



# A POSITIVE IMPACT OF COVID-19 ON AIR QUALITY AT INDIAN CONTEXT

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*Abstract:* Beyond cast, colour & creed countries are suffering from an uncertain event. Both immediate and long term effects are matter of concern. Life losses are the biggest threats with economic rupture. In spite of several negative influences this article focused on positive and hopeful wing, regarding air quality due to eliminating sources of air pollutants as an immediate result.

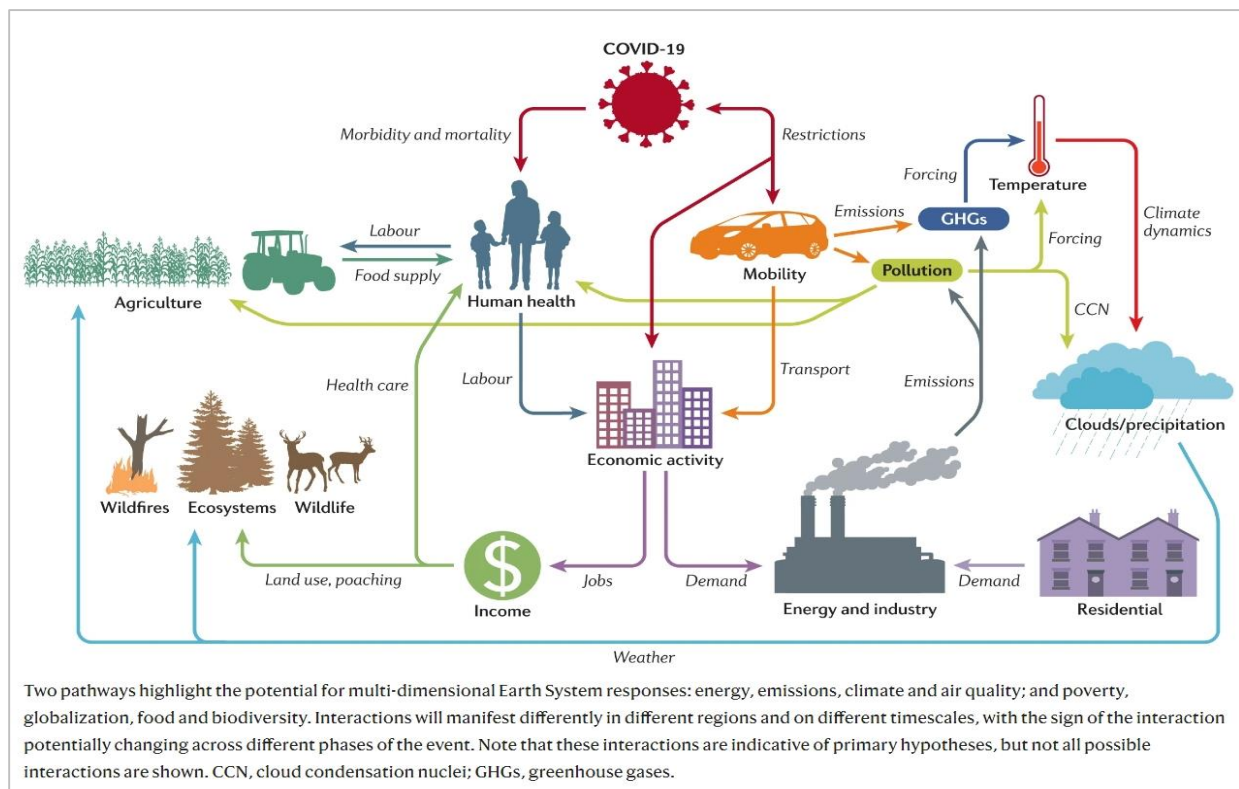
*Index Terms - Covid-19, Air Quality, AQI, India.*

## I. INTRODUCTION

World is going through hardship. Covid-19 spreaded across the globe, threatening and killing millions, moreover resulted into a feeble economy, also have discerning impact over environment due to restricted human activities. This necessarily does not imply that nature is 'getting a break', instead, disrupted by increased pressure from land-grabbing faced by rural areas of tropic, deforestation, illegal mining and wildlife poaching<sup>i</sup>. Many researchers want to observe the event from different angle, the way nature 'reset' imbalance through threshold events<sup>ii</sup>. It is uncertain how climatic break-down impact on Covid-19, researcher predict that warming temperature and higher humidity (e.g. India) might slow or even halt, <sup>iii</sup> <sup>iv</sup> still country experienced both sides of impact markedly (Fig 1). Although in global scale "this narrative of nature having been given a break during Covid, it's not entirely accurate. It's accurate in cities and peri-urban areas," says Sebastian Troeng, executive vice-president of Conservation International. "But unfortunately in the rural areas, the situation is almost the inverse."<sup>v</sup> Environmental reaction (pros and cons) over the period of lockdown and before analysed by various researcher at different dimension.

India undergo several lockdown (25<sup>th</sup> March to 31<sup>st</sup> May) and unlocking periods (1<sup>st</sup> June to 31<sup>st</sup> November), to restrict human activities to maintain 'social distancing' (preferably 'physical distancing') apparently the only general solution to control the spread of coronavirus was to break the cycle of transmission through social distancing.<sup>vi</sup> Lockdown events resulted into nationwide reduction of planned travel, industrial and transport activities. Lockdown periods from 4<sup>th</sup> May, 2020 was eased with several relaxation and finally unlocking period started at June, stating that the phases of reopening would "have an economic focus". Anyway, this 'anthropause' event caused many regions to experience immense down of air and water pollution. A balanced ecosystem comes out of resulted anthropogenic interruption experienced from June. Quality of air improved substantially at major cities with few other environmental parameters as well, visualized by real time satellite images of Indian Atmosphere and Air Quality Index (AQI) calculated by central pollution control board of India.

Figure 1: Earth System interactions linked to the Covid-19 socio-economic disruption.



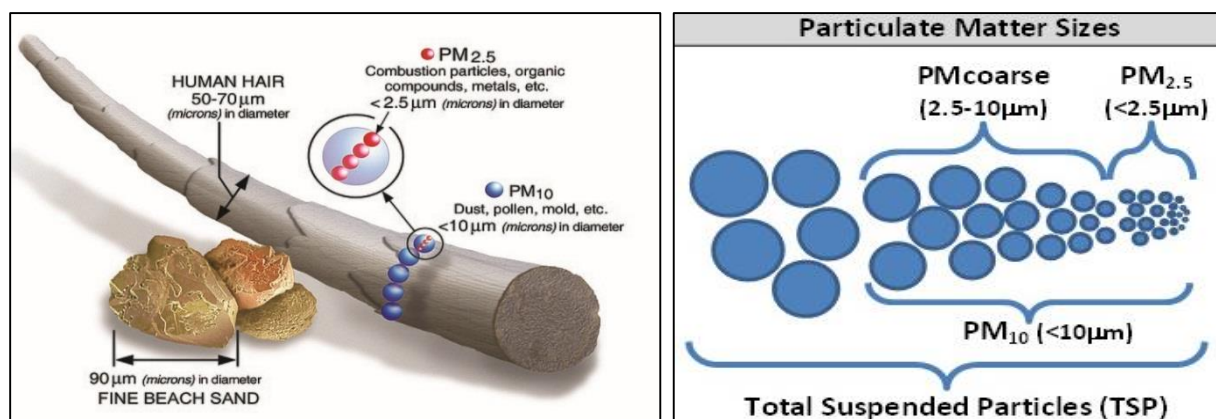
Source: Diffenbaugh, N.S., Field, C.B., et.al. (2020). "The COVID-19 lockdowns: a window into the Earth System". *Nature Reviews Earth & Environment*, ISSN 2662-138X. Retrieved from <https://www.nature.com>, at 2020 October 29.)

As a result of impact of lockdown nature has gain at least 2 months (April and May) as 'healing time'. Skies and Yamuna River retaining its spirit and pattern at Delhi reported<sup>vii</sup>, water of river Ganga had even become drinkable again for the first time in two decades in some places<sup>viii</sup>. Nilgai was spotted walking leisurely on the road of Noida's busiest Sector-18. Similarly, in Kerala's Kozhikode, a Malabar Civet, which is a critically endangered animal, was spotted walking on the road<sup>ix</sup>. Dolphin and pink flamingos have returned to Mumbai in huge numbers amid COVID 19 lockdown<sup>x</sup>. Rare pink gangetic dolphin have become more visible in the Vikramshila Gangetic Dolphin Sanctuary (VGDS) in Bihar, spread over 50 km along the river in Bihar's Bhagalpur district, due to lack of human activities or interference, by Sunil Choudhary, director of Vikramshila Biodiversity Research and Education Centre of Tilka Manjhi Bhagalpur University (15<sup>th</sup> April, 2020). Olive Ridleys arrived Odisha's Gahirmatha Beach and Rushikulya Rookery at desired number<sup>xi</sup>.

## II. IMPACT ON AIR QUALITY:

India has shown a worst air pollution scenario last decades and air quality parameters left the optimum level behind long ago. A research from the Global Alliance on Health and Pollution (GAHP) has shown that India suffers the maximum premature pollution-related deaths in the world, 23,26,771.<sup>xii</sup> Report says "India has seen increasing industrial and vehicular pollution from urban growth while poor sanitation and contaminated indoor air persist in low-income communities". Significantly, India has 14 cities in list of world top 20 polluted cities. Ghaziabad is in first place with PM2.5 pollution level of 110.2  $\mu\text{g}/\text{m}^3$  in 2019 compared to the permissible limit of 60  $\mu\text{g}/\text{m}^3$  (for 24 h).<sup>xiii</sup> On another report at 2019 of State of India's Environment (SoE) says, Air pollution in India is responsible for 12.5 percent of all deaths in the country. 8.5 out of every 10,000 children in India die before they turn five due to poor air, and risk was higher for girls (9.6 out of 10,000). The think tank, Centre for Science and Environment (CSE) also reported that emission of GHGs increased by 22% between 2010 and 2014. Energy sector contributors for 73 percent. Country's capital Delhi run into havoc air pollution issue from 2017. At November 2018 air pollution levels had reached 20 times the recommended WHO's safe limits for air pollution. At the mean time (2017-19) average PM 2.5 was four folds of national standard and 16 times of WHO standard. Government adopted various measures to prevent the situation, converting vehicles to cleaner fuel, restricting vehicle use at specific times and car number, banning the use of polluting industrial fuel, prohibiting the entry of the dirtiest vehicles into the city and closing some power stations.

Figure 2: PM 2.5 and PM 10 compared with a human hair in a graphic from the Environmental Protection Agency



Source: [www.cleanteair.org](http://www.cleanteair.org); [www4.des.state.nh.us](http://www4.des.state.nh.us); [www.epa.gov](http://www.epa.gov)

If we observed timeline of air quality of major cities of India ameliorate is clearly noticeable, a huge drops at PM<sub>2.5</sub>, PM<sub>10</sub> (Fig 2), CO, NO<sub>x</sub> and SO<sub>x</sub> level (selected parameters) between April to May nationwide and the states still undergo sort of human activities (majorly industrial and transport movement). Graphical presentation of air quality scenario (historical outline) of four major cities supporting covid-19 lockdown may pronounce as a positive intervention. Delhi experienced worse condition than Kolkata. A study conducted by Snehal Lokhandwala and Pratibha Gautam (2020) over the impact of Covid-19 on air quality (of April) of Ghaziabad city shows up to 85% and 50% reduction in PM<sub>2.5</sub> and PM<sub>10</sub> concentration respectively compared to Jan 14, 2020; 46% and 40% less compared to April 14, 2019 (year to year comparison)<sup>xiv</sup>. Studies conducted by Sharma, et.al. 2020<sup>xv</sup>; Mahato, et.al. 2020<sup>xvi</sup>; Gautam, 2020<sup>xvii</sup>; Srivastava, et.al. 2020<sup>xviii</sup>; (etc.) show the positive impact over nature. An article published at 15 April, 2020 stated that “direct correlation between current high air pollution levels and incidence of COVID-19, high pollution levels might also increase the risk of contracting COVID-19 in the first place, as particulate matter has the potential to act as carriers for contagion leading to rapid spread over larger areas.”<sup>xix</sup> Patients with interstitial lung disease (ILD) have an increased risk of severe disease and death associated with Covid-19, according to findings from a multicenter case-control study published in the American Journal of Respiratory and Critical Care Medicine.<sup>xx</sup> Air pollution is the cause and aggravating factor of many respiratory diseases like chronic obstructive pulmonary disease (COPD), asthma, and lung cancer,<sup>xxi</sup> impel co-morbidity rate. Studies revealed that air pollution is crucial indicator that affects the COVID-19 transmission and mortality rate (Abdullah et al., 2020; Carrington, 2020; Muhammad et al., 2020). Moreover, had significant correlation with climate indicators such as temperature, dew point, humidity, wind speed, rainfall and COVID-19 transmissions and fatality (Ma et al., 2020; Pirouz et al., 2020; Sobral et al., 2020; Zhu with climate indicators such as temperature, dew point, humidity, wind speed, rainfall and COVID-19 transmissions and fatality (Ma et al., 2020; Pirouz et al., 2020; Sobral et al., 2020; Zhu et al., 2020). Recently, The Calcutta High Court on Thursday (5<sup>th</sup> Nov), division bench of justices Sanjib Banerjee and Arijit Banerjee gave the direction to banned the use and sale of firecrackers on Kali Puja to curb pollution amid the COVID-19 pandemic.<sup>xxii</sup> The restriction should be followed by administration and citizen to respect the unavoidable situation, as firecrackers causes extensive air pollution, leaving metal particles, dangerous toxin, and harmful chemicals (Table 1).<sup>xxiii</sup> It can raise the level of SO<sub>2</sub>, NO<sub>2</sub>, and CO<sub>2</sub> level for days or months. Intoxicating air can cause aggravated cardiovascular illness and respiratory illness and added stress to the heart and lungs<sup>xxiv</sup>, which has further worsen the condition for Covid-19 patients. India is often regarded as ‘fossil fuel country’ and tackle the issue is going to be one of nation biggest challenge. However, ‘this should not be seen as a “silver lining” but it does show how normalized the massive death toll from air pollution has become’ (Centre for research on Energy and Clean Air - CREA). Statistics of distribution PM<sub>2.5</sub>, PM<sub>10</sub>, CO, NO<sub>x</sub> and SO<sub>x</sub> concentration level of 4 major cities introduced (Fig. 3).

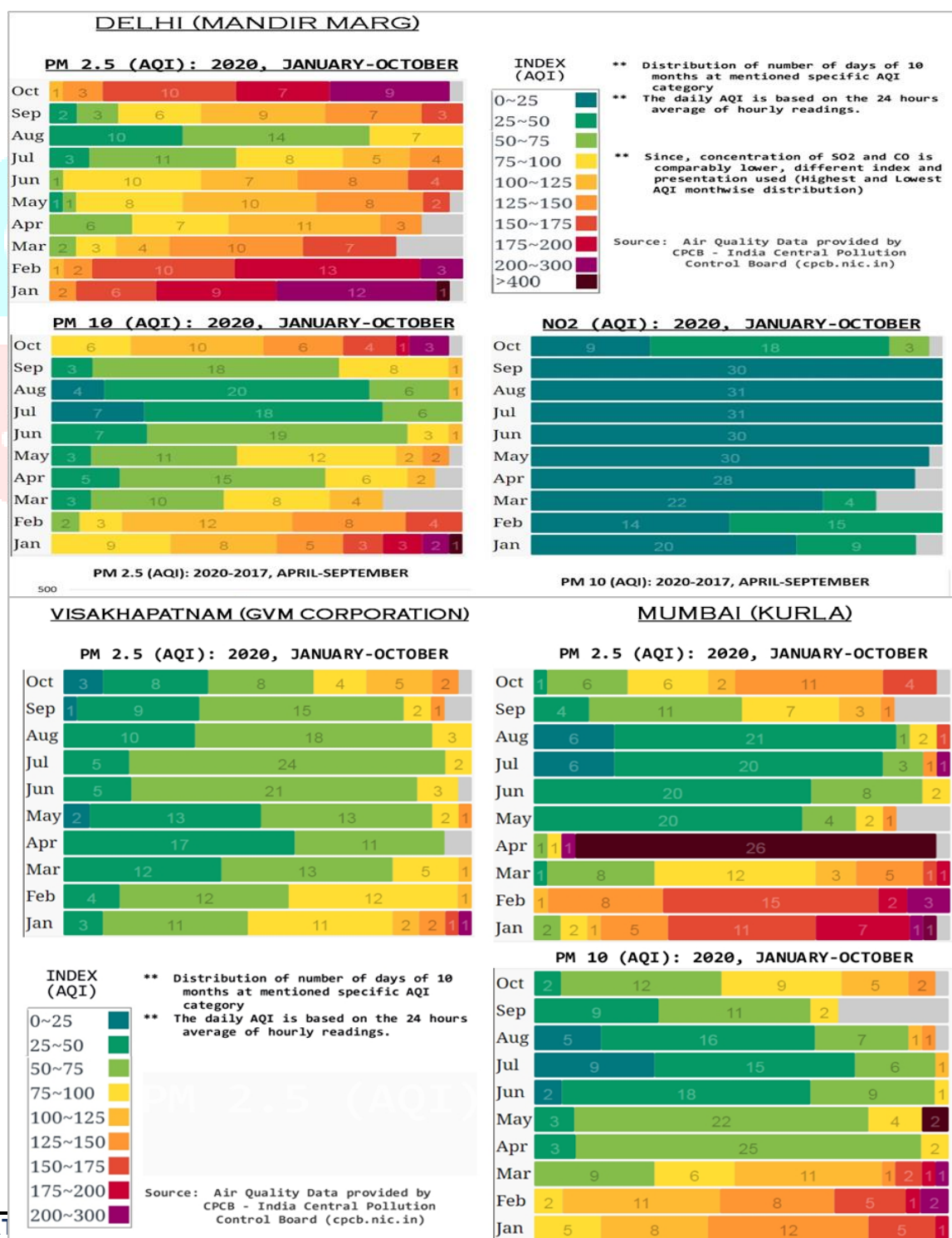


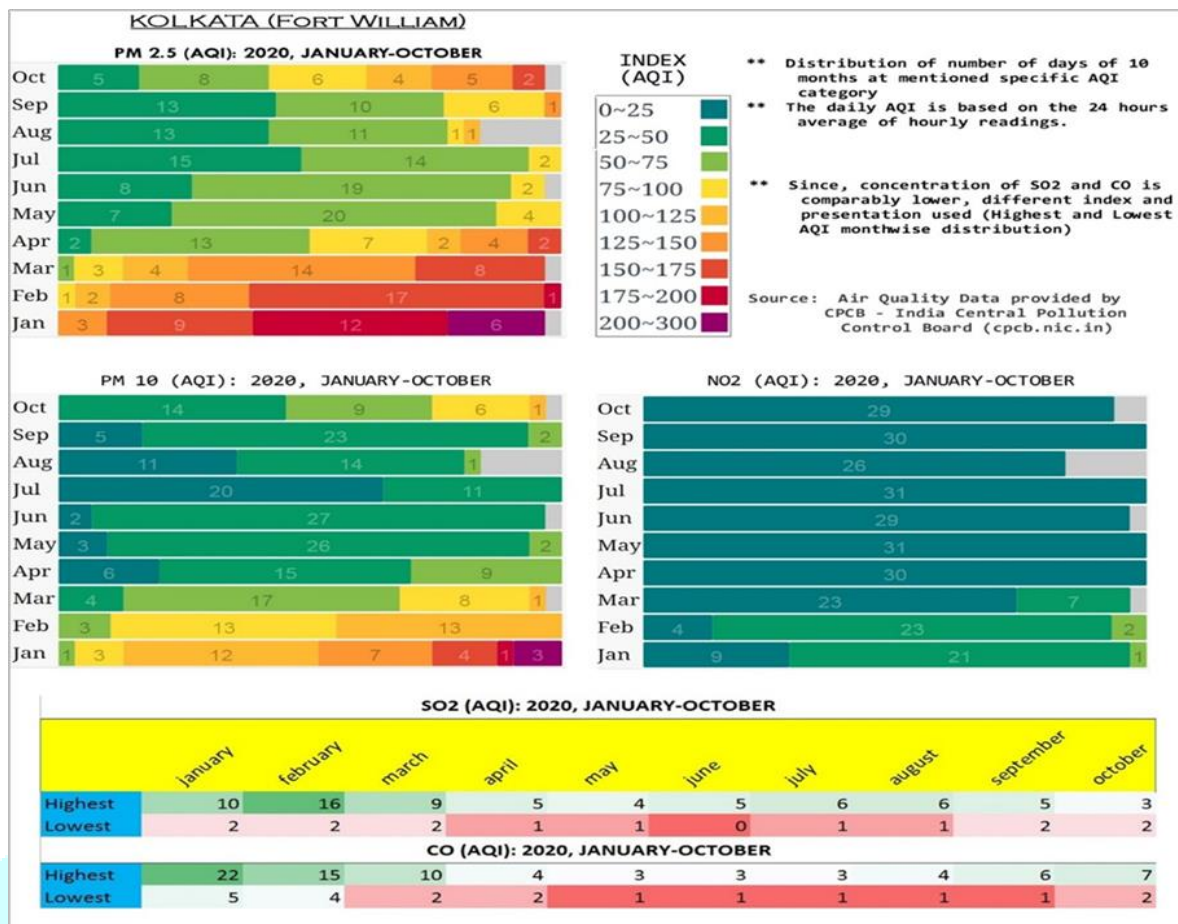
Table 1: Types of air pollutants and normal concentration level within TWA- 24Hrs.

Pollutant	Time Weighted Average	Concentration #	Source Of Pollutant (Anthropogenic)
Particulate Matter (size less than 2.5 µm) or PM2.5 µg/m3	Annual / 24 Hrs.	40 / 60	Primarily come from combustion - fires, automobiles and power plants.
Particulate Matter (size less than 10 µm) or PM10 µg/m3	Annual / 24 Hrs.	60 / 100	Mainly by road and construction dust, and nitrogen dioxide, which comes mainly from vehicular emissions.
Sulphur Dioxide (SO2), µg/m3	Annual / 24 Hrs.	50 / 80	Fossil fuel combustion, smelting, manufacture of H <sub>2</sub> SO <sub>4</sub> , conversion of wood pulp to paper, incineration of refuse and production of elemental Sulphur, etc.
Nitrogen Dioxide (NO2), µg/m3	Annual / 24 Hrs.	40 / 80	Fossil fuel combustion, nitric acid manufacture, welding processes and the use of explosives, etc.
Carbon Monoxide (CO) mg/m3	8 Hrs. / 1 Hrs.	02 / 04	Combustion of organic matter

#Concentration in ambient air of Industrial, Residential, Rural and Other Areas. (Annual Average / 24 hours)  
 Source: www.air-quality.org.uk; www.arthapedia.in; www.who.int; www.epa.gov

Figure 3: Trends for Pollutant concentration at Delhi (Mandir Marg), Visakhapatnam (GVM Corp.), Mumbai (Kurla), & Kolkata (Fort William)





### III. SATELLITE IMAGE OBSERVATION:

To measure air quality changes study satellite images is one of prominent strategy. Aerosol Optical Depth is a measure of how light is absorbed or reflected by airborne particles as it travels through the atmosphere. An optical depth of 1 or above indicates very hazy conditions and less than 0.1 considered 'clean'.<sup>xxv</sup>The data retrieved from MODIS (Moderate Resolution Imaging Spectroradiometer) on Terra and Aqua satellites (Sentinel-5P and AURA) from NASA, creates satellite images of optical depth and size distribution of ambient aerosol over the globe on hourly basis. Copernicus Sentinel-5P shows the average nitrogen dioxide concentration of 1<sup>st</sup> January to 24<sup>th</sup> March and 25<sup>th</sup> March to 20<sup>th</sup> April of 2020 compared to same time of last year, showing some cities across India seeing levels drop by around 40–50% owing to its nationwide quarantine (The European Space Agency) (Fig. 4). The concentration of AOD and other parameters related to AQI drops in India due to reduction of various human-made emission source in both rural and largely in urban areas. According to expert natural phenomenon (e.g. heavy rain in North India around 27<sup>th</sup> March, fire activity at the end of February, dust storm and wind patterns) impacted on AOD, though this year air quality shows such grace to say “we knew we would see changes in atmospheric composition in many places during the lockdown. But I have never seen aerosol values so low in the Indo-Gangetic Plain at this time of year” (Pawan Gupta scientist of Universities Space Research Association (USRA) at NASA’s Marshall Space Flight Center (Fig. 5). The observation of Sentinel-5P satellite reveal improved NO<sub>2</sub> concentration except at north-east and east India triggered by the “location of ongoing coal-based power plants. The largest power station in India, the Vindhyachal Super Thermal Power Station, shows a reduction of only around 15% compared to the same time last year” (ESA, 2020) (Fig. 6). Anthropogenic activities sources of suspended particles and aerosol level in northern India at the beginning of April (Fig. 7) were significantly below the norm for this time of year and the lowest in 20 years of MODIS observations.<sup>xxvi</sup>Visibility was up to the mark, as lockdown eases air pollution, Dhauladhar Mountain range of Himachal visible from Jalandhar (Punjab) after almost 30 years<sup>xxvii</sup>, which is approx. 200k.m. away. Analysing of real-time satellite image and comparison of March-April-May depicts much improvisation of fine particulate matter (PM 2.5) density, primarily added by burning fossil fuel, car engines, power plants and indoor sources are tobacco smoke, cooking.<sup>xxviii</sup>Central Pollution Control Board of India reported total 85 cities experienced across India saw less air pollution in the first week of the nationwide lockdown. On March 21, 2020 a total of 54 cities categorized as ‘good’ or ‘satisfactory’ of 112 cities around India surveyed, whereas 90 cities recorded at 21<sup>st</sup> April (Table 2).

Greenhouse gas emissions (GHG), nitrogen dioxide (NO<sub>2</sub>), water pollution, sound pollution and pollution in coastal areas have reduced significantly due to full or partial lockdowns and strict movement control order (MCO) by many governments across the world (Chakraborty and Maity, 2020; Saadat et al., 2020; Wang and Su, 2020; Zambrano-Monserrate et al., 2020).



Table 2: Distribution of AQI Level of Indian Cities during 21<sup>st</sup> March and 21<sup>st</sup> April.

AQI, Average of 24 hrs.	21 <sup>st</sup> March		21 <sup>st</sup> April	
	2019	2020	2019	2020
'GOOD'(Minimal Impact; AQI: 0-50)	6 (out of 93)	2 (out of 112)	5 (out of 95)	31 (out of 106)
'SATISFACTORY'(Minor breathing discomfort to sensitive people; AQI: 51-100)	25 (out of 93)	52 (out of 112)	29 (out of 95)	59 (out of 106)

Source: Central Control Room for Air Quality Management, Delhi NCR

Figure 4: NO<sub>2</sub> concentrations over India

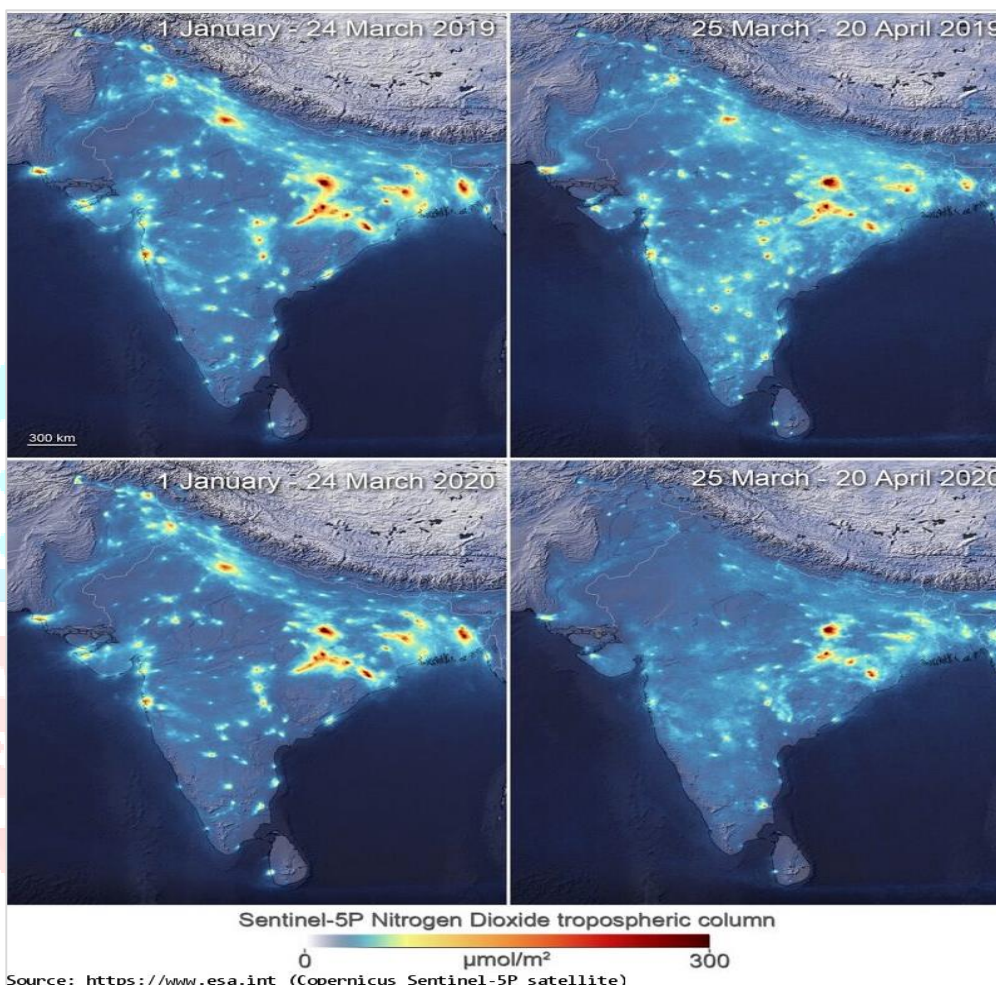
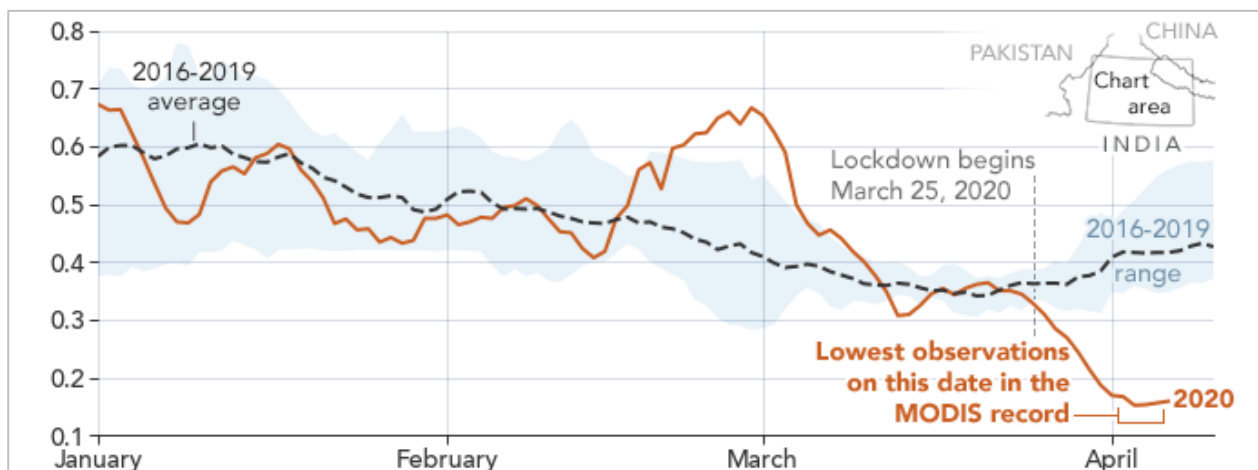
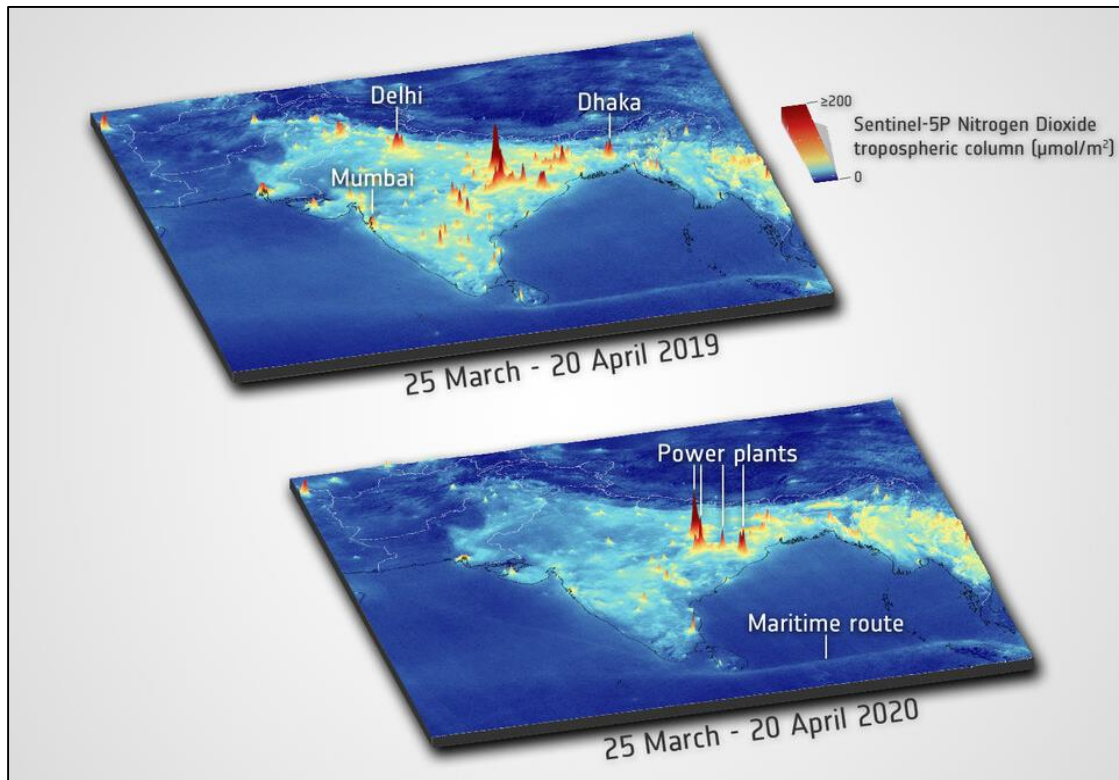


Figure 5: Aerosol Optical Depth (550 nm) over Northern India



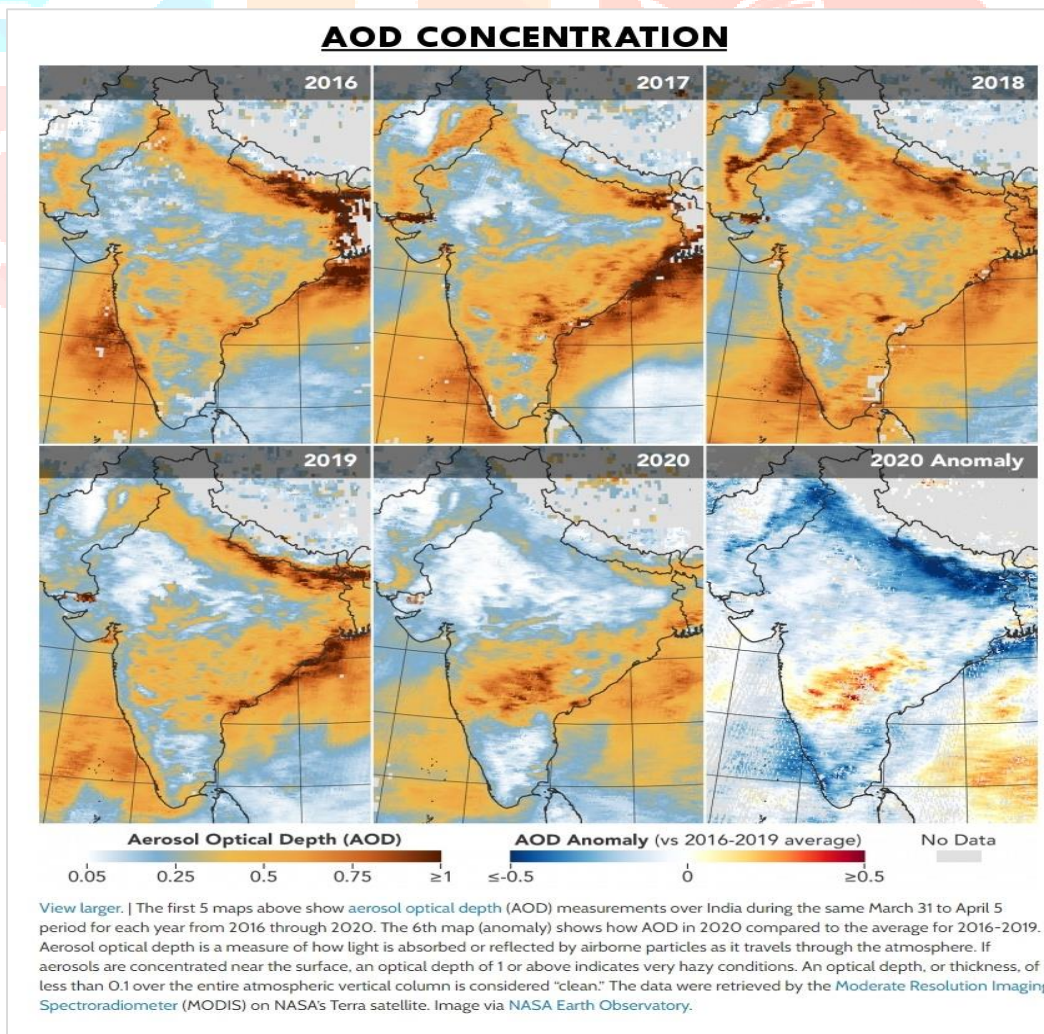
Source: <https://earthobservatory.nasa.gov>

Figure 6: NO<sub>2</sub> concentration tropospheric column over India



Source: <https://www.esa.int>

Figure 7: Aerosol Optical Depth Concentration over India during 2016-2020.





Covid-19 situation did not solve the issues regarding air quality but obviously the situation revealed inter-reliant man-environment relationship. Lock-down is neither planned intervene, nor it is possible for longer period. Hence, we can take lesson to further take environment-centered prospective measure to combat environment issues.

- Implication and planned restriction over human activities. Foundation of strategies supports sustainable development and nourishing environmental health.
- Limited activity or partial lockdown of 3-4 days in every 4 months.
- Community involvement and spreading awareness about the crucial role of environment on human health.
- ‘Chemical management’ to reduce suspended particles in the air. Restrict transport activities, implication of laws. Necessary steps to maintain dispose of harmful industrial, medical and domestic waste. Recycle and decompose should be centre of waste management plan.
- Quick and optimal feedback in case of future epidemic episodes. In addition, researchers, medical personnel and social leaders need to work together to design strategies based on environmental and socio-economic terms.<sup>xxx</sup>
- Emphasize over ‘green energy’ and renewable sources for power generation. Transport and industry sector are major sources of air polluting elements.

#### IV. CONCLUSION:

Lockdown period provides glimpse of fresh environment in terms of air-soil-water, when limited human activities eliminates pollution level at certain level. From an environmentalist view it is highly recommended to shift towards proper management and treatment system. Measures have to be taken in terms of correlation between atmospheric changes with the behavioral changes of human interference and its impact on lifestyle of natural creatures in their respective ecosystem during lockdown period.<sup>xxxi</sup> In addition, this is not only about epidemic situation but a reminder through practical scenario that how much dependent we are over environment. Hence, accepting ‘geocratic’ view rather than ‘weocratic’ may propel the sustainability of ecosystem, so of us.

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