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Covid-19 Pandemic: Effects on Air Quality in Southern States of India

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ABSTRACT

Environmental pollution causes major health hazards. Especially the important air pollutants such as High Particulate Matter ($PM_{2.5}$ and PM_{10}), Sulfur Dioxide (SO_2) and Nitrogen Dioxide (NO_2) cause health problems. However such pollutants have significantly reduced during COVID-19 lockdown period due to closure of factories and reduction in transport. The present study attempts to analyze the variations in the air pollutants in the Southern States of India from 2013 to 2021. The data pertaining to the study period was collected from National Ambient Air Quality Monitoring Programme (NAMP). It attempts to compare the air quality standards of the Sothern States of India between pre- pandemic and post– pandemic period. The same has been compared with the air quality of India.The data relating to Tamil Nadu represents the data of the five major cities of Tamil Nadu Viz. Chennai, Coimbatore, Madurai, Salem and Trichy. Between the pre – pandemic and post-pandemic period a significant reduction is observed in all the three types of pollutants in all the five major cities in Tamil Nadu.

Key words: *Environmental Pollution, COVID-19 Pandemic, Air Quality*

Introduction

The rising level of environmental pollution in all forms is an emerging issue globally especially among the developing countries, experiencing industrial development. The air pollution is posing a major health hazard in India. High Particulate Matter ($PM_{2.5}$ and PM_{10}) causes millions of death in India during 2015 (Guo *et al.,* 2017). The Particulate Matter causes cardiovascular, cerebrovascular and respiratory problems (Sushree Sasmita *et al.,* 2022). Sulfur Dioxide (SO_2) and Nitrogen Dioxide (NO_2) are the other important air pollutants which cause respiratory problems (Jai Shanker Pandey *et al*., 2005).

After the identification of COVID – 19 disease at the end of December 2019, it was declared as pandemic on 26th April 2020. The Nationwide lockdown was announced in India on 24th March 2020. As a result of the complete shutdown of all activities, the levels of all type of pollutants have significantly reduced as officially revealed by the Central Pollution Control Board Data. The level of air pollutants such as $PM_{2.5}$ and PM_{10}, SO_2 and NO_2 has significantly reduced during the lockdown period (Abhishek Saxena and Shani Raj, 2021). The levels of air quality are also found to be improved during the lock down period (Nehul Agarwal *et al.,* 2021).

At this outset the present study attempts to analyze the variations in the air pollutants in the Southern States of India from 2013 to 2021. It attempts to compare the air quality standards between pre- pandemic and post– pandemic period in the study area.

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Methodology

Data Sources

The National Ambient Air Quality Monitoring Programme (NAMP) data relating to the period from 2013 to 2021 was collected. The pre-pandemic period consists of the period from 2013 to 2019 and the post-pandemic period covers 2020 and 2021. The NAMP data has been collected from the Central Pollution Control Board Website https://cpcb.nic.in/.

Study Area

Four southern states of India viz. Tamil Nadu, Kerala, Karnataka and Andhra Pradesh were considered as sample. The same has been compared with the air quality of India.The data relating to Tamil Nadu represents the data of the five major cities of Tamil Nadu Viz. Chennai, Coimbatore, Madurai, Salem and Trichy.

Results and Discussion

When compared to the permissible levels prescribed by WHO, the levels of NO_2 and PM_{10} are much higher in India, revealed in Table 1. The level of particulate matter is double than the prescribed limit. In comparison with the CPCB standards, except PM_{10}

Description of Air Pollutants

Air Pollutant	Sources	Health Impacts	Permissible Limit Annual by WHO	Permissible Limit Annual by CPCB
Sulfur Dioxide SO_2	burning of fossil fuels, metal smelting, petroleum refining and other industrial operations.	Respiratory problems, heart and lung disorders and eye problems	15 µg/m^3	50 µg/m^3
Nitrogen Dioxide NO_2	burning of fossil fuels and biomass and high temperature combustion processes	Respiratory problems	10 ug/m^3	40 ug/m^3
Particulate Matter PM_{10}	emitted from vehicles, industrial combustion processes, commercial and residential combustion and construction industries	Respiratory problems, lung/liver cancer, stroke and bone problems	15 ug/m^3	60 ug/m^3

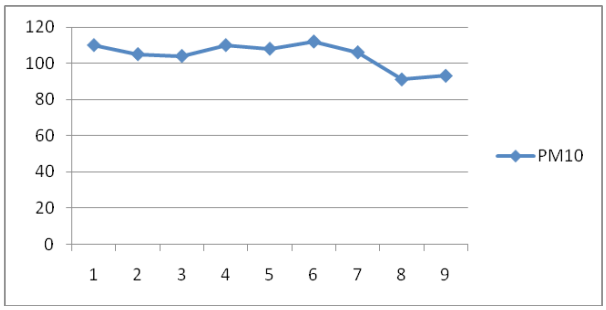
Table 1. Air Quality in India

Year	India		
	Annual Average of SO_2 in µg/m^3	Annual Average of NO_2 in µg/m^3	Annual Average of PM_{10} in µg/m^3
Permissible Limits - WHO	15	15	20
Permissible Limits - CPCB	50	40	60
2013	9	23	110
2014	9	24	105
2015	9	24	104
2016	9	25	110
2017	9	25	108
2018	9	25	112
2019	9	24	106
2020	8	22	91
2021	10	20	93

Source: Central Pollution Control Board Website

the other two parameters were within the permissible limits.

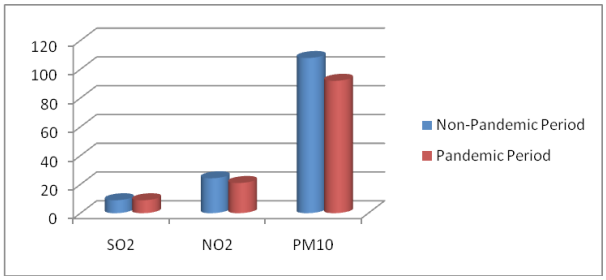
Chart 1. Concentration of PM_{10}



Source: Table 1

Chart-1 shows that the gradual rise is observed in the levels of PM_{10} in India over the period from 2013 to 2019. During the pandemic period it dropped less than 100. The nationwide imposed lockdown has reduced the levels of all types of air pollutants such as SO_2, NO_2 and $PM_{10,}$ as shown in Chart 2.

Chart 2. Concentration of SO2, NO2 and PM_{10}

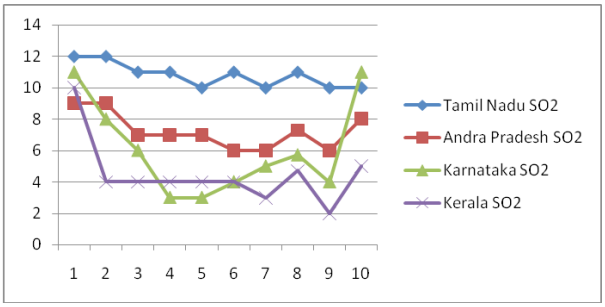


Source: Table 1

Chart-2 reveals that in India significant reduction is observed in the concentration of pollutants viz. NO_2 and PM_{10} by 13 and 15 percentages between the non-pandemic and pandemic period. No change is observed in the level of SO_2 between the periods.

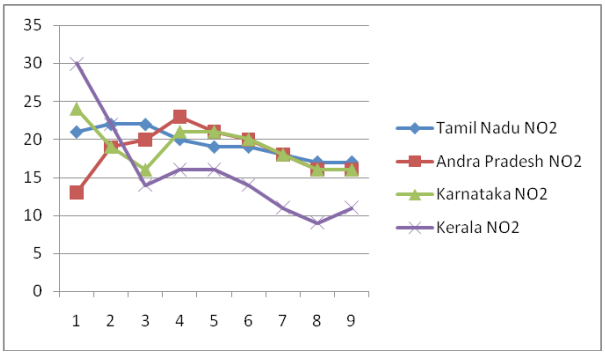
The Pearson correlation test is applied to analyse the relationship between the air pollutants over the period of time from 2013 to 2021. The results are exhibited in Table 2. In India, the concentration of PM_{10} is highly correlated with the concentration of NO_2 at $p<0.1$ significance level. No significant relationship is found between other pollutants in India.

Chart 3. Concentration of SO_2



Source: Table 3

Chart 4. Concentration of NO_2



Source: Table 3

Table 2. Correlations between Air Pollutants in India

	India	SO_2	NO_2	PM_{10}
SO_2	Pearson Correlation	1	-.300	.067
	Sig. (2-tailed)		.433	.864
	N	9	9	9
NO_2	Pearson Correlation	-.300	1	.837**
	Sig. (2-tailed)	.433		.005
	N	9	9	9
PM_{10}	Pearson Correlation	.067	.837**	1
	Sig. (2-tailed)	.864	.005	
	N	9	9	9

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Data Collected from Central Pollution Control Board Website and Computed using SPSS

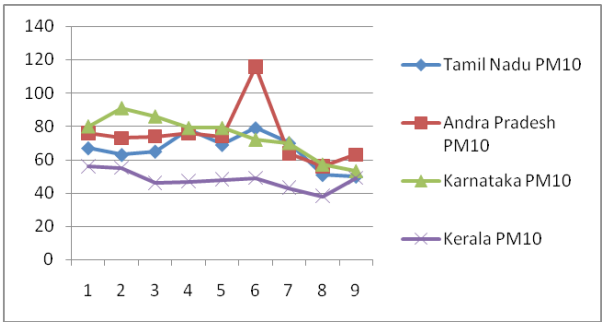
The interstate comparison of air quality standards attempted in Table 3 reveals the fact that the level of SO_2 pollution is much higher in Tamil Nadu State when compared to other States. Its emission is huge from coal fired power plants and oil refineries in Tamil Nadu. Tamil Nadu is found as the highest emitter of sulphur dioxide (Manka Behl, 2019). The large number of thermal power plants in Tamil Nadu contributes to SO_2 pollution.

Concerning NO_2, the levels are much higher in Tamil Nadu when compared to other Southern States viz. Andhra Pradesh, Kerala and Karnataka indicated in Chart-4. In Tamil Nadu, the rising vehicular traffic, thermal power plants and other industrial operations have been contributing to its huge generation (Komal Gowtham, 2022).

The level of PM_{10} is much higher in the States Viz. Andhra Pradesh and Karnataka as shown in Chart 5. In Andhra Pradesh the usage of sulphur rich petroleum coke or petcoke and coal in the industrial areas and rising vehicular traffic were found responsible for the rise in PM_{10}. In Karnataka the reasons such as vehicular emission followed by industrial operations, road dust and burning of garbage accounts for the rise in PM_{10} (Rohith, 2018).

Chart-3 proves that in Tamil Nadu, the concentration of SO_2 is higher than average in India. For Andhra Pradesh, Karnataka and Kerala, the State Average is less when compared to India as a whole.

Chart 5. Concentration of PM_{10}



Source: Table 3

Table 3. Air Quality Standards in Southern States of India

YEAR	Tamil Nadu			Andhra Pradesh			Karnataka			Kerala		
	SO_2	NO_2	PM_{10}	SO_2	NO_2	PM_{10}	SO_2	NO_2	PM_{10}	SO_2	NO_2	PM_{10}
Permissible Limits - WHO	15	15	20	15	15	20	15	15	20	15	15	20
Permissible Limits - CPCB	50	40	60	50	40	60	50	40	60	50	40	60
2013	12	21	67	9	13	76	11	24	80	10	30	56
2014	12	22	63	9	19	73	8	19	91	4	22	55
2015	11	22	65	7	20	74	6	16	86	4	14	46
2016	11	20	78	7	23	76	3	21	79	4	16	47
2017	10	19	69	7	21	74	3	21	79	4	16	48
2018	11	19	79	6	20	116	4	20	72	4	14	49
2019	10	18	70	6	18	64	5	18	70	3	11	43
2020	10	17	51	6	16	56	4	16	57	2	9	38
2021	10	17	50	8	16	63	11	16	53	5	11	49

Source: Central Pollution Control Board Website

Table 4. Correlations between Air Pollutants in Tamil Nadu

Tamil Nadu	SO_2	NO_2	PM_{10}	
SO_2	Pearson Correlation	1	.840**	.318
	Sig. (2-tailed)		.005	.405
	N	9	9	9
NO_2	Pearson Correlation	.840**	1	.385
	Sig. (2-tailed)	.005		.307
	N	9	9	9
PM_{10}	Pearson Correlation	.318	.385	1
	Sig. (2-tailed)	.405	.307	
	N	9	9	9

**.Correlation is significant at the 0.01 level (2-tailed).
Source: Table 3 and Computed using SPSS

Regarding the concentration of NO_2 and $PM_{10,}$ the Indian average is higher than the State averages of four Southern States.

Table 4 provides the correlation results between the air pollutants in Tamil Nadu. NO_2 and SO_2 have found to have a high correlation at 0.01 level. There exists a strong correlation among the pollutants in Kerala revealed by Table 7. In Andhra Pradesh and Karnataka no significant relationship is found between the pollutants revealed by Table 5 and Table 6.

Table 5. Correlations between Air Pollutants in Andhra Pradesh

Andhra Pradesh		SO_2	NO_2	PM_{10}
SO_2	Pearson Correlation	1	-.372	-.149
	Sig. (2-tailed)		.324	.702
	N	9	9	9
NO_2	Pearson Correlation	-.372	1	.334
	Sig. (2-tailed)	.324		.380
	N	9	9	9
PM_{10}	Pearson Correlation	-.149	.334	1
	Sig. (2-tailed)	.702	.380	
	N	9	9	9

Source: Table 3 and Computed using SPSS

Table 6. Correlations between Air Pollutants in Karnataka

Karnataka		SO_2	NO_2	PM_{10}
SO_2	Pearson Correlation	1	.042	-.091
	Sig. (2-tailed)		.914	.816
	N	9	9	9
NO_2	Pearson Correlation	.042	1	.463
	Sig. (2-tailed)	.914		.209
	N	9	9	9
PM_{10}	Pearson Correlation	-.091	.463	1
	Sig. (2-tailed)	.816	.209	
	N	9	9	9

Source: Table 3 and Computed using SPSS

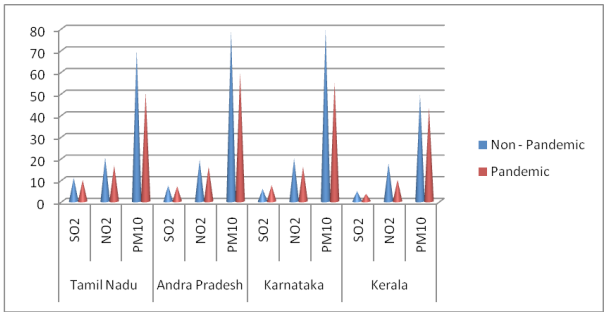
Chart 6 pictorially presents the comparison of loads of pollutants between pre-pandemic and post-pandemic periods. A significant reduction is observed in all the four States in all three types of pollutants. Between the pre – pandemic and post-pandemic periods, the concentration of the pollutant viz. SO_2 has been declined by 9 percent in Tamil Nadu and 20 percent in Kerala. In Andhra Pradesh no change is observed. But in Karnataka its concentration has been raised by 33 percent. The concentration of NO_2 has been reduced by 15%, 16%, 20% and 44% in Tamil Nadu, Andhra Pradesh, Karnataka and Kerala respectively. The concentration of PM_{10} is declined by 29%, 8%, 31% and 15% in Tamil Nadu, Andhra Pradesh, Karnataka and Kerala respectively.

Table 7. Correlations between Air Pollutants in Kerala

Kerala	SO_2	NO_2	PM_{10}	
SO_2	Pearson Correlation	1	.843**	.750*
	Sig. (2-tailed)		.004	.020
	N	9	9	9
NO_2	Pearson Correlation	.843**	1	.854**
	Sig. (2-tailed)	.004		.003
	N	9	9	9
PM_{10}	Pearson Correlation	.750*	.854**	1
	Sig. (2-tailed)	.020	.003	
	N	9	9	9

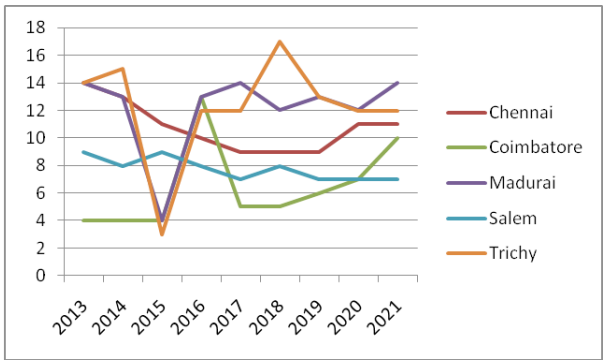
**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Source: Table 3 and Computed using SPSS

Chart 6. Concentration of SO_2, NO_2 and PM_{10} in Southern States of India



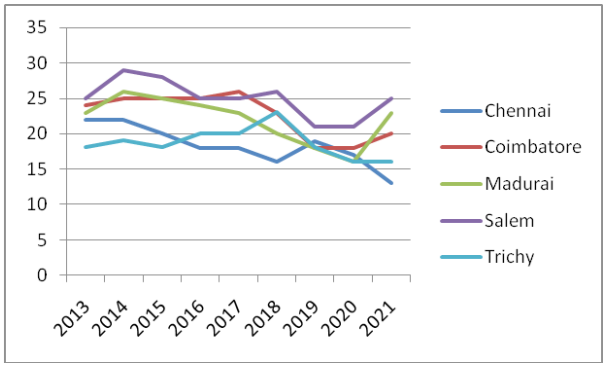
Source: Table - 3 and Computed using SPSS

Chart 7. SO_2 in Metro Cities of Tamil Nadu from 2013 to 2021



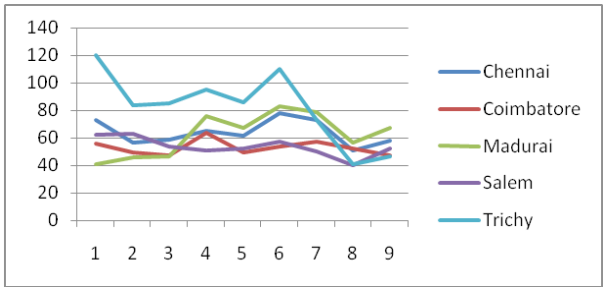
Source: Table 8

Chart 8. NO_2 in Metro Cities of Tamil Nadu from 2013 to 2021



Source: Table – 8

Chart 9. PM_{10} in Metro Cities of Tamil Nadu from 2013 to 2021



Source: Table – 8

Inter – City Comparison of Air Quality in Tamil Nadu

Inter city comparison of air quality in Tamil Nadu was attempted in Table 8. Chart 8 proves that among the five major metro cities in Tamil Nadu, the levels of NO_2 pollution is much higher in Salem City due to the operation of Thermal Power plants and other mining operations in Salem followed by Coimbatore and Madurai. Chart-7 proves that regarding the levels of SO_2 pollution, the cities viz. Chennai, Madurai and Trichy ranks higher due to huge industrial operations. Chart 9 shows that Trichy city ranks first in terms of PM_{10} pollution followed by Chennai City due to vehicular pollution and industrial operations.

Chart 10 gives the levels of all three kinds of pollutants during the pre and post pandemic period in the chosen five metro cities of Tamil Nadu. Between the pre – pandemic and post-pandemic period a significant reduction is observed in all the three types of pollutants in all the five major cities in Tamil Nadu.

Conclusion

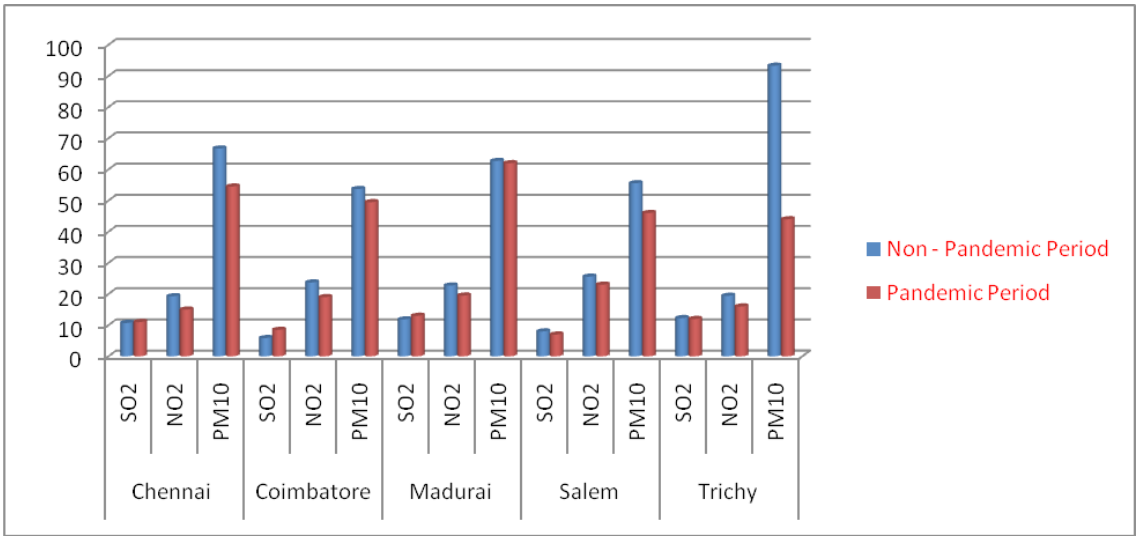
This research paper has analyzed the impact of lockdown on the air quality in Tamil Nadu and India and the correlations between the air pollutants in the study area. In India, the levels of NO_2 and PM_{10} are much higher when compared to the permissible levels prescribed by WHO and the concentration of PM_{10} is highly correlated with the concentration of NO_2 at $p<0.1$ significance level. In Tamil Nadu, between the pre – pandemic and post-pandemic period a significant reduction is observed in all the three types of pollutants in all the five major

Table 8. Inter – City Comparison of Air Quality in Tamil Nadu

Year	Chennai			Coimbatore			Madurai			Salem			Trichy		
	SO_2	NO_2	PM_{10}	SO_2	NO_2	PM_{10}	SO_2	NO_2	PM_{10}	SO_2	NO_2	PM_{10}	SO_2	NO_2	PM_{10}
Permissible Limits - WHO	15	15	20	15	15	20	15	15	20	15	15	20	15	15	20
Permissible Limits - CPCB	50	40	60	50	40	60	50	40	60	50	40	60	50	40	60
2013	14	22	73	4	24	56	14	23	41	9	25	62	14	18	120
2014	13	22	57	4	25	49	13	26	46	8	29	63	15	19	84
2015	11	20	59	4	25	47	4	25	47	9	28	54	3	18	85
2016	10	18	65	13	25	64	13	24	76	8	25	51	12	20	95
2017	9	18	62	5	26	49	14	23	67	7	25	52	12	20	86
2018	9	16	78	5	23	54	12	20	83	8	26	57	17	23	110
2019	9	19	73	6	18	57	13	18	79	7	21	50	13	18	73
2020	11	17	51	7	18	52	12	16	57	7	21	40	12	16	41
2021	11	13	58	10	20	47	14	23	67	7	25	52	12	16	47

Source: Central Pollution Control Board Website

Chart 10. All Types of Pollutants during Pre and Post Pandemic Period for Metro Cities of Tamil Nadu



Source: Table - 8

cities in Tamil Nadu. Since the level of pollutants has observed a significant fall in India during the pandemic lock down period, it may be inferred that a short-term lockdown may be imposed as an effective policy tool to control the air pollution.

References

Abhishek Saxena and Shani Raj, 2021. Impact of Lockdown during COVID – 19 Pandemic on the Air of North Indian Cities. Urban Climate available at https://www.sciencedirect.com/science/article/pii/S2212095520306684?via%3Dihub

Hao Guo, 2017. Source apportionment of $PM_{2.5}$ in North India using source – oriented air quality models. Environmental Pollution available at https://www.sciencedirect.com/science/article/abs/pii/S0269749117314537

Jai Shanker Pandey, 2005. Health Risks of NO_2, SPM and SO_2 in Delhi (India), Atmospheric Environment available at https://www.sciencedirect.com/science/article/abs/pii/S1352231005007223

Komal Gowtham, 2022. NO_2 levels in Chennai up, data Shows. available at https://timesofindia.indiatimes.com/city/chennai/no2-levels-in-chennai-up-data-shows/articleshow/93626471.cms

Manka Behl, 2019. SO_2 Emission, TN Worst in India, Chennai No. 29 in World. available at (https://timesofindia.indiatimes.com/city/nagpur/so2-emission-tn-worst-in-india-chennai-no-29-in-world/articleshow/70752871.cms)

Nehul Agarwal, 2021. Indoor Air Quality Improvement in COVID – 19 Pandemic: Review. Sustainable Cities and Society available at https://doi.org/10.1016/j.scs.2021.102942.

Rohith, B.R. 2018. Air Pollution levels in Karnataka's 11 cities and towns cross limits. available at https://timesofindia.indiatimes.com/city/bengaluru/air-pollution-levels-in-karnatakas-11-cities-and-towns-cross-limits/articleshow/63036922.cms

Sushree Sasmita, 2022. Assessment of sources and health impacts of PM_{10} in an urban environment over eastern coastal plain of India. Environmental Challenges available at https://www.sciencedirect.com/science/article/pii/S2667010022000178

https://www.aqi.in/blog/andhra-pradesh-air-pollution-reached-unhealthy-aqi/