slightly decreasing trend. On the basis of exceedence factor the RSPM showed High at Sahadevkhunta and DIC office, Angaragadia and it was Critical at Rasalpur industrial area during the study period.

From seasonal variation it was observed that SPM & RSPM (PM_{10}) showed high values in winter season most of the time at all stations during the study period. However, the maximum value of SPM was $205 \mu\text{g}/\text{m}^3$ & RSPM (PM_{10}) was $101 \mu\text{g}/\text{m}^3$ in the year 2013-14 during summer season at Rasalpur Industrial area.

Status of Ambient Air Quality at Balasore

Table : 8.1 R.O, SPCB, Sahadevkhunta

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2006	101	129 (66-207)	61 29-110	BDL (BDL- BDL)	10 (BDL-14)	-	-	-	-
2007	100	137 (73-268)	61 (33-105)	BDL (BDL-BDL)	11 (9.3-13.6)	1%	1%	-	-
2008	101	139 (86-205)	66 (36-104)	BDL (BDL-BDL)	11.1 (9.6-13.5)	1%	3%	-	-
2009	102	160 (90-205)	75 (38-108)	BDL (BDL-BDL)	11.3 (9.8-14.0)	8.8%	9.8%	-	-
2010	100	161 (98-206)	73 (39-104)	BDL (BDL-BDL)	11.3 (9.5-11.6)	8%	6%	-	-
2011	103	166 (108-199)	75 (42-105)	BDL (BDL-BDL)	11.4 (BDL-13.6)	-	1%	-	-
2012	105	171 (113-204)	72 (46-102)	BDL (BDL-BDL)	11.8 (9.6-11.5)	6.6%	4.7%	-	-
2013	103	179 (157-204)	81 (60-102)	BDL (BDL-BDL)	11.6 (10.3-14.0)	1.9%	2.9%	-	-
2014	102	180 (157-202)	82 (61-105)	BDL (BDL-BDL)	11.4 (10.0-15.0)	3.9%	3.9%	-	-
Prescribed standard (R)	24 hrly / Annual Avg.	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual Avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

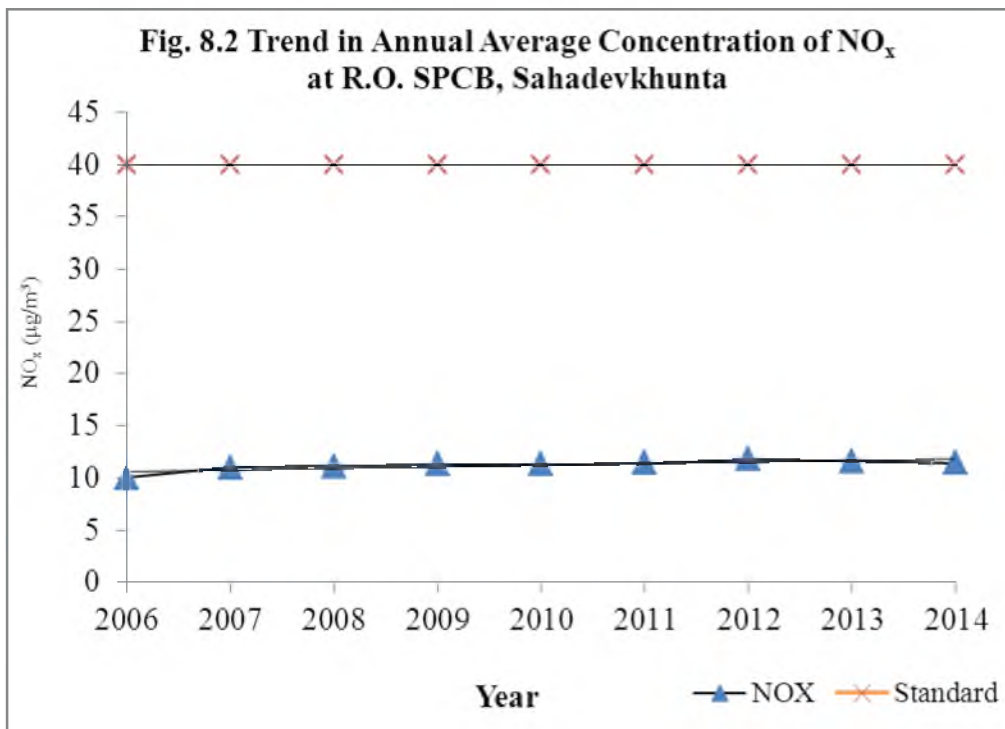
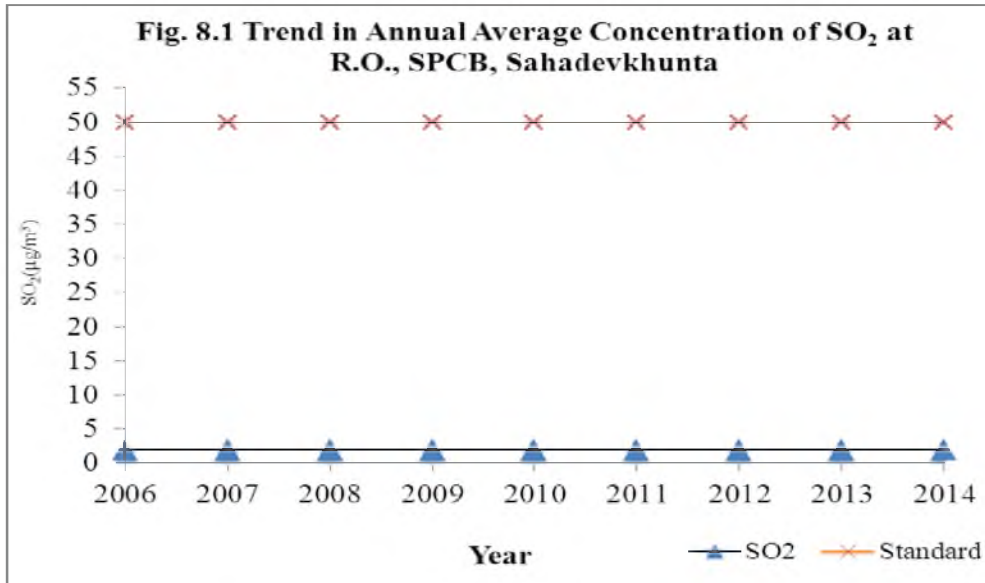
N.B.: BDL - Below Detectable Limit, R – Residential BDL Value for SO₂ - ≤ 4 ,BDL Value for NO_x - ≤ 9 , BDL Value for RSPM - ≤ 5

Table 8.2 DIC Office, Angaragadia

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2012	79	172 (112-198)	77 (55-95)	BDL (BDL-BDL)	11.6 (9.8-13)	-	-	-	-
2013	84	180 (158-204)	81 (58-103)	BDL (BDL-BDL)	11.8 (10.3-13.8)	4.8 %	4.8%	-	-
2014	61	179 (160-201)	82 (66-102)	BDL (BDL-BDL)	11.7 (9.1-14.0)	3.2%	1.63%	-	-
Prescribed standard (R)	24 hrly / Annual avg	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual avg	-	100/60	80/50	80/40	As Per 2009 Standard			

Table 8.3 Rasalpur Industrial Area

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2013	79	199 (184-224)	96 (84-116)	6.8 (4.8-9.3)	14.5 (10.8-21.0)	-	31.6%	-	-
2014	53	197 (176-212)	95 (82-107)	7.3 (5.2-9.1)	12.8 (11.1-15.5)	-	9.4%	-	-
Prescribed standard (I)	24 hrly / Annual avg.	500/360	150/120	120/80	120/80	As Per 1998 Standard			
	24 hrly/ Annual avg.	-	100/60	80/50	80/40	As Per 2009 Standard			



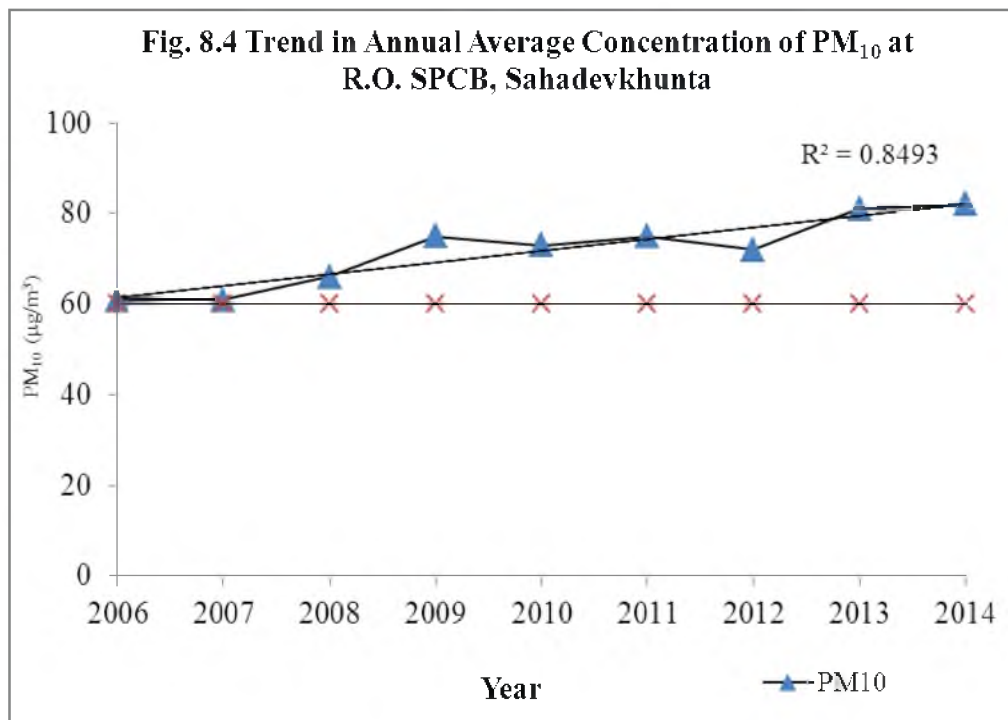
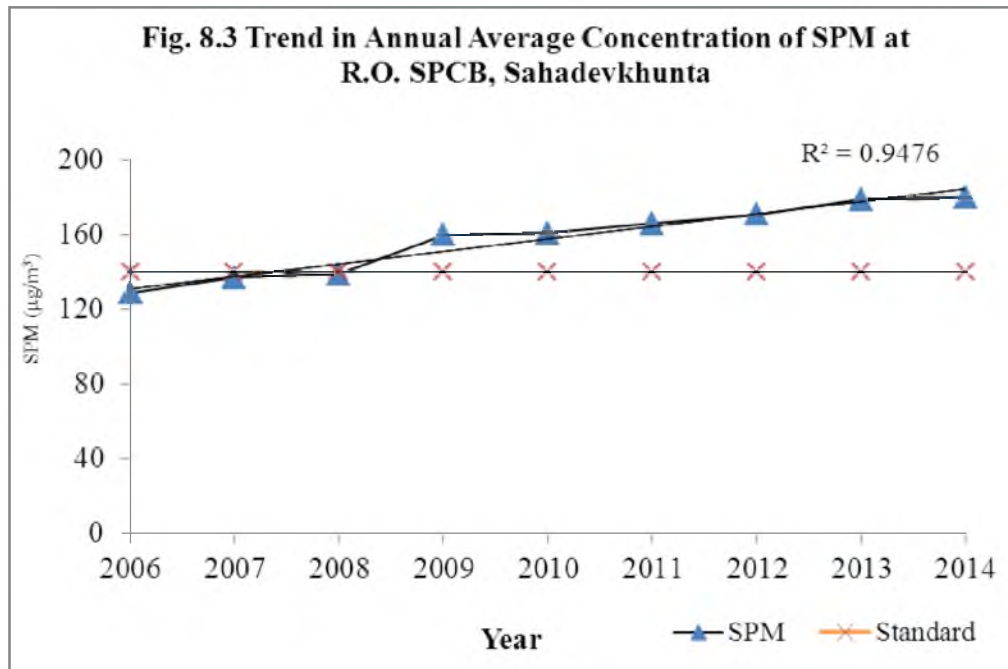


Fig. 8.5

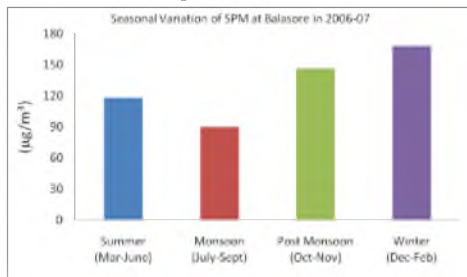


Fig. 8.6

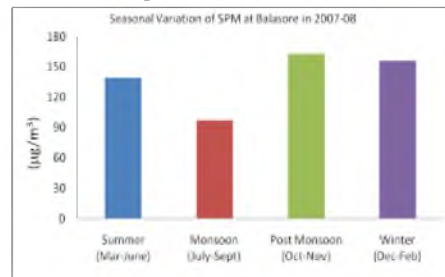


Fig. 8.7

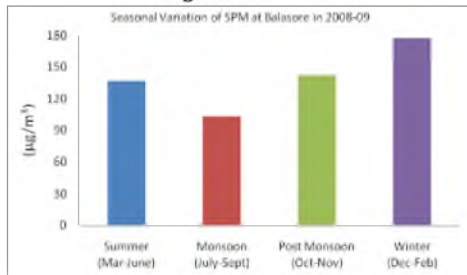


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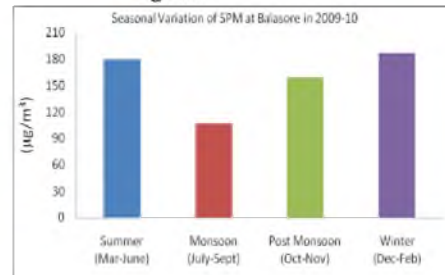


Fig. 8.9

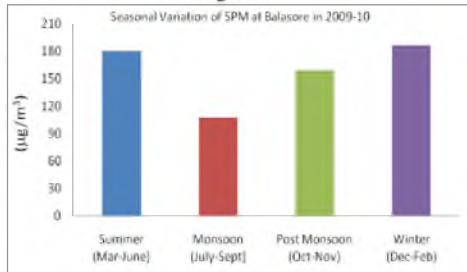


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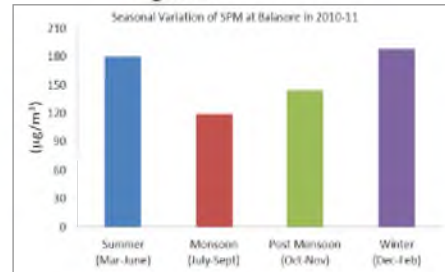


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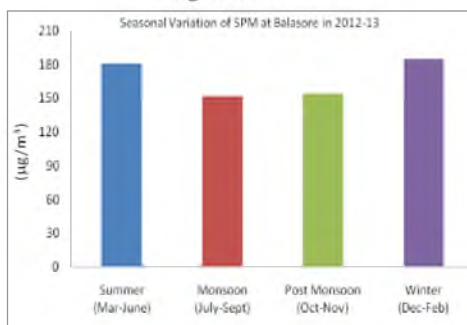


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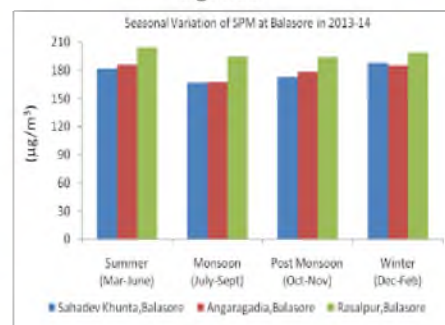


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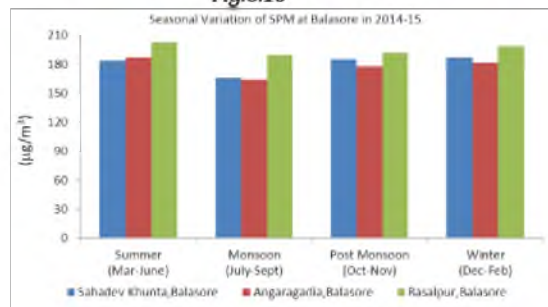


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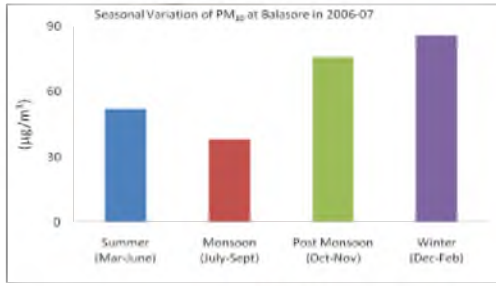


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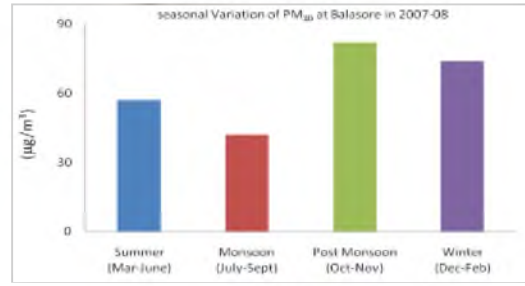


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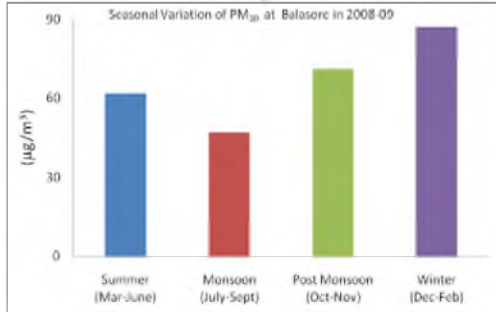


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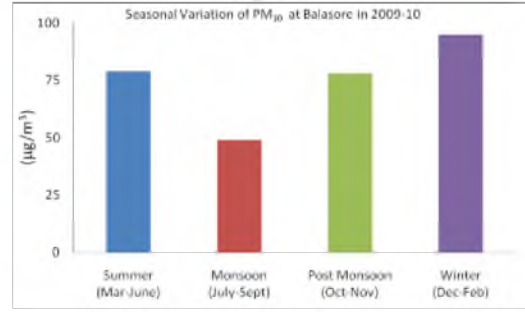


Fig.8.18

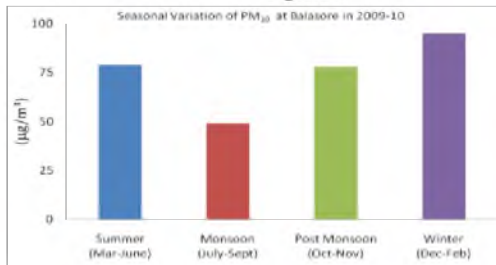


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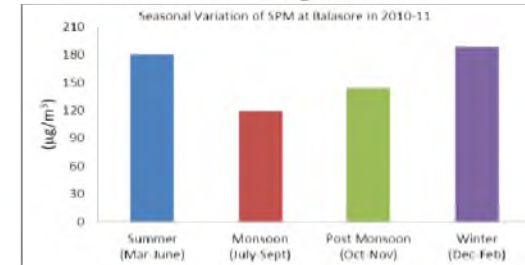


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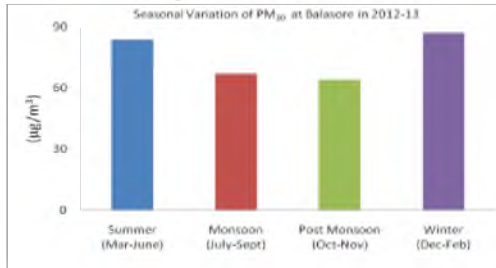


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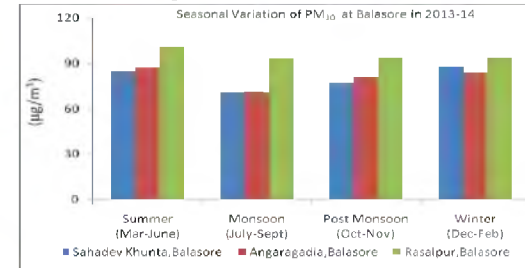


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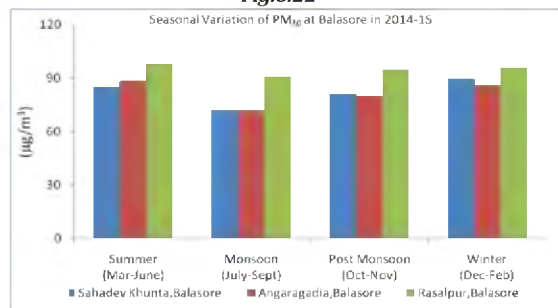


Table: 8.4 **Categorisation of Ambient Air Quality on the basis of exceedence factor of Balasore**

Location	Categorisation of Balasore, (2006 to 2014)								
	SO ₂								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
1. Regional Office, Sahadevkhunta	L	L	L	L	L	L	L	L	L
2. DIC office, Angaragadia								L	L
3. Rasalpur, Industrial Estate								L	L

Location	NO _x								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
	1. Regional Office, Sahadevkhunta	L	L	L	L	L	L	L	L
2. DIC office, Angaragadia								L	L
3. Rasalpur, Industrial Estate								L	L

Location	SPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
	1. Regional Office, Sahadevkhunta	M	M	M	H	H	H	H	H
2. DIC office, Angaragadia								H	H
3. Rasalpur, Industrial Estate								M	M

Location	SPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
	1. Regional Office, Sahadevkhunta	H	H	H	H	H	H	H	H
2. DIC office, Angaragadia								H	H
3. Rasalpur, Industrial Estate								C	C

NB:- L: Low, M: Moderate, H: High, C: Critical



9.0 AMBIENT AIR QUALITY STATUS AND TRENDS OF BERHAMPUR TOWN

The State Pollution Control Board, Odisha monitors the ambient air quality of Berhampur city at one location. The details are presented in Table 9.0. The location of monitoring stations are selected as per the guideline of CPCB and are indicated in Fig.9.0

Table: 9.0 Ambient Air Quality Monitoring Location

Place	Location	Latitude / Longitude	Category of Area
Berhampur	Regional Office Building, Brahmanagar	19 ⁰ 18N/84 ⁰ 51E	Residential

9.1 Description of the location

9.1.1 Regional Office Building, Brahma Nagar

The station is operating in the residential area of the town. NH-5 is within 2 Km. from the site. M.K.C.G Medical college and Hospital is very close to the site. The station is about 3 m above the ground level.

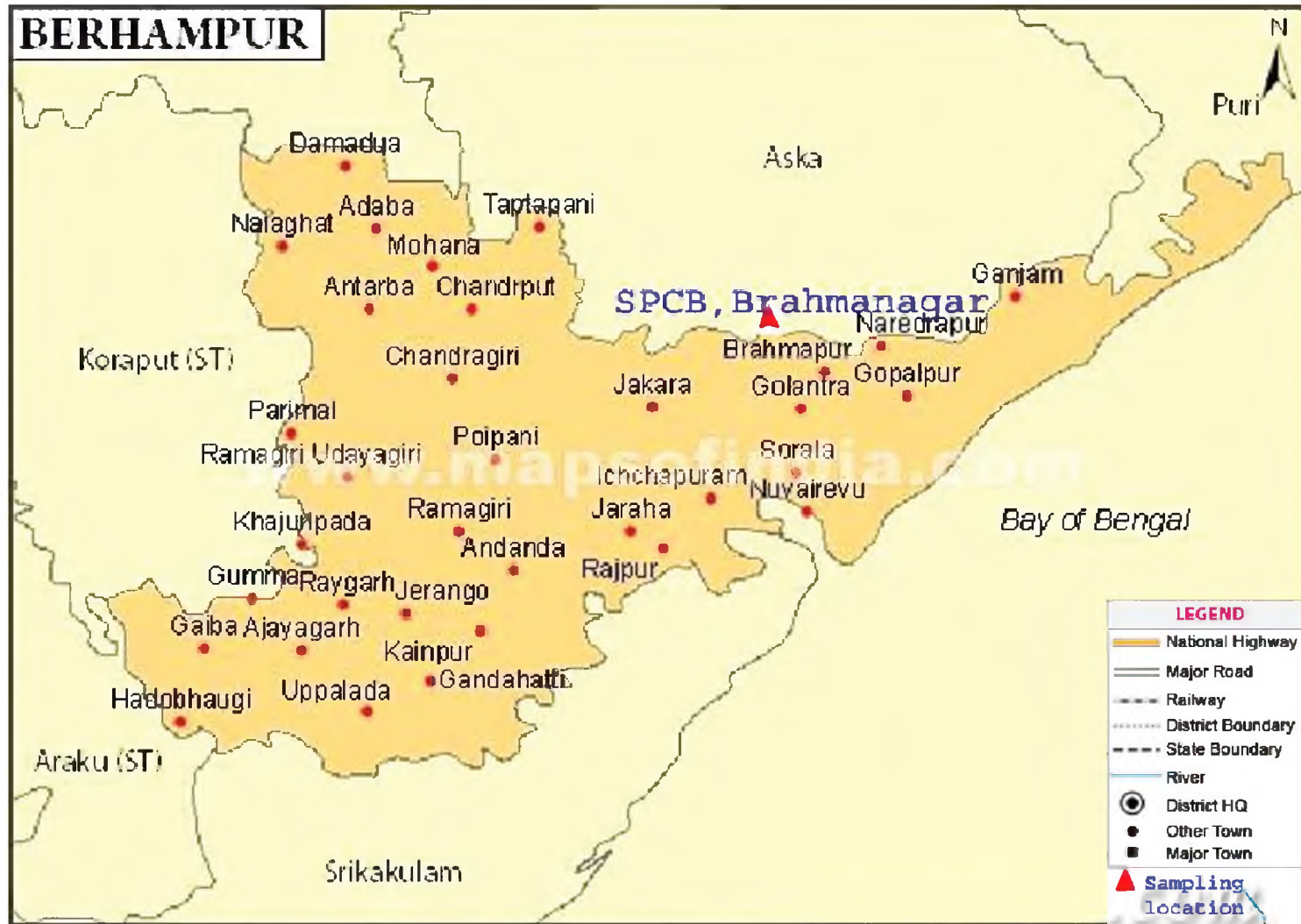


Fig.9.0 Map Showing Sampling Locations in Berhampur Town

9.2 Ambient Air Quality of Berhampur

Ambient Air Quality status of Berhampur town from the year 2006-2014 with respect to annual average value, range value of 24 hrly average and frequency of violation of parameters like SPM, RSPM (PM_{10}), SO_2 & NO_x are presented in Table 9.1 and trend analysis of the parameters are shown in Fig. 9.1 to 9.4, Seasonal variation of SPM & PM_{10} are shown in Fig. 9.5 to 9.22 and Categorisation on the basis of exceedence factor of the area is shown in Table-9.2

9.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at Regional Office Building, Berhampur for the year 2006 to 2014 remained below their respective limits i.e., $50 \mu\text{g}/\text{m}^3$ for SO_2 & $40 \mu\text{g}/\text{m}^3$ for NO_x . The maximum annual average of NO_x was $19.7 \mu\text{g}/\text{m}^3$ in the year 2013. NO_x at Regional Office Building, Berhampur was in decreasing trend from 2006 to 2010 and then it was in increasing trend from the year 2011 to 2014. The exceedence factor of SO_2 & NO_x showed Low category throughout the study period.

9.2.2 SPM & RSPM (PM_{10})

The annual average value of SPM remained more than the limit i.e., $140 \mu\text{g}/\text{m}^3$ in all the year except during the year 2009 i.e., $125 \mu\text{g}/\text{m}^3$ and maximum annual average value was $187 \mu\text{g}/\text{m}^3$ in the year 2012. Maximum frequency of violation for SPM on 24hrly average was 43.3 % in the year 2013.

The trend of SPM at Regional Office Building, Berhampur slightly decreased at the beginning and then increased from the year 2009 -2014. The exceedence factor of SPM showed High from the year 2006 to 2008 & 2010 to 2014 and Moderate in the year 2009.

The annual average of RSPM was above the limit i.e., $60 \mu\text{g}/\text{m}^3$ in all the years except in the year 2007 & 2009. Maximum annual average was $78 \mu\text{g}/\text{m}^3$ in the year 2012 and maximum frequency of violation for RSPM on 24 hrly average was 33.6 % in the year 2013. The trend of RSPM at Regional Office Building, Berhampur was in decreasing trend up to 2009. The trend was increasing from the year 2009-2012. The exceedence factor of RSPM showed Moderate from the year 2006, 2007 & 2009 and High in the year 2008 in the year 2010 to 2014.

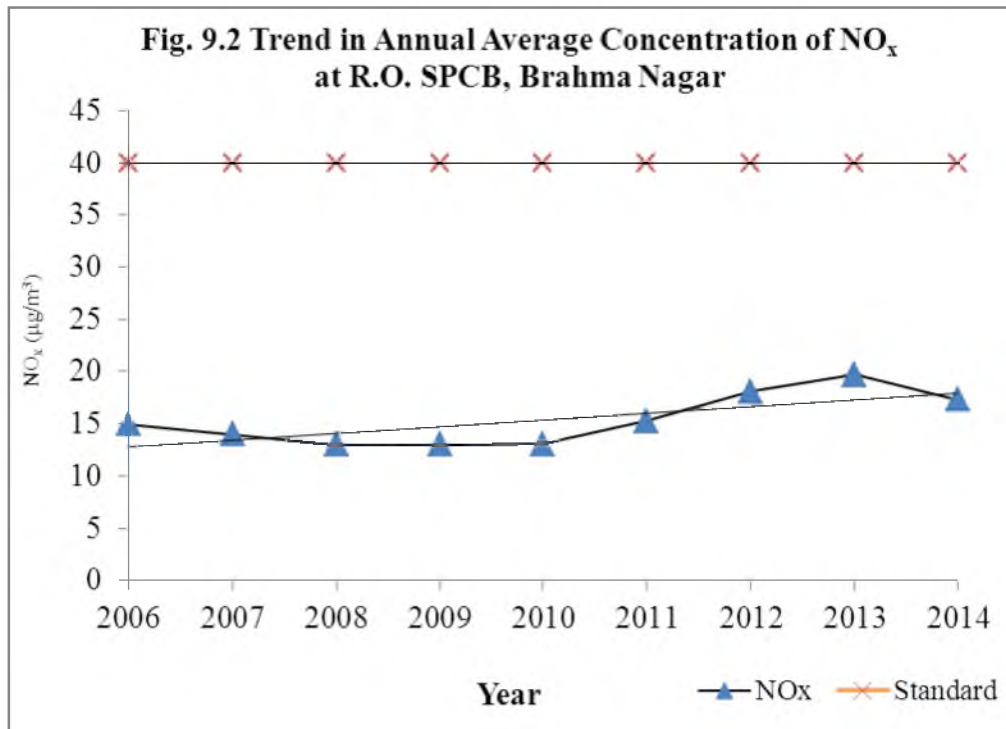
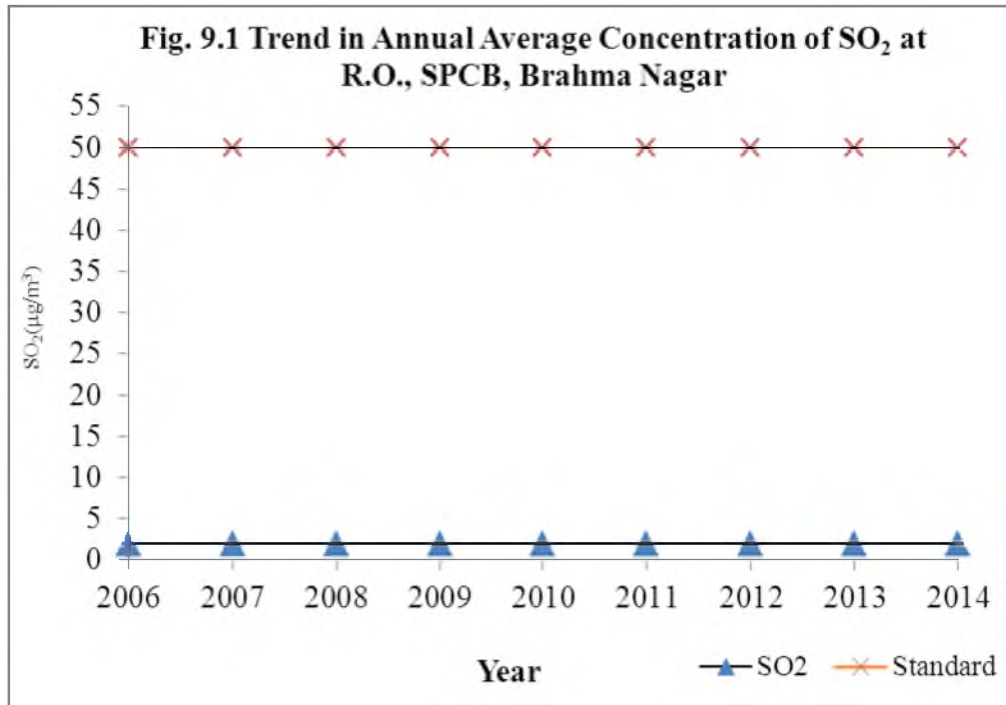
From seasonal variation it was observed that SPM & RSPM (PM_{10}) during winter season showed high value and minimum value in monsoon was observed in the study period.

Status of Ambient Air Quality at Berhampur

Table:9.1 Regional Office Building, Brahmanagar

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2006	103	155 (26-365)	60 (15-126)	BDL (BDL- BDL)	15 (11-22)	34%	12.6%	-	-
2007	104	146 (37-340)	59 (19-179)	BDL (BDL-5.5)	14 (BDL-26)	21.1%	14.4%	-	-
2008	104	150 (33-329)	62 (24-125)	BDL (BDL-BDL)	13 (BDL-21.1)	23%	7.7%	-	-
2009	105	125 (37-305)	55 (19-152)	BDL (BDL-BDL)	13 (BDL-23.3)	18%	9.5%	-	-
2010	104	150 (62-396)	61 (19-177)	BDL (BDL-BDL)	13.1 (BDL-19.3)	16%	7%	-	-
2011	102	179 (63-455)	76 (25-274)	BDL (BDL-BDL)	15.3 (10.5-38.2)	30.3%	18.6%	-	-
2012	105	187 (79-357)	78 (38-188)	BDL (BDL-BDL)	18.1 (13.9- 37.2)	37%	22%	-	-
2013	104	164 (54-294)	74 (23-142)	BDL (BDL-BDL)	19.7 (12.4-29.9)	43.3%	33.6%	-	-
2014	104	174 (97-270)	72 (35-117)	BDL (BDL-BDL)	17.3 (11.7-24.2)	24 %	20.2 %	-	-
Prescribed standard (R)	24 hrly / Annual Avg.	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual Avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

N.B.: BDL - Below Detectable Limit, R – Residential BDL Value for SO₂ - ≤4, BDL Value for NO_x - ≤9, BDL Value for RSPM - ≤ 5



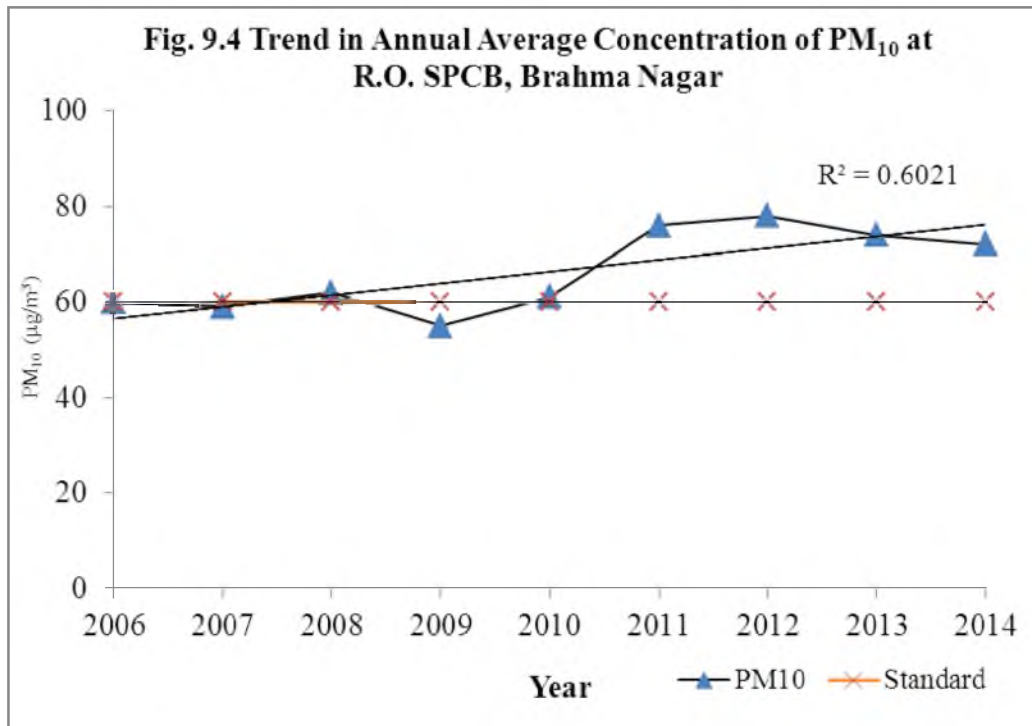
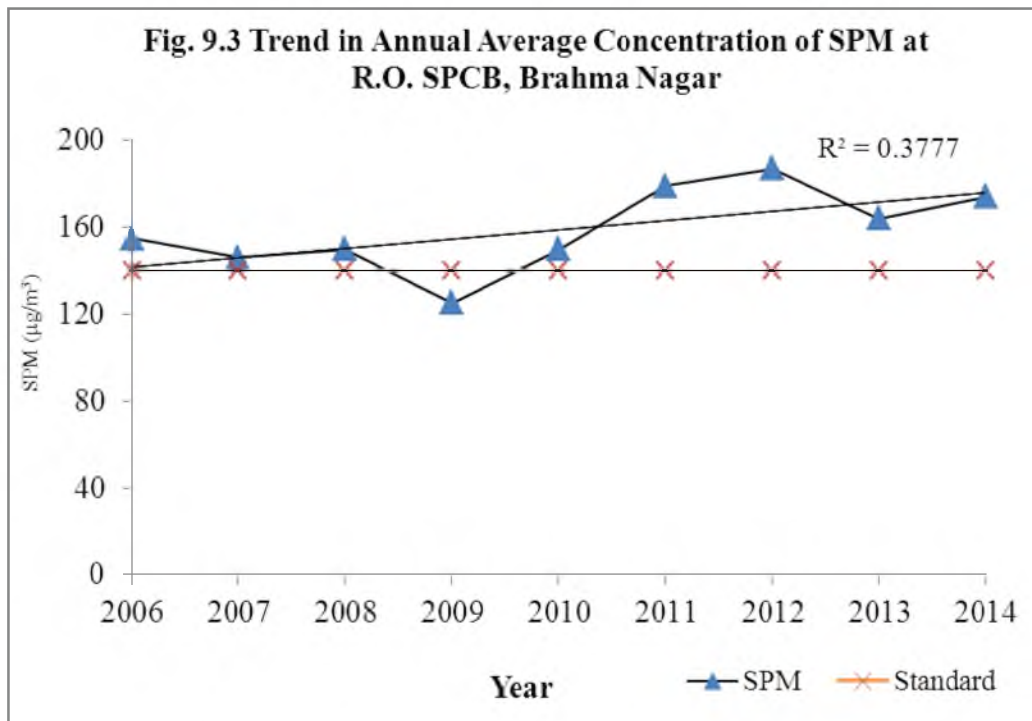


Fig.9.5

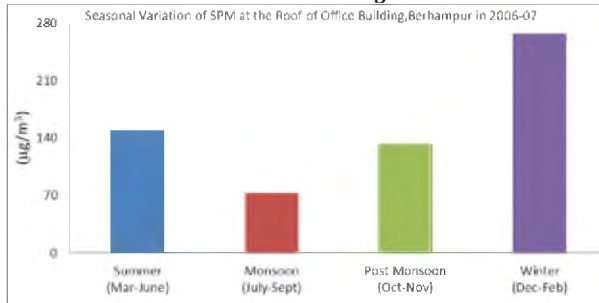


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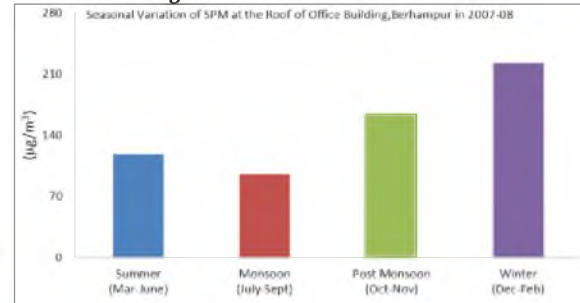


Fig.9.7

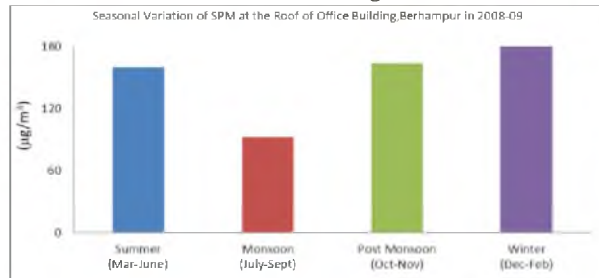


Fig.9.8

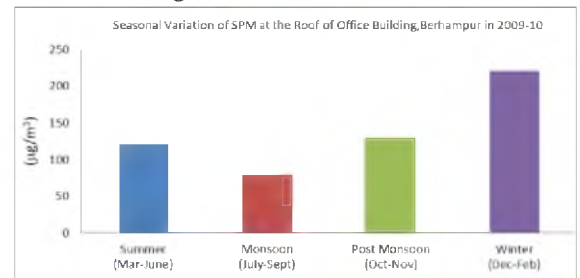


Fig.9.9

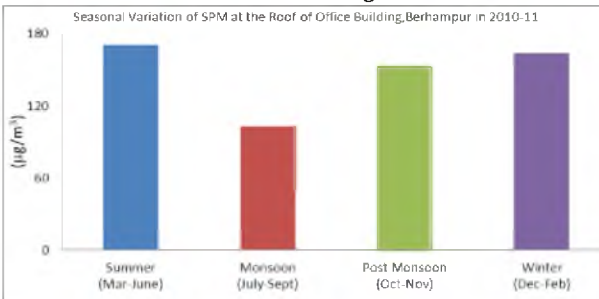


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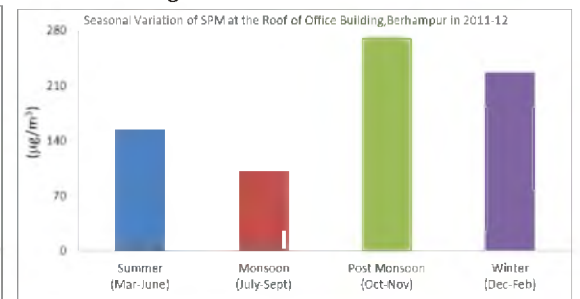


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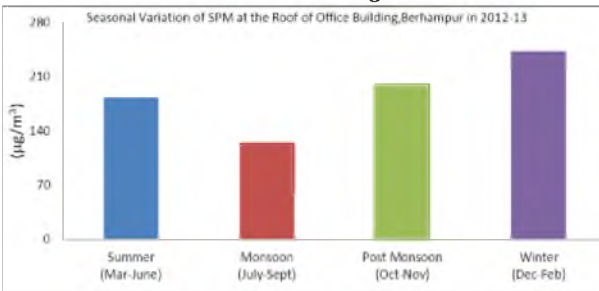


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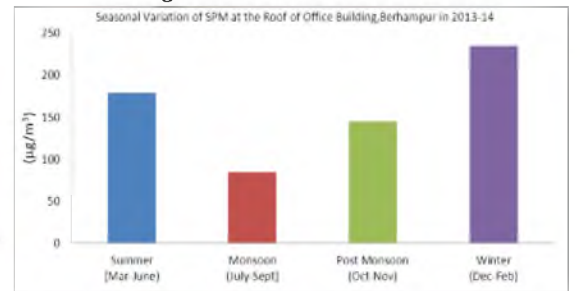
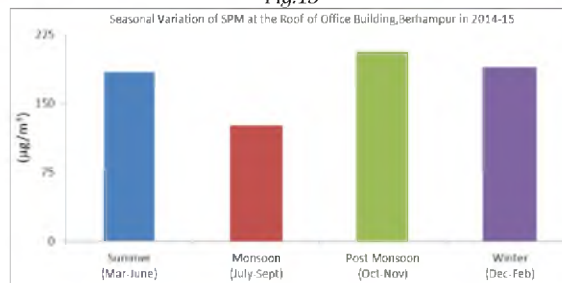


Fig.13



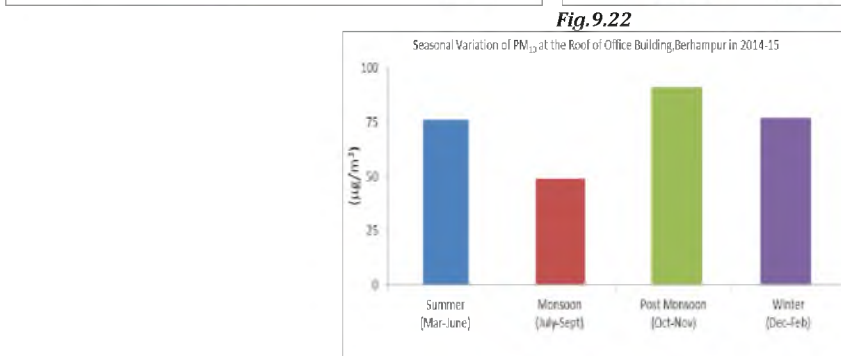
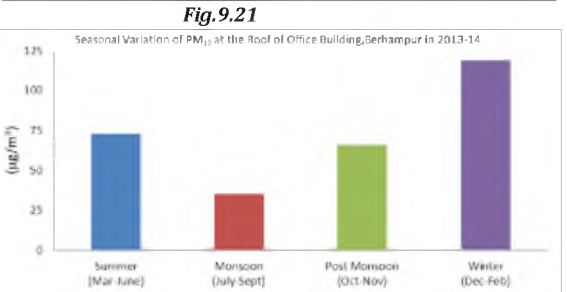
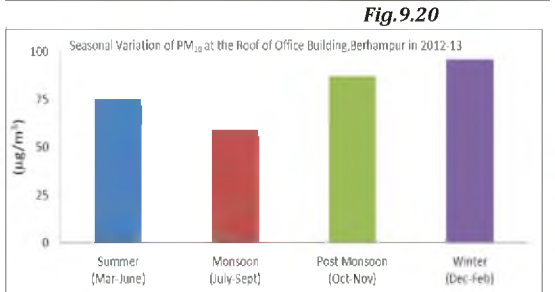
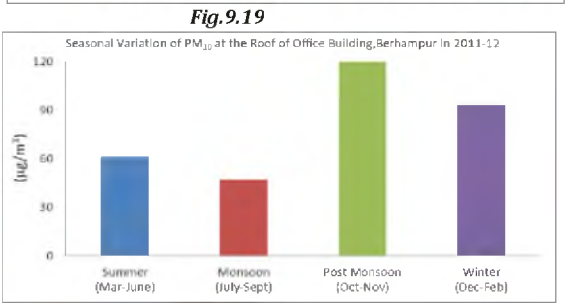
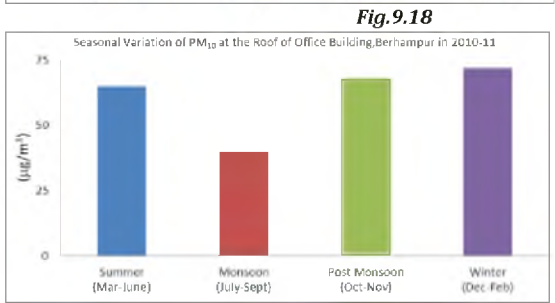
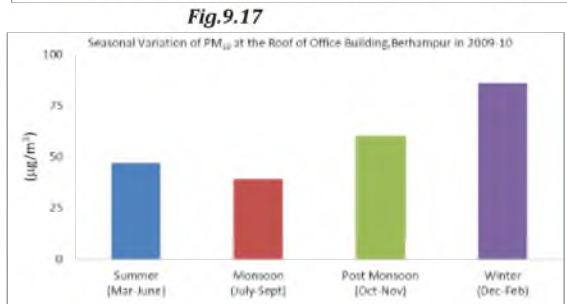
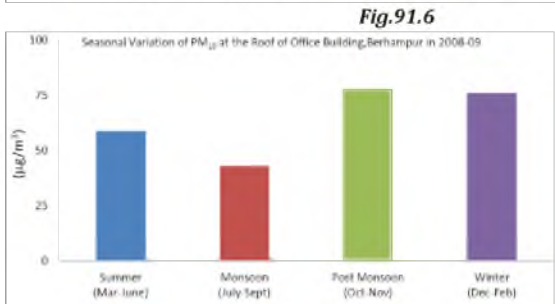
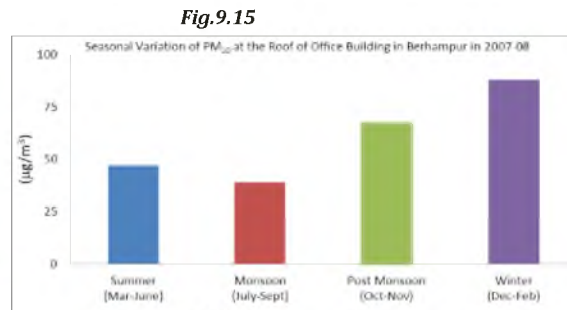
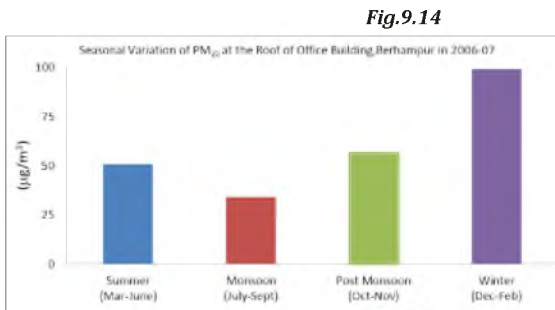


Table 9.2 **Categorisation of Ambient Air Quality on the basis of exceedence factor of Berhampur**

Location	Categorisation of Berhampur, (2006 to 2014)								
	SO ₂								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional Office Building, Berhampur	L	L	L	L	L	L	L	L	L

Location	NO _x								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional Office Building, Berhampur	L	L	L	L	L	L	L	L	L

Location	SPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional Office Building, Berhampur	H	H	H	M	H	H	H	H	H

Location	RSPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Regional Office Building, Berhampur	M	M	H	M	H	H	H	H	H

NB:- L: Low, M: Moderate, H: High

10.0 AMBIENT AIR QUALITY STATUS AND TRENDS OF KEONJHAR TOWN

The State Pollution Control Board, Odisha monitors the ambient air quality of Keonjhar town at one location. The details are presented in Table 10.0. The location of monitoring stations are selected as per the guideline of CPCB and are indicated in Fig.10.0.

Table : 10.0 Ambient Air Quality Monitoring Locations

Place	Location	Latitude / Longitude	Category of Area
Keonjhar	RO Building Baniapat, Keonjhar	21 ⁰ 39.270 N 85 ⁰ 36.577 E	Residential

10.1 Description of the Location

10.1.1 Regional Office Building Baniapat

The station is operating on the roof of Regional Office Building, Baniapat, Keonjhar at a height of 5 m. above the ground level. The station is located in the Residential as well as commercial areas.



Fig. 10.0 Map Showing Sampling Locations in Keonjhar Town



10.2 Ambient Air Quality of Keonjhar

Ambient Air Quality status of Keonjhar town from the year 2006-2014 with respect to annual average value, range value of 24hrly average and frequency of violation of parameters like SPM, RSPM (PM_{10}), SO_2 & NO_x are presented in Table 10.1 and trend analysis of the parameters are shown in Fig. 10.1 to 10.4. Seasonal variation of SPM & PM_{10} are shown in Fig. 10.5 to 10.22. Categorisation on the basis of exceedence factor of the area was shown in Table-10.2

10.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at Regional Office Building, Baniapat for the year 2006 to 2014 remained below their respective limits i.e., $50 \mu\text{g}/\text{m}^3$ for SO_2 & $40 \mu\text{g}/\text{m}^3$ for NO_x . The maximum annual average value of NO_x was $14.8 \mu\text{g}/\text{m}^3$ in the year 2006. NO_x at Regional Office Building, Baniapat was mostly in increasing trend from the year 2006 to 2014. The exceedence factor of SO_2 & NO_x showed Low category throughout the study period.

10.2.2 SPM & RSPM (PM_{10})

The annual average of SPM at Regional Office Building, Baniapat from the year 2008 to 2010 remained above the limit i.e., $140 \mu\text{g}/\text{m}^3$ and maximum annual average observed in the year 2009 i.e., $157 \mu\text{g}/\text{m}^3$. Maximum frequency of violation for SPM on 24 hrly average was 25% in the year 2008. The trend analysis of SPM at Regional Office Building, Baniapat mostly showed an increasing trend from the year 2007 to 2009 & 2011 to 2014. The exceedence factor of SPM showed Moderate from the year 2006 & 2007 & 2011 to 2014 and High from the year 2008 to 2010.

The annual average of RSPM remained above the limit i.e., $60 \mu\text{g}/\text{m}^3$ during the study period and maximum annual average value was observed in the year 2006 i.e., $140 \mu\text{g}/\text{m}^3$ and maximum frequency of violation for RSPM on 24hrly average was 56% in the year 2009. The trend of RSPM (PM_{10}) was mostly in decreasing trend during the study period.

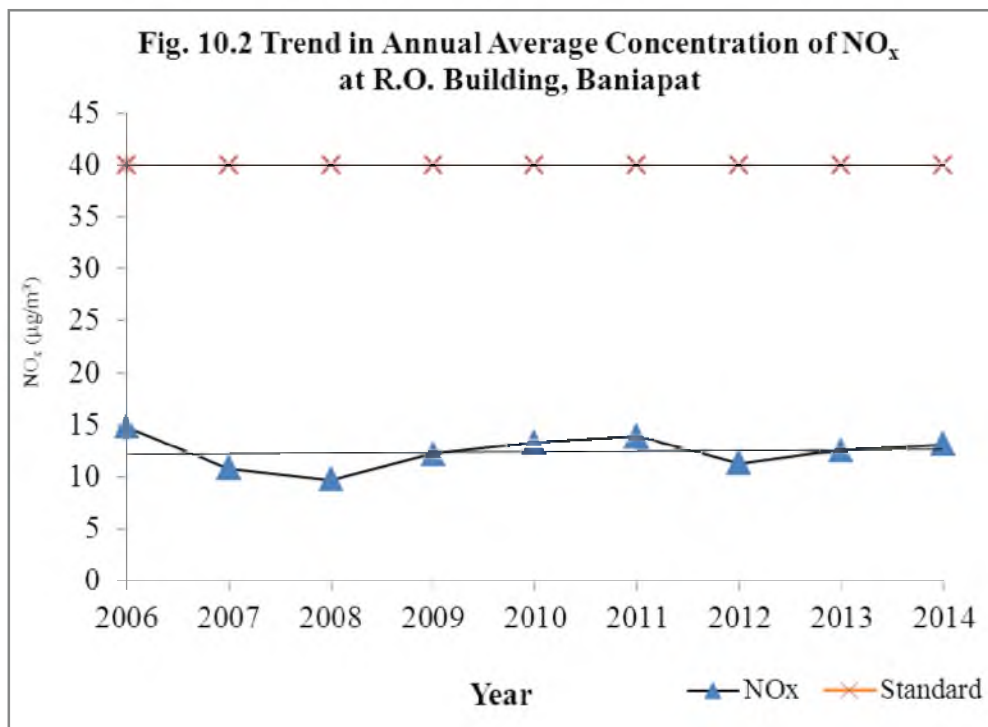
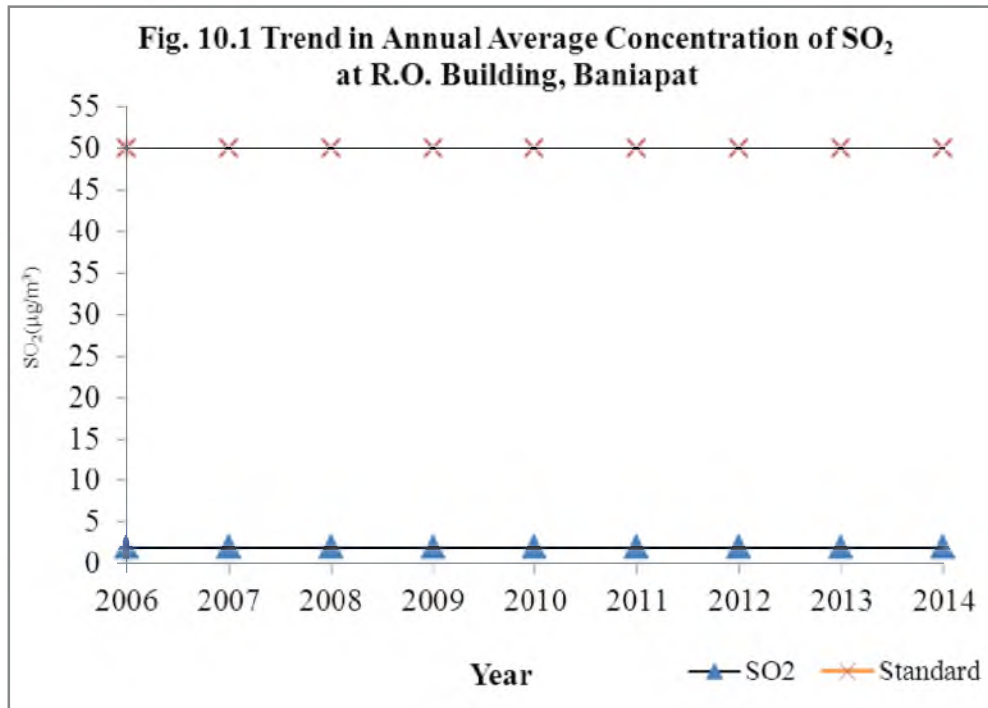
From seasonal variation it was observed that SPM & RSPM (PM_{10}) showed maximum value during winter season and during monsoon it showed minimum value throughout study period. Maximum seasonal average of SPM was $163 \mu\text{g}/\text{m}^3$ in the year 2007-08 and maximum seasonal average value of RSPM (PM_{10}) was $85 \mu\text{g}/\text{m}^3$ in the year 2013-14 during post-monsoon season.

Status of Ambient Air Quality at Keonjhor

Table: 10.1 Regional Office Building, Baniapat

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2006	120	75 (27-156)	140 (53-251)	BDL (BDL- 7.0)	14.8 (BDL-27.2)	15%	5%	-	-
2007	108	131 (35-239)	77 (20-149)	BDL (BDL-15.1)	10.8 (BDL-17.5)	15%	37%	-	-
2008	105	149 (51-268)	90 (30-178)	BDL (BDL-BDL)	9.7 (BDL-15.6)	25%	43%	-	-
2009	101	157 (74-263)	97 (48-152)	BDL (BDL-BDL)	12.2 (BDL-18.5)	20%	56%	-	-
2010	106	144 (67-282)	90 (45-180)	BDL (BDL-BDL)	13.3 (BDL-21.4)	11%	40%	-	-
2011	122	120 (27-206)	77 (16-123)	BDL (BDL-BDL)	13.9 (9.8-17.7)	1.6%	15.5%	-	-
2012	98	120 (70-245)	74 (41-160)	BDL (BDL-BDL)	11.3 (BDL- 16.1)	3%	10%	-	-
2013	101	116 (33-266)	77 (18-165)	BDL (BDL-BDL)	12.6 (10.2-19.0)	21.8%	28.7%	-	-
2014	102	127 (27-251)	75 (9-182)	BDL (BDL-BDL)	13.1 (9.1-20.8)	16.7 %	28.4 %	-	-
Prescribed standard (R)	24 hrly/ Annual Avg.	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual Avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

N.B.: BDL - Below Detectable Limit, R - Residential BDL Value for SO₂ - ≤4, BDL Value for NO_x - ≤9, BDL Value for RSPM - ≤ 5



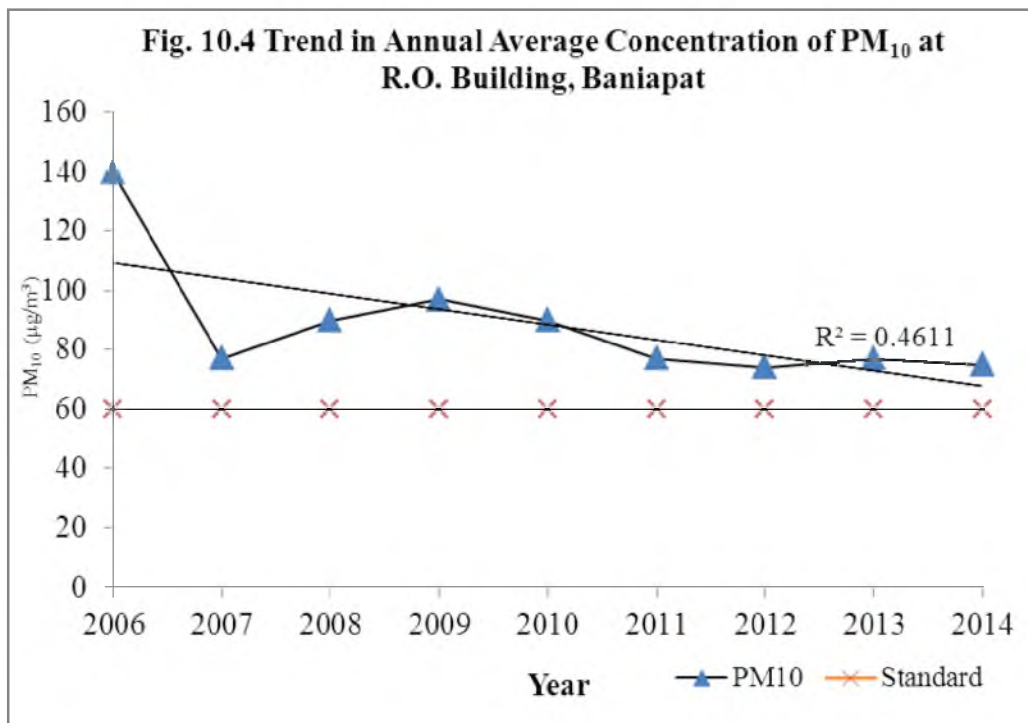
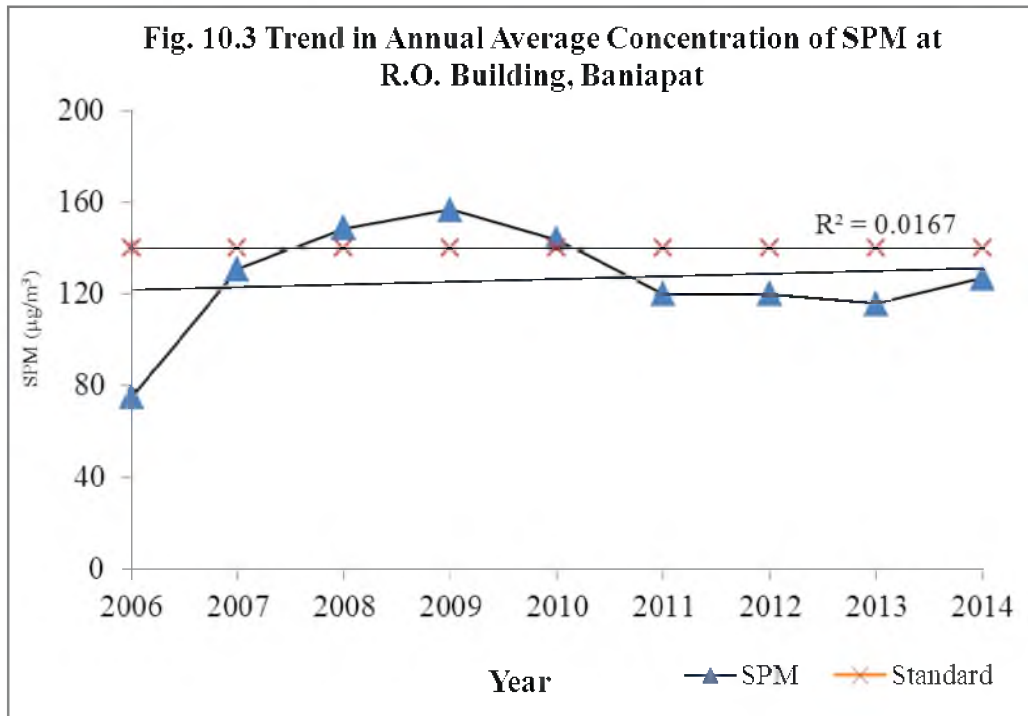


Fig.10.5

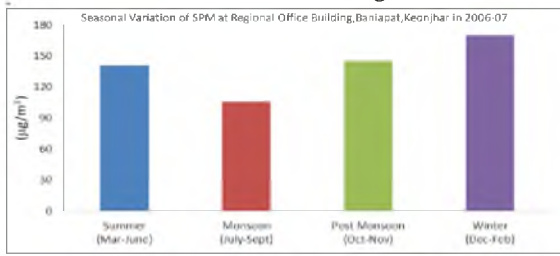


Fig.10.6

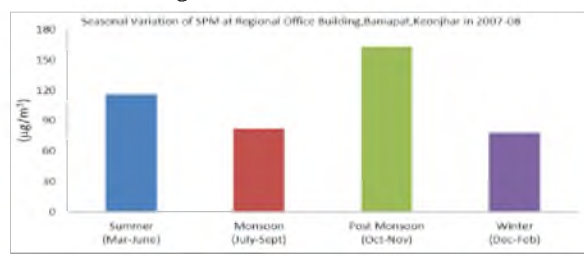


Fig.10.7

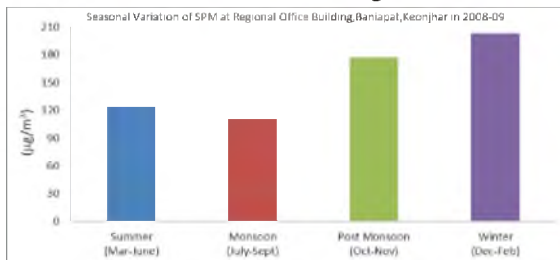


Fig.10.8

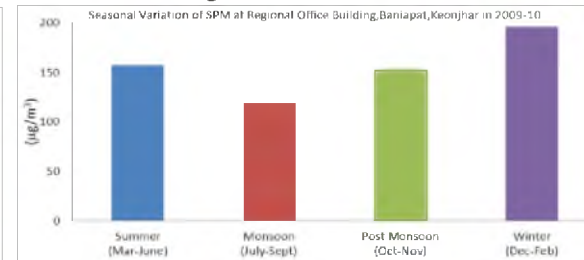


Fig.10.9

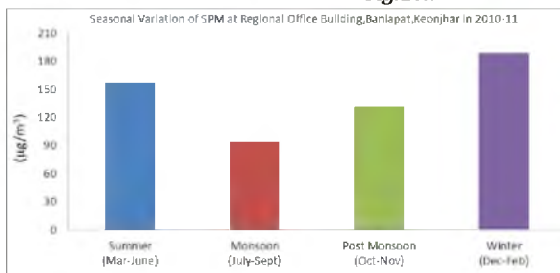


Fig.10.10

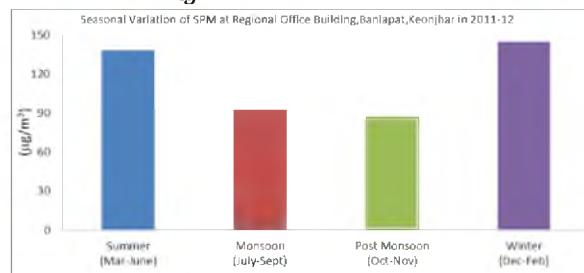


Fig.10.11

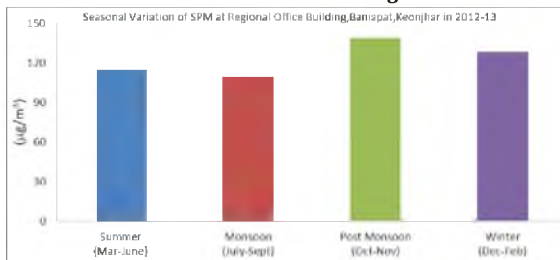


Fig.10.12

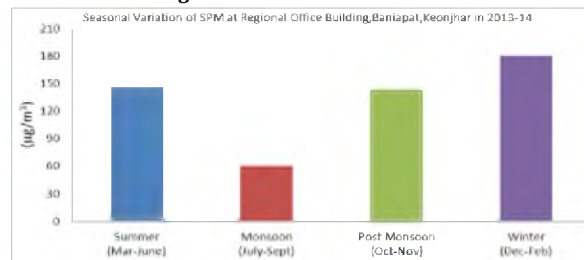


Fig.10.13

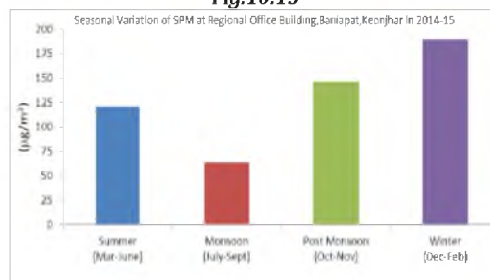


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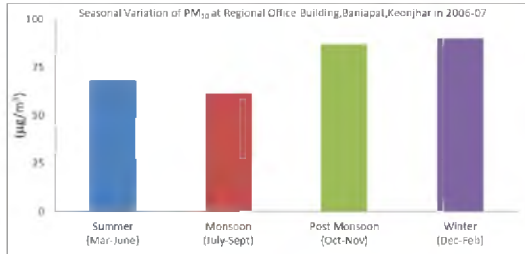


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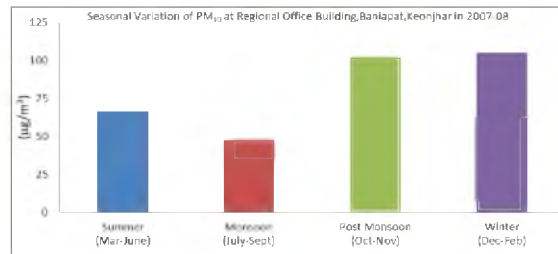


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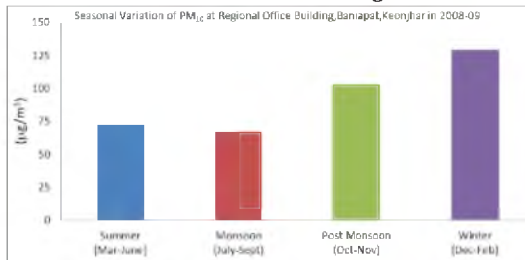


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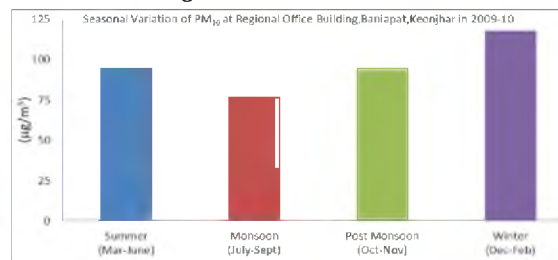


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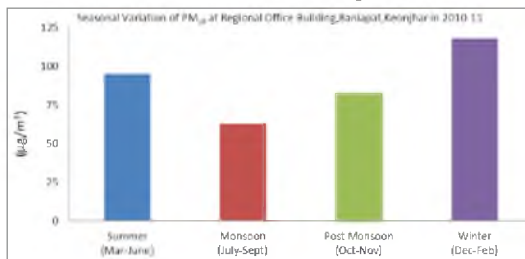


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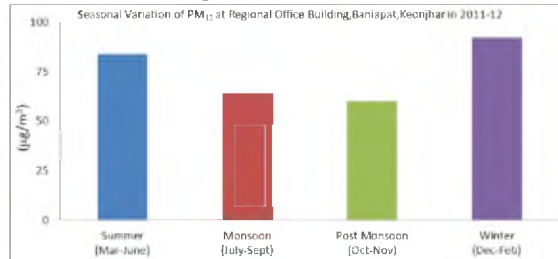


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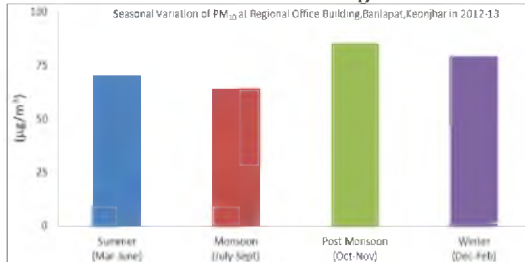


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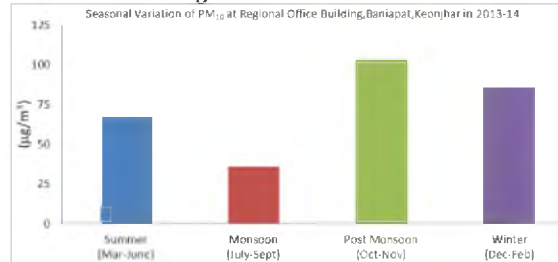


Fig.10.22

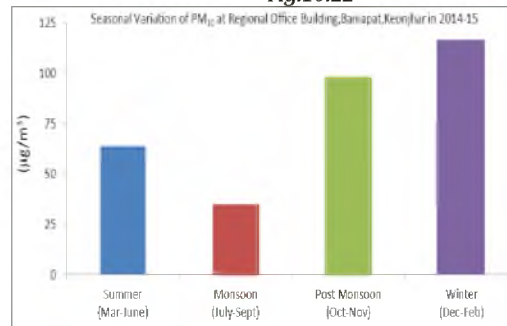


Table 10.2 Categorisation of Ambient Air Quality on the basis of exceedence factor of Keonjhar

Location	Categorisation of Keonjhar, (2006 to 2014)								
	SO ₂								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
R.O. Building, Baniapat	L	L	L	L	L	L	L	L	L

Location	NO _x								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
R.O. Building, Baniapat	L	L	L	L	L	L	L	L	L

Location	SPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
R.O. Building, Baniapat	M	M	H	H	H	M	M	M	M

Location	RSPM								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
R.O. Building, Baniapat	H	H	C	C	H	H	H	H	H

NB:-L: Low, M: Moderate, H: High, C: Critical

11.0 AMBIENT AIR QUALITY STATUS AND TRENDS OF KALINGANAGAR

The State Pollution Control Board, Odisha monitors the ambient air quality of Kalinganagar Industrial area at two locations. The details are presented in Table 11.0. The location of monitoring stations are selected as per the guideline of CPCB and are indicated in Fig.11.0.

Table:11.0 Ambient Air Quality Monitoring Locations

Place	Location	Latitude / Longitude	Category of Area
Kalinganagar	On the roof of Tata steel Office	20 ⁰ 59'19.93''N/85 ⁰ 59'23.89''E	Residential
	Roof of NINL Guest House	20 ⁰ 59'05.40''N/86 ⁰ 00'44.01''E	Industrial

11.1 Description of the locations

11.1.1 On the roof of Tata steel Office

The station is operating on the roof of Tata Steel Office at a height of 3 to 4 m from the ground level. The area is coming under commercial and industrial zones. M/s NINL is 2 km away from the monitoring site. The site is also close to NH-200 and SH from Duburi to Jajpur Road.

11.1.2 Roof of NINL Guest House

The station is operating on the Roof of M/s Nilachal Ispat Nigam Limited, Guest House at a height of 6 m. above the ground level. The guest house is inside the premises of M/s NINL and state highway from Duburi to Jajpur road is passing close to the monitoring site. Other industries MESCO, Jindal and TATA Steel are situated near to the monitoring site



Fig. 11.0 Map Showing Sampling Locations in Kalinganagar

11.2 AMBIENT AIR QUALITY OF KALINGANAGAR

Ambient air quality status of Kalinganagar area at two locations i.e., Roof of NINL Guest House and on the roof of TATA Steel office in the year 2013 & 2014 with respect to annual average value, range value of 24 hourly average and frequency of violation of parameters like SPM, RSPM (PM_{10}), SO_2 & NO_x are presented in Table 11.1 & 11.2. Seasonal variation of SPM & RSPM are shown in Fig. 11.1 to 11.4. Categorisation on the basis of exceedence factor of the locations were shown in Table 11.3.

11.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at both the locations remained below their respective limits i.e., $50 \mu\text{g}/\text{m}^3$ for SO_2 & $40 \mu\text{g}/\text{m}^3$ for NO_x . The maximum annual average value of NO_x was $16.9 \mu\text{g}/\text{m}^3$ on the roof of NINL Guest House & $16.0 \mu\text{g}/\text{m}^3$ on the roof of TATA steel office in the year 2013. On the basis of exceedence factor, SO_2 & NO_x fell under Low category at all locations throughout the study period.

11.2.2 SPM & RSPM (PM_{10})

The annual average value of SPM at both locations were well within the prescribed limit i.e., $360 \mu\text{g}/\text{m}^3$ for industrial area as well as within the 24 hrly limit. There were no frequency of violation observed for SPM in industrial area on 24 hourly average basis at both locations. The maximum annual average value was $218 \mu\text{g}/\text{m}^3$ at NINL guest house and was $219 \mu\text{g}/\text{m}^3$ at TATA Steel office in the year 2014. The exceedence factor at both the locations remained under High category in the year 2013 & Moderate in the year 2014.

The annual average value of RSPM (PM_{10}) at both locations were remained above the limit i.e., $60 \mu\text{g}/\text{m}^3$ during the study period. The maximum frequency of violation for RSPM on 24 hourly average was 47 % on the roof of NINL Guest House in the year 2014 & 40.8 % at Tata Steel office in the year 2013. The exceedence factor showed that both the locations were under Critical category for RSPM (PM_{10}) in the year.

From seasonal variation, it was observed that SPM & RSPM (PM_{10}) showed mostly High values in winter season and Low in monsoon during the study period. However, maximum value for SPM i.e., $251 \mu\text{g}/\text{m}^3$ & PM_{10} i.e., $107 \mu\text{g}/\text{m}^3$ was observed during summer season in the year 2014.

Status of Ambient Air Quality at Kalinganagar

Table:11.1 Over the roof of NINL Guest House

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2013	93	176 (65-312)	93 (32-164)	BDL (BDL-4.2)	16.9 (10.3-25.8)	-	45.0 %	-	-
2014	104	218 (152-289)	98 (59-129)	BDL (BDL-BDL)	10.2 (9.6-11.3)	-	47 %	-	-
Prescribed standard (R)	24 hrly / Annual Avg.	500/360	150/120	120/80	120/80	As Per 1998 Standard			
	24 hrly/ Annual Avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

Table:11.2 Over the roof of TATA

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2013	93	173 (59-328)	89 (32-165)	BDL (BDL-BDL)	16.0 (11.7-21.0)	-	40.8 %	-	-
2014	104	219 (150-274)	98 (69-123)	BDL (BDL-BDL)	10.3 (9.7-12.3)	-	37.5 %	-	-
Prescribed standard (R)	24 hrly/ Annual Avg.	500/360	150/120	120/80	120/80	As Per 1998 Standard			
	24 hrly/ Annual Avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

N.B.: BDL - Below Detectable Limit, R – Residential BDL Value for SO₂ - ≤ 4 , BDL Value for NO_x - ≤ 9 , BDL Value for RSPM - ≤ 5

Fig.11.1

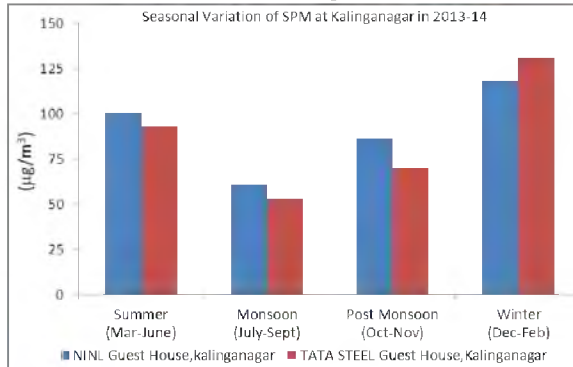


Fig.11.2

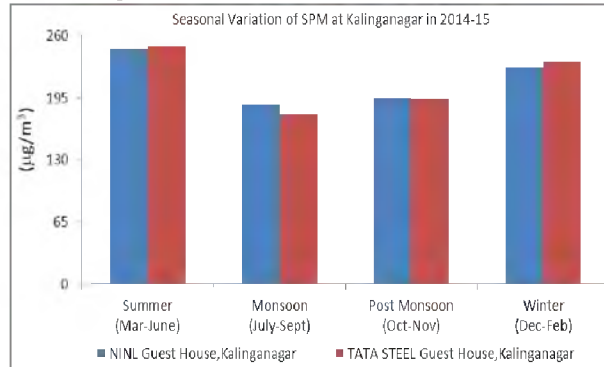


Fig.11.3

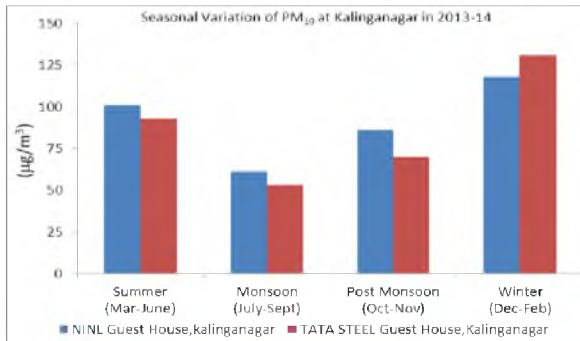


Fig.11.4

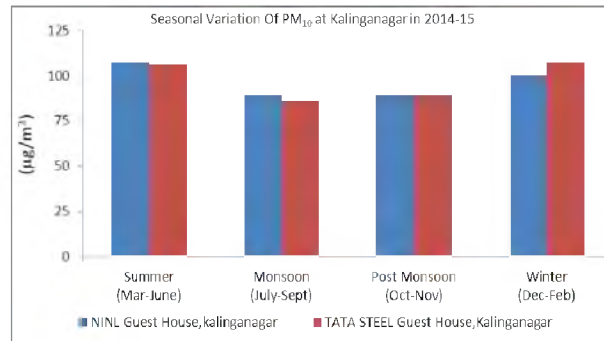


Table 11.3 Categorisation of Ambient Air Quality on the basis of exceedence factor of Kalinganagar

Location	Categorisation of Kalinganagar							
	2013	2014	2013	2014	2013	2014	2013	2014
	SO ₂	SO ₂	NO _x	NO _x	SPM	SPM	RSPM	RSPM
1. On the roof of Tata steel Offices	L	L	L	L	H	M	H	C
2. Roof of NINL Guest House	L	L	L	L	H	M	C	C

NB:- L: Low, H: High, C: Critical

12.0 AMBIENT AIR QUALITY STATUS AND TRENDS OF KONARK TOWN

The State Pollution Control Board, Odisha monitors the ambient air quality of Konark town at one location. The details is presented in Table 12.0 The location of monitoring station is selected as per the guideline of CPCB and is indicated in Fig.12.0.

Table 12.0 Ambient Air Quality Monitoring Location

Place	Location	Latitude / Longitude	Category of Area
Konark	Konark Police Station	19 ⁰ 53'19.8''N/86 ⁰ 05'31.4''	Residential

12.1 Description of the Location

12.1.1 Konark Police Station

The station is operating on the roof of Konark Police station, at a height of 3 m. above the ground level. The site is coming under Residential area & the SH from Konark-Puri marine drive is passing nearby.



Fig. 12.0 Map Showing Sampling Locations in Konark

12.2 Ambient Air Quality of Konark

Ambient Air Quality status of Konark town in the year 2013 & 2014 with respect to annual average value, range value of 24 hrly average and frequency of violation of parameters like SPM, RSPM (PM_{10}), SO_2 & NO_x are presented in Table 12.1. Seasonal variation of SPM & PM_{10} are shown in Fig. 12.1 to 12.4. Categorisation on the basis of exceedence factor of the area was shown in Table 12.2

12.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at Konark Police Station, Konark for the year 2013 & 2014 remained below their respective limits i.e., $50 \mu g/m^3$ for SO_2 & $40 \mu g/m^3$ for NO_x . Maximum annual average value of NO_x was $13 \mu g/m^3$ in the year 2014. The exceedence factor for SO_2 & NO_x were under Low category during the study period.

12.2.2 SPM & RSPM (PM_{10})

The annual average of SPM value at Konark Police Station, Konark remained below the limit i.e., $140 \mu g/m^3$ in the study period and maximum annual average value shown in the year 2014 was $106 \mu g/m^3$. The exceedence factor of SPM showed Moderate in the year 2013 & 2014.

The annual average of RSPM (PM_{10}) remained above the limit i.e., $60 \mu g/m^3$ in the year 2013 & 2014. Maximum annual average value was $69 \mu g/m^3$ in the year 2014. The exceedence factor of RSPM showed High during the study period.

From seasonal variation it was observed that SPM & RSPM (PM_{10}) showed High values during winter season and low value during monsoon during the season.

Status of Ambient Air Quality at Konark

Table: 12.1 Konark Police station

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2013	85	102 (25-325)	65 (15-207)	BDL (BDL-BDL)	12.1 (BDL-25.2)	9.4 %	2 %	-	-
2014	85	106 (31-362)	69 (17-240)	BDL (BDL-7.3)	13 (BDL-21.8)	16.5 %	22.3 %	-	-
Prescribed standard (R)	24 hrly / Annual avg.	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

N.B.: BDL - Below Detectable Limit, R – Residential BDL Value for SO₂ - ≤ 4 , BDL Value for NO_x - ≤ 9 , BDL Value for RSPM - ≤ 5

Fig. 12.1

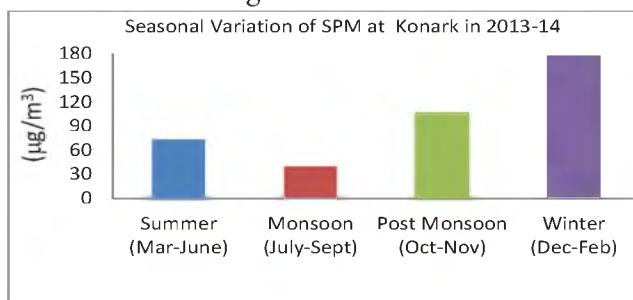


Fig. 12.2

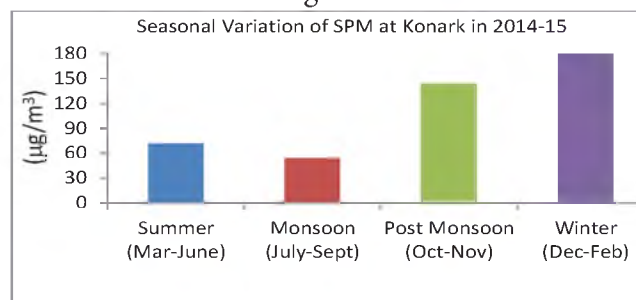


Fig. 12.3

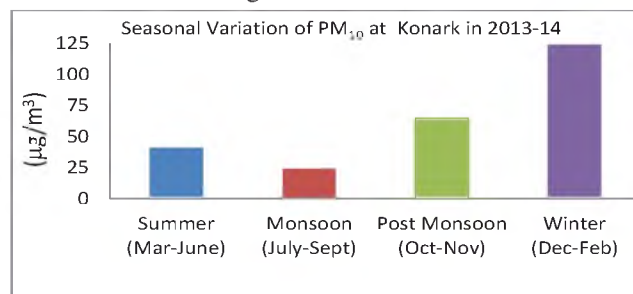


Fig. 12.4

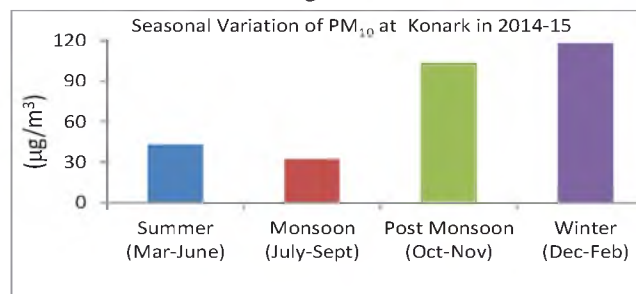


Table 12.2 Categorisation of Ambient Air Quality on the basis of exceedance factor of Konark

Location	Categorisation of Konark							
	2013	2014	2013	2014	2013	2014	2013	2014
	SO ₂	SO ₂	NO _x	NO _x	SPM	SPM	RSPM	RSPM
Konark Police Station	L	L	L	L	M	M	H	H

NB:- L: Low, M: Moderate, H: High

13.0 AMBIENT AIR QUALITY STATUS AND TRENDS OF PARADEEP TOWN

The State Pollution Control Board, Odisha monitors the ambient air quality of Paradeep at three locations. The details are presented in Table 13.0 The locations of monitoring stations are selected as per the guideline of CPCB and are indicated in Fig.13.0

Table:13.0 Ambient Air Quality Monitoring Locations

Place	Location	Latitude / Longitude	Category of Area
Paradeep	1.Roof of guest house, PPL	20 ⁰ 16'27.13'' N 086 ⁰ 38'24.95'' E	Residential
	2.Roof of STP, IFFCO	20 ⁰ 19'21.39'' N 086 ⁰ 39'18.01'' E	Industrial
	3.Roof of the PPT staff Quarters	20 ⁰ 16'04.73'' N 086 ⁰ 38'47.44'' E	Residential

13.1 Description of the Location

13.1.1 Roof of guest house of PPL

The monitoring station is operating on the roof of PPL guest house at a height of 3m above the ground level. The monitoring site is surrounded by residential colony.

13.1.2 Roof of STP, IFFCO

The monitoring station is operating on the roof of sewage treatment plant (STP) of IFFCO inside the factory premises. The site is only 300m away from the residential colony of M/s IFFCO. The monitoring site is 4m above the ground level.

13.1.3 Roof of the PPT Staff Quarters

The station is operating on the roof of PPT staff quarters at a height of 6m above the ground level. The monitoring site is inside the staff quarters of M/S PPT. The monitoring site is close to Badapadia main market complex of Paradeep. The aerial distance of M/s PPL from the site is about 500 m.



Fig. 13.0 Map Showing Sampling Locations in Paradeep Town

13.2 Ambient Air Quality of Paradeep

Ambient air quality status of Paradeep town at three locations i.e., roof of guest house, PPL, roof of STP, IFFCO & roof of the PPT staff quarters for the year 2013 & 2014 with respect to annual average value, range value of 24 hourly average and frequency of violation of parameters like SPM, RSPM(PM_{10}), SO_2 & NO_x are presented in Table 13.1 to 13.3. Seasonal variation of SPM & RSPM are shown in Fig.13.1 to 13.4. Categorisation on the basis of exceedence factor of the town was shown in Table 13.4.

13.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at all locations remained below their respective limits i.e., $50 \mu\text{g}/\text{m}^3$ for SO_2 & $40 \mu\text{g}/\text{m}^3$ for NO_x . The maximum annual average value of SO_2 showed $9.8 \mu\text{g}/\text{m}^3$ at guest house, PPL, $9.9 \mu\text{g}/\text{m}^3$ at STP, IFFCO & $8.9 \mu\text{g}/\text{m}^3$ at PPT staff quarters in the year 2014. The maximum annual average value of NO_x was $12.3 \mu\text{g}/\text{m}^3$ at guest house, PPL, $12.5 \mu\text{g}/\text{m}^3$ at STP, IFFCO in the year 2013 & $12.9 \mu\text{g}/\text{m}^3$ at roof of the PPT staff quarters in the year 2014 were observed. On the basis of exceedence factor SO_2 & NO_x fell under Low category at all locations throughout the study period.



13.2.2 SPM & RSPM (PM_{10})

The annual average value for SPM of Residential area at both locations remained above the limit i.e., $140 \mu\text{g}/\text{m}^3$ in the year 2014. The maximum annual average value for SPM at guest house, PPL was $162 \mu\text{g}/\text{m}^3$ in the year 2014 & at PPT staff Quarters was $182 \mu\text{g}/\text{m}^3$ in the year 2014. Whereas at STP, IFFCO was $179 \mu\text{g}/\text{m}^3$, falling under industrial area was well within the prescribed limit i.e., $360 \mu\text{g}/\text{m}^3$. The maximum frequency of violation for SPM in residential area on 24 hourly average was 26 % at guest house of PPL & 40.2 % at PPT staff quarters in the year 2014. There was no violation at STP, IFFCO. The exceedence factor showed Moderate at guest house of PPL & at PPT staff quarters in the year 2013 and High in the year 2014 and at STP, IFFCO shows Moderate in the year 2013 & showed Low in the year 2014 at STP, IFFCO.

The annual average value of RSPM (PM_{10}) at all three stations remained above the limit i.e., $60 \mu\text{g}/\text{m}^3$ in the year 2014, except at guest house of PPL, at STP, IFFCO & at PPT staff quarters in the year 2013. The maximum annual average value for RSPM at guest house, PPL was $84 \mu\text{g}/\text{m}^3$, at PPT staff Quarters was $95 \mu\text{g}/\text{m}^3$ & at STP, IFFCO was $93 \mu\text{g}/\text{m}^3$. The maximum frequency of violation for RSPM in residential area on 24 hourly average was 30.2 % at guest house of PPL & 34% at PPT staff quarters and 41.2 % at STP, IFFCO in the year 2014. The exceedence factor showed Moderate in the year 2013 & High in 2014, at guest house of PPL, Moderate at PPT staff quarters in the year 2013 & Critical in the year 2014 and at STP, IFFCO showed High in the year 2013 & Critical in the year 2014.

From seasonal variation it was observed that SPM & RSPM (PM_{10}) showed High values in winter season and Low during monsoon season.


Status of Ambient Air Quality at Paradeep
Table:13.1 on the roof of Guest House, PPL

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2013	79	100 (48-297)	49 (18-191)	BDL (BDL-7.4)	12.3 (9.2-16.3)	8.9 %	10.1%	-	-
2014	96	162 (69-406)	84 (33-237)	9.8 (6.1-15.6)	11.4 (9.9-13.7)	26.0%	30.2 %	-	-
Prescribed Standard (R)	24 hrly / Annual Avg.	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual Avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

N.B.: BDL - Below Detectable Limit, R – Residential BDL Value for SO₂ - ≤4, BDL Value for NO_x - ≤9, BDL Value for RSPM - ≤5

Table:13.2 On the roof of IFFCO STP

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2013	62	119 (47-351)	60 (21-194)	BDL (BDL-15.6)	12.5 (BDL-16.3)	-	1.6 %	-	-
2014	97	179 (63-370)	93 (29-211)	9.9 (5.8-17.3)	11.3 (9.9-13.4)	-	41.2 %	-	-
Prescribed standard (R)	24 hrly / Annual Avg.	500/360	150/120	120/80	120/80	As Per 1998 Standard			
	24 hrly/ Annual Avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

Table:13.3 On the roof of Paradeep Port Trust

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)				Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)			
		SPM	RSPM	SO ₂	NO _x	SPM	RSPM	SO ₂	NO _x
2013	50	111 (39-391)	55 (19-203)	BDL (BDL-9.6)	11.9 (BDL-17.8)	18 %	18 %	-	-
2014	97	182 (69-396)	95 (31-208)	8.9 (5.2-14.7)	12.9 (10.6-16.9)	40.2 %	34 %	-	-
Prescribed standard (R)	24 hrly / Annual avg.	200/140	100/60	80/60	80/60	As Per 1998 Standard			
	24 hrly/ Annual avg.	-	100/60	80/50	80/40	As Per 2009 Standard			

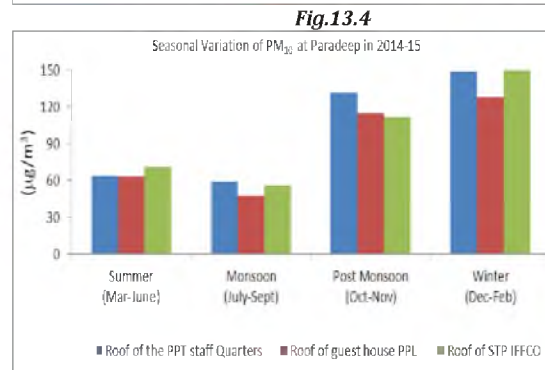
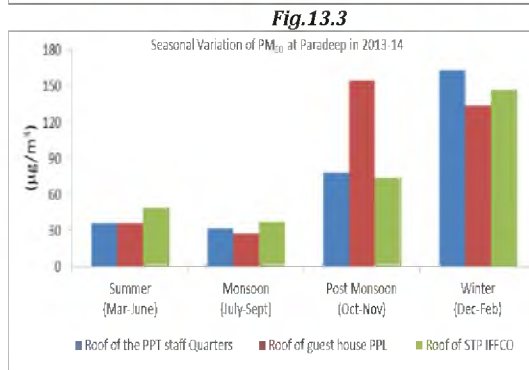
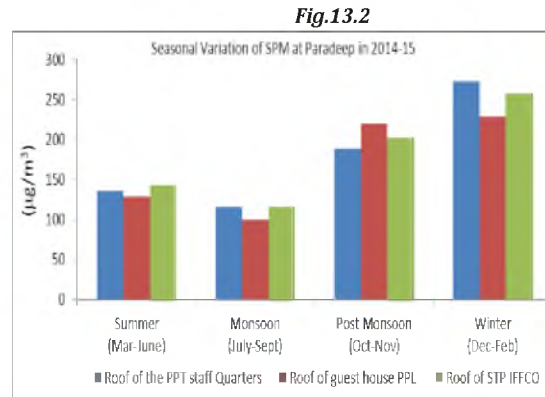
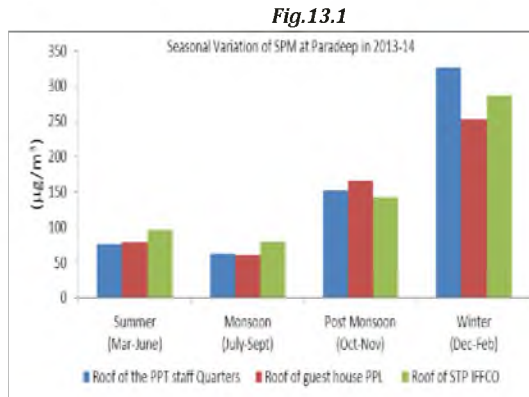


Table 11.3 Categorisation of Ambient Air Quality on the basis of exceedence factor of Paradeep

Location	Categorisation of Paradeep							
	2013	2014	2013	2014	2013	2014	2013	2014
	SO ₂	SO ₂	NO _x	NO _x	SPM	SPM	RSPM	RSPM
Roof of guest house PPL	L	L	L	L	M	H	M	H
Roof of IFFCO STP	L	L	L	L	M	L	H	C
On the roof of Paradeep Port Trust	L	L	L	L	M	H	M	C

NB:- L: Low, M: Moderate, H: High, C: Critical

14.0 AMBIENT AIR QUALITY STATUS AND TRENDS OF PURI TOWN

The State Pollution Control Board, Odisha monitors the ambient air quality of Puri town at two locations. The details are presented in Table 14.0. The location of monitoring stations are selected as per the guideline of CPCB and are indicated in Fig.14.0

Table 14.0 Ambient Air Quality Monitoring Locations

Place	Location	Latitude / Longitude	Category of Area
Puri	1. Sadar Police Station, Puri	19 ⁰ 16'17.1'' N 85 ⁰ 49'57.4'' E	Residential
	2. Town police station, Puri	19 ⁰ 48'29.7'' N 85 ⁰ 49'22.3'' E	Residential

14.1 Description of the Locations

14.1.1 Sadar Police Station

The monitoring station is operating on the roof of Sadar Police Station at a height of 4m above the ground level and it is located in both residential and commercial areas and it is 1 km, from the Railway station. The VIP road is passing nearby the monitoring station.

14.1.2 Town Police Station

The station is operating on the roof of the Town Police Station at about 8m height from the ground level. The station is located in the commercial area and it is 1km away from the Lord Jagannath Temple, Puri.

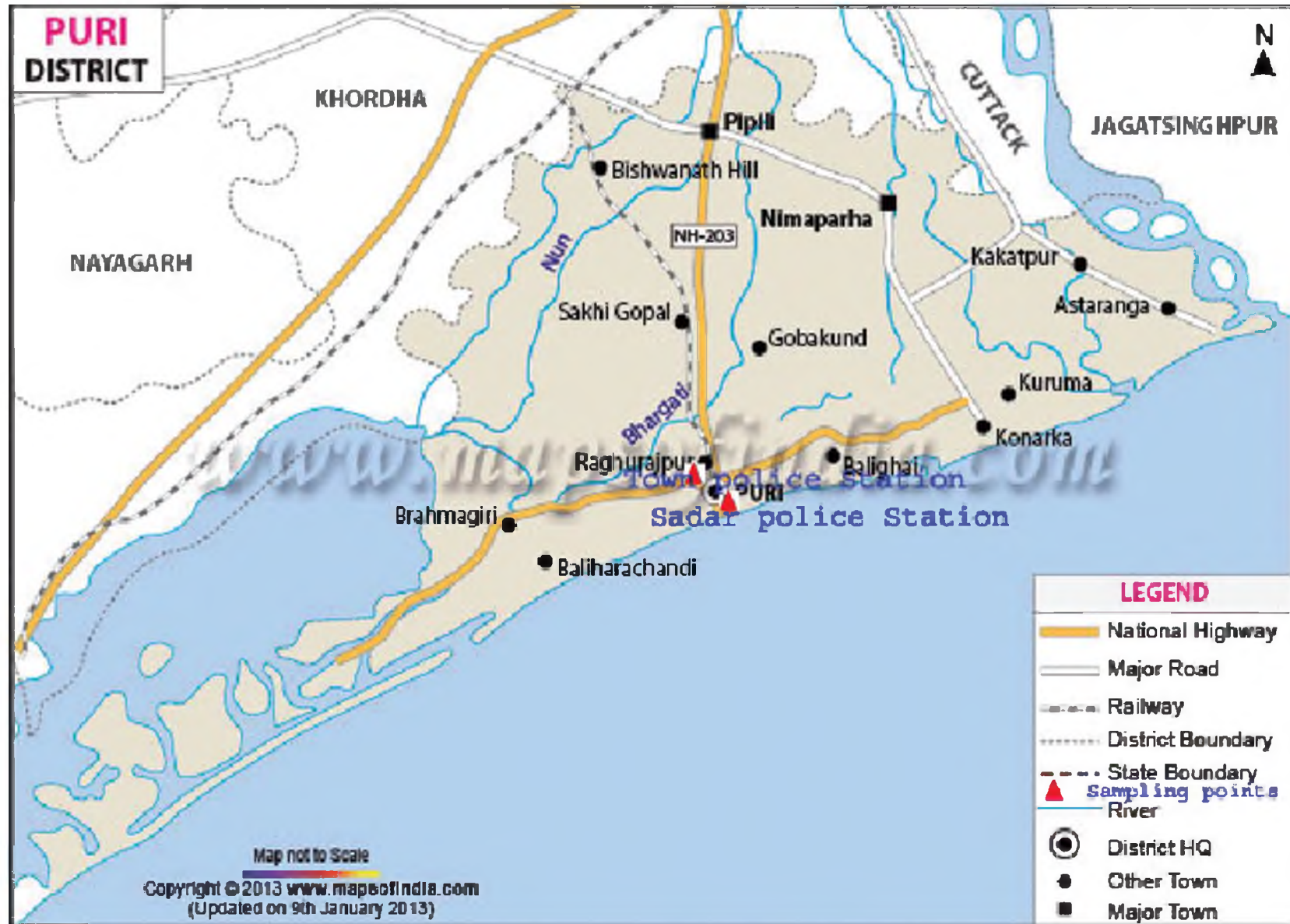


Fig. 14.0 Map Showing Sampling Locations in Puri Town

14.2 Ambient Air Quality of Puri

Ambient Air Quality status of Puri at two locations i.e., at Sadar Police Station & Town Police Station in the year 2013 & 2014 with respect to annual average value, range value of 24hrly average and frequency of violation of parameters like SPM, RSPM (PM_{10}), SO_2 and NO_x are presented in Table 14.1 & 14.2, Seasonal variation of SPM & PM_{10} are shown in Fig. 14.1 to 14.4. Categorisation on the basis of exceedence factor of the area is shown in Table 14.3.

14.2.1 SO_2 & NO_x

The annual average value of SO_2 & NO_x at Sadar Police Station & at Town Police Station for the year 2013 & 2014 remained below their respective limit i.e., $50 \mu\text{g}/\text{m}^3$ for SO_2 & $40 \mu\text{g}/\text{m}^3$ for NO_x . Maximum annual average of NO_x was $16.4 \mu\text{g}/\text{m}^3$ at Sadar Police Station & $14.9 \mu\text{g}/\text{m}^3$ at Town Police Station in the year 2014. The exceedence factor of SO_2 & NO_x remained under Low Category throughout the study period.

14.2.2 SPM & RSPM (PM_{10})

The annual average of SPM value at Sadar Police Station & Town Police Station remained below the limit i.e., $140 \mu\text{g}/\text{m}^3$ during study period and maximum annual average value at Sadar Police Station was $122 \mu\text{g}/\text{m}^3$ and at Town Police Station it was $110 \mu\text{g}/\text{m}^3$ in the year 2014. The exceedence factor of SPM showed Moderate category at both the locations in the year 2013 & 2014.

The annual average of RSPM of both the locations remained above the limit i.e., $60 \mu\text{g}/\text{m}^3$ in the study period, except at Town Police Station in the year 2013 and maximum annual average at Sadar Police Station was $74 \mu\text{g}/\text{m}^3$ in the year 2013 and at Town Police Station it was $66 \mu\text{g}/\text{m}^3$ in the year 2014. The exceedence factor of RSPM showed High category at Sadar Police Station in the year 2013 & 2014 and at Town Police Station it was Moderate category in 2013 & was High category in 2014.

From the seasonal variation, it was observed that SPM & RSPM (PM_{10}) during winter season showed High values and Low values during monsoon season throughout the study period.

14.2.3 $PM_{2.5}$

Ambient air quality with respect to $PM_{2.5}$ was monitored at town Police station, Puri in the year 2014. The annual average value of $PM_{2.5}$ was within the prescribed limit i.e $40 \mu\text{g}/\text{m}^3$. The maximum percentage of violation with respect to 24 hrly. average was 15.6 %. The maximum 24 hrly. average value of $PM_{2.5}$ was $108 \mu\text{g}/\text{m}^3$ observed in the month of January 2014.

Status of Ambient Air Quality at Puri



Table:14.1 Sardar Police Station

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)					Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)				
		SPM	RSPM	PM _{2.5}	SO ₂	NO _x	SPM	RSPM	PM _{2.5}	SO ₂	NO _x
2013	41	120 (42-292)	74 (22-192)	-	BDL (BDL-BDL)	16.1 (BDL-43.5)	17.1 %	29.3 %	-	-	-
2014	66	122 (68-215)	73 (43-139)	-	BDL (BDL-11.3)	16.4 (10.9-27.2)	10.6 %	16.7 %	-	-	-
Prescribed standard (R)	24 hrly / Annual Avg.	200/140	100/60	-	80/60	80/60	As Per 1998 Standard				
	24 hrly/ Annual Avg.	-	100/60	60/40	80/50	80/40	As Per 2009 Standard				

Table:14.2 Town police station

Year	No. of Obs. (24 hrs.)	Parameters ($\mu\text{g}/\text{m}^3$) Annual Average (Range Values)					Frequency of violation of data (24 hrs. Avg.) from prescribed standard (% of violation)				
		SPM	RSPM	PM _{2.5}	SO ₂	NO _x	SPM	RSPM	PM _{2.5}	SO ₂	NO _x
2013	80	87 (45-293)	54 (21-174)	-	BDL (BDL-BDL)	10.6 (BDL-27.1)	3.8 %	16.3 %	-	-	-
2014	65	110 (35-229)	66 (28-160)	39 (6-108)	BDL (BDL-BDL)	14.9 (10.0-25.4)	6.2 %	13.8 %	15 %	-	-
Prescribed standard (R)	24 hrly / Annual Avg	200/140	100/60	-	80/60	80/60	As Per 1998 Standard				
	24 hrly/ Annual Avg.	-	100/60	60/40	80/50	80/40	As Per 2009 Standard				

N.B.: BDL - Below Detectable Limit, R – Residential BDL Value for SO₂ - ≤4, BDL Value for NO_x - ≤9, BDL Value for RSPM - ≤ 5

Fig.14.1

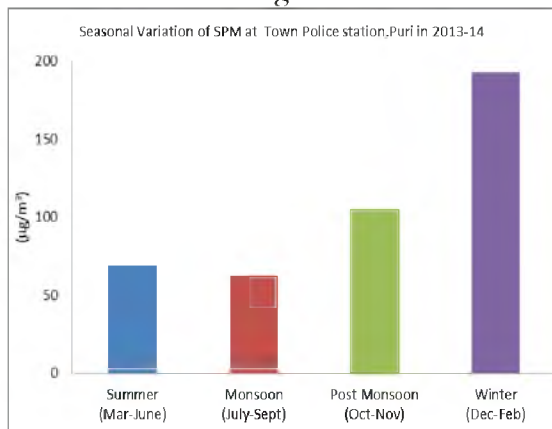


Fig.14.2

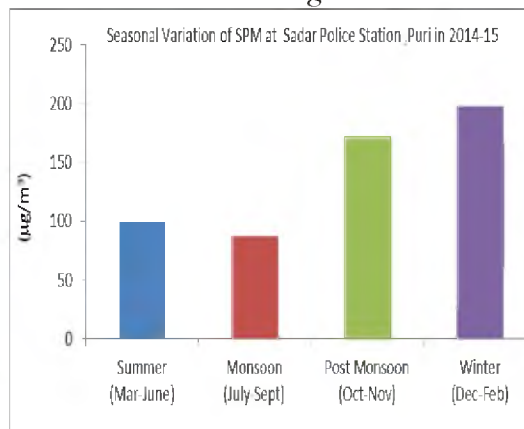


Fig.14.3

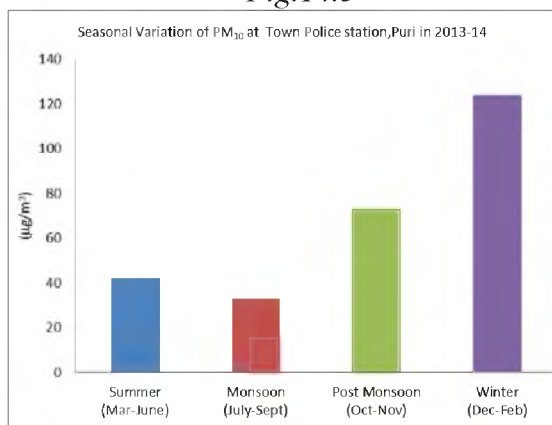


Fig.14.4

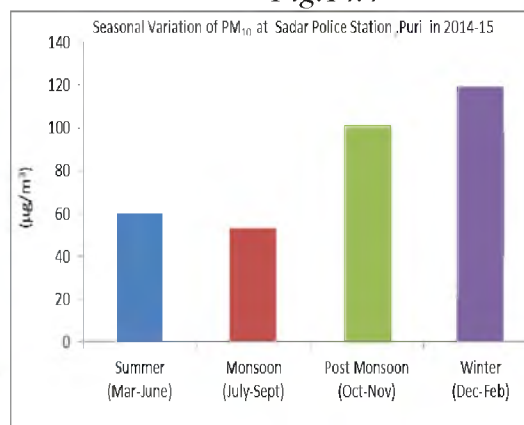


Table 14.3 Categorisation of Ambient Air Quality on the basis of exceedence factor of Puri

Location	Categorisation of Puri							
	2013	2014	2013	2014	2013	2014	2013	2014
	SO ₂	SO ₂	NO _x	NO _x	SPM	SPM	RSPM	RSPM
1.Sadar Police Station, Puri	L	L	L	L	M	M	H	H
2.Town police station, Puri	L	L	L	L	M	M	M	H

NB:- L: Low, M: Moderate, H: High



A. CONCLUSION

1. SO₂

At all the monitored locations of the State for the year 2006 to 2014 the SO₂ concentration were Below Detectable limit (BDL) i.e., $\leq 4.0 \mu\text{g}/\text{m}^3$ except in few areas like Angul, Talcher, Rourkela and Rasulpur of Balasore where SO₂ remains above BDL. However, the values were well below the prescribed limit i.e., $50 \mu\text{g}/\text{m}^3$. In these areas the source of SO₂ was from industrial emission. The maximum annual average of SO₂ was observed at MCL, Talcher as $14.3 \mu\text{g}/\text{m}^3$ in the year 2008. All places fell under Low category in the State on the basis of exceedence factor.

2. NO_x

Oxides of Nitrogen (NO_x) of all monitored stations of Odisha during the year 2006-2014 remained in the Low Category except sometimes under Moderate Category at Angul, Talcher, Rayagada and Badambadi area of Cuttack. The Maximum annual average of NO_x value was $43 \mu\text{g}/\text{m}^3$ as observed at Badambadi traffic tower in the year 2007. The NO_x values of all stations remained well within the prescribed limit i.e., $40 \mu\text{g}/\text{m}^3$. High NO_x at Badambadi area might be due to traffic junction near the monitoring station. From the trend of analysis (from the year 2006 to 2014) it was observed that the trend was increasing at all the monitoring stations except one at Traffic tower, Badambadi which was in decreasing trend and remained unchanged at RO, Baniapat, Keonjhar

3. SPM

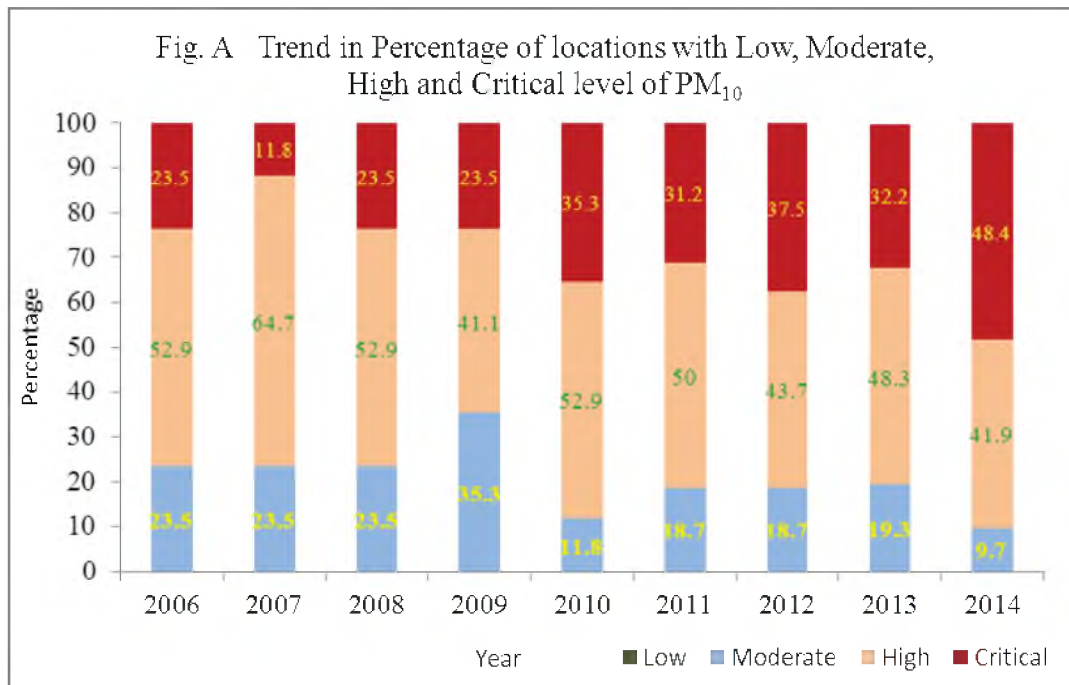
SPM value at all monitoring locations of the State from the year 2006 to 2014 showed that in industrial area the annual average value was below the prescribed limit i.e., $360 \mu\text{g}/\text{m}^3$ and the trend was decreasing. However, at Talcher thermal power station, Talcher, it was in increasing trend. Industrial areas like RO, SPCB, Angul and TTPS, Talcher fell under Moderate category where as at Jaykaypur, Indian farmers fertilizer corporation, Paradeep & at Nilachal Ispat Nigam Ltd, Kalinga Nagar, fell under Low category. In residential area, the annual average value of SPM was above the prescribed limit i.e., $140 \mu\text{g}/\text{m}^3$ at all locations except at Sambalpur & Rayagada. The trend at all residential locations were increasing except at Rayagada which was in decreasing trend. On the basis of categorisation, all locations fell in Moderate to High Categories and at some places it became Critical. The High SPM value in major towns were mainly due to road dust and construction of roads & buildings as well as from domestic sources.

4. PM₁₀

PM₁₀ Values in both industrial and residential area at all locations from the year 2006 to 2013 indicates that the annual average values at all the locations were higher than the prescribed limit i.e., $60 \mu\text{g}/\text{m}^3$ except at few locations like Paradeep, Sambalpur, Rayagada & Town Police Station, Puri where it remained below the limit. The High PM₁₀ values in the major towns indicated

that vehicular emission was the root cause which contributed very fine particles of size less than 10μ to the ambient air. From the trend analysis it was observed that at all locations the trend were in increasing order except at Keonjhar, Sambalpur & Rourkela where the trend were in decreasing order. All monitoring locations fall under High and Critical categories except Moderate Category at Rayagada, Berhampur, Sambalpur and Paradeep areas. The fine dust in major towns came from vehicular emission due to steep increase in number of vehicles in the town area in addition to construction work and cutting of trees due to expansion of road and domestic emission contributed towards PM_{10} .

Trend in percentage of locations with low, moderate, high and critical level of PM_{10} is depicted in Fig. A. PM_{10} level showed an increasing trend in Critical category indicating increase in pollution level during last 9 years.



5. $PM_{2.5}$

$PM_{2.5}$ sample was monitored at Bhubaneswar, Cuttack and Puri in the year 2014. The annual average value of $PM_{2.5}$ at all monitoring location of Cuttack exceeded the limit i.e $40\mu\text{g}/\text{m}^3$. Whereas in Bhubaneswar and Puri all monitoring stations were within the limit except at Capital Police Station, Bhubaneswar i.e, $44\mu\text{g}/\text{m}^3$. The maximum 24 hrly. average value of $PM_{2.5}$ was observed on the day of Deepawali i.e, $504\mu\text{g}/\text{m}^3$ at SPCB office Building Bhubaneswar. Besides that 6.4 to 13.5% of violation to 24 Hourly standard was observed at Bhubaneswar, 22.5 to 35.6% of violation observed at Cuttack and 15% of violation was observed at Puri.



B. RECOMMENDATION

It is revealed from this compilation that Particulate matter both SPM and RSPM are the major constituents for downgrading the Ambient Air Quality. More over non-compliance to Ambient Air Quality Status with respect to RSPM is a major concern. In urban areas the RSPM are mostly generating from the vehicular emission, road dust, domestic fuel like wood, coal, kerosene etc. Hence the following recommendations are proposed to mitigate this problem.

1. Improvement of road conditions, effective traffic planning and management particularly at the traffic intersections, construction of more fly overs and subways and closing of T-Junctions for better traffic flow.
2. Making the city more accessible for cyclist and pedestrians is the most effective way of incentivising walking and cycling and discouraging car use.
3. More than 15 year old commercial vehicles should be phased out from the road, regular check of vehicles with regards to pollution norms, mass transportation system like public bus, train, trams where ever possible shall be encouraged.
4. Adulteration of automobile fuel and lubricants should be regulated by surprise checks.
5. Mass awareness regarding vehicular pollution control, messages/articles related to vehicular emission should be created through newsletters, pamphlets, magazines, television and radio for public awareness.
6. Open burning of dry leaves, tyres, wastes paper, plastic and other garbage etc. should be prohibited. Mass awareness should be created to use waste, dry leaves etc. for composting.
7. Promote the use of LPG/Bio gas for the Domestic purposes.
8. The blanket of green vegetation on dry non-vegetated areas effectively act as protection against wind borne particulate generated from the roads. So the green coverage in the cities and town should be encouraged.
9. Dust and emission control measure during construction and demolition of buildings & roads.
 - (i) Putting up solid barriers around the construction to limit the effect of dust at site.
 - (ii) Using water sprays or sprinklers to keep the dust down during construction activities.
 - (iii) Properly covering lorries that carries the construction material and waste.
10. Cleaning of road dust at frequent intervals particularly in the city area will reduce the menace of dust pollution



REFERENCES

1. Ambient Air Quality status of some selected towns of Odisha, 2006 published by State Pollution Control Board, Odisha
2. Guideline for measurement of Ambient Air Pollutants CPCB (NAAQMS/36/2012-13)
3. Method of Air Sampling and analysis, Third edition AWMA, ACS, AICHE & ADWA
4. National Ambient Air Quality status, 2008 CPCB (NAAQMS/2009-10)
5. Health effects of Air Pollution-A on Kolkata, Dept. of Environmental Govt. of West Bengal Pollution Control Board
6. Transport fuel quality for the year 2015, CPCB PROBES/78/2000-01
7. Epidemiological study on effect of Air Pollution on Human Health (Adults) in Delhi, CPCB Environmental Health Management Series: EHMS/01/2012