Analytical study of seasonal impact on air pollution and proposed solution to improve the air quality.

Dipali Suhas Patil[1]
 Research scholar,
PGRC, IICMR,
Pune, India.
dipali.gawande@gmail.com

Deepali Sunil Sawai[2]
Director,
PGRC, IICMR,
Pune, India
deepalisawai@gmail.com

Abstract

When talking about air pollution, India is leading the world as per WHO [1] reported in Times Of India [2]. Considering which, its high time to concentrate even on the smallest causes of air pollution. In this paper researcher wants to emphasis on, the study of Air Quality Index (AQI) during rainy season, winter and summer seasons for last five years from 2014 to 2018 and analyze the causes of air pollution during these climate changes in Pune (Pimpri & Bhosari Air quality stations). This paper concentrates on the analysis of increase in the air pollution in winter season, further focusing on monthly analysis to find any impact of other factor on AQI and propose the solution to control it to some extent.

Keywords: Air Pollution, Air Quality Index, Winter Inversion.

Introduction

The increase in air pollution in recent years has been considered as growing problem in India, as per the special report on "State of global air 2018" of Health Effects Institute [3] the increase in air pollution has the adverse impacts, which are leading to short term & long-term health issues on human health. As per Gadekar Jaysing (2018) [4][5] makes the issue more vigorous to emphasis on.

The research paper aims to come up with verdicts of increase in the pollution in different seasons. In India specifically there are three seasons occurs during a year, rainy season, winter and summer. For analysis year is broadly divided into three parts, Summer season is considered from March to June, Rainy Season is considered from July to October and Winter season is considered from November to February. The data used for analysis is collected from MPCB (Maharashtra Pollution Control Board, India) website with the help of CPCB (Central Pollution Control Board, India) [6][7].

Systematic study of AQI for five years is carried out to analyse the impact of seasonal changes on air pollution in PCMC area which is in suburban of Pune district in the state of Maharashtra (India), the findings are then examined appropriately to propose the solution to reduce impact of air pollution.

1   Seasonal and year wise air pollution averages

For study, the daily Air Quality Index (AQI) data are collected from the site of MPCB for two stations Pimpri and Bhosari of PCMC area for five years from 01 Jan 2014 to 31 December 2018, and then divided broadly into three seasons as explained above. The data then organized, cleaned and studied to calculate the averages as follows.

Data source: MPCB website, air pollution for Pimpri-Chinchwad and Bhosari air quality stations in Pune, [6]

**Table 1.** Season wise average AQI of Pimpri area

Season wise avg AQI of Pimpri 2014 to 2018

Year	Rainy season	Winter	Summer
2018	75.86666667	126.673913	85.25
2017	63.91397849	127.7640449	84.8556701
2016	79.01538462	132.0131579	103.6979167
2015	68.57894737	131.0707071	79.26153846
2014	67.37234043	124.6041667	75.04444444

Table 2. Season wise average AQI of Bhosari area

Graph. 1. Season wise Average AQI Of Pimpri
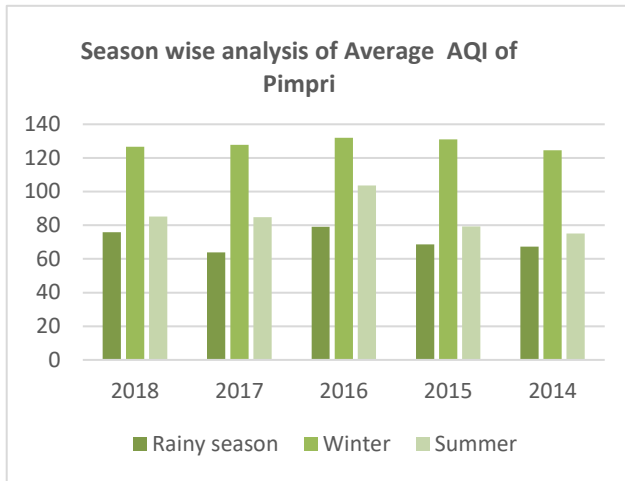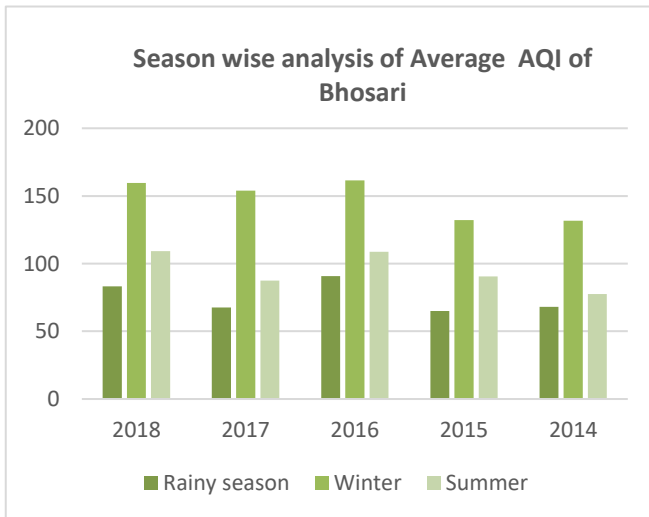
Season wise avg AQI of Bhosari 2014 to 2018			
Year	Rainy season	Winter	Summer
2018	83.33333333	159.5806452	109.25
2017	67.61290323	154	87.51428571
2016	90.80555556	161.4375	108.8666667
2015	65.03030303	132.0606061	90.57575758
2014	68.11764706	131.6666667	77.63636364

The graphical representation of the above season wise averages is as follows:

Graph. 2. Season wise Average AQI Bhosari

AQI of winter season is more than that of other two seasons, hence it is further studied month wise to identify if there is any pattern which influence the overall AQI in months of winter. Following are the tables and graphs.

Table 3. Monthly analysis of average AQI of winter in Pimpri

Monthly analysis of average AQI of winter in Pimpri				
Year	**Nov**	**Dec**	**Jan**	**Feb**
2018	106.4782609	126.6363636	131.6538	142.6667
2017	113.75	121.0434783	143.72	133.1765
2016	130.48	119.5	139.6	126.75
2015	115.875	138.52	129.4583	129.4583
2014	115.826087	142.9166667	125.52	113.75

Table 4. Monthly analysis of Average AQI of winter in Bhosari

Monthly analysis of Average AQI of winter in Pimpri
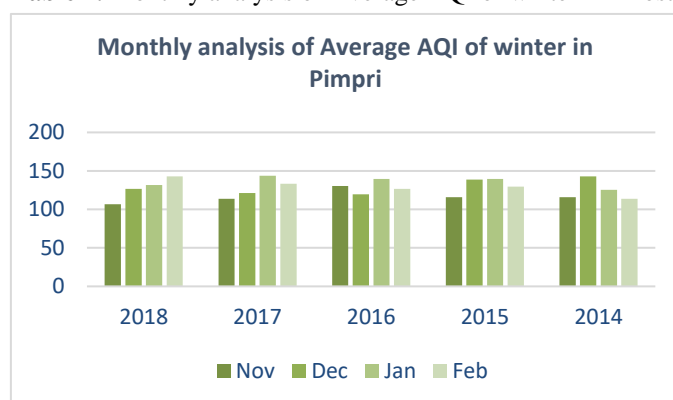
Monthly analysis of Average AQI of winter in Bhosari				
Year	**Nov**	**Dec**	**Jan**	**Feb**
2018	148.8333333	166.75	161.3333	158.5
2017	128.625	166.7777778	178.375	140.625
2016	176.8333333	195.7777778	147	127.5
2015	102.875	133.625	160	128.25
2014	124.25	157	131.2222	114.25

The graphical representation of the above data is done by using charts as follows to comprehend the values more easily.

Graph. 4. Monthly AQI of winter in Bhosari

2   Comparison and analysis of averages

The standard value of AQI as per considered in MPCB is as follows [6],

Table 5. Standards for value of AQI

AQI	Quality classification	Remarks
0-50	Minimal Impact	Good

51-100	Minor breathing discomfort to sensitive people	Satisfactory
101-200	Breathing discomfort to the people with lung, heart disease, children and older adults	Moderate
201-300	Breathing discomfort to people on prolonged exposure	Poor
301-400	Respiratory illness to the people on prolonged exposure	Very Poor
>401	Respiratory effects even on healthy people	Severe

**Graph. 3.** Monthly AQI of winter in Pimpri

By considering the above tables and graphs, it is observed that average AQI of Pimpri and Bhosari areas are high during winter season in these five years.

In Pimpri area, for rainy seasons it ranges from 63 to 79 with lowest and highest in the year 2017 and 2016 respectively, whereas in Bhosari, for rainy seasons it ranges from 65 to 90 with lowest and highest in the year 2015 and 2016 respectively. It has been observed that the AQI was above the satisfactory level during this timeframe in all the rainy seasons but still its gradually going to increase in coming years if neglected.

In Winter season, for Pimpri area AQI ranges from 124 to 132, lowest in the year 2014 and highest in 2016, whereas in Bhosari area it ranges from 131 to 161, lowest in the year 2014 and highest in 2016, overall in winter season for every year the AQI was above satisfactory level which creates the alarming situation to focus on.

And in summer, the AQI for Pimpri area averages from 75 to 103, reading lowest and highest in the year 2014 and 2016 respectively. In Bhosari area, AQI in summer ranges from 77 to 106 with lowest and highest in the year 2014 and 2016 respectively, Observations made the summer reading moderate but highest average reading already crossed the satisfactory level and getting severe.

By above observation the pattern that has found is, the winter season has more AQI than that of other seasons. To know more about the winter season's increase in the AQI, it is studied monthly to find out any influence by other factor. From the table and graph 3 & 4, It has been found that the AQI does not show any extreme or peculiar increase in any of the month and influence the overall AQI of winter season.
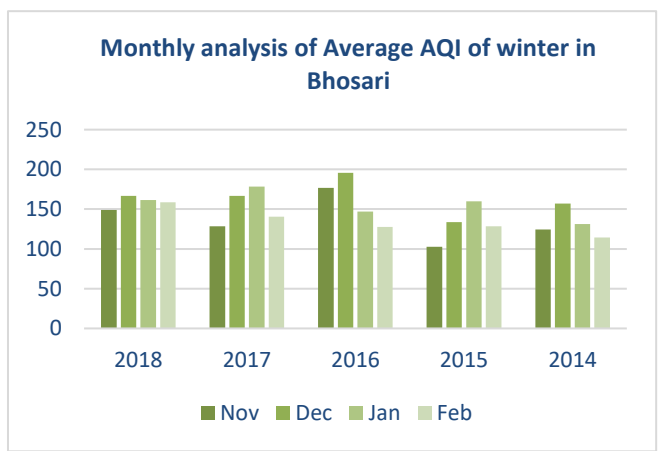
3   Causes and need for the control

As results shows that the AQI was highest in the winter, the causes for the same can be the winter inversion [8], crop burning, industry, vehicles or the wood fires to beat the cold. The researcher wants to focus on the urban domestic causes of air pollution mainly wood fires.

For this study, winter inversion, industry and vehicles are considered constants. Since winter inversion is the phenomenon which cannot be avoided, the usage of vehicle does not drastically increase during winter seasons and also the industrial air pollution remains unaffected due to seasonal changes. More emphasis is given to the causes like wood fires, garbage burning and campfires.

Need for the control is vital as the observations in the study shows that pollution in the city is increasing gradually and has already crossed the satisfactory level for AQI. As per the fact that "A person can live without food for few days, without water for few hours but Can't live without air even for few minutes."[9] It is important to focus on the increasing issue of air pollution which interns causes the bad impact on health and wellbeing of the life leading to the short-term and long-term diseases. Also leads to the environmental issues.

4   Solution

The results of the observation stated above, PCMC is facing air pollution issue more in winter season, also the winter inversion causes the effect more severe. The air quality of PCMC area getting severe [9]. The researcher proposes to have restriction on wood fire, garbage burning and campfires. The more populated country like India, amount of wood fires used during winter nights to beat the cold is more specially by the worker who work over night like watchmen [10]. Instead of which the electric heaters can be used, electric or solar heaters can the cheaper and sustainable solution to reduce the quantity of air pollution. This simple restriction can reduce the ample amount of pollution.

For Industry and vehicle, to control the AQI below standard level, vehicles can be operated less during night and early morning, better way is to use public transports or pooling. And slight change in working timings of Industry, avoiding night and early morning, can be applied where ever possible, to reduce the effect of winter inversion.

5   Conclusion

In this research paper the season wise Air Quality Index of PCMC area for last five years is analyzed. The result shows that, when compared average of pollution data, the highest is recorded in winter season, was moderate in summer season and lowest in rainy season. AQI in the Pimpri area is gradually increasing and will cross the standards for satisfactory level within few years, whereas in Bhosari area AQI was observed more than the Pimpri area. When further studied for monthly analysis of winter season It has been found that the AQI does not show any extreme or peculiar increase in any of the month and influence the overall AQI of winter season. The situation is vital to notice the issue of air pollution. The paper compared and analyzed the data to prove the alarming situation and proposed few solutions to reduce it to some extent. The restrictions on fire burnings can reduce the amount of air pollution created, limited use of vehicles and changes in working timings of industry can reduce the effect of winter inversion, which intern leads to reduce the AQI of PCMC area.

References

1. WHO ambient (outdoor) air quality database Summary results, update 2018.
   Link: https://www.who.int/airpollution/d*a/AAP_database_summary_results_2018_final2.pdf?ua=1 ; Last accessed 2019/10/18
2. TOI, "India tops world in bad air quality: Kanpur, Delhi among 15" Read more at: http://timesofindia.indiatimes.com/articleshow/63997130.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst ; Last accessed 2019/10/18
3. Health Effects Institute. 2018. State of Global Air 2018. Special Report. Boston, MA: Health Effects Institute
4. Gadekar Jaising. Review of Air Quality in Pimpri - Chinchwad, MS, India, Int. Res. Journal of Science & Engineering, January 2018 | Special Issue A3 |: 187-192.

5. Gerard Hoek1*, Ranjini M Krishnan2, Rob Beelen1 , Annette Peters3 , Bart Ostro4 , Bert Brunekreef1,5 and Joel D Kaufman2. (2013). Long-term air pollution exposure and cardio- respiratory mortality: a review. Hoek et al. Environmental Health 2013, 12:43 http://www.ehjournal.net/content/12/1/43

6. Maharashtra Pollution Control Board. Website: http://www.mpcb.gov.in/air-quality/Pune/0000000077#station0 ; Last accessed 2019/01/11

7. CENTRAL POLLUTION CONTROL BOARD MINISTRY OF ENVIRONMENT & FORESTS, (August 2009). Website: http://www.cpcb.nic.in/ e-mail: cpcb@nic.in, "NATIONAL AMBIENT AIR QUALITY STATUS 2008".

8. Temperature Inversions Impact Air Quality, https://legacy.azdeq.gov/environ/air/ozone/Inversion%20Info.pdf ; last accessed on 2019/10/17

9. "Study of Air Pollution Data for Comparing Air Pollution in Pimpri-Chinchwad Area for use in Deep-Learning based Prediction Algorithm", International Journal of Emerging Technologies and Innovative Research (www.jetir.org | UGC and issn Approved), ISSN:2349-5162, Vol.6, Issue 2, page no. pp330-333, February-2019, Available at : **http://www.jetir.org/papers/JETIRAE06078.pdf**

10. KenSexton†John D.SpenglerRobert D.TreitmanWilliam A.Turner; Winter air quality in a wood-burning community: A case study in Waterbury, Vermont; Atmospheric Environment (1967) Volume 18, Issue 7, 1984, Pages 1357-1370