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A study on air quality index (AQI)

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Abstract
The atmospheric air is being polluted by urbanization, industrialization, by anthrogenic activities and the pollutant gases Sulphur dioxide, Nitrous oxide, Ozone gas, Carbon Monoxide and invisible particulate matters pH_{10}& pH_{25} cause respiratory disorders to human beings on the Earth. A critical study air on quality Index (AQI) of different cities of India is carried out in the present paper, basing on the data provided by State and Central Pollution Boards. Average monthly values of air quality for the year 2018 of some cities are taken and the results were studied. The results reveal that out of 37 major cities in Andhra Pradesh, 10 cities recorded unhealthy moderate AQI pollution levels (99-112) and the remaining cities are up to the satisfactory mark (62-89). And out of 8 metro polities of India, Ahmedabad & Mumbai showed 110 & 546 AQI values respectively and Mumbai showed highest 440 PM_{10} and 213 PM_{25}ug/m^3 values which are 4-6 fold high to the permissible values. So, it is concluded that sincere awareness is required to the people about the quality of air.

Keywords: population increase-natural/anthropogenic activities-air pollution-health problems-air quality index

Introduction

Industrialization, urbanization, increase of luxuries in human life, lack of awareness, increase in population and scientific development, the atmospheric air is polluted. The dust particles, allergens, chemical pollutant gases, small solid & liquid droplets and emissions from motor exhaust, power plants, broilers, wood & agriculture burning, invisible particulate matter increases air pollution and creates severe respiratory disorders particularly in old people and children. The pollute air quality values are 4-5 fold high danger to the permissible levels. To check and monitor the suspend components of air and its quality tool known Air Quality Index (AQI) is introduced by Environment Protection Agency (EPA) in USA 2-3 decades ago. AQI gives the complete air data and tells the quality of air whether it is good, satisfactory or unhealthy to inhale. (CPCB (2014) [4], Sarella &Anjali (2015) [6], Shivangi et.al, (2015) [20], Gummeneni et.al (2012) [12] & GBD Study (2017) Rohit Sharma et.al (2019) [19] & Guttikonda et.al (2019) [13].

AQI is an indicator which gives weighted values of individual air pollution related parameters into a single number, expressed in μ gm/m^3 and is followed worldwide and also in India since 2-3 decades (Mukesh Sharma 2003).

It is calculated based on the weighted values or dose-response relationship of various pollutants and particulate matter present in the air and can be measured hourly, daily or seasonally of a particular area on particular time. "IND-AQI" an Air Quality Index is followed in India as specified by CPCB, Ministry of Environment & Forest of India. It can also say that AQI works like a thermometer that ranges from 0-500 degrees communicating the pollutants and not account for temperature. (Sarella &Anjali, (2015) [6] Shivangi et.al, (2015) [20], Rao, & Rao, (1989) [18] & Beig *et al*. (2018), Rohit Sharma et.al (2019) [19] & Greenstone et.al 2014 & 2020) [10, 11]

Brief examination of pollutant air

Generally, gases like Sulphur Dioxide, Nitrous Dioxide, Ozone gas, Carbon Monoxide and particulate matters are present in the polluted air (GBD study 2017, Green Pease Assessment -2019 & Rao, & Rao 1989) [18].

Sulphur Dioxide

Sulphur Dioxide is colorless& reactive gas produced when Sulphur coating fuels like coal & oil are burned in the atmosphere. It irritates the nasal passage and creates problem in breathing.

Nitrous dioxide

Nitrous dioxide is a colorless gas coming mainly from industries and blocks the nasal passage.

Ozone gas

Ozone is present in Earth's upper atmosphere up to 6 to 30 miles along the Earth's surface and protects human beings from U.V. Rays. Bad ozone gas also comes from vehicles, power plants, boilers, refineries and pollutes the atmospheric air. This is very sensitive to old people & children and also reduces the lung functions in adults.

Carbon monoxide

Carbon monoxide is odorless & colorless gas present in the atmospheric air, which comes 75% from vehicle exhaust. This gas is present mainly in urban areas. The effect of CO is very high when it is not burn completely in the atmosphere and creates more breathing disorders in human beings.

Particulate matters

These are small liquid & solid droplets coming from motor vehicles, power plants, wood & agricultural burning and also the visible & non-visible pollen grains. These matters enter into the nasal passage and blocks the lungs. Basing o the size there are PM_{25}& PM_{10}. The AQI chart following in India (with 0 to 500 grade) is given for an idea.

Chart of Air quality Index (AQI)

(Framed by and being followed in India)

Table 1

S No	AQI	Quality of Air	Health Effect
1	0-50	Good	Minimal Impart
2	51-100	Satisfactory	Minor breathing discomfort to sensitive people
3	101-200	Moderately Polluted	Breathing discomfort to the people suffering with lung diseases, asthama& heart diseases
4	201-300	Poor	Breathing discomfort on prolongs exposure
5	301-400	Very Poor	Creates respiratory illness
6	401-500	Severe	Affects healthy people and impacts those with existing diseases

The Present Study

In this paper, critical study on Air Quality Index of different cities of India is observed, basing on the data provided by State and Central pollution Boards. The negative impact of unhealthy air is studied. For this, the AQI values of 37 cities in Andhra Pradesh and 8 metros of India for the year 2018, recorded by pollution boards are taken.

Methodology

Generally, the air quality is measured by Geo Stationary Operational Environmental Satellites (GOES-R) or by Joint Polar Satellite System (JPSS). State and Central pollution Boards measures air quality following above methods on the ground with the help of satellite systems.

Results

1. AQI values of 37 cities of Andhra Pradesh during the year 2018 were observed and are given in the Table-1.
2. AQI values of 8 metro polities of India of the year 2018 were given in the Table-2.

When the data of 37 important cities of Andhra Pradesh is observed, out of them 10 were found to moderately pollute level (99-112) and the remaining 27 cities are upto the satisfactory range (62-85).

The corresponding PM_{25} values of 27 cities are under normal range. (The PM values for the 10 cities which show moderately pollute level are not available).

The 27 cities of AP which recorded satisfactory status of air quality are given in the Table-1.

Table 2: AQI values and PM25 Values of some cities of Andhra Pradesh (These cities are having satisfactory Air Quality Index)

S. No	Name of the City	AQI	PM $_{25}$ (µg/m^3)	Status of Air quality
1	Amaravathi	78	13.2	Satisfactory
2	Betamcherla	72	24.1	Satisfactory
3	Cuddapah	64	22.1	Satisfactory
4	Dharmavaram	89	24.1	Satisfactory
5	Dhone	80	23.1	Satisfactory
6	Erraguntla	64	18.1	Satisfactory
7	Guntur	78	25.2	Satisfactory
8	Gudur	62	17.1	Satisfactory
9	Guntakal	83	27.1	Satisfactory
10	Kurnool	72	22.1	Satisfactory
11	Kondapalli	83	27.2	Satisfactory
12	Macherla	72	22.1	Satisfactory
13	Mangalagiri	80	26.2	Satisfactory
14	Nandyal	66	19.1	Satisfactory
15	Nellore	57	15.1	Satisfactory
16	Ongole	57	15.1	Satisfactory
17	Pedana	72	22.1	Satisfactory
18	Penugonda	74	23.1	Satisfactory
19	Rajahmundry	85	16.8	Satisfactory
20	Renigunta	53	13.1	Satisfactory
21	Samalkota	80	26.2	Satisfactory
22	T.P.Gudem	78	25.2	Satisfactory
23	Tirupathi	66	19.2	Satisfactory
24	Tuni	74	23.1	Satisfactory
25	Vijayawada	76	24.1	Satisfactory
26	Yeram	74	23.1	Satisfactory
27	Yarade	83	27.2	Satisfactory

*The above values of the year 2018 * Source- AP Pollution Control Board, A.P.

Table 3: The AQI values of remaining10 major cities in Andhra Pradesh (These cities are moderately polluted)

S. No	Name of the City	AQI	Status of Air quality
1	Hindupur	112	Moderately polluted
2	Ichapuram	108	Moderately polluted
3	Parvathipuram	108	Moderately polluted
4	Bobbili	103	Moderately polluted
5	Ganjuvada	103	Moderately polluted
6	Palkonda	103	Moderately polluted
7	Paslakimidi	103	Moderately polluted
8	Salur	103	Moderately polluted
9	Amudalavalasa	99	Moderately polluted
10	Chicacole	99	Moderately polluted

Source: APPCB

The values are for the year 2018

* The PM values of the above cities were not found

In the second step, average monthly AQI values of 8 metro cities of the year 2018 is observed, along with its pollutants is given in the present study in the Table-3. The results of 8 metro polity cities of India, Mumbai recorded 546 AQI followed by Ahmedabad and Kolkata 110 & 80 respectively. New Delhi recorded AQI 63 grade and it is up to the satisfactory range. The cities Hyderabad, Pune and Bengaluru exhibited low values comparatively. PM_{25} & PM_{10} values of Mumbai are very high and are 440 & 213µgms/m^3. Ahmedabad recorded PM_{25} (23) and PM_{10} (59) values (Table-3).

Next to Ahmedabad, Kolkata and Hyderabad cities recorded high air suspended particulate matters.

Regarding the pollutant gases present in the air, Chennai recorded high values of Sulphur Oxide and Nitrous Oxide followed by Ahmedabad and Bengaluru. It is also observed that ozone values of Ahmedabad and Bengaluru were very high than the permissible level and the metros Bengaluru & New Delhi followed the above cities in ozone values (Table-3).

Table 4: Average AQI values of Metro polities of India and the corresponding pollutants present in the air (in the year 2018).The values are µg/$m^{3.}$

S. No	Name of the City	AQI	PM_{25}	PM_{10}	So_2	No_2	O_3
1	Ahmedabad	110	23	59	14	08	107
2	Bengaluru	53	15	19	14	08	57
3	Chennai	25	09	N/A	21	08	31
4	New Delhi	63	19	47	10	49	57
5	Mumbai	546	440	213	04	12	25
6	Pune	50	25	32	09	08	18
7	Hyderabad	64	13	34	05	10	39
8	Kolkata	80	25	42	09	09	63

Source: Central Pollution Board, New Delhi * year-2018

*The estimated pollutants of some highly polluted cities of India having abnormal air quality is given in the following chart to have an idea with the normal permissible values.

Table 5

S. No.	Gas	Range (Value in µg/m^3)	Normal Range
1	So_2	411	20 µg/m^3
2	No_2	12	40 µg/m^3
3	O_3	35	100 µg/m^3
4	Co	260	100 µg/m^3
5	PM_{10}	54	20 µg/m^3
6	PM_{25}	24	35 µg/m^3

***Source:** CPCB. WHO values (who.internetnews/room/fac2 May 2018)

In this context another tool, Air Quality Life Index (AQLI) is introduced very recently to check the air quality which is linked with the life span of the man.

AQLI (Air Quality Life Index)

The awareness on air quality is increased in recent years and another tool known as Air Quality Life Index (AQLI) is introduced by Energy Policy Institute at the University of Chicago USA (EPIC). AQLI gives the concentrations of air pollutants and their impact on the life span of man and also deals with the consequences of exposure to air pollution. EPIC is a worldwide organization which works on a variety of energy & environment economic projects and other environmental issues including the social impacts of climate change, food & agriculture. EPIC - India is a joint international forum which is working currently with central &several state pollution boards in India to check the pollution by reducing the emissions to normal level.

(Annual report on air pollution, July 2020- by Greenstone and Chaire Fan).

Greenstone, Professor in Economics, the School of Harris, University of Chicago, USA. Greenstone and Chaire Fan are mainly attached with EPIC and working on AQLI.

A recent survey report of World Health Organization (WHO) (year 2020) says that the air pollution with particulate matter gradually decreases the global life expectancy nearly by two years in some developed countries and 4-6 years in South Asian countries like Nepal, Bangladesh, Pakistan & India. The report also says that the deaths to long exposure of pollution are higher than to deaths of TB/AIDS, Cancer & Cigarette smoking.

Discussion

In the present study the cities & methods which are observed high air quality index values were highly populated and industrialized. The development of industries, urbanization & scientific development & lack of awareness are the causes, to check and monitor U.S. EPA introduced AQI and as this is a global problem so many countries came on a single platform and discussed the causes and remedies (or) solutions.

In this context 'Green Peace' a Non-Governmental organization jointly working with so many nations on air pollution disclosed that air pollution became 'Global Burden of Disease' in developed & developing countries and the people were facing many breathing disorders & premature deaths and the deaths caused by air pollution are higher to deaths occurring due to tobacco chewing, smoking, cancer and AID's. Another survey report of WHO & International Air Quality Agency (IAQA) stated 70-80% of global population are breathing unhealthy air particularly in highly populated & poor countries like India where carbon monoxide from cooking stoves and dust particles coming from forest fire, agricultural burning and also from vehicle exhaust. The WHO also cautioned that the 10-15 highly polluted cities in India were severely suffering in the world and Kanpur is the most polluted city in the world with AQI grade 320, New Delhi, Mumbai, Meerut, Kolkata are the cities followed by Kanpur. The WHO report also says that air quality with particulate matter in states like U.P., West Bengal, Maharastra & Telangana were crossing the National Ambient standards and an awareness is required to the people residing there (Shivangi et.al. 2015 [20], Sarella 2015, US EPA Report, 2016, GBD (2017&2018) CPCB 2014 [4], Gummeneni et.al 2012 [12], Rohit Sharma et.al 2019 [19] and Greenstone et.al 2014 &2020 [10, 11].

The News Paper survey report (Indian Express& Times of India) and the recorded documents says that pollution levels are high in Northern states like Bihar, U.P. & Chattisgarh when compared the southern regions. The lack of knowledge, awareness, the living styles & cooking habbits of northern people are the reasons. The report also views that suffocation problem and respiratory disorders become more in winter season because of carbon monoxide coming from cooking & motor exhaust will not burn completely in winter due to low atmospheric temperature and also due to the dust particles coming from burning of agricultural wastes after the harvest (CPCB 2014, Rao &Rao1989 [18], and Beig et. al, 2018 &WHO Report 2020) [4, 18].

Along with atmospheric temperature, sunlight and wind currents were also responsible for increasing the pollution. In winter the wind is calm and the air currents will not disperse properly in the air compared to the summer season and the rate of pollution is high in the winter. In summer times the strong wind scatters fast and negative impact of pollution will be low. Another factor in the summer season the chemical reactions in atmosphere will be high as a result more ozone gas is produced from power plants, refineries and vehicles etc., which cause irritation to the

respiratory system and to the functions of lungs too. Where as in rainy times all the pollutions present in the air were washed away and may come down as acid rains and pollutes the air, land & water (Shivangi et.al, 2015, Kumar 2011, Mukesh Sharma 2014, Kamath 2014& Rohit Sharma et.al 2019) [20, 17, 16, 19]

Conclusion

All the above mentioned factors show negative impact of air quality and raise the pollutants present in the air. Due to this all living things face severe mental & physical health problems and disorders and may Looses life span upto 3-5 years. So it is suggested that awareness is required to the people and the Governmental bodies has to implement strict rules to check and control air pollution. It may concluded that an alround scientific & industrial development is required and it is also the responsibility of the citizens & Government bodies to maintain healthy conditions to live on the Earth and for the coming generations.

Some Institutes and Boards Monitoring Air Quality Index (AQI)

1. International AQI Monitoring Systems (IAQIS)
2. Environmental Protection Agency (EPA).
3. World Health Organization (WHO).
4. Ministry of Environment, Forest & Climate Change (MO EFCC)
5. National Ambient Air Quality Standards (NAAQS)
6. National Air Quality Monitoring Programme (NAQMP)
7. Central Pollution Board and State Pollution Board &
8. So many Non-Governmental Environmental Agencies like "Green Peace Environment Treat" etc.

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