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Research Article

AN ANALYSIS OF AIR POLLUTION IN KERALA

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ABSTRACT

Air pollution index is an overall scheme that transforms the weighted values of individual air pollution related parameters into a single number. In the Indian context, most commonly used air pollution index (API) is a four parameter model. The longer and more intense the exposure of people to air pollutants such as particulate matter (PM), nitrogen oxides, carbon monoxide, sulphur dioxide etc., the greater the negative impact on their health. The effects range from minor eye irritation, respiratory symptoms, to decreased lung and heart function, hospitalization and even premature death. Hence this study was conducted to study the quality of air in all the districts of Kerala for a period of nine years during the period 2008-2016.

INTRODUCTION

Air is an important and vital component of earth's environment and slight change in its composition can have varied effects on growth and development of organisms on this planet. Air pollutants released from various sources exert detrimental effects on vegetation. The major reason for air pollution is industrial emissions including automobile emissions. Air pollutants have a lot of adverse effects on various platforms. So it is very much important to monitor the air quality status of an area to know whether it is polluted or not. According to source apportionment studies conducted by the Central Pollution Control Board (CPCB, 2010), in cities such as Delhi, Kanpur, Bangalore, Pune, Chennai and Mumbai show that transport sector contributes to more than 70% of the ambient air pollution.

The scientific evidence about the health effects of air pollution is compelling. The longer and more intense the exposure of people to air pollutants such as particulate matter (PM), nitrogen oxides, carbon monoxide, sulphur dioxide etc., the greater the negative impact on their health. The effects range from minor eye irritation, respiratory symptoms, to decreased lung and heart function, hospitalization and even premature death. Hence this study was conducted to study the quality of air in all the districts

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of Kerala for a period of nine years during the period 2008-2016 (Biju and Vijayan, 2014; Bindu, 2008).

MATERIALS AND METHODS

Study area

All the 14 districts of Kerala were selected for the study. With in each district, few locations were chosen for a period of nine years from 2008 to 2016 and they are as follows Thiruvananthapuram (4 locations), Ernakulam (7 locations), Kollam, Alappuzha, Kottayam, Kozhikode, Kannur and Kasargode (2 locations each), Pathanamthitta, Idukki, Thrissur, Palakkad, Malappuram and Wayanad (1 location each). The monthly and yearly averages of different pollutants such as SO_2, NO_2, SPM and RSPM were studied.

Air Pollution Index (API)

Air pollution index is an overall scheme that transforms the weighted values of individual air pollution related parameters into a single number. In the Indian context, most commonly used air pollution index (API) is a four parameter model as, shown below.

$$API = \frac{1}{4}\left(\frac{SO_2}{SSO_2}+\frac{NO_2}{SNO_2}+\frac{SPM}{SSPM}+\frac{RSPM}{SRSPM}\right)\times 100$$

where SO_2, NO_2, SPM (suspended particulate matter) and RSPM (respirable suspended particulate matter) are measured values, SSO_2, SNO_2, SSPM and SRSPM are standard values as per the National Air Quality Standard, 2009. The range of air quality index and its interpretations are given in the Table 1 below.

Fine particles ($PM_{2.5}$) pose greatest health risk. These fine particles can get deep into lungs and some may even get into the bloodstream, Exposure to these particles can affect a person's lungs and heart. Coarse particles ($PM_{10\text{-}2.5}$) are of less concern, although they can irritate a person's eyes, nose and throat (United States Environmental Protection Agency, 2018). Hence Central Pollution Control Board (CPCB) eliminated SPM in ambient air from the standard in November 2009 (National Ambient Air Quality Status and Trends in India-2010). (Kerala State Pollution Control Board, 2010) (KSPCB) is a subsidiary of CPCB and this instruction has been followed. Subsequently in all the Water and Air Quality Directories published by the KSPCB after 2010 have not included data on SPM (Cropper, *et al*., 1997; Dcruz, *et al*., 2017; Khan and Ghouri, 2011; Waseem, *et al*., 2013).

However, the formula for calculating API remains unchanged and the resultant API values tend to be smaller by ignoring SPM values from the calculation of API. The entire data for this study were obtained from various issues of Water and Air Quality Directory published by KSPCB.

RESULTS AND DISCUSSION

The annual average of SO_2, NO_2, RSPM and SPM from 14 districts of Kerala have been shown in (Fig. 1). The value of highest SO_2 was observed during the year 2008 (4.24 µg/m^3) and the lowest during the year 2015 (2.89 µg/m^3). The value of NO_2 was highest during the year 2016 (15.86 µg/m^3) and the lowest during 2013 (9.71 µg/m^3), average RSPM level was highest during the year 2013 with a value of 45.58 µg/m^3 and the lowest during 2011 (38.4 µg/m^3).

The values of SPM were available only for three years during 2008-10. We can see that SPM values were highest during the year 2008 with a value of 79.21 µg/m^3 followed by 2009 (76.17 µg/m^3) and least in the year 2010 with a value of 64.03 µg/m^3. There is a gradual decrease in SPM in the ambient air during this period.

(Fig. 2) shows the Air Pollution Index for three years with SPM. The figure shows that during the year 2008 API value was highest ie.,70.89 followed by the year 2009 with a value of 68.18 and least in the year 2010 with a value of 59.34. The values of API fall within the range of 50-75 during three years. Hence we can say that in Kerala as a whole, moderate air pollution existed during the years 2008-10. Moreover, the quality of air has improved during the period under consideration. API values calculated by including

Table 1. Range of air quality index and its interpretation

S. No.	API Value	Inference
1	0-25	Clean air
2	25-50	Light air pollution
3	50-75	Moderate air pollution
4	75-100	Heavy air pollution
5	>100	Severe air pollution

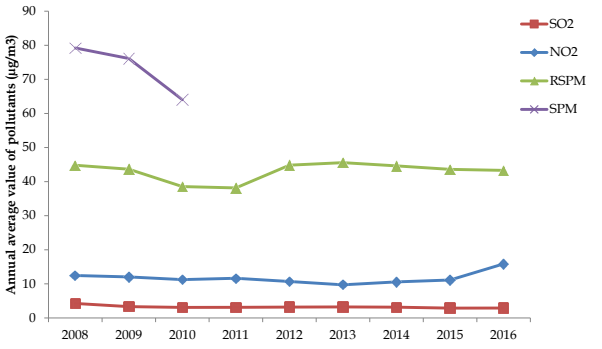

Fig. 1 Air pollutants in Kerala during 2008-2016.

SPM are higher than those calculated by excluding SPM.

Air pollution index excluding SPM during 2011-2016 has been shown in (Fig. 3). The API was highest during the year 2016 (38.41) followed by 2012 (36.28), 2013 (36.16), 2014 (36.07), 2015 (35.64) and least in the year 2011 (32.67). The values of API fall within the range of 25-50 during the six years. Hence we can say that all the districts of Kerala had light air pollution during 2011-16.

From Tables 2 and 3, we can classify the districts in Kerala on the API both by including and by excluding SPM into four ranges of air pollution index. Idukki has least API both with and without SPM among all districts of Kerala.

Table 4 shows that four districts viz., Thiruvanathapuram, Alappuzha, Palakkad and Kasargode had experienced heavy air pollution which needs to be addressed as it is affecting the quality of ambient air. Seven districts fall under moderate air pollution category which is indicating the need for measures to control which otherwise would fall under heavy air pollution category.

Table 5 shows that eleven districts fall under the range of light air pollution and two districts under moderate air pollution. Idukki and Patanamthitta districts had clean air.

(Fig. 4). shows the SO_2, NO_2, RSPM and SPM levels over the different months in an year in 14 districts of Kerala. The SO_2 is at its peak in the month of October

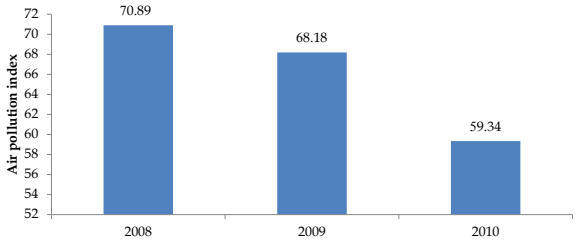

Fig. 2 Air pollution index including SPM during 2008-2010.

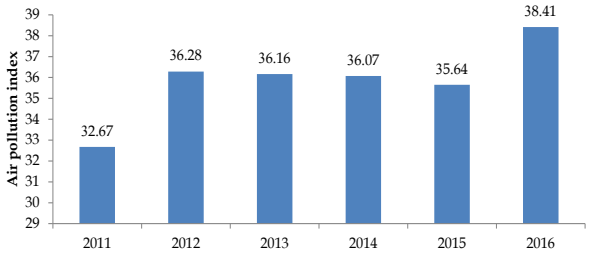

Fig. 3 Air pollution index excluding SPM during 2011-2016.

Table 2. Average API values including SPM in different districts of Kerala during 2008-2010

S. No.	Districts	API including SPM (2008-2010)
1	Thiruvananthapuram	87.84
2	Alappuzha	81.64
3	Palakkad	78.34
4	Kasargode	76.09
5	Thrissur	72.89
6	Kollam	72.26
7	Wayanad	67.03
8	Ernakulam	66.87
9	Kottayam	63.04
10	Kozhikode	61.51
11	Kannur	54.08
12	Pathanamthitta	47.99
13	Malappuram	44.24
14	Idukki	37.02

Table 3. Average API values excluding SPM in different districts of Kerala during 2011-2016

S. No.	Districts	API excluding SPM (2011-2016)
1	Kottayam	58.04
2	Thiruvananthapuram	52.76
3	Ernakulam	44.39
4	Kozhikode	41.15
5	Thrissur	40.24
6	Kollam	37.07
7	Kannur	36.53
8	Kasargode	32.19
9	Malappuram	30.88
10	Alappuzha	29.8
11	Palakkad	29.66
12	Wayanad	27.55
13	Pathanamthitta	24.28
14	Idukki	17.72

Table 4. API including SPM during 2008-2010

S. No.	Range of API	Districts	Inference
1	25-50	Pathanamthitta	Light air pollution
		Malappuram	
		Idukki	
2	50-75	Thrissur	Moderate air pollution
		Kollam	
		Wayanad	
		Ernakulam	
		Kottayam	
		Kozhikode	
		Kannur	
3	75-100	Thiruvanathapuram	Heavy air pollution
		Alappuzha	
		Palakkad	
		Kasargode	

(5.09 µg/m^3) and falls to 3.11 µg/m^3 in July. NO_2 levels reach a peak during the month of July (18.89 µg/m^3) and drastically reach the lowest in the next month of August (10.8 µg/m^3). The RSPM values are high during the initial two months of the year (January and February with values of 52.58 and 51.16 µg/m^3 respectively) and it falls to 35.72 µg/m^3 in the month of August. Level of SPM starts with a value of 81.98 and 80.94 µg/m^3 during January and February respectively and falls to the lowest value of 62.26 µg/m^3 in July. Similar trend is observed in both RSPM and SPM values during the year.

(Fig. 5). shows the average Air Pollution Index over different months in an year. The maximum API is observed in the month of January (76.41) followed by February (74.83) and the least during the month of August (56.58). Majority values of API fall within the range 50-75 but only in the month January it falls within the range of 75-100. Hence we can conclude that during February to December there was moderate air pollution whereas the month of January witnessed heavy air pollution.

Table 5. API excluding SPM during 2011-2016

S. No.	Range of API	Districts	Inference
1	0-25	Patanamthitta	Clean air
		Idukki	
2	25-50	Ernakulam	Light air pollution
		Kozhikkode	
		Thrissur	
		Kollam	
		Kannur	
		Kasargode	
		Mallapuram	
		Alappuzha	
		Palakkad	
		Wayanad	
3	50-75	Kottayam	Moderate air pollution
		Thiruvananthapuram	

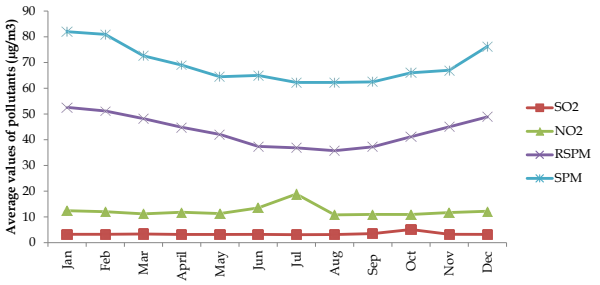

Fig. 4 Average values of pollutants from all districts during different months.

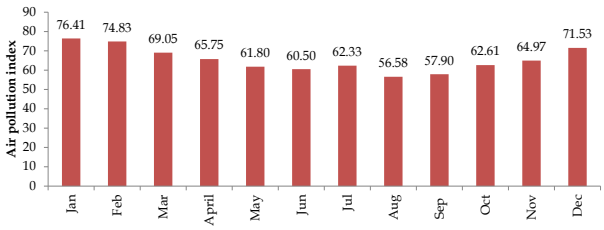

Fig. 5 API from all districts during different months.

CONCLUSION

Air pollution index is an important measure to check the quality of the air that surrounds the environment within which we live. The analysis carried out suggests that when the air is mixed with suspended particulate matter the quality of air decreases. The district of Thiruvananthapuram, the capital city of Kerala, experienced heavy air pollution which attracts attention of the government, NGOs, private organizations and the public to reduce the pollution of air by planting more trees, more usage of public transport than the private vehicles, pollution test for all the vehicles periodically, setting up of new standards for the control of air pollution, creating awareness among the people by organizing street plays or through programmes or campaigns etc. so that the people will understand the ill effects of low quality air and come forward to reduce the pollution and thereby improve the quality of air.

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