

ENVIRONMENTAL IMPLICATIONS OF COVID-19: WHAT DOES IT MEAN FOR UTTAR PRADESH?

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ABSTRACT

A number of interesting theories have emerged regarding the implications of pandemic Covid-19 on the world in terms of pollution, health statistics, economic cost etc. The healthcare sectors of even advanced and rich countries are completely puzzled over the causes, effects and treatment of this mysterious disease. The other side of Covid-19 is that the lockdown imposed during the first wave of Covid-19 had halted the industrial, transportation and other such economic activities which had influenced environmental indicators also. The present study assesses the impact of lockdown on purifying environment in Uttar Pradesh, which is the most populated state in India. The study found that there has been a reduction in the pollutant levels in most of the cities of Uttar Pradesh during lockdown period, thereby, improving environmental quality. Major reduction was observed mainly in $PM_{2.5}$ and PM_{10} .

KEY WORDS : COVID-19, Uttar Pradesh, Environmental implication of COVID-19.

INTRODUCTION

The spread of novel coronavirus has led to global emergency creating a health crisis which is unprecedented in nature. This spurt of Covid-19 is probably the biggest health crisis which humankind are facing. It is so because in the past also world has experienced these types of pandemic but world was not so much integrated as it is nowadays which has accelerated the spread of this disease. The crisis has also worsened due to the rapid transmission rates which this disease carry. It has worsened to the extent that world's superpower (United States of America) is incapable to cope with Covid-19 pandemic. The rapid rate at which human to human transfer of this disease is taking place is dreadful thereby, sending an alarming signal for the healthcare industry throughout the world. In addition to this, Covid-19 pandemic has also alerted Nations to build up related infrastructure to cope with sudden spread of this and other similar diseases. Particularly for countries with negative population growth rate, Covid-19 pandemic poses a serious threat to their demographic dividend. This is

a crisis which will have a long-lasting impact particularly on the health industry. Surprisingly, this has also exposed the flaws and weaknesses in the healthcare infrastructure in USA, U.K, Italy, France etc. which is also supposed to possess one of the best healthcare facilities in the world. Post Covid-19 crisis, at least world need one decade to come back on the required socio-economic structure of their respective countries. The economic conditions of many countries have been badly affected by the unanticipated expenditures on healthcare industries as well as economic losses. Particularly, economically weak economies have experienced an unimaginable level of bump from this Covid-19 pandemic.

As is apparent, this Covid-19 has become a potential threat particularly for human health globally. The Covid-19 has undoubtedly become one of the most contentious disease in the world however, from environmental point of view Covid-19 seems to be blessings in disguise for the world. Owing to unprecedented lockdown due to Covid-19 pandemic, the environmental indicators have improved remarkably throughout the world.

Therefore, in this light, the present study investigates the effects of lockdown on the improvement of environmental indicators in the state of Uttar Pradesh, India. The study takes into consideration the pollutants namely-PM_{2.5}, PM₁₀, O₃, NO₂, SO₂, O₃. The period of study is from 23rd January to 31st May 2020 including all the four lockdown phases- 25th March to 14th April, 15th April to 3rd May, 4th May to 17 May and 18th May to 31st May. Our study is unique because as per our investigations, this is the first study to analyse the environmental consequences of Covid-19 pandemic in Uttar Pradesh.

The paper is divided into five sections. Section 2 deals with the review of literature, Section 3 provides the description about Covid-19 pandemic, Section 4 provides a detailed study of impact of imposition of lockdown on pollutant levels in selected cities of Uttar Pradesh while Section 5 concludes the study.

REVIEW OF LITERATURE

The study by Bashir (2020) revealed that the implementation of lockdown has led to reduction in the pollutant's levels of PM_{2.5}, PM₁₀, SO₂, NO₂ and CO in California. Their study suggested for a change in the environmental policies in order to have a control over the release of pollutants. Bontempi *et al.* (2020) have investigated the contagion dynamics in the light of Covid-19 diffusion. They asserted that fundamental factors have been largely ignored by most of the environmental studies based on Covid-19 pandemic. Cross national evidence on the causal impact of Covid-19 on air pollution have been investigated by Dang and Trinh (2020). The study found that lockdowns have helped in reducing air pollution globally.

Leal and Hernandiz (2020) investigated the correlation between the environmental indicators and number of confirmed Covid-19 cases near air quality monitoring stations in Victoria, Mexico. The study found a very strong association between the CO and Covid-19 cases. In addition to this a significant relationship is found between particulates matters and confirmed cases of Covid-19. The pollutants level have gone down during lockdown period. Kumari and Toshniwal (2020) have analysed the changes in the air quality by comparing the pre lockdown period with the lockdown period. A remarkable reduction in the PM_{2.5}, PM₁₀ and NO₂ have been detected in selected

major cities of Beijing, Bengaluru, Delhi, Lima, Mumbai, Rome and Wuhan in addition to a reduction in the concentration levels. Liu *et al.* (2020) have evaluated the impact of spread of Covid-19 on air quality and health of 597 major cities of 76 countries. Their study found varying responses of pollutants to restrictions imposed to counter Covid-19. However, an overall reduction in the pollutants have helped to improve the health statistics of these regions as well.

Lokhandwala and Gautam (2020) in their study asserted that lockdown have worldwide reduced the pollutants levels. This study confirms a reduction in the level of carbon emissions during lockdown in addition to improving the quality of rivers water. Mahato. The route to Covid-19 transmission was investigated by Noorimotlagh *et al.* (2020) which found air borne transmission in indoor air environment as the most dominant factor. Study suggested improved ventilation, interpersonal distance of more than 2 m, etc as an effective way to avoid the spread of SARS-CoV-2. Paital *et al.* (2020) viewed that lockdown has helped in bringing down the number of Covid-19 cases along with recuperating nature. Their study asserts that the implementation of lockdown has helped to bring down pollutants in the atmosphere specially CO₂ and NO₂. In addition to this, they have called for stringent lockdown measures to protect environment.

Shakil *et al.* (2020) found a significant relationship between purifying environment and Covid-19 pandemic. The authors on the basis of 57 studies conclude that restrictions implemented due to Covid-19 has led to the improvement in the environmental quality particularly in China, Italy, USA and Spain. Shehzad, Sarfraz and Shah (2020) also proves that Covid-19 have significantly improved air quality. A significant decline in Nitrogen Dioxide was found in Mumbai, Delhi and different regions of Gujarat. The study argued that lockdown is beneficial for environmental health. Siddique *et al.* (2020) asserted that SARS-CoV-2 followed by lockdown have led to unprecedented improvement in the air quality worldwide. The study also challenges the capability of the worldwide health infrastructure to deal with the Covid-19 pandemic. The authors viewed that relaxation of lockdown is linked with increasing air pollution.

A continuous decline in the PM_{2.5} and Air quality Index (AQI) have been found by Singh and

Chauhan (2020) in Delhi and Kolkata. They argued that a strict control on vehicular movements and industrial activities have helped in improving environmental quality in these two highly polluted cities in the world. The study by Wang and Su (2020) found an improvement in the air quality of China by a decline particularly in NO₂ in addition to a decline in carbon emissions. The authors asserted that quarantine helps in reducing environmental degradation.

Covid-19 Pandemic

This disease originated in the Wuhan city of China's Hubei province, on 29th December 2019 (Huang *et al.*, 2020; Zhou *et al.*, 2020; Zhu *et al.*, 2020; Acter *et al.*, 2020). It was formerly known as 2019 novel coronavirus (2019-nCoV) named by the World Health Organisation (WHO). However, due to its massive spread WHO designated 2019-nCoV as sixth Public Health Emergency of International Concern on 30th January (Wee *et al.*, 2020, WHO 2020, Acter *et al.*, 2020). The SARS CoV-2 has spread to almost all the countries of the world. The Covid-19 cases in India initially increased at a slow rate but in the month of March, the rapid increase in the number of confirmed cases had raised a warning signals for the government to take immediate steps to curb the rising cases by implementing nationwide lockdown from 25th March 2020. This timely imposition of lockdown has certainly played a significant role in receding the confirmed cases of Covid-19 pandemic thereby, saving lakhs of lives in the second most populated country of the world.

The first known case on the severe illness made by a CoV was reported in the year 2003, and it was named as "Severe Acute Respiratory Syndrome" (SARS) that lead to a severe epidemic in China (WHO, 2020). A second severe epidemic by a CoV was reported in the year 2012 in Saudi Arabia, and it was referred as the "Middle East Respiratory Syndrome" (MERS) (Chafekar and Fielding, 2018; WHO, 2020a; Yao *et al.*, 2020). Again, in December 2019, the third severe case by CoV was diagnosed first in China which is now a pandemic almost in entire world affecting 210 countries. The present CoV is found to be a mutated form (ID-19) of its earlier two forms and has been named SARS-CoV-2 or CoV-19 and the disease caused by it is therefore, named as COVID-19 (Paital *et al.*, 2020).

The name Covid-19 is formed from *Co* which stands for 'Corona', *Vi* stands for 'Virus' and *d* stands for the 'disease'. The first Covid-19 case was

related to seafood market in Hubei province, China and most initial cases were related to source infection from Hunan seafood wholesale market (Huang *et al.*, 2020, Chakraborty and Maity, 2020). In this market live animals are sold such as snake, bird, bat, frog, marmot and rabbit etc. According to the genomic analysis SARS Cov-2 is phylogenetically related to severe acute respiratory syndrome-like (SARS-like) bat viruses therefore, bats could be the possible primary source of transfer of viruses. Although intermediate source of origin and transfer to humans is not clearly known, however, it has been established that this virus has a rapid human to human spreading capability (Chakraborty and Maity, 2020). The first case of coronavirus outbreak in India was reported on 30 January 2020 in Kerala's Thrissur district when a student had returned home from Wuhan University in China (Rawat, 2020). The morbidity rate by the disease is found to be very high in elderly patients, and also in patients suffering with co-morbidity such as asthma, diabetes, cancer and cardiac diseases (Chu *et al.*, 2004; Dong *et al.*, 2020; Zhou *et al.*, 2020)

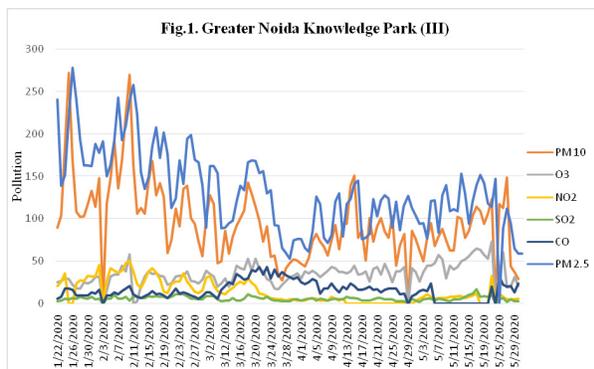
Researches have been carried out continuously to find the exact cure through trials at eminent institutes throughout the world with perplex suggestions as of now. The fact is well proved by the failure of the healthcare system of most developed and rich counties of the world such as USA, Italy, Spain and France etc in combating COVID-19 pandemic. These countries are found with high infection as well as high morbidity rates as compared to other countries of the world. However, regarding prevention and cure, many countries are making significant progress towards the development of vaccines, medicines etc including India.

Environmental Impact in Uttar Pradesh

The spread and impacts of COVID-19 resulted in a widely reported unprecedented improvement in air quality. Several ground and satellite observations have shown cleaner air in developed and developing countries (Newburger and Jeffery, 2020). The cleaner skies do show how fast and how far human efforts can bring down pollution collectively when the emission budget is reduced significantly. However, attaining sustainable clean air cannot be attained by the restrictive lockdowns at a higher socioeconomic cost. Shifting to cleaner and renewable energy and transportation is essential. Many evidences show that long- and short-term

changes in air quality have an immediate impact on underlying health conditions (heart attacks, strokes, and emergency room visits) (Apte *et al.*, 2018; Burnett *et al.*, 2018; Lim *et al.*, 2012). An improved air quality reduces other pressures on frontline healthcare facilities besieged with COVID-19 cases. COVID-19 has shown that global and collected societal efforts may indeed be able to reduce emissions substantially and sustainably to mitigate imminent climate change (Siddique *et al.*, 2020)

India implemented nationwide lockdown to control the Covid-19 outbreak by shutting down educational institutions, workplaces, industries, transport etc and urged people to stay home. Apart from controlling Covid-19 cases, it has also positively affected the environmental indicators in India. This lockdown led to an unexpected benefit in the country with six out of 10 of the world's most polluted cities possessing cleaner air. India accounts for the highest pollution-related deaths in the world with more than 2 million people every year, according to a December 2019 report by the Global Alliance of Health and Pollution. Approximately one million people died in 2015 due to ambient particulate matter (PM) pollution alone in India (Guo *et al.*, 2017). Indian cities have been always making into the top 20 most polluted cities of the world for the past few years and exceeding the ambient air quality standards recommended by the World Health Organization and Central Pollution Control Board (CPCB) (Mukherjee and Agrawal, 2018). Pictures of pristine clear waters of the Ganges, were enthusiastically shared on social media during lockdown. India's pollution monitoring body said the water had even become fit for bathing in some areas, according to real-time monitors placed along the 2,575-kilometer (1,600-mile)-long river. An analysis by the Delhi Pollution Control Board found that the quality of the Yamuna River flowing along New Delhi has also improved during the lockdown.



The report cited a decrease in runoffs from 28 industrial clusters and less trash (India Today, 2020).

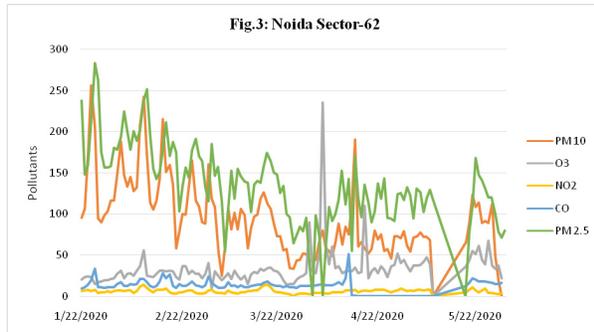
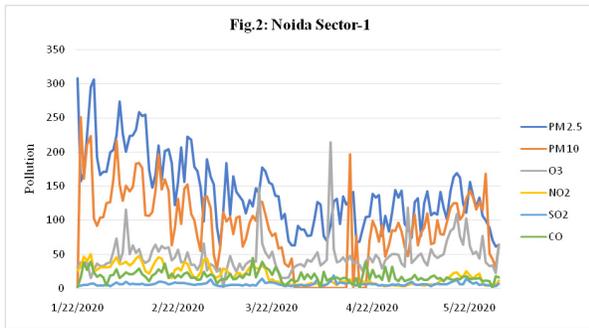
The present study is based on the performance of selected environmental indicators in Uttar Pradesh during lockdown period. This study finds a positive relationship between strict lockdown norms and improved environmental indicators. The imposition of lockdown in India from 25 March 2020 was the need of the hour as post 25 March 2020, world as well as India has witnessed a rapid surge in Covid-19 cases, however, the rate of increase in Covid-19 cases were low due to lockdown otherwise it would have been much higher in the absence of such strict restrictions.

The phase-wise pollution scenario of most polluted cities during lockdown period confirms the positive impact of lockdown on the improvement in environmental indicators of industrial cities of Uttar Pradesh.

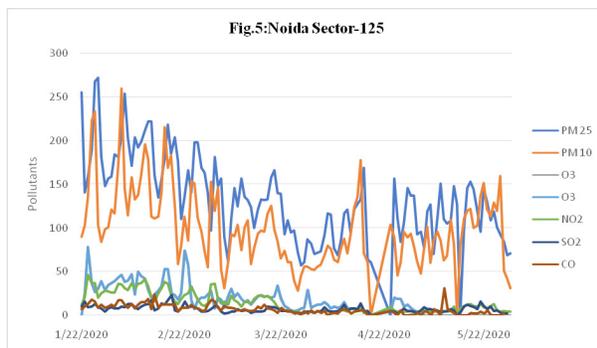
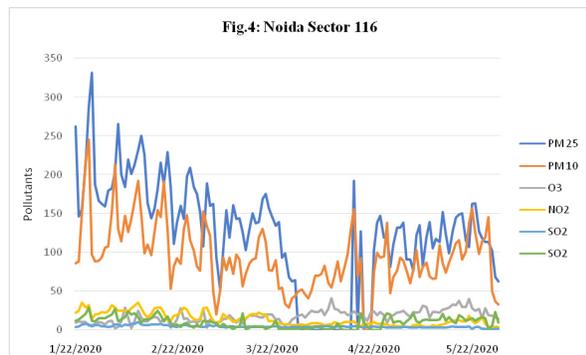
Greater Noida was created as an extension to Noida. It is an industrially developed city with many large industrial establishments. Greater Noida is managed by Greater Noida Industrial Development Authority (GNIDA) whose aim is to promote industrial progress of the region. It continues to attract economic activities which is observable from the level of industrial establishments in Greater Noida. It is 'observable' in Fig.1 that during the lockdown period environmental indicators significantly improved, bringing down the pollutants to low level. Particularly, $PM_{2.5}$ and PM_{10} reduced significantly in the second phase of lockdown.

Noida which is developed across Yamuna river, Noida Sectors have also witnessed a significant improvement in the environmental indicators during lockdown period in India. NOIDA stands for New Okhla Industrial Development Authority. It was developed as an extension of Delhi and is part of NCR (National Capital Region) which possess huge industrial establishments. Fig. 2,3,4,5 shows improvement in air quality particularly in the first phase of lockdown in Noida Sector-1, Noida Sector-62, Noida Sector-116 and Noida Sector-125 with significant fall in pollutants levels mainly $PM_{2.5}$ and PM_{10} during lockdown period.

Another hub of industrial establishment and centre of export is Kanpur which is traditionally known for its industrial establishments in India. It was popularly known as 'Manchester of India'. Its favourable location with easy access to two National Highways further provides an added opportunity to



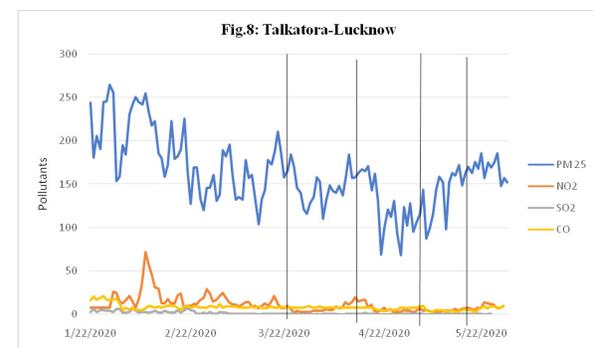
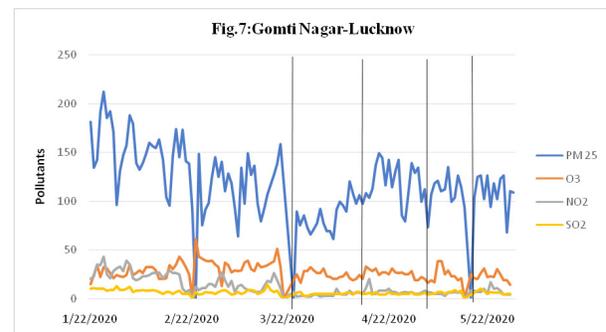
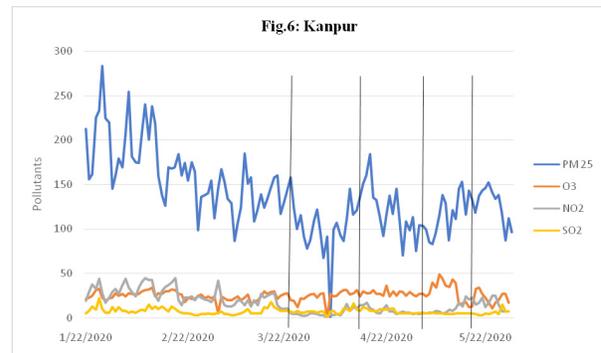
this city to foster industrial development both in terms of availability of raw materials as well as to the transportation of products to the markets. The industries mainly include- leather industries, plastic industries, textiles industries, woollen and jute textiles, fertilizers, metal ware, etc. Interestingly, Kanpur is also listed among one of the most polluted cities of the world. There is no denying the fact that



this lockdown turned out to be a blessing for the air quality of Kanpur which improved significantly. As Fig. 6 shows that all the pollutants particularly $PM_{2.5}$ have reduced significantly during lockdown period.

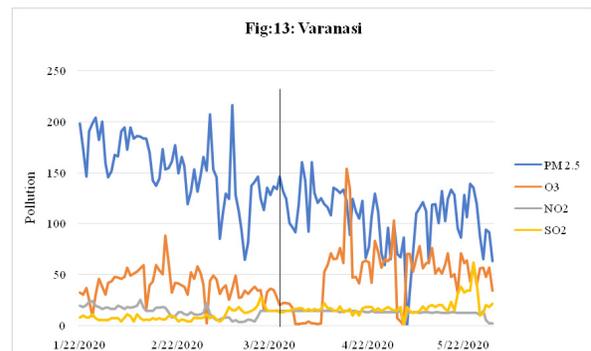
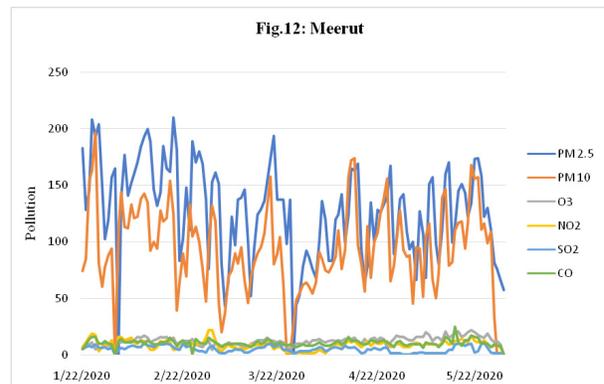
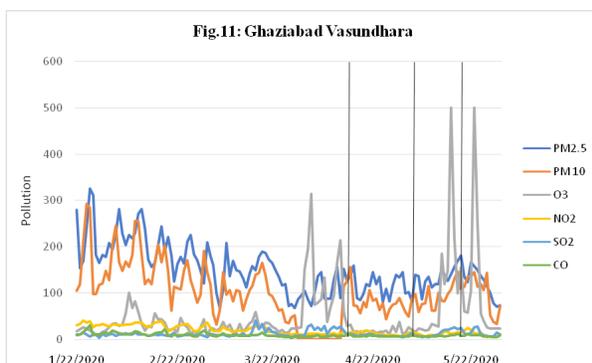
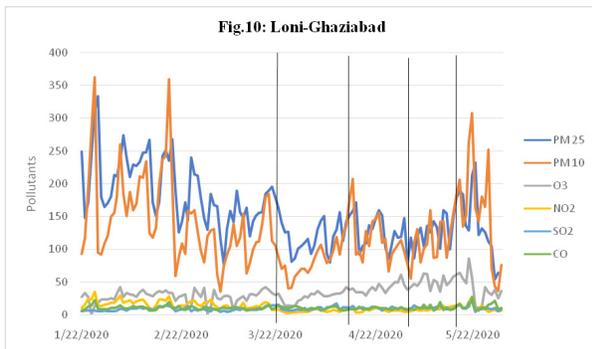
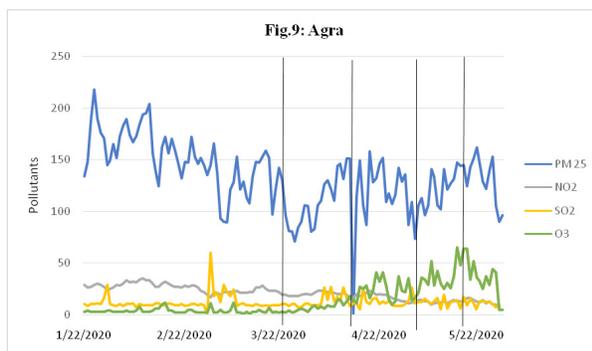
Lucknow is another significant centre of high revenue economic activities mainly related to Real Estate industries e.g Gomti Nagar. One of the most prominent trading places in Uttar Pradesh, Lucknow provides ample of opportunity to variety of industries to flourish. In addition to this, Lucknow is known for its traditional industries mainly *Chikan* work industries, Tobacco industries, Khadi products etc. Lucknow also witnessed a significant decline in $PM_{2.5}$ and NO_2 pollutants with maximum fall in the first phase in Gomti Nagar-Lucknow and second phase of lockdown period in Talkatora-Lucknow.

Agra is another key economic centre of Uttar Pradesh. Apart from tourism, Agra is home to



several other prominent industries namely- iron foundries, footwear industries, electrical industries and leather industries etc. Agra has been one of the worst sufferer of pollutant related repercussions e.g pollution of Yamuna river, effect on Taj Mahal etc which has attracted enormous debate. There has been a significant decline in the pollutant levels mainly $PM_{2.5}$ since the implementation of lockdown in Agra

Ghaziabad is home to several industrial establishments including tobacco industries, industrial machineries, electronic goods etc. A continuous fall in pollutants levels is noticeable in Ghaziabad-Loni (Fig.10) post the spread of Covid-19 since early March. However, the fall becomes more rapid during the lockdown period. In Ghaziabad-Vasundhara (Fig.11) mainly the second phase witnessed the lowest amount of pollutant levels.



Meerut possess another one of the largest industrial hubs of UP mainly producing sports goods, agro based products and musical instruments, etc. It is one of the largest producers of gold jewellery also. Its nearness to Delhi provides ample opportunity for a flourishing industrial establishment. The industrial hub in Meerut got a boost after this city was included in NCR. Meerut also experienced a clean environment during lockdown mainly in the first phase of lockdown (Fig.12).

Varanasi is one of the most popular places in the world. Varanasi is traditionally a very significant centre of economic activities mainly related to saree industries (Banarasi sarees), sculpture, metal manufacturing industries, fragrances, etc. Silk weaving is a dominant industry in Varanasi. The favourable impact of lockdown on improvement in air quality was observed in Varanasi also. Mainly the second phase of lockdown in Varanasi witnessed maximum reduction in pollutants levels particularly $PM_{2.5}$ (Fig.13)

CONCLUSION

The study explored the environmental aspects of Covid-19 in Uttar Pradesh by focussing on the relationship between reduction in pollutant levels with lockdown. The implementation of nationwide

lockdown from 25th March 2020 was very essential to control the rapid increase in the number of Covid-19 cases in the second most populated country like India. In addition to this, nationwide lockdown has helped in purifying environment also. The data reveals an improvement in the air quality as economic activities slowed down with a downward trend noticeable in pollutants namely PM_{2.5}, PM₁₀, O₃, NO₂, SO₂, O₃ in the selected cities of Uttar Pradesh. The most affected pollutants were PM_{2.5} and PM₁₀. This clearly depicts the perilous impacts of mainly industrial activities on the environment. Highest fall in the pollutants level have been mostly observed in the first and second phases of lockdown. However, depending upon the level of pollutants its effect on environmental quality will differ in intensity and even within country there can be significant variations.

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