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Review of Air Quality in Pimpri - Chinchwad, MS, India.

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ABSTRACT

Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment. Pollutants with the strongest evidence for public health concern include particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). Pimpri-Chinchwad is fastly growing city and Asia's one of the biggest automobile hub. Due to increase in industries and urbanization, the air and water pollution has become a big problem. Due to huge number of vehicles, the percentage of Sox, NOx and RSPM is very high and air in many areas has become unhealthy. Long-term exposure to polluted air can have permanent health effects such as accelerated aging of the lungs, loss of lung capacity and decreased lung function, development of diseases such as asthma, bronchitis, emphysema, and possibly cancer.

Keywords biological materials, chemicals, particulates, diseases such as asthma, bronchitis, emphysema, and possibly cancer.

INTRODUCTION

World Health Organization (WHO) has defined that air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Air pollution can be outdoor or indoor. Outdoor air pollution has its origin from natural and anthropogenic sources.

Natural sources contribute substantially to local air pollution whereas anthropogenic sources lead to air pollution at global level. The contribution from human activities far exceeds natural sources. Human activities that are major sources of outdoor air pollution include –

1. Fuel combustion from motor vehicles
2. Heat and power generation plants and boilers
3. Industrial facilities such as manufacturing factories, mines, and oil refineries
4. Municipal and agricultural waste sites and waste incineration/burning and
5. Residential cooking, heating, and lighting with polluting fuels

According to the World Health Organization (WHO) India is home to 13 of the 20 most polluted cities in the world. Half of Delhi's 4.4 million children have permanent lung damage that they will never fully recover from. Pune is ranked 52 in the world's most polluted cities and 20 in India. [1] The 2017 State of Global Air report, published by the Health Effects Institute, shows that air pollution-related deaths in Indian between 1990 and 2015 rose by almost 150%. 3 million deaths every year as a result of exposure to ambient (outdoor) air pollution. There are 4.3 million deaths every year as a result of household exposure to smoke from dirty cook stoves and fuels. [2] An estimated 3 million premature deaths globally are linked to ambient air pollution, mainly from heart disease, stroke, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections in children.[3]

Classification of Air Pollution

Air pollution is classified into two types-

1. Primary Pollutants- Primary pollutants are substances that are directly emitted into the atmosphere from sources. The main primary pollutants known to cause harm in high enough concentration are CO, CO_2, CH_4, NO, N_2O, NH_3, Sulfur, H_2S.

2. Secondary Pollutant- Secondary Pollutants are not directly emitted from sources but instead from in the atmosphere from primary pollutants (also called precursors). The main Secondary Pollutants known to cause harm in high enough concentration are NO_2, HNO_3, NO, O_3, VOC, H_2SO_4, nitric acid. Organic aerosols formed from VOC in gas to particle reactions. The following table shows sources and effects of the main pollutants.

Pollutant	**Sources**	**Effects**
Sulfur Dioxide (SO_2)	Thermal power plants and industries, industrial boilers and processes, coal-burning stoves, heaters.	eye irritation, dead aquatic life, lung damage, acidic precipitation, damage to property and forests
Nitrogen Oxides (NOx)	Vehicles, industrial boilers, power plants, commercial and residential heaters. coal burning stoves	Lung damage, forms acid rain and destructs roads, buildings, statues and forests
Hydrocarbons	Dry cleaning operations. auto paint shop, service stations, chemical plants, auto emission.	Carcinogenic, damage Lungs.
Particulates	Diesel engines, Power plants, steel industry, flour mills, windblown dust, wood stoves.	Eye irritation, damage to lungs, damage to crops, reduce visibility,
Ozone	Vehicle exhaust. photochemical smog	Eye irritation, Lung damage, respiratory tracts problems.
Lead	Vehicles burning, leaded gasoline, power plants, metal refineries.	Brain, kidney damage, Smog formation.
Carbon monoxide	vehicles burning, gasoline, kerosene- or wood-burning stoves, dry cleaners	Headache reduced mental alertness, damage to heart. death, smog
PM10 and PM2.5	Transportation, Brick kilns, Stone crushing units, automobile industries.	Respiratory Diseases, Skin and eye related problems, Carcinogenic.

Measurement of Air Pollution

Air pollution is measured in terms of air quality index (AQI) . An air quality index (AQI) is a number used by government agencies to communicate to the public how polluted the air currently is or how polluted it is forecast to become. As the AQI increases, an increasingly large percentage of the population is likely to experience increasingly severe adverse health effects. An increase in air quality index signifies increased air pollution and severe threats to human health. In most cases, AQI indicates how clear or polluted the air in our surrounding is, and the associated health risks it might present. The AQI centers on the health effects that may be experienced within a few days or hours after breathing polluted air.

AQI calculations focus on major air pollutants including: particulate matter, ground-level ozone, sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO). Particulate matter and ozone pollutants pose the highest risks to human health and the environment. For each of these air pollutant categories, different countries have their own established air quality indices in relation to other nationally set air quality standards for public health protection.

Air Quality Index Categories

The AQI is divided in six categories and each category is meant to correspond to different health concern levels. Below is an explanation of the categories and their meanings.

Study Area

Pimpari Chinchwad is situated at a height of 530 m above the sea level. It has pleasant climate all the year round. There are three rivers Pavana, Mula and Indrayani flow through this area. Pimpri Chinchwad is a part of Pune Metropolitan City in the state of Maharashtra, India. It is the urban agglomeration of Pune. It consists of the towns of Pimpri, Chinchwad, Nigdi, Akurdi, Ravet, Bhosari, Pimple Gurav, Moshi, Punawale, and Sangavi, which are governed by a common municipal body - Pimpri Chinchwad Municipal Corporation or PCMC. It is located to the north-west and is connected to the centre of Pune city via the Old Pune-Mumbai Highway.

The Pimpri Chinchwad is adjoining city of Pune. The Pimpri-Chinchwad Municipal Corporation has developed very fast in terms of industrial, commercial and residential growth. The MIDC has also set up industrial centers in the area known as Chinchwad, Pimpri and Bhosari. Geographically, the area falling in Pimpri-Chinchwad Corporation is situated in between River Mula & River Indrayani. Air, water and sound pollution in Pimpri Chinchwad is on the rise. This is attributed to increasing urbanization, growth of industries, and changed lifestyle.

Meanings of AQI categories

Numerical Value	Air Quality Index Levels of Health Concern	Meaning
0 to 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk
51 to 100	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 to 150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 to 200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
201 to 300	Very Unhealthy	Health warnings of emergency conditions. The entire population is more likely to be affected.
301 to 500	Hazardous	Health alert: everyone may experience more serious health effects

Source: http://airnow.gov/index.cfm?action=aqibasics.aqi

Sources of air pollution in Pimpri Chinchwad

Pune is one of the major industrial hubs in Asia and many of these industries are situated in Pimpri-Chinchwad area. Industrialization started in 1954 with the arrival of Hindustan Antibiotics Limited in this area. PCMC is now home to the Indian operations of major automobile companies like Premier Limited, Mahindra & Mahindra Ltd - Truck & Bus Division, Mahindra Engineering services, Bajaj Auto, BEL Optronic Devices Limited, TATA Motors (formerly TELCO), Kinetic Engineering, Force Motors (formerly Bajaj Tempo) Daimler Chrysler, Thermax and Autoline Industries. In addition to this, several heavy industries such as Forbes-Marshall, Thyssen Krupp and GEA Ecoflex, Alfa Laval & Sandvik Asia have their manufacturing units in the town and also the German company KSB Pumps, Swedish bearing company SKF [4].

Database and methodology

The Central Pollution Control Board (CPCB), back in 1984, initiated National Ambient Air Quality Monitoring (NAAQM) at the national level to regularly monitor ambient air quality of selected major urban cities and industrial towns of the country. This was later renamed as the National Air Monitoring Programme (NAMP). The ambient air quality monitoring network involves measurement of a number of air pollutants at different strategic locations in the country. The task of any monitoring network thus involves the selection of pollutants, the selection of locations, frequency, duration of sampling, sampling techniques, infrastructural facilities, manpower, operation, and maintenance. [5]

In Pimpri-Chinchwad city instruments have been installed to measure air pollution, at two places - Sector23, Water Purification Center, Nigadi and Growth Lab, Nasik Road, Bhosari, with the help of IITM - (Indian Institute of Tropical Meteorology). Also LED DISPLAY (Light Emitting Diode), showing the level of air quality, have been installed at Pimpri Chowk circle and Chaphekar Chowk. National Ambient Air Quality Standards

Sr. No	Pollutants	Time Weighted	Industrial, Residential, Rural and Other Area	Ecological Sensitive area (Notified by Central Government)
1	SO_2	24 hours	80	80
2	NO_X	24 hours	80	80
3	RSPM(PM10)	24 hours	100	100

Courtesy- http://www.pcmchelpline.in/helpline/english/callcenter-faq.php?type=21

Real-time Air Quality Index (AQI) from January to November 2017 is given in the table.

Month	SOx			NOx			RSPM		
	Min	**Max**	**Avg**	**Min**	**Max**	**Avg**	**Min**	**Max**	**Avg**
January	13	59	25.4	55	158	110.12	85	266	146.6
February	18	68	30.12	9	166	85.41	61	271	136.76
March	13	50	28.92	29	177	67.85	31	186	89.96
April	15	40	24.68	13	80	37.68	39	211	81.96
May	13	31	25.71	21	142	54.67	26	191	74.25
June	9	39	19.12	12	67	29.75	15	378	56.58
July	8	39	16.96	18	59	32	15	115	34.96
August	9	27	16.92	20	79	36.96	11	69	29.46
September	13	31	19.7	19	62	40.7	6	81	29.13
October	6	27	16.15	20	96	54.04	27	378	104.46

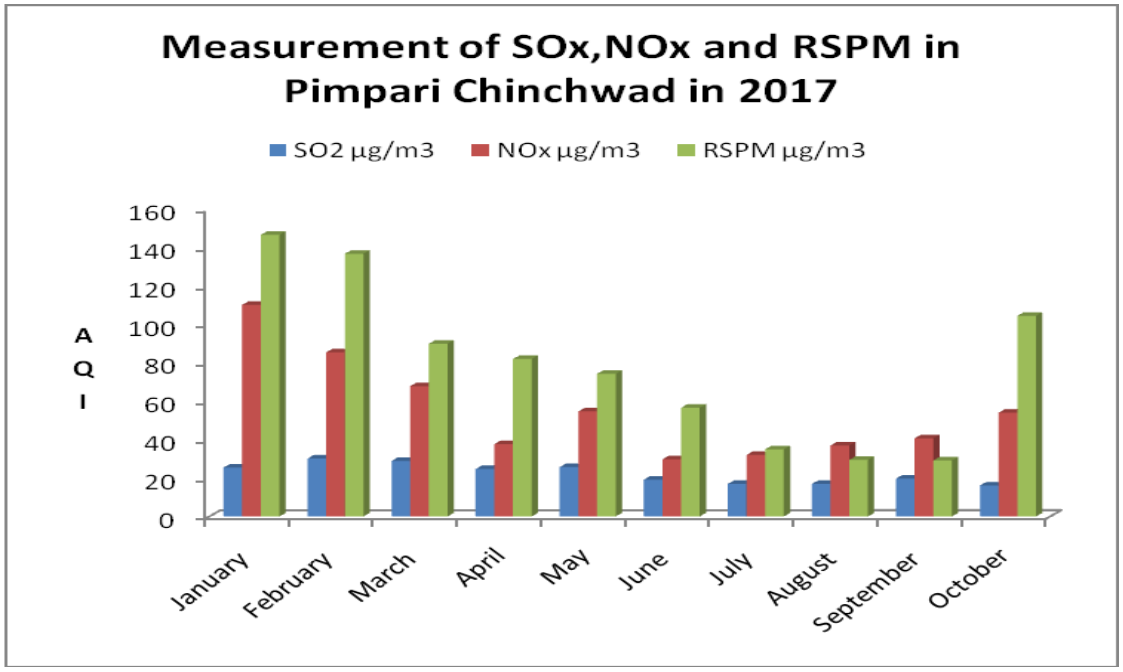

Fig. : Average Pollutionin Pimpari Chinchwad in 2017.

DISCUSSION

The air quality in the PCMC area is mainly declining due to vehicular pollution and industrial pollution.

Vehicular Pollution

According to the Pune RTO's statistics, till February end, the vehicle population of Pune including Pimpri Chinchwad was 34,90,569. Out of the total vehicle population, Pune city has a total of 24,53,717 vehicles while Pimpri Chinchwad has a population of 10,36,852 vehicles.

Out of the total 24,53,717 vehicles in Pune, nearly 75% of them that is 18,40,834 are two-wheelers. Apart from two-wheelers, the city has 4,30,440 four-wheelers which includes 3,74,445 small cars. In the year 2003, Pune had a total of 10,57,379 vehicles registered with Pune RTO.

The twin city Pimpri Chinchwad is also facing a problem of poor public transport system and it has a total of 10,36,852 vehicles of which 7,72,655 are two-wheelers and 1,55,943 are four-wheelers. [6]

Due to the development of the urban areas as centres of trade, commerce and industries, the growth in vehicular traffic has been alarming in Pune city and Pimpri- Chinchwad. Air pollution from vehicles is of serious concern. The health effects caused by vehicular pollution in the cities are indicated through increasing incidences of cough, headache, nausea, irritation of eyes, and various bronchial and respiratory diseases besides visibility problems.

The main pollutants emitted from automobiles are hydrocarbons, lead/ benzene, carbon monoxide, sulphur dioxide, oxides of nitrogen and suspended particulate matter. Though the number of vehicles is one of the major factors on which vehicular pollution depends, there are other reasons for the increased vehicular pollution in urban areas. These include: fuel quality, vehicle maintains, traffic congestion, poor road conditions and old automotive technologies.

Industrial Pollution.

Pimpri- Chinchwad area has a cluster of small scale industries in Bhosari MIDC. These companies are mainly related to automobile sector and are main cause of cause air pollution. The brick kilns and stone crushing units are also significantly declining the air quality in the city. These companies should adopt the rules and regulations of Maharashtra Pollution control Board.

In order to tackle the issue, it wants to take a multi-pronged approach, including awareness on air pollution , tree plantation drives, increase CNG buses, ban on vehicles aged over 15 years and to promote use of public transport.

Nearly 70% of air pollution is caused by the increasing number of vehicles. For this, PCMC wants to reduce the number of private vehicles and improve public transport. The Pune Mahanagar Parivahan Mahamandal Ltd will add 200 mini buses, 800 BRT buses, 50 Tejaswini buses (for women), and 550 buses by private contractors to its fleet. The civic body has proposed a clean development mechanism to reduce air pollution.

CONCLUSION

The main source of pollution in Pimpari Chinchwad area is vehicular emission. The air quality is fast deteriorating because of bad public transport. The only solution to the issue is that we need more efficient public transport, so that it discourages citizens to use private vehicles. Increasing the green cover in the city will not reduce particle pollution. We have to reduce vehicular emission, which is the biggest source of pollution in the cities. The industries have been reducing pollution because it is related to their profit margin. The more energy efficient they are all the more they will save. It is mainly the sheer number of vehicles on the city roads that is adding to the pollution. Maharashtra Pollution Control Board has to take strict actions against the companies who are polluting the atmosphere of city. Metro rail is a good option but it may take at least 20 years before we can actually use it. The PMPML has to be improved and side-by-side there has to be constraints over private vehicles.

Conflicts of interest: The authors stated that no conflicts of interest.

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