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Editorial

What is Changed in COVID-19 Lockdown?

Dear Readers

I am pleased to present before you this issue of ENVIS Newsletter dedicated to COVID-19. The COVID-19 lockdown is a very rare phenomenon when the whole globe has come to a standstill. All the manmade outdoor activities have been shut down. There are no aircrafts flying, no road transport and no industry operations. Mankind is caged inside the house. Evidently, this lockdown has seen significant changes in the levels of air, water and soil pollution. A larger impact, however, can be observed in our society and the norms it defines as a whole.

The lockdown has led to very effective environmental pollution cleansing - especially air and water pollution. During the lock down, the air is very clean, there is no haze, high visibility is seen. Due to high visibility, the Himalayan mountain range can be seen from Jalandhar which is 200 km away. Since, there are no outdoor operations, there is no noise which has allowed birds to proliferate in various localities. The number of colorful birds cited on the trees and buildings has increased during the lockdown.

In my opinion the COVID-19 lockdown is a turning point for e-education, working culture and social engineering. It has forced many to change their lifestyle and has led to the adoption of ‘Work from Home (WFH) as a new work culture. For one thing, the stress and rush involved in commuting to work on a daily basis has been almost completely removed. This also leads to reduced consumption of fuel, indirectly reducing the level of air pollution. People are sleeping and rising as per their convenience, this has provided a relaxed condition which is a healthy aspect. Unfortunately, not all is well. There are reports of increasing domestic violence, and increased social distancing behavior is leading to more distant treatment of other people, despite the level of connectivity the internet provides. Nevertheless, people are trying to pass time at home for by finding new methods of keeping busy. This emergency has given the opportunity for creative minds to exhibit their talent and engage more deeply with their hobbies. Cooking, music, singing, lecturing, dancing, writing poetry etc. are attempted by the artists in order to keep busy and to utilize the time.

While the pandemic and subsequent lockdown have led to many problems, including but not limited to the disease itself, the halt in industrial activity and manufacturing, as well as reduced global cooperation, on the smaller scale, for the environment and for the average person, it has also brought several unanticipated benefits and relief.

This issue of the newsletter highlights air pollution and health scenarios before and after COVID-19 lockdown covering from global to local scales. It also highlights that the reduced anthropogenic activities have provided a favorable environment for the butterfly population in NCR Delhi. A report describes the origin of the novel coronavirus SARS CoV-2.

Wishing you a safe stay and healthy life

Sincerely

(UMESH CHANDRA KULSHRESTHA)

Coordinator, JNU ENVIS RP
Reduction in Global Air Pollution During COVID-19 Lockdown

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Abstract
The present article aims to evaluate the observed changes in air quality amid the global lockdown scenario arising due to the outbreak of novel coronavirus COVID-19. There has been a significant reduction in PM_{2.5}, NOx levels. The prevailing lockdown situation has brought all the major human activities such as industries, automobiles, construction works, etc., to a halt. There is a foreseeable global economic slowdown bringing in lots of negativity in the economic front. However, there are reasons to be happy on the environmental front where various reports suggest a significant improvement in the air quality in various parts of the world, due to coronavirus lockdown.

1. Introduction
The novel coronavirus (COVID-19) pandemic outbreak created chaos to regular human life across the world. It has affected almost 180 countries with more than 1.8 million reported cases worldwide so far. In the recent past few weeks, the confirmed cases have almost doubled its number and is increasing continually at the alarming rate of 20% new cases per day. As per the Ministry of Health & Family Welfare (MoHFW), total 11439 COVID affected cases were reported so far in India upto 15th April 2020. However, the present number is much more.

In December 2019, many pneumonia cases were suddenly observed in the Wuhan (China) city, as the result of infection to a novel coronavirus (Li et al., 2020; Wu et al., 2020; Xu et al., 2020). The World Health Organization (WHO) has defined this new syndrome as a Covid-19 for CoronaVirus Disease 2019 (Sohrabi et al., 2020; WHO, 2020a). The coronavirus outbreak has spread across the globe and in the pretext of the situation on 11 march World Health Organisation has declared a COVID-19 as a global pandemic disease (WHO, 2020).

In order to restrain the current spread of the Coronavirus, most countries of the world are imposing strict and preventive measures by aggressive testing regime and bringing countries to lockdown to enact the social distancing. The coronavirus outbreak has sent the global economy reeling as businesses are getting closed as billions of people shelter at home. Air travel, vehicle traffic, and industrial production have rapidly declined in recent weeks, with much of the world frozen in place until the virus which has killed more than 100,000 people globally, can be safely contained (The Atlantic,2020; The Hindu,2020). This is the world's largest lockdown, which means all Industrial work, running factories, religious worshiping and construction work has come to an halt. In the midst of travel bans, movement of citizens is a lot less. Self-isolation orders, home stay, practice social distancing is being implemented all over the world to stop the spread.
of coronavirus. Despite several adverse effects to economy and health this has led to a huge drop in air pollution. Also, this shutdown is a rejuvenation of the environment and Earth system due to reduced anthropogenic activities and air pollution (Kulshrestha, 2020). Air pollution has been responsible for an average of 4.2 million deaths every year across the globe. China, from where the pandemic COVID-19 started, is also a country severely affected by air pollution (He et al., 2020a,b) Air pollution in China was responsible for 4000 preventable fatalities each day i.e. 1.6 million deaths in 2016 (Rohde and Muller, 2015; Wang et al., 2012). Many models predicted mortality due to air pollution (Hoek et al., 2013), with an increase of all-factor mortality varying from 0.13% per 10μg/m³ of NO₂ per day (He et al., 2020a,b) to 2% per 10μg/m³ of NO₂ on a 5 day period (Chiusolo et al., 2011). The last two months have seen a massive reduction in poor air quality, especially in virus hard-hit areas like China, India and Northern Italy, as well as a number of metropolitan areas throughout the U.S. Although, the current Corona outbreak has brought the global economy to halt but we see striking blue skies and clear water in places, from Venice to Beijing, Los Angeles to Bangalore. In fact, Himalayan mountain range “Dhauladhar” is now clearly visible from Jalandhar, a city in the state of Punjab, India explaining the extent of damage done our environment. The various space agencies like NASA, European Space Agency and other institutions observed and studied Satellite data and found significant improvement in air quality in the past weeks while comparing with the same dataset recorded a year ago at the same time (FT, 2020; ET, 2020).

“When we talk about improvement in air quality, it means reduction in NO₂, CO₂ and particulates matter like PM₂.₅”. The fossil fuel burning and industrial processes are the primary source and responsible for the emission of these harmful particles. The level of Air pollution has drastically fall in most of the developed and developing countries as authorities restricted movement and strictly imposed curfews in the wake of the Coronavirus outbreak. The most significant improvements in air quality are observed over metropolitan cities and regions laden with industrial areas, factories and thermal power plants (The Guardian, 2020a).

2. Changes in Nitrogen Dioxide (NO₂)

Nitrogen Dioxide (NO₂) is one the most toxic gases. If the concentrations found above 200 micrograms per cubic meter in the air, it causes significant ill effects to the human and plant as well. As we know the atmosphere is composed of 78 % nitrogen gas and through the process of fossil fuel combustion in the engine of automobiles, industrial processes and power plants, NO₂ is produced as a by-product. Nitrogen dioxide is also responsible for respiratory illnesses like asphyxia and asthma as such.

3. Changes in Carbon dioxide (CO₂)

The fossil fuels combustion and biomass burning are the primary source for the emission of carbon dioxide (CO₂). According to the report of CICR (Center for International Climate Research) Norway in 2020 Global emissions of CO₂ could reduce by 0.3% to 1.2 % (IEEE, SPECTRUM,2020).

4. Changes in Particulate matter (PM ₂.₅)

PM ₂.₅, which is less than 2.5 micrometres in diameter, is mainly considered dangerous as it can go deep into the lungs, pass into blood and other organs, causing serious health risks (7News, 2020).
Air Pollution in India

During the lockdown period in India, the concentration of PM$_{2.5}$, PM$_{10}$, CO, and NO$_2$ were observed to decrease by 43%, 31%, 10%, and 18% respectively (Sharma et al., 2020). While, the concentration of O$_3$ was increased by 17% and there was negligible changes in SO$_2$ concentration. Sharma & co-workers (2020) reported the air quality index (AQI) reduced by 44, 33, 29, 32 and 15% in north, south, east, west and central India, respectively.

Current pollutions statistics over Europe

The Sentinel-5P recent data confirmed reduction in NO$_2$ concentration over mega cities like Madrid, Paris and Milan all around Europe. It has been observed that the average concentration of NO$_2$ dropped by 24% during the past 4 weeks and the pollution level was also decreased by 21% than the same time period of 2019. On an annual basis, in Bergamo also showing the amount of NO$_2$ decreased almost by 50%. In Barcelona showing weekly dip of 40% and 55% decrease over the years (ESA,2020; BGEN,2020).

Over Milan

The atmospheric changes occur over northern Italy due to smoke from clusters of factories stuck against the Alps making it a pollution hotspot of western Europe. After the lockdown proposed on March 9, 2020, the level of NO$_2$ in Paris, Milan and another northern city of Italy has decreased by 40%. It is so unprecedented." “Previously, the country has experienced some alteration in air pollution for a day or so due to weather conditions.

But such a massive change was experienced for the first time. Now there is a possibility of a stoppage of industrial activity in Italy. During the lockdown, a major fraction of the human population is confined in their houses so there is huge reduction in traffic activities. This has contributed to a huge reduction in NO$_2$ and fine particles. This could be another important factor responsible for the clear atmosphere. (The Guardian, 2020a).” *In Europe, CO$_2$ emissions from large sources could plunge by more than 24 percent this year.*” (source: IEEE SPECTRUM news)

Over UK

Though in the UK, the spread of disease took a week later than that of Italy and the government responded accordingly. At Marylebone in London has shown huge reduction in the pollution level (The Guardian, 2020a). The contribution of Road traffic in the emission of NO$_2$ is about 80% in the UK. For the diesel car, which has not been driven during lockdown reduces 52 mg of the pollutant in the air per kilometre on an average.

National Centre for Atmospheric Science (NCAS) data suggested a significant reduction in NO$_2$ and PM$_{2.5}$ levels. NCAS has shown average air pollution levels over the last five years (2015-19) from 15 February, to 24 March (Fig.1). The 10 cities considered are Birmingham, Bristol, Belfast, Cardiff, Glasgow, London, Leeds, Manchester, Newcastle, York (BBC News, 2020).
**NO₂** results suggested the concentration of NO₂ decreased in 2020 as compared to 2015-19 for every city except Belfast and York. The reason behind high NO₂ concentration at these locations may be the result of few monitoring stations.

**PM_{2.5}** aerosols are originated from different sources. Since, the anthropogenic activities which were major sources of fine particle emissions are stopped during the pandemic, their levels show a dip during COVID 2020 period at every location.

![Fig. 1. Mean concentration (a) NO2 (b) PM2.5 for 2015-19 and 2020 from 15th Feb to 24 Mar (Source: NCAS, U.K).](image)

Volatile Organic Compounds, or VOCs are mainly contributed from solvents. These are an irritant, too. They are in inkjet printers, glues, paints, and cleaning products. It’s not clear yet, the levels of VOCs might change during lockdown period.

**Ozone(O₃)** is a respiratory irritant. The levels of ozone are increased at several places (Fig. 2) as compared to the highest concentration observed in the last five years during this time. The formation of ozone at ground depends on complex chemical reactions, which takes place in the absence of certain gases, will lead to the O₃ formation (BBC, 2020).
Current pollutions statistics over China

$\textit{NO}_2$

In central China, over the Wuhan city, a drop of levels of air pollution is seen during strict lockdown since January, 2020 (Fig.3). This is the city of 11 million people, transportation hub, home of hundred factories and other hardware industries. NASA report suggested a drop in NO2 level by 10-30% over central and eastern China (The Guardian, 2020b).
A complete shutdown was declared across Hubei province in China. The residents were advised to stay home to curtail the coronavirus spread. The lockdown had given an unintended advantage of seeing a blue sky.

According to China’s Ministry of Ecology and Environment the quality of air has improved by 21.5% compared to last year. Satellite images from NASA and ESPA have been released showing a significant reduction in NO₂ emissions; released by vehicles, industries and power plants in metro cities in China since January, 2020. The toxic gases cloud over the wide industrial areas have almost vanished.

In Beijing, PM₂.₅, EC and OC emissions were decreased by 20%, 50% and 10%, while the concentrations of these pollutants were decreased by 10%, 25% and 5%. NOₓ, SO₂, and VOCs emissions were decreased by 50%, 20%, and 30% while concentrations of NO₃, SO₄, and secondary organic aerosols (SOA) were decreased all by less than 20% (Wang et al., 2020).

**CO₂**

In accordance with the Center for Research on Energy and Clean Air (CREA), during feb to March, 2020, emission of CO₂ was dropped-off by upto 25% due to contain the coronavirus measures. As it is known that China’s contribution in CO₂ emissions is 30% annually worldwide, therefore there is a huge drop in CO₂ emission, even over a limited period of time. CREA estimates 200 million tons of CO₂ is more than 50% of annual emissions production of the UK.

**Coal consumption is reduced**

According to the Centre for Research on Energy and Clean Air (CREA), reduction in oil, steel production and 70% fall in flights operation, leads to the decline in CO₂ accumulation in the atmosphere. Apart from these, the biggest reason for sharp decline in emission is reduction of coal usage in China. During 2018 in China 59% of total energy generation is derived from coal as it is the largest consumer and producer in the world. In industries, power plants and millions of households’ coal is used as the main source of energy and heat. It has seen 36% drop in consumption of coal during February 3 to March 1, 2020 by Its biggest coal-based power station as compared to previous year.

Overall, the figures suggest that China’s carbon emissions decline by upto 25% over a period of four week, as outlined below, equivalent to around 200m tonnes of CO₂ (Mt CO₂). Although, slowly demands are coming to normal levels over an extended period of seven-week lockdown, have brought the drop off so far to around 250 Mt CO₂, with emissions some 18% lower than usual levels (CNN, 2020).

**Over Hong Kong**

Due to the COVID-19 pandemic outbreak, partial lockdown has also been imposed in Hong Kong. During this period, it was found that the air quality of the city has significantly improved. As per the data obtained from Hong Kong University School of Public Health, environmental organization Clean Air Network analysis proposed a significant drop in air pollutants by 1/3 from January to February, 2020.

Mongkok, Causeway Bay and Central are the monitoring sites which are the most engaged areas of Hong Kong, revealed that PM₂.₅ declined
by 32%, while PM$_{10}$ decreased by up to 29% and NO$_2$ level dropped by up to 22%.

The decline in pollutants has direct correlation with the preventive measures like shutdown of public places, restriction on people movement and a partial shut off of the border with the mainland China as such implemented by the Hong Kong government. During this lockdown period the mainland china has also stooped the industrial activity resulted in a huge drop in regional smog in the southern part of Guangdong (CNN, 2020; Mercury, 2020).

**Over South Korea**

In South Korea, NO$_2$ levels also decreased due the less industrial activities and the less emissions from its coal fired plants. In addition to that in South Korea air quality improved due to the less contribution of transported smog from China where industrial activities have also been stopped due to the COVID-19 pandemic (The Guardian, 2020a).

**America**

According to NASA, the obtained satellite data also (Fig. 4) revealed the north eastern part USA has seen a sharp decline in atmospheric concentration of NO$_2$ which is 30% in March, 2020 as compared with march, 2019 afterwards coronavirus lock downs. Berman and Ebisu (et al, 2020) also reported 25% reduction in NO$_2$ concentration in the U.S. The metropolitan city like Seattle, Atlanta, Los Angeles, Chicago and New York also witnessed the sharp decline in Nitrogen dioxide levels. According to Columbia University researchers, the reduction in vehicular traffic resulted in more than 50% reduction in CO emissions than normal average levels in New York. (CNBC, 2020; NYT, 2020; CNN Edition, 2020; Space, 2020).

![Fig. 4. A map of Northeast United States showing decrease in air pollution levels due to coronavirus stay-at-home measures (Source: NASA).](image)

6. Conclusion

Multiple reports indicate a significant drop in the concentration of major air pollutants such as NOx, CO and PM$_{2.5}$ across Europe, China, Hong Kong, South Korea and America. Indian cities have also experienced a significant improvement in the air quality. The lockdown scenario has revealed that the fossil fuel burning is the major cause of air pollution. This confirms the IPCC findings on present era climate change. Therefore, it is the need of time to understand the 'new normal' situation and start the industries accordingly. If we
ignore the environmental regulations for a faster manufacturing of products, there is a possibility of irreparable damage to the nature.

References


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Global Health Impacts due to Covid-19

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Abstract
COVID-19 pandemic is the greatest challenge faced by the globe. Rapid spread of coronavirus infections has resulted in a global health crisis. The World Health Organisation (WHO) has declared “Public Health Emergency of International Concern” on 30th January 2020 and later on March 11, 2020 declared it as pandemic. The outbreak of this deadly virus was started from the wet market of Wuhan city of China. A total of 19,115,986 cases have been reported all over the world till August 2020. Approximately, 210 countries all around the world are COVID-19 infected. Each affected country is coming up with several initiatives to cope up with this deadly virus. Maximum number of cases has been recorded from the United States (US) followed by Brazil and India. As of August 5, 2020 the number of cases in India has increased rapidly with a total of 2,024,502. The growth of COVID-19 population has an exponential rate. The pandemic has severely affected the economics of the globe too. It has raised the need for super medical facilities and nutritious foods. The ‘New Normal’ values of environmental, social and scientific changes have indicated a need for new policies focused upon environment, education and employment (3E).

1. Introduction
The COVID-19 pandemic and the global lockdown have significantly affected human health, environment and society. The environment and social changes and the future implications of COVID-19 lockdown have been described by Kulshrestha (2020). The Coronavirus (COVID-19) disease is a respiratory illness that was first identified in the Wuhan city, Hubei Province of China (WHO, 2020). This outbreak of the 2019 novel coronavirus soon spread quickly worldwide in just one month. The first case outside China was reported in Thailand where a woman had visited Wuhan city. The process of spread was continued. By the end of March, COVID-19 spread to almost 200 countries all over the world. The 2019-nCoV is a zoonotic disease that spreads from animal to humans. But now it is spreading from human to human. 2019-nCoV is the seventh strain of coronavirus (WHO, 2020). It often spreads when someone comes into contact with the infected identity. It is transmitted through the droplets produced by coughing & sneezing of infected person and close contact with the infected person. However, researchers suggest to accept the airborne transmission of this virus. (Hadei et al.,2020; Mutuku et al.,2020). Common symptoms of COVID-19 are fever, sore throat, dry cough, breathing problem, headache, fatigue, loss of smell and taste, muscle pain and diarrhoea etc. However, there are cases which did not show any such symptoms.
The name ‘Corona’ is derived from Latin which means crown or wreath. Coronavirus are large (120-160nm) enveloped RNA viruses that have a single stranded genome and spike glycoprotein on their envelope. Genetic changes in the "Spike" protein that gives the virus "crown-like" shape have resulted in 14 mutations in the Spike. Fig. 1 shows the structure of the coronavirus.

As of today, there are 6 strains of coronavirus “L strain” being the original one that appeared in Wuhan in December 2019. “L strain” is the most frequent and aggressive strain which accounts for 70% of cases in total. Its first mutation “S strain” from L strain appeared in the beginning of 2020. By mid-January 2020 “G and V strains” were also reported. Strain G and its related strains GH and GR soon spread to Europe, Italy, North America and South America. In Asia where Wuhan is located, L strain appeared initially but soon G strain and its variant spread rapidly in March. But now “L strain and V strain” are decreasing gradually (CDC, 2020).

1. International Scenario:

The pie chart given below shows the distribution of COVID-19 cases in various countries. The United States has 26.33% of cases followed by Brazil (14.86%), India (10.27%), Russia (4.64%) etc. (Worldometers, 2020).
Fig. 2 shows the country wise cases of COVID-19. Countries like the United States, Italy, China, France, Germany, Spain and Iran. During the second week of April, 613,886 cases have been recorded in the United States within only twenty-six days whereas China has recorded a total of 80,824 cases in forty-two days. However, it’s been 100 days since New Zealand has controlled the COVID-19 pandemic outbreak through sealing their international borders and strict adherence to the WHO guidelines as well as strict 14 days quarantine for their travellers. The COVID-19 scenario and the number of coronavirus affected population in different countries is discussed below-

**China**

The first case of 2019-nCoV was reported on 31st December 2019. As the number of persons infected with this virus was increasing in Wuhan City, the government decided to shut down the city and a public health emergency was declared in the city. With time, 2019-nCoV started to spread all over the world as people were migrating from one country to another. On 30th January 2020, World Health Organisation (WHO) Declared “Public Health Emergency of International Concern” and later declared it as pandemic on 11th march 2020 (WHO, 2020).
On January 7th 2020, according to WHO China identified a virus and named it the novel virus ‘2019-nCoV’ which belonged to the corona virus family that includes SARS (severe acute respiratory syndrome) and MERS (middle east respiratory syndrome).

China reported its first death due to 2019-nCoV on January 11th 2020, a 61 year old man who had purchased goods from wet market of Wuhan city. Wuhan city was soon locked down on 23rd January 2020 where around 550 people were infected and 17 were dead. According to a study which analysed all the cases of COVID-19 diagnosed nationwide in China till February 11th 2020, it was reported that around 86.6% of the confirmed cases were 30-79 years old.

Overall fatality rate was only 2.8% and COVID-19 was mild for 81% of patients. It was also seen that fatality rate was higher in patients with cardiovascular disease followed by diabetes, chronic respiratory disease and hypertension. Fatality rate was more in males having 2.8% than females with 1.7%. As of 4th April 2020, recovery rate of patient in China is 95.85% and the death rate is 4.15% (Worldometers, 2020). In recent months, there is no significant rise in the number of cases. Fig. 3 shows the number of COVID-19 cases in China.

Hong Kong declared ‘virus emergency’ and restricted its link to the mainland China on January 25th 2020.

**Fig. 3. Number of cases of COVID-19 in China.**
**United States**

The spread of coronavirus rose dramatically since the first week of March and today the U.S. has the highest number of cases in the world. All the 50 states are affected with the coronavirus but the most affected one is New York with the highest number of deaths and cases reported more than any single country alone. Today around 4.6 million cases have been reported in the US with the highest number of cases from California followed by Florida, Texas and New York (Worldometers, 2020). COVID-19 has resulted in an increase in national unemployment rate in the U.S. from 3.5% in December 2019 to 11.1% in June 2020 with the highest rate 14.7% during April 2020. As the concern among the people was too low in the U.S., almost all age groups from 20-80 year old have shown an equal number of cases of coronavirus.

**Italy And other European Countries**

Soon it was noticed that Europe was becoming an epicentre of COVID-19 with the country. The first case of coronavirus in Italy came at the end of January & North Italy was severely hit by the virus especially in the region of Lombardy. After mid of march, the cases in Italy kept on increasing with approx. 35,713 infections and recorded 475 deaths in a single day i.e. the highest death toll of any nation. Italy has shown 21,067 deaths in forty-one days that caused Italy to overtake China as the country with the maximum number of 2019-nCoV deaths. Figure 2 clearly states how cases in Italy increased after the first week of March and now it has almost become constant with approx.200cases per day. Today the recovery rate in Italy is 85.08% while the death rate is 14.92% (Worldometers, 2020). COVID-19 in Italy mostly hit people above 50 years old and only 1 in 4 individuals were of age 19-50. In Italy the percentage of COVID-19 infection in females is slightly more than males.

Two new cases in Italy were recorded in the first week of February. Lombardy in Italy reported its first local transmission of virus resulting in total of six cases. Meanwhile World Health Organisation named the new coronavirus ‘COVID-19’. By February 15th 2020, the death toll crossed 1500 and 66,472 infected person in China as well as France reported Europe's first casualty from virus. Till 26th February 2020 the global death toll was nearly 2800 with about 80,000 infected cases. With increasing cases in Italy, the government imposed a strict regulations for people living there. Quarantine in the affected areas of Italy was one of the major steps taken by the government. In the second week of March, both Iran and Italy reported their highest death toll in 24 hour time period. Soon Germany recorded about thousand cases in the country. Russia is the country with the highest number of coronavirus cases among all the European nations whereas the UK reported the highest number of deaths as of data provided till July 30, 2020.

At the same time Spain saw an increase of 25% in infections in a single day (Statista, 2020). Spain reported its first case in the end of January, 2020 when a tourist from Germany was tested positive in Canary island. Further, the cases started increasing rapidly and the Government decided to impose a national lockdown on 15th March 2020. Apart from this Spanish population were made aware of the risk caused by the virus. All the Schools were closed by the Spanish authorities on March 12, 2020.
Preventive measures were provided at the workplaces and work from home was promoted. About 60% of the population raised their hygiene standards and avoided visiting crowded places even before the lockdown was imposed. Highest number of cases was seen in the community of Catalonia of Spain (Statista, 2020).

The number of cases of COVID-19 was increasing day by day in Germany and Spain. The first case of COVID in Germany was reported on January 27 in Bavaria. Germany’s strong health care system with a large number of hospital beds and ICU’s helped them to fight with this deadly virus. It did large scale antibody testing nationwide and became a pioneer in PCR testing. Apart from this Germany government took several steps like restriction on mass gatherings, closure of schools, ban on entering of non-EU residents, physical distancing of 1.5 meters etc. Berlin was the most affected followed by Munich and Hamburg. Results show that age groups of 35-59 years were severely affected by the deadly virus (Statista, 2020).

The number of deaths in Italy is 35,171 followed by France with 30,296 and Spain with 28,498 till August 5th 2020 (Statista, 2020). Italy and few other nations of Europe are medically advanced countries still they were unable to handle the situation and control the spread of pandemic due to the uncontrolled rate of COVID transmission.

**India**

India confirmed its first case of 2019n-CoV on 30th January 2020 in Kerala. On March 25th 2020, Indian government decided to lockdown up to April 15th 2020 in the country after looking at the increase in the infected cases in different parts of the country. Now COVID-19 in India has spread to 17 states. In India also, person with diabetes and cardiovascular diseases showed fatality cases. Recently, the Health ministry has confirmed that 42% of the cases of COVID-19 is in between the age group of 21-40 years (ET, 2020). Table 1 gives the age wise percent of COVID-19 affected cases. Till August, 2020, the total number of cases in India is 1,910,681 with death toll 39,856 having recovery rate of 96.93% (Worldometer, 2020). However, the rate of fatality is declining in India.

<table>
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<th>Age Group</th>
<th>Percentage of Cases</th>
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<tr>
<td>0-20 years</td>
<td>9</td>
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<tr>
<td>21-40 years</td>
<td>42</td>
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<tr>
<td>41-60 years</td>
<td>33</td>
</tr>
<tr>
<td>&gt;60 years</td>
<td>17</td>
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</tbody>
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In order to control the spread of the virus, the Indian government also took an initiative for complete lockdown. Lockdown was done in three phases in India to control the coronavirus cases coming from different states of the country. Phase 1 of lockdown was done from 25th March 2020 to 14th April 2020. The phase 2 was seen from 15th April 2020 to 3rd May 2020 while the phase 3 was implemented from 3rd May 2020 to 17th May 2020. According to a new report from the Health ministry, currently 82% of cases are from 10 states and 66% of COVID-19 cases are from 50 districts.
of India. As on 15th April 2020, the number of cases in India increased rapidly with a total of 11,855 having an exponential growth. Maximum number of cases in India are from Maharashtra followed by Tamil Nadu and Delhi (Statista, 2020). Fig. 3. shows the state wise coronavirus cases in India.

Indian government took a number of other preventive measures to control and minimise the transmission of coronavirus. ‘Janta curfew’ was observed all over the country on March 22 from 7am to 9pm followed by which a nationwide lockdown phase 1.0 was announced. All the factories, schools, colleges, offices and government officials remained closed in phase 1.0 lockdown only essential commodities were allowed. Government labs are equipped with proper reagents to test the samples of coronavirus as well as ensure availability of coronavirus drugs in India. Indian government arranged for the evacuation of Indian citizens for their safety from countries like Wuhan, Maldives, U.S., UK and quarantined them at different places.

Indian government has also provided some relief packages under the ‘Atmanirbhar Bharat’ program to aid the people affected by COVID-19. Medical insurance is also provided to all the healthcare workers like doctors and nurses who have served during this pandemic. Adequate information about affected cases and the guidelines for citizen safety is provided by the government (MOHFW, 2020).

![Fig. 3. Number of coronavirus cases in Indian states. (Source: www.statista.com).](image)

Central Asia and Middle-East

The UAE was the first country of the Middle East to report a coronavirus positive case. Taking into account of the Middle East countries, Iran tops in the list of positive COVID-19 cases followed by Bahrain and Kuwait. With the increasing number of in Iran, all the other countries closed their borders with Iran. This means the pandemic has created a geo-political conflict too. Soon Iran became one among the worst hit countries with 4747 cases. In
Qatar the number of infected patients increased from 24 to 262. By the mid of March, the number of global deaths crossed 4600 with 126,100 infected persons (Worldometer, 2020)

Several precautionary measures were taken by the countries to combat the coronavirus cases in the middle-east. For example- entry of tourists is temporarily banned in Saudi Arabia from coronavirus affected countries that has further affected pilgrims visiting Mecca and Medina.

Conclusion

The COVID-19 pandemic has more severely affected China, Italy, USA countries where a higher fraction of the population is distressed by the coronavirus infection. The effect is also seen in other countries including India. Though the number of cases is high but the fraction of the population affected is very less, much lower than predicted in the beginning by various agencies and media. People with diabetes and cardiovascular diseases have shown more fatality cases. It seems that people of India have more immunity against viral severity which is probably due to their spicy diets which have medicinal ingredients, yoga practice extreme environmental conditions (sunrays, unhygienic surroundings etc.) and hard field work. The pandemic has impacted the social and educational environments. Nevertheless, the pandemic has taught us a lesson how to cope with the medical emergency. The pandemic has raised the need for more and improved medical facilities worldwide. It has also suggested to conduct more authentic research about the virus and pathways of transmission. There is also a need to reconstruct the roadmap of economic policies based on the ‘new normal’ experienced during the pandemic.

References:


Akanksha Roy, Ph D student.
Tracing the origins of the novel coronavirus
SARS-CoV-2

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The presence of coronaviruses in the world has been recorded as early as the 1930s as causative agents of acute respiratory infections in domesticated chicken (1). Later, viruses belonging to the same family were discovered in mice and pigs (2). It was not until the 1960s that this group of viruses were isolated from humans in the UK and the US where they were mostly responsible for causing common colds (3). At some point after 1960, the virus appears to have jumped from animal hosts to humans, appearing in 2003 as SARS-CoV (or Severe Acute Respiratory Syndrome coronavirus) that originated in southern China where it quickly became endemic (4). Although some cases were also reported in Europe, North America, Asia, Australia and New Zealand, the disease largely remained localised in China. Patients infected with SARS-CoV exhibited multiple symptoms including a fever of ~100°F or more, sore throat, diarrhea and in severe cases progressive pneumonia that caused significant mortality. The genetic origin of SARS-CoV was traced to bats also found in the south-west region of China. New SARS-CoV cases have not been reported after 2004 but the virus has appeared with alarming frequency in new avatars in different parts of the world since then. For example, in 2004, a new species of coronavirus called HCoV-NL63 (Human Coronavirus NL63) was identified in a child suffering from severe respiratory infection in the Netherlands (4). The origin of this virus was also traced to bats. In 2005, Hong Kong reported another species of human coronavirus called HCoV-HKU1 which caused acute respiratory infections (4). However, unlike the previously discovered human coronaviruses, HCoV-HKU1 was found to have originated from mice. Some cases of HCoV-HKU1 were also reported in Australia, US and France. In 2012, another new species of human coronavirus, called MERS-CoV (or Middle East Respiratory Syndrome Coronavirus) was identified in Saudi Arabia (4). The virus was believed to infect humans through contact with camels but its genetic origins were traced to bats. Like other human coronaviruses, MERS-CoV also caused respiratory infections.

Currently, the world is battling a novel strain of coronavirus, SARS-CoV-2, which causes coronavirus disease 2019 (or COVID-19). SARS-CoV-2 originated in Wuhan, China in November/December 2019 (5) and quickly spread all over the world within a few months forcing WHO to declare COVID-19 as a pandemic. The genetic origins of SARS-CoV-2 have also been traced to bats from where the virus appears to have jumped to humans through an intermediate animal reservoir whose identity is unclear. The virus typically infects humans via respiratory droplets released from infected persons while sneezing or coughing. In severe cases, it rapidly colonises the lungs and is capable of causing severe pneumonia and multi-organ failure.
SARS-CoV-2 infection is dependent on the binding of the viral outer surface protein called ‘spike’ with the angiotensin-converting enzyme-2 (ACE2) which is abundantly present in the cells of the lungs. Even though SARS-CoV-2 has been reported to cause maximum damage to the lungs, recent studies have shown that it can affect other body organs also. Multiple studies have shown that the virus can also affect the central nervous system (6), the gastrointestinal system (7), the cardiovascular system (8) and the kidneys (9). So far more than 13 million people have been infected across the world and world-wide efforts are on to develop an effective drug against COVID-19 with little success. In the absence of a vaccine or an effective drug, disease management currently relies on supportive measures only. Until an effective treatment is readily available, preventing COVID-19 appears to be dependent on social distancing, wearing appropriate face masks and frequently hand washing.

References


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Countrywide Air Pollution Scenario in India during COVID-19 Lockdown

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Abstract
A nationwide extensive lockdown was implemented in India by the government on March 24, 2020 in response to COVID-19 crises that had taken the entire world by storm. This chapter discusses the impact of the lockdown exercise against corona crises on the air pollution levels of various Indian cities. The halting of all non-essential activities and a rigorous shutdown of the economy, proved to be blessings in disguise for the air quality levels in Indian cities. Localized improvements in air quality were noticeable in the Air Quality Index (AQI) after the ‘Janta curfew’ itself which was just a one day lockdown implemented on March 22, 2020. Significant net decrease in AQI was observed in various Indian cities as the lockdown progressed further. According to Central Pollution Control Board (CPCB), on 29th March, 2020 there were 91 cities under ‘Good’ & ‘Satisfactory’ categories and a total of 31 cities were with ‘Good’ AQI values across India. These observations suggest that tackling air pollution is possible by relying on clean energy for our future needs and better policy making in this direction.

1. Introduction:

The COVID-19 crisis has led to widespread human suffering in the whole world. In view of the repercussions that this fatal pandemic might cause in India, the authorities imposed a nationwide lockdown. Stringent travel regulations and interruption of non-essential activities (including the ones related to air polluting emissions) resulted in local air quality betterment across many towns and cities in the nation. Air pollution levels declined as a fortuitous result of measures taken during lockdown to curb the outbreak of COVID-19. Primary activities contributing to air pollution are industries, vehicular traffic, biomass burning, construction activities and road dust resuspension (Kumar et al., 2014; Kulshrestha and Sharma, 2015). Additional activities in urban areas such as operation of restaurants, DG sets, landfill fires, etc. increase air pollution (CPCB, 2020). The vehicles stayed off the roads, construction activities were put on hold, and factory productions stopped. Such rigorous regulations on India’s economy were initiated to stop the spread of COVID-19 but they provided an adjuvant benefit of clearing the choking air that the entire population was breathing. (CNN, 2020).

The air quality across some major SAFAR cities is represented in Fig. 1 (taken on 4th April, 2020) which showed AQI as satisfactory during the lockdown period. Percent reduction in PM$_{2.5}$ and NO$_x$ concentrations was also compared in these SAFAR cities in table 1 after lockdown was enforced in the country (SAFAR, 2020).
Fig 1: Air Quality across SAFAR Cities: AQ-Index (ImageSource: SAFAR website).

TABLE 1: Percent reduction in NOx and PM2.5 levels during COVID-19 lockdown.

<table>
<thead>
<tr>
<th>CITY</th>
<th>$\text{PM}_{2.5}$ (% reduction) in AQI</th>
<th>NOx (% reduction) in AQI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELHI</td>
<td>49</td>
<td>63</td>
</tr>
<tr>
<td>MUMBAI</td>
<td>53</td>
<td>57</td>
</tr>
<tr>
<td>AHMEDABAD</td>
<td>61</td>
<td>36</td>
</tr>
<tr>
<td>PUNE</td>
<td>38</td>
<td>55</td>
</tr>
</tbody>
</table>

As Indian citizens stayed at home and made social distancing a habit, the air quality data improved and showed reduction in harmful levels of PM$_{2.5}$ which are microscopic particles capable of entering the bloodstream and passing on to other organs causing deleterious health effects. The sharp decline in hazardous pollutants and the concomitant pristine blue skies mark a dramatic shift for India that contains 21 of the world’s 30 most polluted cities (QZ, 2020). AQI has greatly improved in major cities and particulate matter pollution is at an all-time low. Fig. 2 shows a comparison of AQI of important Indian cities during late March as compared to the same time last year in 2019.
It can be observed that the air quality for all these cities is significantly better right during the lockdown. Various meteorological factors also come in play for the observed dip in concentration of pollutants such as surface wind speed and direction, local temperature, relative humidity, mixing layer height, rainfall etc. The national average levels tend to drop lower in the summer due to higher average wind speeds are higher and increased atmospheric mixing. Heavy rains in the northern and western regions of the country also helped in bringing down the pollution levels. Rain very efficiently scavenges pollutants from the atmosphere and lowers particulate matter levels (Ecowatch, 2020).

2. Impact of ‘Janta Curfew’ on air quality in India:

The Janta Curfew and lockdown were implemented on March 22, 2020 and March 24, 2020 respectively across India. These events brought about the ancillary benefit of improvement in air quality in the country. The cities chosen for the analysis are Indian cities with a million plus population which showed net decrease in AQI levels a day after the enforcement of Janta Curfew on March 22, 2020. A well noticeable net decrease in AQI can be seen in Fig. 3 for different cities such as Patna, Delhi, Meerut, Faridabad, Ludhiana etc.
2.1 Effect of Janta Curfew in Delhi:

Due to minimal traffic movement on the roads that provided for essential units coupled with favorable weather conditions, significant decrease was seen in PM10 and NOx levels. Eventually, by the end of March Delhi moved to the ‘Satisfactory’ category from the earlier ‘Moderate’ category (ETEnergyworld, 2020). PM2.5 levels were reduced by 44% in Delhi during March 22-23, 2020 as compared to a day earlier before the curfew was implemented which marks a significant reduction. The hourly data analysis showed a continuous dip in the concentration values that started 10.00 am onwards on the Janta Curfew day. A drop in PM10 (67 µg/m³) and PM2.5 (34µg/m³) was observed at 05.00 pm. In comparison to 21st March, decrease in number of on-road vehicles resulted in decline of CO levels (32%) and NOx levels (51%) during 22nd -23rd March (CPCB, 2020). Dust & construction activities (43%), industry (20%) and transport (17%) are some of the prominent PM10 contributing sources.

The on-road vehicular movement was scarce as compared to routine days and the commercial activities were halted. Air quality data revealed that due to strict enforcements, PM10 and PM2.5 levels were decreased by about 35 to 40%. The air pollution reduction trend in NCR towns was comparatively less marked as compared to NCT of Delhi. A decrease in PM10 levels was observed on March 22, 2020 in all neighboring towns with Gurgaon as the exception. It is interesting to note that PM2.5 levels were still high, showing only slight reduction in Noida (6%) and Ghaziabad (9%), due to the localized combustion activities in NCR towns. Similarly, while there was a pronounced decrease in NOx levels in Noida (55%) and Ghaziabad (51%), such was not the scenario for Gurugram (4%). Here, high NOx emissions were encountered during early hours of curfew due to heavy traffic congestion during the peak time. The impact of curfew restrictions on air pollution was much more apparent on March 23, 2020 as compared to levels prior to curfew on March 21, 2020.
Similar effect of reduction of pollutants and improved air quality was seen in Delhi in 2018-19 due to implementation of Graded Response Action Plan (GRAP) by Environmental Pollution Control Authority (Singh and Kulshrestha, 2020).

2.2 Effect of Janta Curfew & Lockdown in Other Indian Cities:

The advancement in AQI monitored in 85 cities became a prominent feature of this exercise due to very low traffic load and uniform closing of non-essential units during the one day Janta Curfew and a nationwide lockdown following it. Most of the Indian cities with a million plus population and high population density showed remarkable betterment in air quality. The cities lying in the Indo-gangetic plains showed more pronounced improvement in AQI values with 17 cities shifting to ‘Satisfactory’ category and 7 cities making it to the ‘Good’ category eventually. The AQI value in coastal areas also improved but not as much as the Indo-gangetic cities. On the Janta curfew day, Chennai and Mumbai were in ‘Satisfactory’ category but some increase in AQI value was recorded in Chennai on the next day, arising from local contributions. Higher AQI value was seen in Kanpur also, with PM$_{2.5}$ as the major pollutant in the city. Air quality impact could not be observed in industrial towns such as Satna, Singrauli, Chandrapur, Vapi and Ratlam which was probably due to high SO$_2$ release in industrial areas. However, Janta Curfew resulted in overall improvement in air quality across the country with variable magnitude of improvement due to contribution from local sources. Out of 115 cities, at the onset of pre lockdown period on March 16, 2020, only 55 cities were falling in the ‘Good’ & ‘Satisfactory’ AQI categories. However, as the time went by, the number of cities under ‘Good’ & ‘Satisfactory’ categories began to subside, with more and more cities slumping in the ‘Moderate’ category till March 21, 2020. However, the situation changed on the day of implementation of Janta Curfew, when 67 cities made it to the ‘Good’ & ‘Satisfactory’ AQI category. It is interesting to note that on 29$^{th}$ March, 2020, there were 91 Indian cities under ‘Good’ & ‘Satisfactory’ categories with a total of 31 cities in the ‘Good’ AQI values. However, some cities like Lucknow, Kalyan, Guwahati, Singrauli & Muzaffarpur were under ‘Poor’ category during March 25-28, 2020 with PM2.5 high emissions seemingly emanating from local sources in Lucknow and Guwahati. Overall, it can be inferred from Fig 4 (CPCB, 2020) that a number of Indian cities had rapidly shifted from AQI in moderate category to AQI in satisfactory and AQI in good category due to the enforcement of Janta Curfew and continued lockdown in March, 2020.
Fig 4: Indian cities in various AQI categories during sustained lockdown period (ImageSource:CPCB).

3. Conclusion

We are facing a pertinent question whether this good air phase is sustainable after the lockdown terminates. However, prevention of pollution levels bouncing back to their earlier state as the economy turns a corner and the COVID19 crisis passes, can be realized by shifting our focus from the current fossil fuel based economy to clean energy thriving systems (CREA, 2020). Though it is being looked at as a "silver lining," but it should be emphasized that such lockdowns should not die down our genuine need for consistent policy change to fix air quality and abate climate change. It may be concluded that plummeting pollution levels are steered by economy driven factors more than the air quality policies. At the hands of causing human suffering, breathing clean air in the existing corona crises cannot be the most ideal way to bring down air pollution, but it indicates that air pollution is manmade and we can cut down on pollution by resorting to clean and sustainable energy options, making them a nationwide feature in future.

References

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Ankita Katoch, Ph D student.
Air Quality of NCR Delhi during COVID-19 Pandemic: Changes in PM$_{2.5}$, NO$_2$ and O$_3$ AQI

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Abstract

The COVID-19 lockdown has significant environmental impacts. It is noticed that post lockdown air is much cleaner. The Air Quality Index (AQI) before the lockdown was falling under poor category at most of the sites in Delhi NCR but the air quality has improved to satisfactory level during the lockdown. For example, the average value of AQI at Punjabi Bagh was noticed as 212 before the lockdown which dropped down to 74 during the lockdown indicating a significant improvement in air quality. Similarly, AQI values of NO$_2$ also showed a significant improvement during the lockdown.

1. Introduction

Globally, the air quality has been an issue of concern for everyone. There are examples of how several serious episodes of air pollution around the globe have been damaging mankind. The degraded quality of air is responsible for several harmful effects on the environment, problems for example smog, acid rain, low visibility resulting in increased premature deaths, respiratory diseases (McCubbin et al. 2002; Gupta et al. 2006; Mishra and Kulshrestha, 2020; Chowdhury, and Dey, 2016) and other health problems (Susanna et al. 2019).

In 1955, U.S. congress made efforts to address the problem of air pollution by adopting the Clean Air Act (CAA). In due course of time, the United State Environment Protection Agency (U.S. EPA) created the Air Quality Index (AQI) in order to report the daily levels of criteria pollutants on a color-coded scale which ranged from 0 to 500. In India, The Ministry of Environment, Forest and Climate Change (MoEFCC), directed the Central Pollution Control Board (CPCB), to take initiatives for developing and operationalizing a National Air Quality Index (NAQI) in association with all the State Pollution Control Boards (SPCBs), which would inform people about the quality of air they breathe in simple terms as well as its likely health impacts (CPCB, 2015). The CPCB, started a nation wide release of hourly AQI for criteria pollutant in tabular form on real time monitoring basis with the help of color coded and standards set by “National Ambient Air Quality Standards” (NAAQS). Fig-1 illustrates these color codes and their meanings.
Generally, the air quality of Delhi falls under the poor categories due to high concentrations of the criteria pollutants e.g. PM$_{2.5}$ and PM$_{10}$ (where PM stands for Particulate Matter), Nitrogen Dioxide (NO$_2$) and ground level Ozone (O$_3$). The PM$_{2.5}$ and PM$_{10}$ have been recorded violating the limits of NAAQS (Dholakia, et al., 2013; Kulshrestha, 2015; Sidhwani, et al., 2015; Singh and Kulshrestha, 2016). The National Ambient Air Quality Standards (NAAQS) have been defined for criteria pollutants in ambient air (CPCB, 2009). These standards have been mentioned for two categories i.e. i). Industrial/ residential areas and ii). Ecologically sensitive areas. The Central Pollution Control Board (CPCB) of the Ministry of Environment, Forests and Climate Change (MoEFCC) has been assigned the responsibility of air quality monitoring for which several monitoring stations have been installed throughout the country. The CPCB in collaboration with the Indian Institute of Tropical Meteorology (IITM), Pune which is part of the Ministry of Earth Sciences (MoES) has been watching the quality of air. The System of Air Quality Weather Forecasting and Research (SAFAR) program of the MoES provides AQI prediction for different sites in India. The CPCB and SAFAR have been providing the AQI for eight pollutants, such as PM$_{10}$, PM$_{2.5}$, NO$_2$, Sulfur Dioxide (SO$_2$), Carbon Monoxide (CO), Ozone (O$_3$), Lead (Pb) and Ammonia (NH$_3$).

This is an effort to analyze air pollution scenario through AQI comparisons during COVID-19 lockdown period and just before the lockdown. It is pertinent to inform the citizens, particularly for those who already have health problems related to poor air quality. Furthermore, if the citizens are well aware and educated about the air quality related problem, it is easy to manage the monitoring campaigns. Thus, the appropriate information about air quality is the need of time.

In the present study, we have focused exclusively on the variation of PM$_{2.5}$, O$_3$ and NO$_2$ concentrations. The reason behind selecting the aforementioned pollutants is that these are the prime indicators of air pollution in Delhi-NCR. Out of 38 sampling sites in Delhi, 24 sites are governed by the Delhi Pollution Control Committee (DPCC), 6 by Indian Meteorological Department (IMD) and the rest 8 sites are controlled by the CPCB. Table 1 shows the AQI difference at Income Tax Office (ITO), Delhi Technical University (DTU), Punjabi Bagh and Anand Vihar stations before and after lock down period. The AQI data was downloaded from the official site of CPCB (https://app.cpcbccr.com>AQI_India).
### TABLE 1: Air Quality Index of below given sites taken before and during Lock down period

<table>
<thead>
<tr>
<th>Dates of AQI Values of various Stations</th>
<th>Anand Vihar Station</th>
<th>DTU Station</th>
<th>ITO Station</th>
<th>Punjabi Bagh Station</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AQI of PM$_{2.5}$</td>
<td>AQI of NO$_2$</td>
<td>AQI of ozone (O$_3$)</td>
<td>AQI of PM$_{2.5}$</td>
</tr>
<tr>
<td>02-01-2020</td>
<td>414</td>
<td>74</td>
<td>61</td>
<td>324</td>
</tr>
<tr>
<td>11-01-2020</td>
<td>304</td>
<td>88</td>
<td>62</td>
<td>320</td>
</tr>
<tr>
<td>20-01-2020</td>
<td>334</td>
<td>75</td>
<td>12</td>
<td>312</td>
</tr>
<tr>
<td>29-01-2020</td>
<td>185</td>
<td>70</td>
<td>24</td>
<td>228</td>
</tr>
<tr>
<td>07-02-2020</td>
<td>314</td>
<td>90</td>
<td>41</td>
<td>313</td>
</tr>
<tr>
<td>16-02-2020</td>
<td>274</td>
<td>109</td>
<td>45</td>
<td>324</td>
</tr>
<tr>
<td>22-02-2020</td>
<td>126</td>
<td>57</td>
<td>17</td>
<td>120</td>
</tr>
<tr>
<td>29-02-2020</td>
<td>103</td>
<td>56</td>
<td>41</td>
<td>124</td>
</tr>
<tr>
<td>08-03-2020</td>
<td>200</td>
<td>69</td>
<td>24</td>
<td>201</td>
</tr>
<tr>
<td>16-03-2020</td>
<td>128</td>
<td>60</td>
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<td>0</td>
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<td>22-03-2020</td>
<td>198</td>
<td>56</td>
<td>65</td>
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<tr>
<td>23-03-2020</td>
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<td>45</td>
<td>80</td>
<td>96</td>
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<td>25-03-2020</td>
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<td>0</td>
<td>0</td>
<td>66</td>
</tr>
<tr>
<td>26-03-2020</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>113</td>
</tr>
<tr>
<td>27-03-2020</td>
<td>49</td>
<td>19</td>
<td>44</td>
<td>95</td>
</tr>
<tr>
<td>28-03-2020</td>
<td>37</td>
<td>19</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td>29-03-2020</td>
<td>47</td>
<td>20</td>
<td>67</td>
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</tr>
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<td>30-03-2020</td>
<td>52</td>
<td>22</td>
<td>84</td>
<td>0</td>
</tr>
<tr>
<td>31-03-2020</td>
<td>63</td>
<td>24</td>
<td>86</td>
<td>0</td>
</tr>
</tbody>
</table>

From the above table, we are able to conclude several significant results, which are helpful for us to understand the importance of clean air. Table-1 gives the values of AQI of PM$_{2.5}$, NO$_2$ and O$_3$ at Anand Vihar, DTU, ITO and Punjabi Bagh sites before the COVID-19 lock down period and during the lockdown period. The major observations noticed during the lockdown have been described below-
Particulate Matter 2.5 (PM$_{2.5}$):
The average AQI values of PM$_{2.5}$ before lock down at all four sites were 238 (Anand Vihar), 244 (DTU), 239 (ITO) and 212 (Punjabi Bagh) were falling in the poor category of (orange color) standard set by NAAQS. On the other hand, during lock down the condition is very favorable to breathe. The average values of AQI were noticed as 97 (Anand Vihar), 74 (Punjabi Bagh) in satisfactory category or 153 (ITO) and 101 (DTU) in moderate category.

Nitrogen dioxide (NO$_2$):
NO$_2$ AQI values also showed similar decrease as seen in case of PM$_{2.5}$ AQI like PM$_{2.5}$. The NO$_2$ AQI values varied -before the lockdown period as follows: from 75 to 31 at Anand Vihar; 48 to 18 at DTU; 39 to 38 at ITO; and 72 to 44 at Punjabi Bagh. The values of AQI at Anand Vihar and Punjabi Bagh sites before lock down were in satisfactory category with (light green color code) but with time change, the conditions are much better and reached good category (dark green color) during lock down period.

Ozone (O$_3$):
In case of O$_3$, the results are just opposite to PM$_{2.5}$ and NO$_2$ pollutants i.e. the O$_3$ AQI values significantly increased during lock down, in comparison to the values before lock down at all four as follow- from 35 to 70 at Anand Vihar, from 66 to 77 at DTU, from 36 to 48 at ITO and from 23 to 36 at Punjabi Bagh stations. Fig. 2 shows the display of daily and hourly data on the CPCB website (https://app.cpcbccr.com/AQI_India). We have taken data of only one site i.e. Anand Vihar. This is hourly data of all pollutant with minimum, maximum and average values. The figure also shows the date and time along with prominent pollutant of that day with advisory and category in color code.

Figure: 2. Air Quality Standards of Anand Vihar station before and after lockdown period.
Conclusion

The results have shown that due to the lockdown, the concentrations of both PM$_{2.5}$ and NO$_2$ significantly decreased. On the other hand, the values of ground level ozone have increased during this period, because of the reason that during lockdown period the atmosphere is very clear due to low emission and production of particulate matter and other pollutants, due to which the sunlight reaches to earth surface is high which help in formation of photochemical smog or ground level ozone due to reaction with volatile organic compounds (VOCs) and oxides of nitrogen (NO$_x$). Net NO/NO$_2$ ratios are low. Also, the ban on plastic burning and closure of tire oil units has helped in stopping the release of HCl and chlorine in the air. In the absence of such factors, the ozone destruction is limited (Kulshrestha and Mishra, 2019). In the absence of quenching, the ozone levels seem to be increased but actually, these are the normal values of ozone in this region. It can be noticed that the AQI for PM$_{2.5}$ and NO$_2$ at all sites i.e. Anand Vihar, DTU, ITO and Punjabi Bagh showed the decreasing patterns during the days of lockdown. It suggests preparing a new inventory of the sources of air pollution in residential areas. The data showed that lockdown period showed significant decrease in pollution level over Delhi-NCR region (National Capital Region). The success of this kind cannot be achieved without implementing strict actions by government agencies in Delhi city during Odd-Even scheme I-II and III for overcome the pollution levels over Delhi-NCR region (Singh and Kulshrestha, 2016). Actions taken by government agencies establish to overcome the severity of pollution over Delhi and NCR region i.e. Environmental Pollution Prevention and Control Authority (EPCA) are somewhat similar to this lockdown conditions. Strict steps like implementation of Graded Response Action Plan (GRAP) in which several actions are taken like, controlled entry of heavy-duty trucks, ban on construction activities, implementation of odd-even rule for vehicles, shutting down schools during extreme condition, closing of brick kilns and crushers; restricting diesel generator etc. This action plan can further be implemented in other major cities also during peak pollution periods (Singh and Kulshrestha, 2020).

Thus, the study concluded that the lockdown period was very effective regarding the air quality improvement of NCR. Therefore, the study suggests a need to plan these kinds of exercises in other cities around the world where air pollution is a problem, for providing healthy air to the citizens.

References:


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Yogender Singh, Ph D student.
COVID-19: Air Pollution and Health Effects in Ludhiana, Punjab

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Abstract
The COVID-19 complete lockdown has brought a significant positive changes in air quality in the Ludhiana city. Before the lockdown, the average concentration of PM$_{2.5}$ was 62 µg/m$^3$ which is brought down to 30.76 µg/m$^3$ during the lockdown marking a 50.5% reduction. Similarly, the average NOx concentration is reduced by 47.3% as compared to the prior to the lockdown.

Introduction
Punjab is a state eminent for its agricultural prowess and high-speed industrialization. Among the few industries in its initial period were that of food grains, brick kilns and cotton ginning which further expanded to the manufacturing sector with the emergence of green revolution (Planning Commission 2002). Also, the population in Ludhiana has grown tremendously with the current population of 3.4 million (Census 2020). This growth in population, transport sector, agricultural burning and the fleeting industrialization has worsened the air quality thereby affecting the health of the people of Punjab (CPCB, 2011; Envis Punjab, 2015). This chapter briefly discusses the status of air pollution and health effects of the residents in the Ludhiana city of Punjab before and during the lockdown period.

Air Pollution in Ludhiana
Punjab was not alien to the problem of air pollution because of it being an agricultural state and open burning of crops being the major contributing factor. The increase in industrialization in the last few decades has however deteriorated the air quality to alarming levels.

Measures to control the pollution levels have been introduced from time to time but never proved adequate compared to the pace of increase in emission levels. Financial viability of eco-friendly measures is the most common hurdle being faced in changing people’s habits. For example, burning of crop left-overs after harvesting wheat and paddy is much less time consuming and cheaper. Similarly, for industries, APCE (Air Pollution Control Equipment) has been made compulsory but small-scale industries like brick kilns have not adopted them mostly because of them being mobile.
The state faces challenges like inadequate vigilance and lack of awareness about the importance of environment protection. Another contributing factor is the people’s preference to use private vehicles over public transport.

Almost all districts of Punjab have higher particulate matter concentration than prescribed standards by the Central Pollution Control Board (CPCB). This is a potential threat to the public health. Agricultural burning, industrial and vehicular emissions are the major contributors to deteriorating air quality in the state.

Ludhiana, in particular, is a major industrial hub of the state. Within the city, industrial emissions and vehicular exhaust are the main contributors to air pollution. However, around the main city and district boundaries, the crop residue burning adversely affects the air quality in both Punjab and the neighbouring state of Haryana especially during the harvest season of March/ April and October/ November.

**Coronavirus Pandemic**

Whole world is witnessing the century’s most dreadful time with the outbreak of Coronavirus Pandemic. All across the globe, business, companies, institutes, travel, tourism, etc. never stopped but now everything is in standstill mode since February 2020. Each single place with each of its individual is affected and is in a state of shock and fear. India with the second largest population in the world is also severely affected and if the requisite precautions and measures are not taken at appropriate time, it may turn out to be as disastrous as it was for China, Italy and the USA.

The government of India has imposed a complete lockdown after the Janta Curfew where people by their own experienced a curfew by being at their home for the entire day on 22nd March 2020. Social distancing is the only solution towards controlling the spread of this virus and hence such measures are being taken. One of the states to be affected with this outbreak of COVID-19 is Punjab. Punjab has been in full curfew from 23rd March 2020 - first time in last three decades since militancy was rooted out. As of 31st March 2020, coronavirus positive cases reached to 41, which is around 3.3% of the total positive cases in India and death toll to 4 in the state. Ludhiana, which is the major industrial hub of the state had two cases so far.

**Air Pollution during the Lockdown Period**

The lockdown period has brought enormous difficulties for the people because they cannot step out of their houses, majority of the people now cannot work including daily wage earners and hence cannot have an income to get their basic needs fulfilled. But amidst this chaos this complete lockdown has brought massive improvements in the status of air quality in the Ludhiana city also along with the whole world.

**Particulate Matter**

As shown in figure 1, January 2020 onwards and before lockdown i.e. prior to 22 March 2020 the average concentration of PM$_{2.5}$ (Particulate Matter with diameter equal to or less than 2.5 µm) and PM$_{10}$ (Particulate Matter with diameter equal to or less than 10µm) was $62.22\pm1.17$ µg/m$^3$ and $64.82\pm2.18$ µg/m$^3$ respectively.
During the lockdown the concentrations of PM$_{2.5}$ and PM$_{10}$ dropped significantly by 50.5% (at 30.76±2.26 µg/m$^3$) and 53.2% (at 30.33±1.50 µg/m$^3$) respectively. This significant reduction in PM$_{2.5}$ and PM$_{10}$ levels may be because of the restrain on industrial, commercial and construction activities and the resulting negligible combustion caused by them, omission of unnecessary vehicles from the road and hence the lesser dust resuspension (CPCB, 2020; Singh and Kulshrestha, 2016).

**Sulphur Dioxide (SO$_2$)**

A remarkable reduction in the SO$_2$ concentration has been noticed during the lockdown period. Before lockdown the average SO$_2$ concentration was 3.22±0.16 µg/m$^3$ but during lockdown this was greatly reduced to 0.93±0.09 µg/m$^3$ i.e. by 71%. This huge drop could become possible because of the temporary closure of industries using fossil fuel combustion due to the lockdown (CPCB, 2020). Also, substantial SO$_2$ emissions are being contributed by the stubble burning in the region around Ludhiana city (Gupta et al, 2013).
Nitrogen Oxides (NOx) and Carbon monoxide (CO)

The average NOx concentration reduced by 47.3% with levels during the lockdown at 6.4±0.09 µg/m³. Before lockdown, the average concentrations were as high as 12.12±1.21 µg/m³ lying in the wide range from 4.8 – 78.41 µg/m³. This can be attributed to the negligible presence of the vehicles on road and hence the resulting emissions. In Ludhiana, there are frequent traffic congestion, traffic jams and long waiting time in red traffic lights especially during weekends because of which the NOx concentration increases. In addition, there were two fire events, one at the godown of the scrap goods on 13th march and the other at the godown of the sweet shop on 15th march, which when the NOx concentrations peaked the most (The Tribune, 13 & 15 March 2020. For similar reasons, the average concentration of CO was dropped from 0.07 mg/m³ to 0.017 mg/m³ i.e. by a good 75.7%.

Fig 3 Daily average concentrations of (a) NOx and (b) CO in Ludhiana at Punjab Agricultural University Monitoring station. Specified in the box are the values during the Lockdown Period from 23-03-2020 to 02-04-2020. Data Source: CPCB (Real Time Air Quality Index (AQI) at Punjab Agricultural University Monitoring station)
References

Census India 2020 (http://www.dataforall.org/dashboard/censusinfoindia_pca/).


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Kopal Verma, Ph D student.
Air pollution and health effects in Meerut, India during COVID-19 Lockdown

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Abstract

Air pollution is proliferating unprecedentedly at local regional and planetary scale with no sign of being plummeted into immediate or near future. This surge in pollutants' level into the atmosphere is causing perpetual fear of health deterioration among affected people and plunging socio-economic condition of communities in jeopardy by posing hectic health cost and exacerbating pre-existing health complications. In this study, we have put light on the effect of COVID-19 lockdown (hereafter referred to as lockdown) on air pollution level and its probable effects on COVID-19 mortality in people of Meerut city. The ten days secondary data of various air pollutants (Including criteria pollutants) collected from Ganga Nagar Air quality monitoring station, Meerut, India. Though lockdown is a health-economy paradox for developing nations, such as India, data from this analysis elucidate that after implementation of this lockdown, level of all air pollutants plummeted significantly. When inferences from these results aligned with a new study conducted by researchers at Harvard T.H. Chan School of Public Health on Correlation of air pollution level with COVID-19 mortality, it may be concluded that together with reducing dynamics of COVID-19 infection, lockdown may reduce the COVID-19 mortality rate owing to the reduction in air pollution level. Thus, lockdown may reduce, COVID-mortality in two-dimensional way.

1. What is air pollution

As a critical environmental health concern, air pollution threatening everyone on the planet and occurs when the air is contaminated by varying chemical, biological and physical agent that alters natural atmospheric composition (WHO, 2019). Although both natural and anthropogenic sources are responsible for air pollution, in the course of Anthropocene, anthropogenic activities have been proven major drivers of air of pollution, and now 91% population of the world is living in places which have transgressed the pollution limit suggested by the guidelines of World health organization (WHO, 2018; Crutzen, 2016).

2. Air pollution in Meerut, India

Air pollution is threatening both developed and developing countries. Moreover, as a precarious health risk, air pollution is threatening India in an unprecedented way with much concern for the densely populated region and megacities. Delhi – National Capital Region (Delhi-NCR) is one of the impeccable paradigms of such air pollution realms in India (Balakrishnan et al., 2019; Census, 2011).
At one hand where a profound focus has been given to the monitoring of air pollution over the national capital Delhi, and effective pollution-curbing measures have taken tackle it, on the other hand, less has been done for tier-II cities. One such city is Meerut. As a typical example of urban agglomeration, this city is located in Uttar Pradesh state of India (Fig. 1) with a population of 1,305,429 (Census, 2011). The pollution levels found in Meerut exceed the safe limits by 2-4 times (down to earth), plunging the health of a population of its ~ 1.3 million residents in jeopardy.

![Fig.1 Map depicting the location of Meerut city (Not to scale).](image)

### 3. Major sources of Air pollution in Meerut

The sources of pollution in Meerut vary for its agriculturally and industrially dominated outskirts and for urbanization dominated core. Major sources of air pollution in this city includes industrial facilities, tobacco smoke, Stoves at home, motor vehicles, and agricultural activities in the outskirts, dusty construction sites. The outskirts of the city, which are wide and open space, receive pollution from local industrial stack and agricultural emission with a significant contribution from sources in Delhi and other polluted regions of Delhi-NCR. Contrary to this, core urban agglomeration of the city faces accumulation and increased concentration of these pollutants into compactly distributed and densely populated residential settlements with a significant contribution from yearly-perpetual traffic pollution and small industrial operations. In addition to this, intermittent sources such as occasional fireworks and seasonal agricultural residue burning; less emphasis on the prohibition of the old and polluting vehicle inside the city which are otherwise banned Delhi; entry of diesel-based heavy commercial vehicle during daytime by transgressing prohibiting rules; lack of cleaner fuel such as CNG (Compressed Natural Gas) in public transport; poorly regulated industrial operation add new dimensions in pollution of this city (DTE, 2017).
4. Health effects of Air pollution in Meerut

Air pollution in Meerut affect all, but each age group, especially people who have any kind of respiratory illness. Moreover, this dirty air is more precarious for young children, infants and old-aged people and those who have any kind of previous respiratory complications. For instance, exposure to polluted air poses various kind of health complications (Table1.).

People with Chronic obstructive pulmonary disease (COPD) and asthma problem need to be more vigilant and should take more precautions. Even a tiny surge in dust pollution can exacerbate asthma symptoms, COPD, and several other respiratory illnesses (DTE, 2017).

<table>
<thead>
<tr>
<th>Air Pollutant</th>
<th>Health effect(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₃</td>
<td>Low concentration can provoke coughing, chest pain, throat irritation, and asthma penetrates deeply into lungs, bronchiolar and bronchial injury</td>
</tr>
<tr>
<td>VOCs</td>
<td>Nausea, liver damage, asthma and mucous membrane annoyance</td>
</tr>
<tr>
<td>CO</td>
<td>Fatigues, chest pain and sore eyes (low concentration) Impaired vision and headaches, tissue hypoxia</td>
</tr>
<tr>
<td>NO₂</td>
<td>Cause a variety of pathological changes including the destruction of cilia lining respiratory airways, penetrates deeply into lungs, bronchiolar and bronchial injury</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>Lung cancer, Eye irritation, affect upper airways and mucous membranes</td>
</tr>
<tr>
<td>PM₂·₅</td>
<td>Nose, Eye, lung, and throat irritation, sneezing, coughing, shortness of breath and runny nose, damage to alveoli and bronchioles</td>
</tr>
<tr>
<td>SO₂</td>
<td>Lungs impairment, respiratory illness, damage to the skin and upper airways</td>
</tr>
</tbody>
</table>

5. Effect of lockdown on the pollution level of Meerut

It is axiomatic that currently, the whole world is confronting with COVID-19, which is an infectious disease caused by a new coronavirus introduced into humans for the first time.

Owing to its spreading across the world, WHO recently announced COVID-19 outbreak a pandemic (WHO, 2020).
Owing to its globally ubiquitous spreading, a third of the global population is on coronavirus lockdown to stop spreading of its infection (Business Insider, 2020). Akin to many COVID-19 affected countries, on March 24, GOI announced a 21-day-long national lockdown (25th March-14th April) after a surge in COVID-19 infection cases across the country, sending 18% of the world’s population indoor. Like other parts of the world, lockdown in India plummeted the social and economic dynamics (Bloomberg, 2020b) leading drastic halt into dynamics major air pollution sources, for instance, automobiles, trains, factories planes, etc. across the country. This halt turned skies of the some of the most polluted cities of the country clean and blue which resulted into the improvement of air quality index (AQI) of almost 90% of the 103 cities continuously monitored by India’s Central Pollution Control Board (CPCB) of GOI on 29th march 2019 and plunged it to a satisfactory level (Bloomberg, 2020a). To see the effect of this lockdown on the air pollution level of Meerut we took 10 days data (5 days prior to lockdown and 5 days during the lockdown) of Sulphur dioxides (SO₂), Particulate matter with an aerodynamic diameter < 2.5 μm (PM<sub>2.5</sub>), articulate matter with an aerodynamic diameter < 10 μm (PM<sub>10</sub>), Nitrogen dioxide (NO₂), Carbon monoxide (CO), Ozone (O₃), Ammonia (NH₃), Nitrogen oxides (NOx), Benzene (C₆H₆), Xylene ((CH₃)₂C₆H₄) and Toluene (C₆H₅C₃) from AQI monitoring station (CAAQMS,2020) situated in Ganga Nagar, Meerut, India (Table. 2).

The data (Table 2) and its corresponding plots (Fig.2) clearly showing the plummeted air pollution during lockdown, which can be attributed to the halt in anthropogenic pollution sources during lockdown.

### TABLE 2. 24-hourly average concentrations of various pollutants before and during the days of lockdown measured at Ganga Nagar, Meerut, India. The shadowed dated are depicting the lockdown days. Unit: PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub>, NO, NH₃, SO₂, O₃, C₆H₆, (CH₃)₂C₆H₄, C₆H₅CH₃ in µg/m³, NO<sub>x</sub> in ppb and CO in mg/m³.

<table>
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<tr>
<th>March, 2020</th>
<th>PM&lt;sub&gt;2.5&lt;/sub&gt;</th>
<th>PM&lt;sub&gt;10&lt;/sub&gt;</th>
<th>NO&lt;sub&gt;2&lt;/sub&gt;</th>
<th>NO</th>
<th>NO&lt;sub&gt;x&lt;/sub&gt;</th>
<th>NH₃</th>
<th>SO&lt;sub&gt;2&lt;/sub&gt;</th>
<th>CO</th>
<th>O₃</th>
<th>C₆H₆</th>
<th>(CH₃)₂C₆H₄</th>
<th>C₆H₅CH₃</th>
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<td>20</td>
<td>75.6</td>
<td>169.91</td>
<td>21.29</td>
<td>0.94</td>
<td>12</td>
<td>33.7</td>
<td>1.3</td>
<td>19</td>
<td>0.52</td>
<td>0.33</td>
<td>1.99</td>
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<tr>
<td>21</td>
<td>101.33</td>
<td>214.3</td>
<td>27.07</td>
<td>1.25</td>
<td>15.3</td>
<td>38.3</td>
<td>1.7</td>
<td>19</td>
<td>0.94</td>
<td>0.19</td>
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<tr>
<td>22</td>
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<td>264.81</td>
<td>23.26</td>
<td>1.06</td>
<td>13.1</td>
<td>54.7</td>
<td>1.5</td>
<td>18</td>
<td>1.04</td>
<td>0.03</td>
<td>0.76</td>
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<td>23</td>
<td>57.58</td>
<td>115.24</td>
<td>14.13</td>
<td>0.49</td>
<td>7.65</td>
<td>36.3</td>
<td>1.1</td>
<td>20</td>
<td>0.45</td>
<td>0.07</td>
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<td>64.24</td>
<td>134.04</td>
<td>17.43</td>
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<td>9.53</td>
<td>35.1</td>
<td>1.2</td>
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<td>0.64</td>
<td>0.04</td>
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<td>25</td>
<td>69.7</td>
<td>161.92</td>
<td>17.3</td>
<td>0.57</td>
<td>9.58</td>
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<td>26</td>
<td>34.05</td>
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<td>0.38</td>
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<td>0</td>
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<tr>
<td>27</td>
<td>50.25</td>
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<td>7.15</td>
<td>0.33</td>
<td>3.93</td>
<td>30.7</td>
<td>1.3</td>
<td>13</td>
<td>0.22</td>
<td>0.01</td>
<td>0.53</td>
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<tr>
<td>28</td>
<td>-</td>
<td></td>
<td>6.87</td>
<td>0.5</td>
<td>3.89</td>
<td>33.9</td>
<td>1.1</td>
<td>9.8</td>
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<td>11.76</td>
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<td>4.89</td>
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<td>1.2</td>
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<td>0</td>
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<td>17</td>
<td>0.1</td>
<td>0</td>
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Prescribed Standards: 0-60, 0-100, 0-80, 0-80, 0-400, 0-80, 0-4, 0-180, 0-5, 0-5, 0-5.
5. Possible effect of plummeted air pollution during lockdown on COVID-19 mortality in Meerut

Air pollutants pose a myriad of threat to human health (Table1), but hitherto no study has done which elucidate the correlation of air pollution with on COVID-19 mortality in India. Recently a new study by researchers at Harvard T. H. Chan School of Public Health on Correlation of air pollution level with COVID-19 mortality suggests that an increase of only 1µg/m³ in fine particulate (PM$_{2.5}$) is associated with a 15% increase in COVID-19 mortality. Taking this study into consideration, it may be inferred that reduction in air pollution level in Meerut and other parts of India, during COVID-19 may reduce the death rate of COVID-19 patients. In addition to this, a reduction in air pollution will also be beneficial for better health which can boost immunity resulting in less cases of infection.

6. Conclusion

As a part of Delhi-NCR, Meerut is one of the most polluted city India. Level of air pollution in the town remains above the safe limit prescribed by WHO and CPCB during the course of an almost whole year. This transgressed pollution level deteriorating health and causing and exacerbating several respiratory and other health complications among the residents of this city.
This pollution can be attributed to the ubiquitous pollution sources distributed in and outside the city. Data from air quality monitoring stations suggest that in the course of lockdown days, the air pollution level in the city fall drastically, resulting in the clear sky and “satisfactory” AQI. Plummeted air pollution may be beneficial for the people struggling with COVID-19 infection and subsequently may reduce the mortality among these people. In the final analysis, this lockdown may help curb COVID-19 epidemic by bottlenecking social interaction and reducing COVID-19 mortality by combating debilitating air pollution in this city.

7. References


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Moh Naseem, Ph D student.
COVID-19 lockdown: Air Pollution and Health effects in Rewari, Haryana (India)

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Abstract

Covid 19 is a pandemic disease affecting more than 160 countries lead to a series of drastic and unprecedented changes on a global level. Lockdown decision taken by the Government of India in order to fight with COVID-19 which is caused by the novel coronavirus (SARS-CoV-2) has both good and bad sides. It is good for the environmental perspective but bad for the global economy as it came to a screeching halt because of the closing of all non-essential activities. As we know air quality in megacities and other major population areas is a serious problem due to their high pollutant concentrations above permissible limits and their health hazards. In India, the high demand of automobiles on account of rapidly increasing population significantly affects the environment directly or indirectly, particularly in urban areas. Furthermore, the increasing rate of vehicular population attributes to degradation of the atmospheric conditions which are responsible for a number of diseases. Hence, the increasing concentration of SO₂, NOₓ, CO₂, CO, etc. is of serious concern because of their above permissible levels. The nationwide Janta Curfew on March 22, 2020 and lockdown since March 24, 2020, have resulted in substantial improvement in air quality in the country, as revealed by data analysis and comparison of data for time before enforcement of restrictions. As a result of a combination of stringent travel restrictions, functioning of only essential commercial units and prevailing weather conditions, air quality improvement has been noted in many towns and cities across the nation. Significant reduction was noted for PM₁₀, PM₂.₅, NO₂ levels and less pronounced for other pollutants. A brief analysis of data generated from continuous ambient air quality monitoring network and findings are summarized in this chapter.

1. Air pollution

Today, we live in a world where we acknowledge that the air we breathe is not pure due to air pollution. Rapid increase in vehicular traffic and industrial activities during the past few decades has resulted in poor air quality (Pipal et al., 2014, Dholakia et al., 2013, Guttikunda et al., 2013). According to reports, ambient air pollution levels are exceeding the international WHO standards (Gupta et al., 2002).

Now-a-days, ambient air pollution is a major concern of the highly developed world as it has serious toxicological, epidemiological effects on the environment and human health. It has several natural and anthropogenic sources of emission but motor vehicles, power plants and industries contribute a significant part of air pollution.
The major pollutants causing air pollution include carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen oxides, total suspended particulate matter, ozone, formaldehyde, lead, radon, volatile organic compounds and other toxic pollutants.

According to WHO, there are six major air pollutants which include atmospheric particulate matter (PM10, PM2.5), ground level O3, CO, NO2, SO2, and Pb. In India, air pollution has been identified as the fifth biggest cause of mortality (Lim et al., 2012).

2. COVID-19: Consequences

Covid-19 is a pandemic disease affecting more than 160 countries and most of them are developed countries. Covid-19 infected as well as death cases are increasing every day and most of the countries declared a lockdown situation. Lockdown situation has both good and bad sides.

Good sides are mainly for environmental aspect with some advantages such as drastic reduction in pollution, green house gases and global warming ozone layer healing improved city and personal hygiene opportunities for home and housing society cleaning and sanitation enjoying family time household inventory management.

3. Sources and level of pollutants in Rewari (Haryana) prior to and during lockdown

Haryana is among the northern most states in India and surrounds the national capital Delhi from three sides. Historically, an agricultural state, now is a well-developed industrial hub. The state is one of India’s largest centres for automobiles and accounts for two thirds of passenger cars, 50% of tractors and 60% of motorcycles manufactured in the country.
Rewari is an urban city in Haryana which lies between 27° 46’ ; 28° 28’ N & 76° 15’; 76°51’E. Total geographical area of the district is 1594 sq.km. The climate of Rewari district can be classified as tropical steppe, Semiarid and hot which is mainly dry with very hot summer and cold winter except during monsoon when moist air of oceanic origin penetrates into the district.

The major pollution sources in the district are vehicular emissions, fossil fuel burning, biomass burning. 24 hourly average concentration of criteria air pollutants prior to and during the lockdown period is as shown in the below table 1. Levels of PM$_{10}$, PM$_{2.5}$, NO$_2$, CO (Fig 2 and 3), a major pollutant released from vehicles, power plants and factories, plummeted after the mass quarantine. Closing industrial plants and asking people to stay at home has led to a sharp drop in the burning of fossil fuels resulting in lesser emission of green house gases. All the criteria pollutants showed a significant reduction during the lockdown.

### TABLE 1. Average Concentration (24 hourly) of criteria air pollutants before and during lockdown period measured at Municipal Corporation Office, Dharuhera. Units: PM$_{10}$, PM$_{2.5}$, O$_3$, NO$_2$, SO$_2$, NH$_3$ in µg/m$^3$ and CO in mg/m$^3$. Here shaded rows are depicting the lockdown days.

<table>
<thead>
<tr>
<th>Date (2020)</th>
<th>PM$_{2.5}$</th>
<th>PM$_{10}$</th>
<th>O$_3$</th>
<th>NO$_2$</th>
<th>SO$_2$</th>
<th>NH$_3$</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 March 20</td>
<td>53</td>
<td>152</td>
<td>32</td>
<td>53</td>
<td>18</td>
<td>11</td>
<td>2.7</td>
</tr>
<tr>
<td>18 March 20</td>
<td>72</td>
<td>206</td>
<td>37</td>
<td>60</td>
<td>35</td>
<td>29</td>
<td>2.99</td>
</tr>
<tr>
<td>20 March 20</td>
<td>80</td>
<td>205</td>
<td>44</td>
<td>49</td>
<td>27</td>
<td>31</td>
<td>1.06</td>
</tr>
<tr>
<td>22 March 20</td>
<td>76</td>
<td>189</td>
<td>42</td>
<td>46</td>
<td>22</td>
<td>30</td>
<td>0.92</td>
</tr>
<tr>
<td>24 March 20</td>
<td>53</td>
<td>157</td>
<td>40</td>
<td>24</td>
<td>23</td>
<td>31</td>
<td>0.74</td>
</tr>
<tr>
<td>26 March 20</td>
<td>44</td>
<td>62</td>
<td>20</td>
<td>14</td>
<td>9</td>
<td>31</td>
<td>0.6</td>
</tr>
<tr>
<td>28 March 20</td>
<td>18</td>
<td>25</td>
<td>30</td>
<td>11</td>
<td>9</td>
<td>30</td>
<td>0.47</td>
</tr>
<tr>
<td>30 March 20</td>
<td>49</td>
<td>69</td>
<td>44</td>
<td>10</td>
<td>13</td>
<td>29</td>
<td>0.6</td>
</tr>
<tr>
<td>1 April 20</td>
<td>27</td>
<td>37</td>
<td>40</td>
<td>6</td>
<td>10</td>
<td>29</td>
<td>0.64</td>
</tr>
<tr>
<td>3 April 20</td>
<td>31</td>
<td>43</td>
<td>57</td>
<td>2</td>
<td>14</td>
<td>22</td>
<td>0.59</td>
</tr>
<tr>
<td>5 April 20</td>
<td>44</td>
<td>64</td>
<td>57</td>
<td>3</td>
<td>19</td>
<td>20</td>
<td>1.02</td>
</tr>
<tr>
<td>7 April 20</td>
<td>35</td>
<td>49</td>
<td>51</td>
<td>3</td>
<td>14</td>
<td>22</td>
<td>0.67</td>
</tr>
<tr>
<td>9 April 20</td>
<td>35</td>
<td>49</td>
<td>61</td>
<td>3</td>
<td>14</td>
<td>22</td>
<td>0.71</td>
</tr>
</tbody>
</table>

| Permissible limits | 60 | 100 | 180 | 80 | 80 | 400 | 4 |

Note: The shaded rows depict the lockdown days.
The comparison of daily concentration values shows a substantial decreasing trend for all the above mentioned pollutants except NH₃, before and during lockdown period (Fig 2 and 3). Since majorly NH₃ originates from decomposition of organic matter (municipal waste, sewage, etc.), the reduction in concentration was not as significant as that observed for other pollutants. The maximum value of PM2.5 was 80 µg/m³ on March 20, 2020 (before lockdown) which dropped to 18 µg/m³ on March 28, 2020 (during lockdown). Similarly, maximum and minimum values for PM₁₀, NO₂, SO₂ were 206, 60, 35 and 25, 3, 9 µg/m³ before and during lockdown period respectively. The restriction on industrial activities, vehicular movement and other non-essential activities during the lockdown period is attributable to the declining trend.

The graphs below (Fig. 4, 5 and 6) depict hourly variation in concentration for PM2.5, PM10, NO₂ for 21st (pre curfew), 22nd (curfew) and 23rd (post curfew) March 2020. The comparison of hourly concentration values shows a decrease in PM₁₀, PM₂.₅, NO₂ levels during March 21-23, 2020. On March 22, 2020 (curfew day) the value of PM₂.₅ reaches its maximum (170 µg/m³) at 08:00 Hrs which may be due to increase in vehicular movement before the curfew hours which dropped to 40 µg/m³ at 20:00 Hrs.
Similarly, the maximum value of PM10 was 300 µg/m³ at 08:00 Hrs on curfew day which dropped to a minimum of 92 µg/m³ at 18.00 Hrs. Furthermore, these levels reduced to 72 µg/m³ at 14.00 & 16.00 Hrs post curfew day.

Similarly, the maximum value of NO2 was 100 µg/m³ at 22:00 Hrs on March 21, 2020, which dropped to a minimum of 12 µg/m³ on March 23, 2020 at 15.00 Hrs.

4. Health effects

Air pollution has a significant impacts on human health, triggering, and inducing many diseases resulting in increase in morbidities and mortalities, particularly in the developing countries.

Air pollution can cause lungs dysfunction, asthma problems, and difficulties in breathing from mild to severe depending on short or long term exposure to children and adults.
Also, it is one of the causes of adverse birth outcomes like premature birth, low birth weight and small gestational age births. Particulate pollution causes respiratory diseases as it penetrates deep into the lungs even it causes cardiovascular impacts by entering the bloodstream. In 2013, WHO International Agency for Research on Cancer (IARC) classified it as a cause of lung cancer. Long-term exposure to ambient fine particulate matter (PM_{2.5}) is associated with increased mortality and cause-specific diseases (Brook et al., 2010).

5. Conclusion
Strict laws, rules and legislating policies need to be created in order to control air pollution causing activities and to maintain a balance between economic development and the environment. Strategies such as increase in tree plantation, electric vehicles, fuel prices, road taxes and public transport can reduce the ambient air pollution. Furthermore, improvement in fuel efficiency, public awareness and maximum use of public transport may maintain the environment sustainable.

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https://app.cpbccrc.com/ccr/#/caaqm-dashboard-all/caaqm-landing/data

Sudesh, PhD student.
Reduced ‘Anthropogenic load’ during ‘lockdown’, helped uncommon butterflies to resurface in Delhi-NCT

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Abstract

The aim of the present study was to evaluate and observe the impact of reduced levels of anthropogenic load during lockdown that included air-pollution, human interference on vegetation, urbanization and favourable environmental parameters on the sensitive life of the butterflies on Delhi-NCT.

Introduction

Butterflies are important bio-indicators and can sense the slightest alteration in the ecosystem and its balance in nature because of their highly sensitive and specific habitat requirements. Their richness is influenced by the environment, floral diversity, level of air-pollutants, presence of native flora, larval host plants, invasion of exotic species of plants, use of pesticides and related microhabitat. Any kind of disturbance or alteration in any of the above mentioned factors in their habitats, adversely affect their population in the given environment. Transformation of habitat/land/ecosystem by removing native flora on the pretext of de-weeding, leaf litter removal for cleaning purpose, pruning for routine maintenance and other related activities including urbanization and developmental activities directly impacts butterfly diversity. Other anthropogenic activities that increase air-pollution as a result of traffic density also eliminate butterflies in their early developmental stages. In the present study the observation areas were restricted to only those areas where one or the other butterfly observer was either residing or going for work during the ‘lockdown’ period under essential service category because of the outbreak of COVID-19 pandemic in the national capital. Observations were collected from Jawaharlal Nehru University (JNU), Chanakya Puri, Rohini, Motilal Nehru Marg, Noida, Greater Noida and around residential areas as individual mobilities were greatly restricted. It was just a co-incidence that all these areas, where butterfly observers were recording observations, were either green zones or busy road side gardens close to Lodi gardens, Surajpur wildlife sanctuary and JNU campus itself which is a ridge forest and serves as green lung of Delhi despite it’s connectivity with two major arterial roads ‘Aruna Asif Ali road’ on the east side and ‘Nelson Mandela Road’ on the west side (Prakash,S. (2009)). Observations were strictly limited to 88 days in total w.e.f. 15th March, 2020 to 10th June,
2020 that included the ‘lockdown’ period of 68 days in Delhi-NCT and 10 pre-lockdown as well as 10 post-lockdown days; this buffer period was treated as control period to analyze the impact of other pre-existing parameters which were already there during normal routine days of non-lockdown period. The rationale of this study was to evaluate the impact of ‘lockdown’ on the diversity of butterflies in the national capital due to improved environment of Delhi-NCT and it's microhabitat because of no human interference.

Material & Methods

The observations were collected by all the observers effective from 15th march upto 10th June 2020 in Delhi-NCT. The observation area of NCT Delhi (28°25′–28°52′N and 76°50′–77°21′E) which was undertaken for the present study w.e.f.15th March (Control) up to 10th June (Control) was actually the exact time when all the butterflies are seen on their wings in their respective habitats in Himalayas and southern wetter parts of the country. Observations were also pooled from other reliable observers from Delhi-NCT who shared their photographs with dates and locations. Observations were digitally recorded and uploaded on BOI web page www.ifoundbutterflies.org by all the observers. The observation period was restricted from 15th march upto 10th June 2020 with a margin of 10 days pre-lockdown and 10 days post lockdown to observe the variation in population density before and after the lockdown and was treated as a control period to assess the impact of anthropogenic activities.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Species Name</th>
<th>Pre-lockdown sighting March 15 - 24.03.2020</th>
<th>Lockdown sighting March 25 - 31.03.2020</th>
<th>Lockdown sighting April 01 - 30.04.2020</th>
<th>Lockdown sighting May 01 - 31.05.2020</th>
<th>Post-lockdown sighting June 01 - 10.06.2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Papilio clytia clytia – Linnaeus 1758, Common Mime</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Delias eucharis – Drury 1773, Indian Jezebel</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Spindasis ictis ictis – Hewitson 1865, Common Shot Silverline</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Argynnis hyperbius – Linnaeus 1763, Tropical Indian Fritillary</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>Acraea terpsicore – Linnaeus, 1758, Tawny Coster</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Table explains that except Argynnis hyperbius no other species was observed in the pre-lockdown period. Also only Acraea terpsicore was recorded in the month of April. Rest of the species were recorded in May. Again in June not a single one of the species was sighted.
1. *Papilio clytia clytia* Linnaeus, 1758 – Common Mime - (Plate-1)

Big swallowtail butterfly (90-100 mm) without tail and black body. It occurs in 2 forms- Brown form-clytia with white post-discal spots on UP/UNH. White form dissimilis with black and white stripes and white post-discal spots on UP/UNH. Yellow sub-marginal spots UNH in both forms. Exhibit best example of Batesian mimic, copying brown crows (Brown form) or Blue tiger (white form). Best season to observe them is between March-November in traditional natural habitats which are the Himalayas and Southern parts of India but in Delhi-NCT they were recorded in May. One specimen was recorded from Asola Bhatti on 12th July 2016 by Sohail Madan. Sita, S. recorded *P. clytia clytia* on 21st May, 2020 from NIPGR-JNU and next day on 22nd May, 2020 Sambhava Jain recorded the same white form from Noida, Gautam Buddha Nagar of NCT.

2. *Delias eucharis* (Drury, 1773) – Indian Jezebel-(Plate-2)

Medium sized (65-82 mm) UNH is yellow with black veins marginal series of large red-orange spots, black edges on both sides, usually weak flier, nectar feeder. Larval host plant is from Loranthaceae family, (*Dendrophthoe falcate*) which are parasitic in nature and is widely distributed in India. Usually common in its natural habitats. Mostly seen on the top of trees during day being high flyers. Chaudhary, R. observed and photographed one specimen in April 2008. Prakash S. collected two specimen on 26th November 2012 and 25th May 2013 from JNU. Thereafter Sita, S. recorded on 1st May, 2020 from NIPGR-JNU & J.S. Waraich recorded it on 2nd May, 2020 from Noida Gautam Buddha Nagar-NCT. Again from 9th to 18th May, 2020 Komath, S.S. continuously observed two individuals in her home garden for complete ten days at JNU.

3. *Spindasis ictis ictis* (Hewitson, 1865) – Indian Common Shot Silverline-(Plate-3)

Small butterfly (30-35 mm) with two tails and a lobe shows significant seasonal variations and individual variations. Base colour varies from yellow to cinnamon red. Both sexes have triangular orange discal patch with brown spots. Male-blue shot not extending above V.2, Female-greyish brown. Can be observed on wings from March-September in traditional natural habitat which are Himalayas, North-east India. The last specimen was collected from Tilpat Valley by Rohit, K. (2016). During lockdown Sita, S. recorded one specimen on 13th May 2020 from NIPGR-JNU.
4. **Argynnis hyperbius hyperbius** (Linnaeus, 1763) – Tropical Indian Fritillary-(Plate-4)

Medium sized butterfly (65-75 mm). Ranges are Himalayas, North India, North-east India, Rajasthan and Gujarat. Feeds on nectar of flowering plants from violaceae family which are ornamental and grown during winter in Delhi & many are weeds (Larsen 1988 b). Usually seen in gardens and road sides, forest edges. Female exhibits Batesian mimicry and mimics Plain tiger and Striped tiger. Best observed from March to December in traditional natural habitats. Prakash, S. recorded a single specimen from Lodi gardens 21st may 2013. Maurya, C.B. recorded two individuals of both the sexes from Motilal Nehru Circle on 16th to 19th March 2020, soon after that Singh, D. visited the same place in the last week of March and found them fluttering in the same place. Interestingly there is a published record of A. *hyperbius*. from the residence of former Chief Minister of Delhi late Smt. Sheila Dixit in an official booklet of Delhi Govt. ‘Glimpses of nature’ 3, Motilal Nehru Marg (2007). Singh, D. also recorded two individuals from 7th May to 10th May 2020 from his residence in Chanakya Puri. Maurya, C.B. also observed female laying eggs by the end of March (Plate-4a). Chaudhary, R. collected and hand raised a single caterpillar of it from Acharya Narendra Dev College, Delhi and released the same at Sunder Nursery on 26th February, 2018 (personal communication to Prakash, S.). The observations of Maurya & Chaudhary are suggestive of breeding record of *A. hyperbius* in Delhi.

5. **Acraea terpsicore** (Linnaeus, 1758) – Tawny Coster-(Plate-5)

Moderate average sized (50-65 mm). Black margin, border on both wings, slow flyer, and feed on nectar of flowers. Larval host plant includes cucumbers (Cucumbitaceae) and passion flower (Passifloraceae). Seen in gardens and open scrub forests. Lower elevation, Nomadic butterfly species, Larval host plant *Adania hondala, Modec palmate*. Larsen (2002) observed it’s breeding from Delhi and caterpillars feeding on plants from Malvaceae family. Prakash, S. had observed three individuals of both sexes from Bhatti Mines on 21st May 2013 and later on Maurya, C.B. recorded one female from Sanjay Van on 26th August 2017 and during lockdown Singh, D. recorded single specimen from his home garden in Chanakyapuri on 5th May 2020. Chaudhary, R. also recorded it in Rohini residential area on 30th April 2020.
Results & Discussions

The rationale of the present study was to assess and evaluate the impact of ‘anthropogenic activities’ on the biodiversity, with focus on butterflies of the Delhi-NCT, during ‘lockdown’. Because of their highly sensitive nature and specific microhabitat requirement they serve as the best model of bio-indicators study. The butterflies species that the authors have used in this study (Table-1) as model are not new for the Delhi-NCT region and have already been taxonomically enlisted in previous studies by Jandu (1941, 42, 43), Donahue (1967), Ashton (1972), Larsen, T.B. (2002), Prakash, S. (2013, 2016, 2019), Biswas et al (2017) and Madan, S. (2017). For the past few years they haven’t been authentically reported from Delhi-NCR. It is possible that both the life-line ecosystems of Delhi-NCT, river Yamuna & Aravalli ranges have not been able to provide the expected ecosystem services to the city’s biodiversity due to rapid urbanization & inevitable developmental activities and butterflies being sensitive to urbanization might not have bred or migrated in the region [Clark et al (2007), Fontaine et al (2016)]. Butterflies respond to the slightest alteration in their respective habitats be it air-pollution (Larsen
human activities, developmental activities or urbanization [Sevastopulo (1975), Monalisa & Aisha (2020)]. Monalisa et al (2020) have mathematically analyzed the rate of rapid urbanization of Delhi through biodiversity indices and suggested that green patches have significantly reduced and shown how this has adversely influenced diversity of butterflies in the city. There are other reports too that the green zones of Delhi have shrunk drastically because of developmental activities (Mohan, M. (2003) and Census of India (2011)). The built-up area of the Delhi region has swelled to 45.18% in 2013 from 25.17% in 1989 shrinking the green zones from 31.73% to 22.47% and sparse vegetation from 37.40% to 29.37% [Mukhopadhyay, A. et al (2013)], this indicates the rate of rapid urbanization in Delhi-NCT in the past two decades has had an adverse affect on the faunal diversity.

During the lockdown period for 68 days, due to the ‘Covid-19’ Pandemic, all human activities were close to zero and uncommon butterflies got the opportunity to breed and complete their metamorphosis uninterrupted, which was almost impossible during non-lockdown conditions because of human activities. There was no vehicular traffic on the roads and no functional industries and factories emitting enormous amount of toxic-pollutants which used to kill butterfly eggs, larvae and pupae, but also seriously affected human life in the national capital. All govt. and non-govt. offices were closed including horticulture department which otherwise could have removed larval host plants of these butterflies on the pretext of de-weeding, pruning, spraying insecticides usually (malathion & chlorpyrifos) intentionally or un-intentionally to maintain the city’s roadside and historical gardens and nurseries for ornamental value of the city. Therefore, caterpillars of the said butterflies species got a fair chance to develop and transform to pupae and eventually to adult butterflies without any hindrance by gardeners. It was just a co-incidence that weather in the national capital remained most favorable, with optimum temperature and humidity, a pre-requisite for butterflies to grow and survive. All these factors collectively played a vital role in either migrating (Larsen, T.B (1986)) or re-surfacing of these uncommon butterfly species in the city because of reduced anthropogenic stress and favourable climatic conditions of Delhi-NCT. In the past also two uncommon butterflies re-surfaced in the city (Chaudhary et al (2019)). In the present study the authors had started their observations 10 days before lockdown (pre-lockdown) and concluded 10 days after lockdown (post-lockdown) to use this period as control, and to our surprise the population of butterflies drastically depleted soon after unlock phase-1 began. Not surprising, this was also the case during the pre-lockdown period, with only one species Argynnis hyperbius hyperbius (Table-1) being recorded conclusively, suggestive of impact of ‘anthropogenic stress’ on their life cycle. The absence of all other five species in April month were presumably considered as the oviposition and metamorphosis period which is usually is 4-5 weeks for a normal butterfly to complete it’s life-cycle and emerge as an adult on the wings in the first week of May in the city. The absence from 1st to 10th June was probably due to increased temperature that fluctuated between 42 to 46 degree reducing optimal humidity which is not suitable for butterflies to survive. The overall decline among other species of Delhi’s butterflies was also observed due to all these factors.

Also other normal human activities also resumed within Delhi-NCT including vehicular traffic
releasing toxic gases or air pollutants. All these factors worked against butterflies. The authors propose a further study on the subject to record complete life cycle of all these butterflies in order to document whether these species have adapted and established to breed in the city.

Acknowledgements

Authors are thankful to J.S. Waraich and Sambhava Jain for sharing their observations of Jezebel from Noida and Greater Noida, respectively, for the present study

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Dr. Surya Prakash, SLS, JNU
World Metrology Day 2020: Measurements for Global Trade

To commemorate the occasion of the World Metrology Day, on 20th May 2020, YOHO–GLP, School of Environmental Sciences and JNU ENVIS RP organised an online Webinar. Theme of the webinar was ‘Measurements for Global Trade’. Time duration was two hours (Fig.1).
**World Metrology Day 2020: Measurements for Global Trade**

(May 20, 2020) | 4.00 - 5.30 pm

**Webinar Theme: Measurements for Global Trade**

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**Programme Schedule**

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Time</th>
</tr>
</thead>
</table>
| **Inaugural Address By**  
Prof. U.C. Kulshrestha, Moderator  
ENVIS Coordinator/Dean, SES, JNU | 4:05 - 4:15 PM |
| **Dr. J.P. Gupta**  
Chairman-Expert Appraisal Committee(I) MoEF&CC, Govt.  
Chairman-Environment Committee PhD Chamber of Commerce & Industry | 4:15 - 4:25 PM |
| **Dr. Sanjay Yadav**  
Vice-Chairman Metrology Society of India  
CSIR-National Physical Laboratory, New Delhi | 4:25 - 4:35 PM |
| **Mr. A.K. Jha**  
Senior Director EIA Accreditation,  
QCI-NABET, New Delhi | 4:35 - 4:45 PM |
| **Prof. Paulraj Rajamani**  
Radiation Measurement Expert  
SES, JNU | 4:45 - 4:55 PM |
| **Mr. Tej Pratap**  
Research Scholar & YoHo Leader,  
SES, JNU | 4:55 - 5:05 PM |
| **Questions from Audience** | 5:05 - 5:15 PM |
| **Concluding Remarks by Prof. U.C. Kulshrestha** | 5:15 - 5:25 PM |
| **Vote of Thanks by Mr. Piyush Kumar Verma**  
Research Scholar & YoHo Leader, SES, JNU | 5:25 - 5:30 PM |

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**Organized by:**

JNU ENVIS Resource Partner on Geodiversity & Impact on Environment  
School of Environmental Sciences, Jawaharlal Nehru University, New Delhi

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**Figure 1:** Poster and programme schedule circulated online of Webinar on World Metrology Day
Panellists included experts and professionals working in the field of Metrology. Unique feature of this webinar was that not only experts but young students also got a chance to share their experiences.

It was attended by more than 40 participants, across the country. Participants included university students, researchers, faculty members and professionals working in the area of metrology.

Webinar was moderated by Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU (Fig.2). He initiated the panel discussion by highlighting the importance of this day and metrology. He emphasized the importance of metrology as a subject and recalled how he understood the importance of metrology since his student days. He mentioned about the starting of ‘Metrology’ course in JNU in 2009-10, which has been the first in the university system in India. He congratulated young leaders of YOHO –GLP for taking this initiative to celebrate the occasion of the World Metrology Day. Then he invited Dr. J.P.Gupta to present his views.

Dr. J.P.Gupta, Chairman- Expert Appraisal Committee (Industry –II), MoEF&CC, Gol. Chairman-Environment Committee PHD Chamber of Commerce & Industry (Fig.3). Dr. Gupta presented his views on the importance of metrology in global trade. He highlighted the importance of Reliability, Loyalty, Dedication, Quality Assurance and branding in International trade.
Dr. J.P. Gupta, Chairman- Expert Appraisal Committee (Industry –II), MoEF&CC

Dr. Sanjay Yadav- Vice Chairman, Metrology Society of India, CSIR-NPL, New Delhi (Fig.4). He talked about the close relationship between metrology and sustainable development. He described how measurement standards were established. Role of National Physical Laboratory (NPL) in ensuring testing, precision and reliability. He mentioned in 2019, MoEF&CC authorized NPL for environment measurement standards. He advocated for establishing a strong infrastructure in the field of Metrology and urged for coordination among government, industry and research institutions. He said only a clean environment will insure better international trade.
Mr. A K Jha – Senior Director, EIA Accreditation QCI-NABET, New Delhi (Fig.5). He mentioned that the Quality Council of India was established by the Cabinet decision. It is a national body established for granting accreditation. He said that quality and metrology are interdependent and in every field applied metrology is used. He explained how EIA conducting organisations are given accreditation after thorough checking of various parameters. Earlier practice was to give accreditation to individuals which is no more followed now and only institutions are given accreditations for conducting EIA.
Figure 5: Mr. A K Jha – Senior Director, EIA Accreditation QCI-NABET

Prof. Paulraj Rajamani – Radiation Measurement Expert, SES, JNU (Fig.6). He shared his radiation studies experiments and showed effects of mobile phone radiation on human health. Various experiments and case studies were discussed. He mentioned how 5G will play a pivotal role in coming times, especially in the field of online education. It is expected that by 2021, India will introduce 5G services.
Mr. Tej Pratap – Research Scholar and YoHo Leader, SES, JNU (Fig.7). He highlighted the activities of YoHo-GLP and various facilities available in CIF, SES, JNU. Also talked about the importance of metrology and how students are benefitting from various instruments and facilities available in CIF, SES. Highlighted that Log Book maintenance has been initiated by his group.

Concluding remarks were given by Prof. Umesh Kulshrestha. Vote of thanks was extended by Mr. Piyush Kumar Verma, Research Scholar and YoHo Leader, SES, JNU. E-certificates were distributed to all the participants.
International Biodiversity Day

On the occasion of the International Biodiversity Day, on 22nd May 2020, JNU ENVIS Resource Partner, School of Environmental Sciences organised an online Webinar. Theme of the webinar was ‘Our Solutions are in Nature’. Time duration of the webinar was two hours (Fig.1).
### Webinar Theme: ‘Our Solutions are in Nature’

**Date:** 22nd May, 2020  
**Time:** 11am - 1pm

<table>
<thead>
<tr>
<th>Speakers</th>
<th>Time</th>
</tr>
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</table>
| **Inaugural Address by**  
Prof. U.C. Kulshrestha, Moderator  
ENVIS Coordinator/Dean, SES, JNU | 11:05 - 11:15 AM |
| **Dr. CBS Dutt**  
Former Scientist, NRSC/ISRO | 11:15 - 11:30 AM |
| **Prof. Brij Gopal**  
(Retd.) SES JNU, Centre for  
Inland Waters in South Asia | 11:30 - 11:45 AM |
| **Dr. Anup Chandra**  
Scientist – E, Forest Research Institute | 11:45 AM - 12:00 PM |
| **Prof. P.K. Joshi**  
SES, JNU | 12:00 - 12:15 PM |
| **Dr. Usha Mina**  
ENVIS Co-Coordinator, SES, JNU | 12:15 - 12:30 PM |
| **Questions from Audience** | 12:30 - 12:45 PM |
| **Concluding Remarks**  
Prof. U.C. Kulshrestha | 12:45 - 12:55 PM |
| **Vote of thanks by Swati Singh**  
Programme Officer, JNU ENVIS RP | 12:55 – 1:00 PM |

*Organized by:*
JNU ENVIS Resource Partner on Geodiversity & Impact on Environment  
School of Environmental Sciences, Jawaharlal Nehru University, New Delhi

**Figure 1:** Poster and programme schedule circulated online of Webinar on International Biodiversity Day
Panelists included experts and professionals working in the field of Biodiversity. It was attended by more than 200 participants, through Webex platform and Facebook live broadcast. Participants were from different parts of the country and included university students, researchers, faculty members and professionals.

Webinar was moderated by Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU (Fig.2). He initiated the panel discussion by highlighting the importance of holistic development. He gave an example of holistic aspect of Lake Concept and how it can solve the problem of air pollution in Delhi NCR. He called upon the young generation to work on holistic development. He said lockdown has given us a new normal which should be maintained. He also thanked and congratulated participants for showing such a big response. He invited next panellist Prof. Brij Gopal to share his views on the topic.

Prof. Brij Gopal, Retd. Prof. SES JNU, & Head Centre for Inland Waters in South Asia (Fig.3). He started his discussion by raising a question about Biodiversity and a solution to nature. First of all we should understand the meaning of nature and forest. He reiterated No Forest means No Nature and said it is told that forest cover has increased, but in reality forests are declining as more and more projects get environmental clearances. Nature is not just growing few trees. For a solution, revert back to nature and review it.
Dr. CBS Dutt, Former Scientist NRSC/ISRO – Introduced the concept of species diversity, also talked about alpha & beta diversity (Fig.4). He discussed the effect of fragmentation on biodiversity and how the fragmentation matrix helps to understand biodiversity loss. Role of ISRO in study of Indian Biodiversity and development of Geo-spatial data was discussed in detail. EIA and Biodiversity studies were also put forward, science of manifestation due to pollution, various types of pollutants were discussed in his talk. In end he talked about contemporary challenges and new phylogenetic arrangement in plant taxonomy of Indian plants.

Dr. Anup Chandra, Scientist E, FRI – Highlighted importance of biodiversity, said we cannot sustain without biodiversity (Fig.5). World knows only about 1.7% of total biodiversity. He said wild relatives of species are important for biodiversity conservation, also discussed about medicinal plants, timber, urban forestry and how we are totally dependent for these on nature. In India we have 23% area as forest, 16 major types and 216 sub-types of forest, 4 hotspots, biosphere reserves and national parks for conservation. He ended his discussion by focusing on threats to biodiversity, like anthropogenic pressure, dam construction etc.
Prof. P. K. Joshi, SES, JNU – He talked about biodiversity loss and said 80% of wild mammals and half of the plants have been lost. It is time for “Radical-rebooting of Humanity’s Relationship with Nature” (Fig.6). Mentioned about the history of biodiversity science and said it is relatively new science which started in 1985. He also mentioned about World Economic Forum’s Global Risk survey where Biodiversity Loss and Ecosystem Collapse is among top five risks which will impact life in the coming 10 years. The way the world is treating biodiversity soon we will see more pandemics. He said nature based solutions are important for sustainable development, Goal 5, 10, 16 are related to biodiversity. 30% of Indian population directly drives its livelihood from Biodiversity and another 30% population is indirectly dependent on biodiversity. 50% of world GDP is directly dependent on nature, thus we see clear cut dependency on nature. Today atleast 75% land and 66% marine species are facing danger of extinction.

Then he talked about how G7 promoted Environment conservation by signing the Fashion Pact. He ended his discussion with the fourth industrial revolution is need of the hour where net positive for nature is ensured.

Dr. Usha Mina, ENVIS Co-coordinator & Associate Professor, SES, JNU – She initiated her discussion with proper definition for nature is required. Immunity for Covid-19 and we are looking for a solution in nature (Fig.7). Highlighted importance of conserving nature. She also talked about large-scale destruction of nature and biodiversity in Sunderbans due to cyclone Amphan.
She said disturbing nature beyond a limit can be disturbing, we are close to losing millions of species, the rate of biodiversity loss is unprecedented. It is time to reduce the negative environmental effect, and prevent loss of indigenous people. Talked about five pillars of biodiversity and three global agricultural heritage system in India, like Kora puda (various paddy and pulse spp.) in Odisha, in Kashmir (for saffron cultivation) and Kuttanad farming in Karnataka (rice cultivation under water below sea level).

Concluding remarks and vote of thanks were extended by Prof. Umesh Kulshrestha. Participants shared their views and comments about the webinar. Last but not the least e-certiﬁcates were distributed to all the participants.

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World Environment Day, 2020

The School of Environmental Sciences celebrated World Environment Day, 5th June 2020. On this occasion, a webinar was organized on the theme ‘Time for Nature’ in collaboration with JNU-ENVIS Resource Partner. Time duration of the webinar was two hours. Panelists included international experts and professionals working in the field of Environment. These were- 1). Professor Peringe Grennfelt, Former scientific director at IVL Swedish Environmental Research Institute and adjunct professor at Gothenburg university, Member of the Royal Academy of Agriculture and Forestry in Sweden, 2). Dr Sharath K Pallerla, Director, Ministry of Environment and Forest and Climate Change, New Delhi, 3). Dr Sunita Narain, CEO, Center for Science and Education (India), 4). Prof S R Wate, Former Director, CSIR-NEERI, Ngapur and former Chairman, CSIR-RAB, India, 5). Prof N H Lin, National Central University, Taoyuan, Taiwan, 6). Dr Ilora Ghosh, Associate Professor (Toxicology), SES, JNU. Professor Umesh Kulshrestha, Dean and ENVIS-Coordinator moderated the panel discussion. The activities of a new student outreach programme called Young Holistics (YoHo) were presented. The YoHo program also helps the students in their all-round development. There are around 30 activities of the YoHo program. The Leads of three activities had organized their events which were described by each Lead during the celebration. It was attended by more than 650 participants, through Webex platform and Facebook live broadcast. Also, the participants were from different parts of the country and included university students, researchers, faculty members and professionals.
World Environment Day 2020: Time for Nature

Date: 5th June 2020 | Time: 1200 - 1400 IST

Webinar Theme: Time for Nature

Organized by:
JNU ENVIS Resource Partner on Geodiversity & Impact on Environment
School of Environmental Sciences, Jawaharlal Nehru University, New Delhi
Ministry of Environment, Forest & Climate Change, Govt. of India, New Delhi

Registration link:
https://docs.google.com/forms/d/e/1FAIpQLScl-eE8oHzXGjvY8KrnKdC92MFWxhzjbCbfLWLCB4Hi6KLJ-Q/viewform/viewform
e-certificate will be provided to participants

Prof. Perringe Grennfelt
Member Royal Academy of Agriculture & Forestry, Sweden

Dr. Sharath K. Pallerla
Director (Policy), MoEF&CC Govt. of India

Dr. Sunita Narain
CSE, India

Dr. Satish Wate
Former Director, CSIR-NEERI & Chairman, CSIR-RAB

Prof N H Lin
National Central University, Taoyuan, Taiwan

Prof. Umesh Kulshrestha
Dean & ENVIS Coordinator SES, JNU

Dr. Ilora Ghosh
Associate Professor (Toxicology) SES, JNU

Swati Singh
PD, JNU-ENVIS

YoHo Leads

Yogender Singh
Ankita Katoh
Ankita Singh

Jnu-envis@nic.in
jnuessenvis@gmail.com
www.facebook.com/jnuenvis
@JnuEnvis

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Figure 1: Poster and schedule of the Webinar widely circulated on social media platform
Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU - He welcomed all the eminent speakers and the participants. Gave a brief introduction of all the speakers. Highlighted the importance of the World Environment Day and this year’s theme ‘Time for Nature’. He then invited first speaker Prof. Peringe Greenfelt to deliver his talk.

Figure 2: Prof. Umesh Kulshrestha, Dean & ENVIS Coordinator, SES, JNU

Prof. Peringe Grennfelt, Member Royal Academy of Agriculture & Forestry, Sweden- He talked about ‘Today’s Environmental Problems in a historical perspective: Air Pollution’. Discussed about air pollution problem in chronological manner from 1970’s onwards and major air pollution events around the world were highlighted. He established the importance of history in connection with today's environmental problems. Professor Grennfelt advocated the importance of science supported policy decisions and shared his experience about long range transport of pollution and the LRTAP. His lecture very well provided the linkages of environmental problem with Sustainable Development Goals.

Figure 3: Prof. Peringe Grennfelt, Member Royal Academy of Agriculture & Forestry, Sweden
Dr. Sharath K. Palleria, Director (Policy), MoEF&CC, Govt. Of India - He commenced his talk by saying “Let’s nurture the nature so that we can have a better future.” Discussed Indian Biodiversity, 7-8% of globally recorded species and four biodiversity hot spots found in India. Over 47,000 species of plants and 100,000 species of animal have been recorded. India has divided into ten bio-geographic zones based on which conservation planning is been taken up. Talked about various national reports and various legal instruments for conservation and sustainable use.

Dr. Sunita Narain, Center for Science and Environment, India- Commenced her discussion by asking how do we protect our environment. Discussed various burning environmental issues like increased frequency and rapidification of cyclones due to change in temperature of earth and sea. Dr Sunita talked about extreme rain events, locust attack, how low economic groups are becoming victims of climate change. She said we want clean air to breath as well as economic development. Green stimulus for public transport, green combustion. She put emphasis on `the conservation has to move towards a green economy and in the hands of local governance especially in rural areas.

Dr. Satish Wate, Former Director, CSIR-NEERI & Chairman, CSIR-RAB- He said that if you protect nature, nature will protect you. He highlighted that we depend on the environment for air, water, soil, food, minerals etc. He discussed about five the components of environment. Prof Wate talked about recent chemical factory accidents and how severally they impact our environment. He said we should become sensitive to environment, in order to properly understand it. He advocated for risks assessment exercise very similar to the impact
assessment. He also highlighted the need of mitigation steps and preparation of management plans.

**Figure 6:** Dr. Satish Wate, Former Director, CSIR-NEERI & Chairman, CSIR-RAB

**Prof. N H Lin, National Central University, Taoyuan, Taiwan** - Discussed about his SEAS project which started in 2007. This project investigates the impacts of aerosol particles on weather and the total SE Asian environment. Prof Lin talked about Biomass-burning haze in South-East Asia and shared case study of Chrang Mai in northern SEA. He concluded by sharing outcome of the project, some of the outcomes are international agreements and successful coordinated actions.

**Figure 7:** Prof. N H Lin, National Central University, Taoyuan, Taiwan

**Dr. Ilora Ghosh, Associate Professor (Toxicology), SES, JNU** - She focused that understanding the environment should be our motto. Protecting environment to reduce further pandemic risks. She discussed in detail about Coronavirus Disease 2019 by SARS-CoV-2. Introduced the participants to common signs of infections, myths and truths about coronavirus. She discussed major causes of this devastating pandemic. She talked about mutants of coronavirus, how repeatedly and independently they mutate. Dr Ilora explained the toxicity in Coronavirus patients and how higher dosages of medication can lead to renal failure. She concluded that environmental should be protected and environmental problems like Climate change should be addressed if we want to protect ourself from any further pandemics.
World Environment Day: Time for Nature

Young Holistic (YoHo) Leaders; Mr. Yogender Singh, Ms. Ankita Katoch and Ms. Ankita Singh - They updated about the various activities for Environment Day Celebrations like Poetry, Quiz and Summary writing competition conducted by their respective groups. Results of these competitions were also declared.

Vote of Thanks was extended by Ms. Swati Singh, Programme Officer, JNU ENVIS RP. She also appraised about the various online competitions like Poster Making, Photography and Painting conducted by JNU ENVIS RP to celebrate World Environment Day. Results of these competitions were also announced.

Session came to an end with distribution of e-certificate to all the participants. Very positive feedback was received from the participants.
One Day Yoga Workshop on INTERNATIONAL YOGA DAY 21st June, 2020

The YoHo Yoga Club of School of Environmental Sciences, JNU organised a ONE-DAY YOGA WORKSHOP on International Yoga Day on 21st June 2020 from 9:00 am to 10:30 am. The workshop started with the words of wisdom shared by Prof. Umesh Kulshrestha, Dean, School of Environmental Sciences, J.N.U. Mrs. Kopal Verma, Lead of YoHo Yoga, a certified trainer from the Art of Living Organisation, carried the Yoga workshop forward. The workshop started with a basic introduction of Yoga, Pranayama and Dhyana and their implementation in day-to-day lives, practical demonstration of Sukshama Vyayama, Surya Namaskar, various asanas, Kapalbhati and Bhashrika Pranayama. Then, this workshop was followed by a guided meditation. A total of 23 people from different walks of life joined the session. They enjoyed the session fully and were greatly benefitted. A few people shared their experiences as very enjoyable, useful, informative and excellent. Feedback forms were filled by the participants and they are looking forward to attending similar sessions in future. The session was concluded by Prof. Umesh Kulshrestha sir, Dean, School of Environmental Sciences, J.N.U.

Few snippets from the session:

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Poster, Painting & Photography Competitions

Theme: Time for Nature

Results

Photography Competition
Total number of entries received: Forty seven (47).
Winners

<table>
<thead>
<tr>
<th>Position</th>
<th>Winner</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Position</td>
<td>Shefali Chauhan</td>
</tr>
<tr>
<td>Second Position</td>
<td>Mohit Phulara</td>
</tr>
<tr>
<td>Third Position</td>
<td>Pavin Krishnamoorty</td>
</tr>
</tbody>
</table>

Painting Competition
Total number of entries received: Thirty four (34)
Winners for Junior School Group

<table>
<thead>
<tr>
<th>Position</th>
<th>Winner</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Position</td>
<td>Divyadharshini B.</td>
</tr>
<tr>
<td>Second Position</td>
<td>Kanishka Singh</td>
</tr>
<tr>
<td>Third Position</td>
<td>Dhruvika Gulia</td>
</tr>
</tbody>
</table>

Winners for Senior School Group

<table>
<thead>
<tr>
<th>Position</th>
<th>Winner</th>
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<tbody>
<tr>
<td>First Position</td>
<td>Nitesh Thamir</td>
</tr>
<tr>
<td>Second Position</td>
<td>Khushboo Mourya</td>
</tr>
<tr>
<td>Third Position</td>
<td>Sambit Chandra</td>
</tr>
</tbody>
</table>

Winners for College/Employed Group

<table>
<thead>
<tr>
<th>Position</th>
<th>Winner</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Position</td>
<td>Premsee Chandak</td>
</tr>
<tr>
<td>Second Position</td>
<td>Deepti Singh</td>
</tr>
<tr>
<td>Third Position</td>
<td>Yashraj Chandak</td>
</tr>
</tbody>
</table>

Poster Competition
Total number of entries received: Seven (7).
Winners

<table>
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<tr>
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<tbody>
<tr>
<td>First Position</td>
<td>Shilpa Rawat</td>
</tr>
<tr>
<td>Second Position</td>
<td>Snehasish Ghosh</td>
</tr>
<tr>
<td>Third Position</td>
<td>Sibtain Kadri</td>
</tr>
</tbody>
</table>
WORLD ENVIRONMENT DAY
PHOTOGRAPH COMPETITION 2020

Shefali Chauhan
1st Position

Mohit Phulara
2nd Position

Pavin Krishnamoorty
3rd Position
WORLD ENVIRONMENT DAY
PAINTING COMPETITION 2020

Divyadharshini B.
First Position

Kanishka Singh
Second Position

Dhruvika Gulia
Third Position

Junior School Group

Nitesh Thamir
First Position

Khushboo Mourya
Second Position

Sambit Chandra
Third Position

Senior School Group

Premsee Chandak
First Position

Deepti Singh
Second Position

Yashraj Chandak
Third Position

College/Employed Group
WORLD ENVIRONMENT DAY
POSTER COMPETITION 2020

SAVE THE GREEN
LET THE EARTH SMILE

Snehasish Ghosh
2nd Position

Shilpa Rawat
1st Position

If you want Enjoyment,
Please save your Environment...

Sibtain Kadri
3rd Position

Taxonomic and ecological aspects of flora of Gurez valley in Kashmir Himalaya, India

World Environment Day

Nature does not need any invitation to be beautiful.

Please save Our Nature
कोरोना लॉकडाउन

लॉकडाउन के दरम्यान
मोबाइल व इंटरनेट ने
समझा दिया जीवन का रहस्य
कि इस थमी सी जिंदगी की
रफ्तार कहीं ज्यादा है

पहुंचा दिया बचपन में
वो सब आने लगा मन में
जब गर्मियों की कुटियों में
खूब खपत करने के बाबजूद
खूब वक़्त था अपनों से बाँटने को

जब घूमते थे बाहर
kिसी को इतता नहीं थी
अब, घर बैठे हो रही
ट्रेकिंग मोबाइल से

पर मन बसी वो भाग दौड़
फांय फांय घर में भी कराती है
कभी बालकनी की चाह तो
कभी किचन में घुसाती है

लगता है घर पे सबकी व्यस्तता
शत प्रतिशत हो गयी है
अभी व्यस्त हैं बाद में फोन करिये
सुनसुनकर मुसीबत हो गयी है

'कोरोना' की सीख, कि तुम रुबरु होना
केवल दूर के संचार से
ना गले मिलना, न मिलाना हाथ
बस, नमस्ते बचाये बुखार से

: उमेश कुलश्रेष्ठ 'चंद्र'
COVID-19

मानव जनित परिस्थितियों से कुदरत भी नाराज हुई
हवा तब साफ हुई
जब मास्क लग गए

शहरों को बसाने में लग गया
जब होमो सेपियंस
कुदरत ने किया इन्डोर
पूरा मानवीय वंश

पँची को रखा था पिंजरे में
फिर दया कर छोड़ दिया
खिड़की से देखा सामने कल
तो बैठा हंस रहा मुझ पर

ई सर्विंग्स ने फीका कर दिया था
हाथ धोके पीछे पड़ना
पर कोविड ने सिखाया पुनः
हाथ धोने के पीछे पड़ना

अरसे से नहीं मुनी थी चिड़ियाँ की चहक
न देखा था उजला आसमां
इन नज़ारों से लगा कि
घर में बैठे, तब बस्ती आबाद हुई

: उमेश कुलश्रेष्ठ "चंद्र"
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School of Environmental Sciences
Jawaharlal Nehru University
New Delhi – 110 067

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