



Air Quality Of Dhanbad During Pre-Lockdown, Lockdown And Post-Lockdown Periods

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Abstract : Air quality of Dhanbad has been studied for the period from April, 2019 to March, 2021 considering seven important pollutants. The analyses have been made using the data available on the website of central pollution control Board (CPCB). It is clear from the graphical representations and analyses that the first lockdown phase was better than second lockdown phase in the context of air quality of Dhanbad. Interestingly, CO was found to be 40% less in 2020-21 compared to that observed in 2019-20 which strongly supports impositions of proper regulatory restrictions in mining, industries and transportations also.

Index Terms: COVID 19, pollutants, air quality index, CPCB.

I. Introduction

It is now well known that the whole world has gone through stressful periods due to coronavirus disease i.e. COVID 19[1]. India also has witnessed the impact of COVID 19 from March, 2020 onwards. Because of this pandemic several restrictions have been imposed in different sectors for getting control over this infectious disease. Following the increased number of victims of this pandemic, first and second lockdown periods in different phases were observed in different months of 2020 and 2021. The restrictions were executed in the fields of domestic and international flights, trains, transportations other than medical and official emergencies, productions in various industries in uncontrolled manners and activities leading to ecological and environmental imbalance to reduce the bad influence of COVID 19. Such restrictions have influence on environmental issues like air quality, environmental pollutions, health problems, global warming and climate change. In this context, we have studied the air quality of Dhanbad (Jharkhand) for the periods from April, 2019 to March, 2021.

It is known that air quality of a particular area can be determined from the study of Air Quality Index (AQI)[2]. Central Pollution Control Board of India has proposed several regulations and guidelines for the calculation of Air Quality Index [3-4]. To access the air quality, seven pollutants (PM10, NO, NO₂, NH₃, SO₂, CO and O₃) are considered in the present study.

Dhanbad, well known as coal capital of India, is the second most populated city of Jharkhand after Jamshedpur. Activities related to large number of coal mines contribute to a large extent to the air pollution in Dhanbad [5]. SO₂, NO_x and Particulate Matter are the most important emissions during coal mining and these are the important factors for distressing the air quality of Dhanbad [6].

The objectives of the present study is to compare the atmospheric pollutant concentrations in Dhanbad during the pre-lockdown, lockdown and post lockdown periods. The assessment of impacts of lockdown on air quality is important to consider an alternative action plan for betterment of air quality of Dhanbad in coming years. This will also help to take necessary measures which may lead to better results in regard to industry and economic condition [7] as well.

The plan of the paper is as follows. Methodology for analysis of the data available for seven pollutants is given in section II. Graphical representations and analyses are presented in section III. Section IV contains conclusions of the present study.

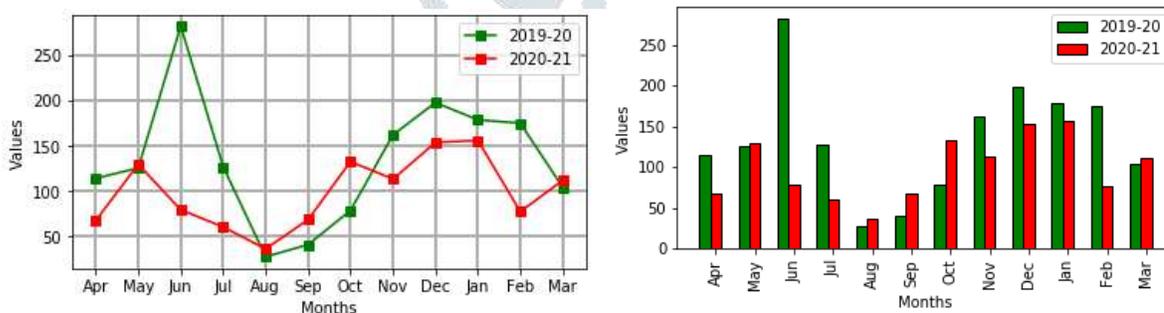
II. Methodology

The ambient air quality data have been collected for this work from Continuous Ambient Air Quality Monitoring Station (CAAQMS) [8] situated at Tata Stadium, Jorapokhar, Dhanbad, available in the website of Central Pollution Control Board (CPCB) for the seven major pollutants namely, Particulate matter with diameter < 10 μm (PM₁₀), Nitrogen Oxide (NO), Nitrogen Dioxide (NO₂), Ammonia (NH₃), Sulphur Dioxide (SO₂), Carbon Monoxide (CO) and Ozone (O₃). To analyze the air quality, data were taken for the period from April 2019 – March 2020 and April 2020 - March 2021. Mean for every month is calculated for each parameter and accordingly plots have been drawn. For convenience Bar diagrams have also been depicted to analyze the pollutants. For comparing the air quality during first and second lockdown periods in 2020 and 2021 respectively we have considered the values of the above mentioned seven pollutants from the same station. For this mean for every week and month is calculated for each parameter and accordingly plots have been drawn.

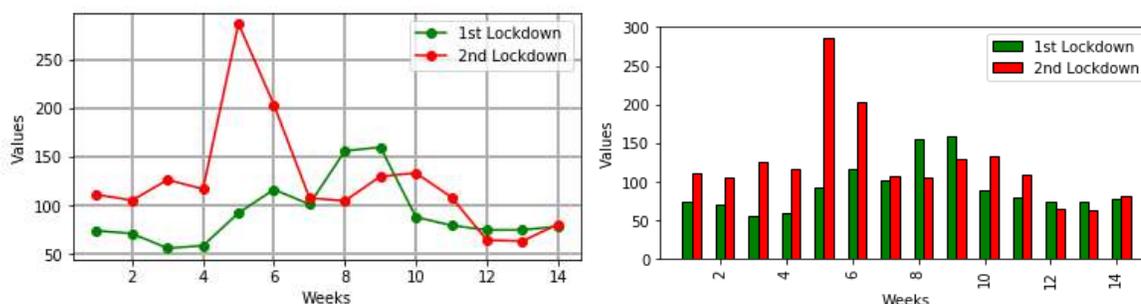
III. Graphical representations and Analyses

(i) PM₁₀

For comparison of PM₁₀ [9] during the above mentioned period the following graphs have been drawn.



Figs. 1(a) & 1(b) : PM₁₀ level :Year 2019 - 20 Vs Year 2020 – 21

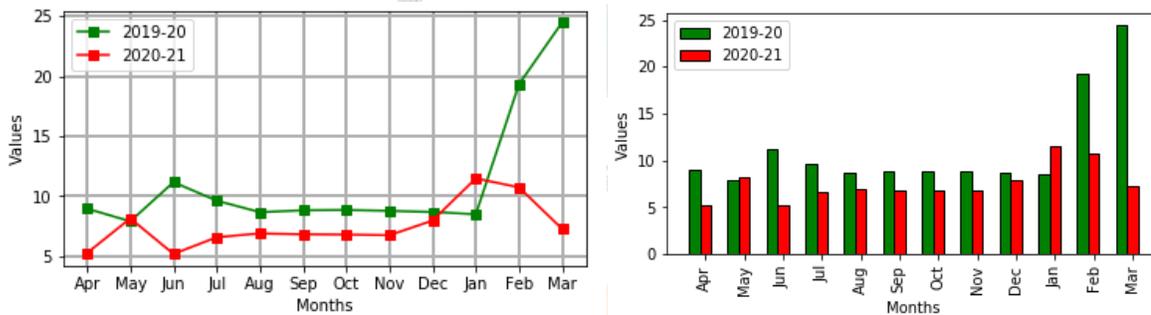


Figs. 2(a) & 2(b) : PM₁₀ level :1st Lockdown VS 2nd Lockdown

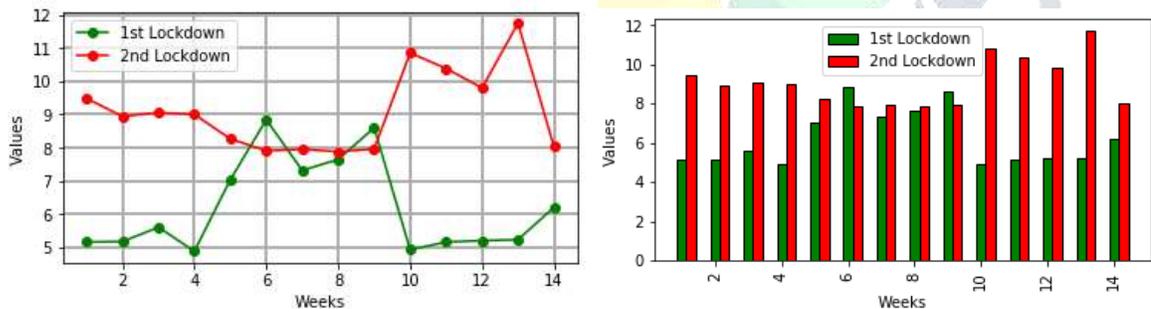
The comparison between monthly data of PM10 concentration in 2019-20 and 2020-21 shows a mixed trend. PM10 concentration was less in the year 2020-21 in compared to year 2019-20. The average value of PM10 concentration level in year 2019-20 is 30% more and 10% less in year 2020-21, than the standard specified by National Ambient Air Quality Standard (NAAQS) [10,11]. There was around 26% reduction in PM10 in the year 2020-21 in compared to 2019-20. The minimum concentration of PM10 level was in August 2020. This was owing to the fewer number of vehicles on the roads due to the circumstances obtained by COVID 19 pandemic and also little open cast coal mining work due to rainy season. And the maximum concentration of PM10 was in June 2019 which can be owed to the increasing temperature and dry conditions that increased the level of PM10 [12]. A significant reduction in weekly average values of PM10 can be observed in first lockdown period. But, there was a minor increase in the PM10 level between 7th to 9th weeks of first lockdown. Reduction in PM10 level was around 27% during the first lockdown period as compared to the second lockdown period. The weekly time series plot clearly shows that the PM10 concentration level in first lockdown is much better than second lockdown.

(ii) NO

The following graphs have been drawn for the above mentioned period to compare NO [13]:



Figs. 3(a) & 3(b) : NO level :Year 2019 - 20 Vs Year 2020 – 21

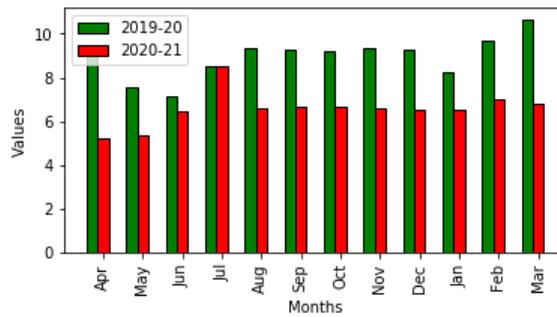
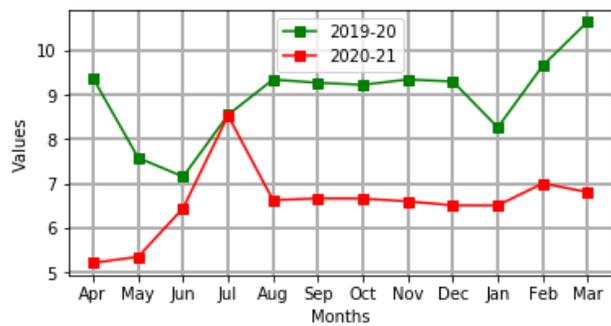


Figs. 4(a) & 4(b) : NO level :1st Lockdown VS 2nd Lockdown

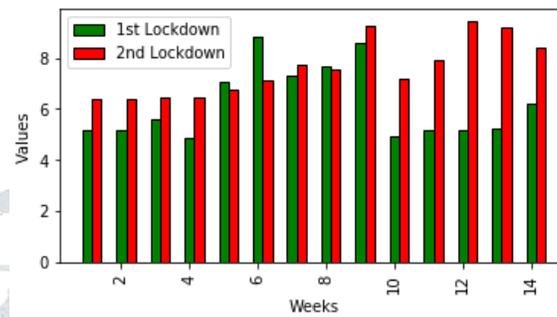
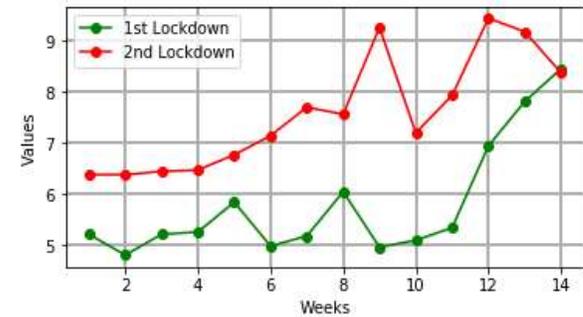
The concentration level of NO was comparatively less in the year 2020-21 than in 2019-20. There was around 32% reduction in NO in the year 2020-21 as compared to 2019-20. The minimum concentration of NO was in June 2020. And it is a well-known fact that the concentration of NO level gradually increases in winter especially December onwards due to more combustion of fuel, lubricant and coal used by street people and in slum areas. These are used to comfort and protect from cold in the season [14]. Reduction in weekly average values of NO can be seen in first lockdown period. But, there is an insignificant increase in the NO level in 6th and 9th week of first lockdown as compared to second lockdown periods. Increase in NO level was around 30% in second lockdown period compare to first lockdown period, which is not desirable.

(iii) NO₂

Comparison of NO₂ [15] was studied for the above mentioned period and the following graphs have been drawn.



Figs. 5(a) & 5(b) : NO₂ level :Year 2019 - 20 Vs Year 2020 – 21

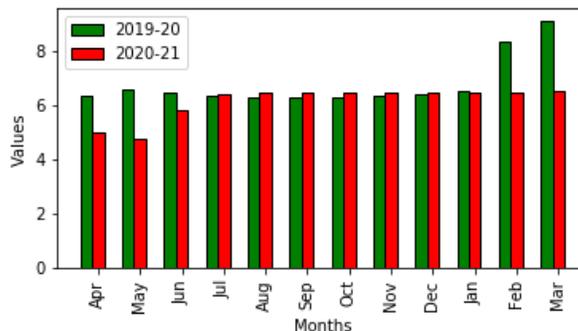
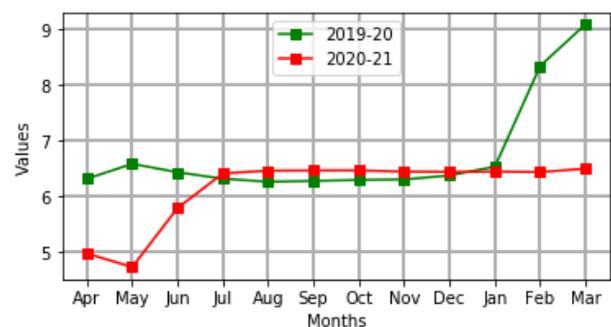


Figs. 6(a) & 6(b) : NO₂ level :1st Lockdown VS 2nd Lockdown

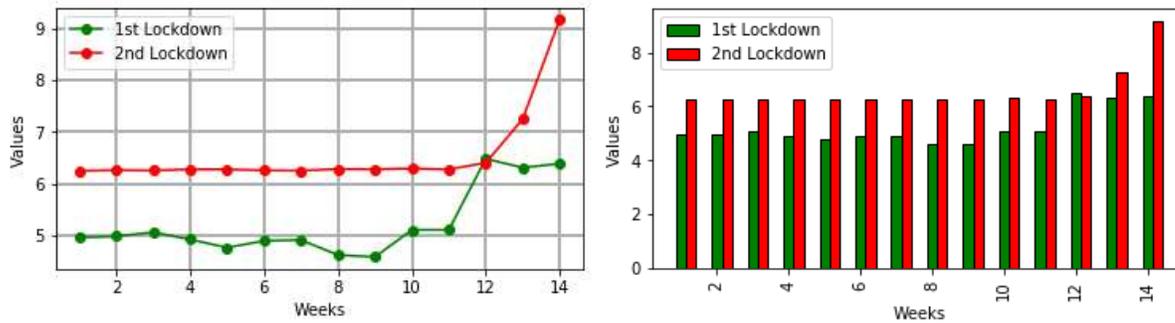
In year 2020-21 the concentration level of NO₂ was 26% which is somewhat less in compared with that of year 2019-20. Furthermore it is noticed that the concentration of NO₂ was minimum in April 2020. It is a recognized fact that the concentration of NO₂ level gradually decreases in summer season because of the less usage of combustion power plants and heating appliances used in factories and homes, also the road constructions and several other structural construction is reduced in summer season. But in lockdown period, the concentration of NO₂ level increases in summer season. The reason of increase of movement of vehicles was due to the relaxation in lockdown period, although the level of NO₂ is lesser than the mean value of previous year. Reduction in weekly average values of NO₂ can be seen in first lockdown throughout the lockdown period. There was around reduction of 23% in NO₂ levels during the first lockdown period as compared to the second lockdown period. The average value of NO₂ concentration level is 87% less in year 2019-20 and 93% less in year 2020-21. These levels are compared as per the standard specified by NAAQS. As per the weekly time series plot, the NO₂ concentration level during second lockdown period was significantly higher than first lockdown period.

(iv) NH₃

Comparative study of NH₃ [16] during the above mentioned period leads to the following graphs as shown below.



Figs. 7(a) & 7(b) : NH₃ level :Year 2019 - 20 Vs Year 2020 – 21

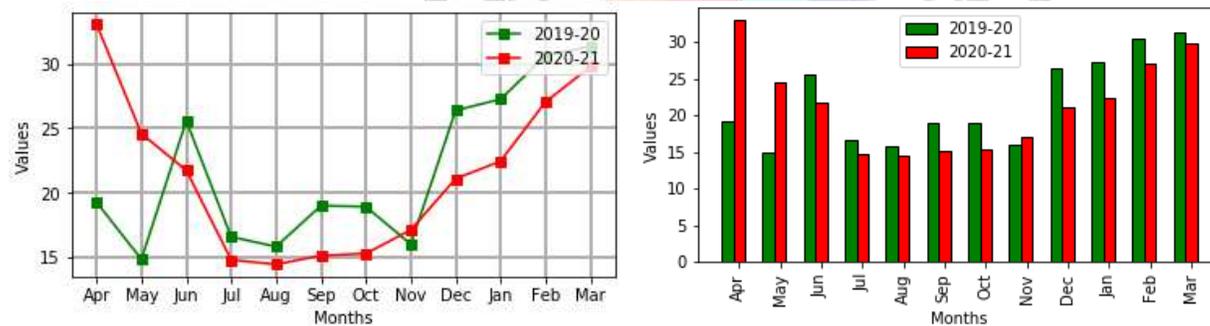


Figs. 8(a) & 8(b) : NH₃ level :1st Lockdown VS 2nd Lockdown

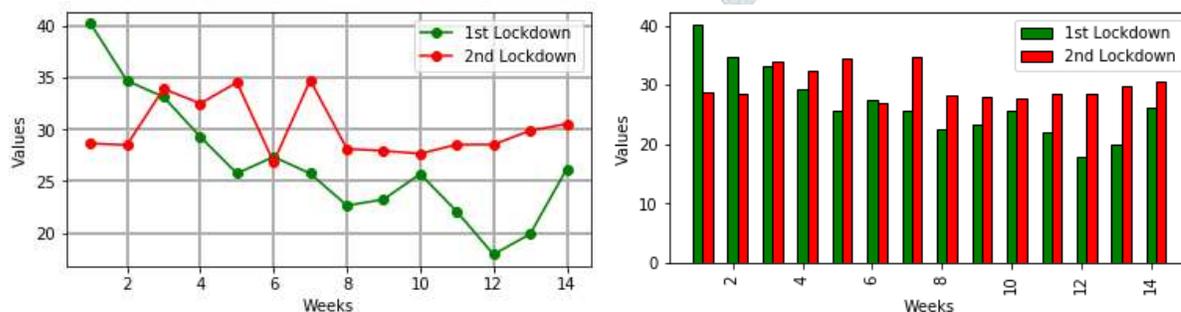
The concentration level of NH₃ was comparatively less in the year 2020-21 than in 2019-20. There was around 10% reduction in NH₃ in the year 2020-21 as compared to 2019-20. The minimum concentration of NH₃ was in April 2020 because of strict implementation of lockdown guidelines issued by the Disaster Management department of state. The major sources of emission of NH₃ are power plant, factories and agriculture. All factories and agricultural activities were completely closed during the lockdown period. NH₃ level was reduced by an amount around 20% during the first lockdown period as compared to the second lockdown period. The weekly time series plot clearly shows that the NH₃ concentration level in first lockdown was much better than second lockdown periods.

(v) SO₂

Comparison of SO₂ [17] during the above mentioned period gives rise to the following graphs as drawn below.



Figs. 9(a) & 9(b) : SO₂ level :Year 2019 - 20 Vs Year 2020 – 21



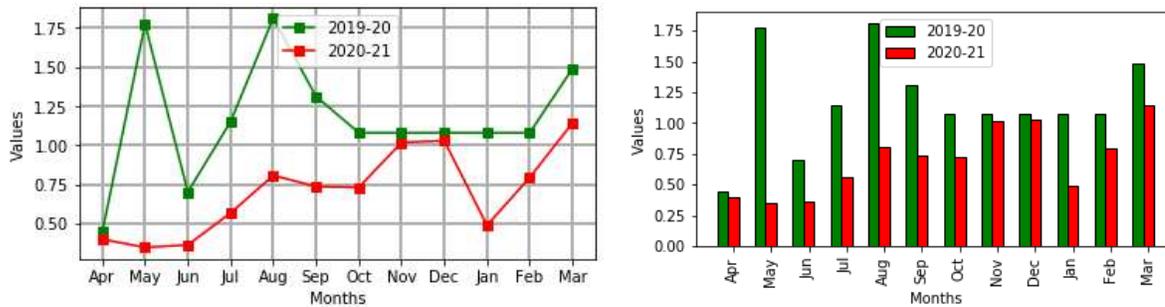
Figs. 10(a) & 10(b) : SO₂ level :1st Lockdown VS 2nd Lockdown

The concentration level of SO₂ was comparatively less in the year 2020-21 than that of 2019-20. There was around 2% reduction in SO₂ in the year 2020-21 as compared to that of 2019-20. The minimum concentration of SO₂ was in July 2020. The average value of SO₂ concentration level is 50% less in year 2019-20 and 53% less in the year 2020-21 in comparison with the standard values as specified by NAAQS. The less value of SO₂ in 2020-21 might

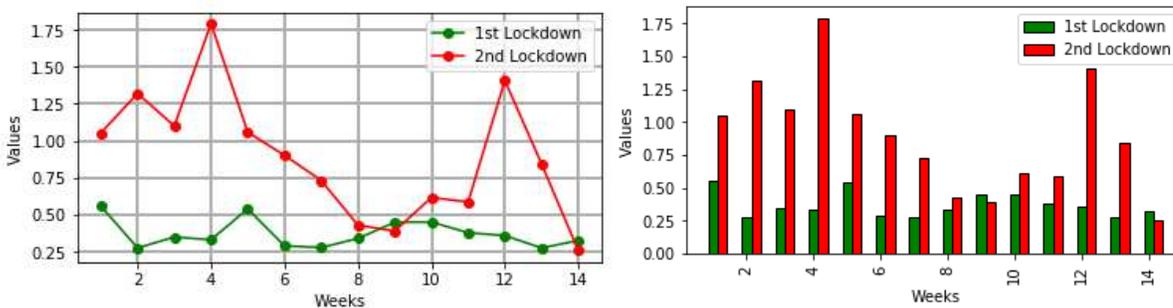
be due to less activities in chemical factories and industries due to strict implementations of lockdown rules. There was around reduction of 12% in SO₂ levels during the first lockdown period as compared to the second lockdown period. The weekly time series plot clearly shows that the SO₂ concentration level in first two weeks of first lockdown period was high because most of the industries were still working in full strength with the labours and afterwards SO₂ concentration level was much better than second lockdown period.

(vi) CO

We have plotted the graphs for comparing the data available [8] for CO [18] during the above mentioned period.



Figs. 11(a) & 11(b) : CO level :Year 2019 - 20 Vs Year 2020 – 21

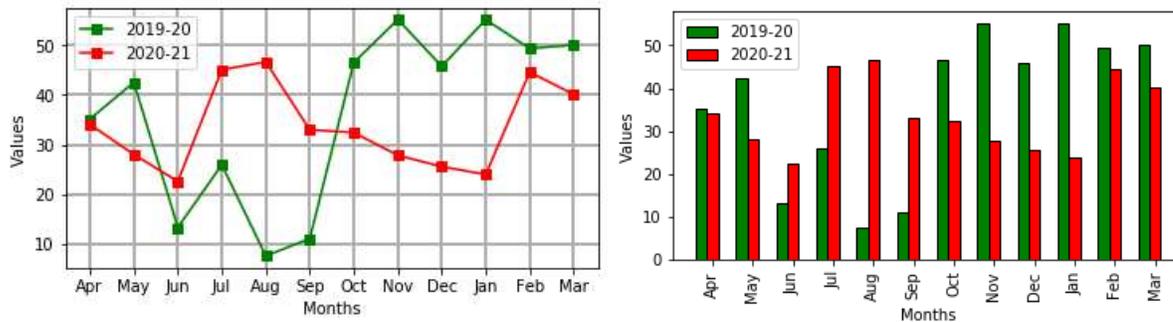
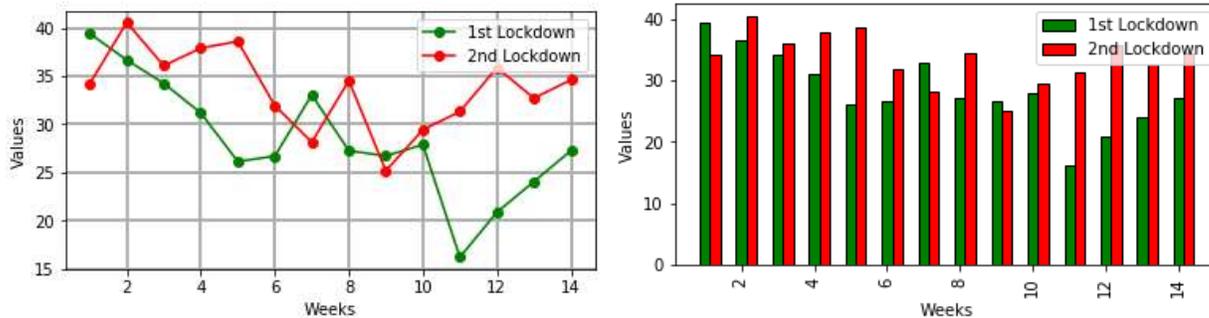


Figs. 12(a) & 12(b) : CO level :1st Lockdown VS 2nd Lockdown

The concentration level of CO was comparatively less in the year 2020-21 than that of 2019-20. There was around 40% reduction in CO in the year 2020-21 as compared to 2019-20. The minimum concentration of CO was in April 2020. The average value of CO concentration level is 63% less in year 2019-20 and 82% less in year 2020-21. The values of concentration levels were compared with the standard values specified by NAAQS. The major reduction in the concentration value of CO was due to complete lockdown in the first wave of COVID 19 and nearly complete lockdown in the second wave of COVID 19. Weekly time series plot exhibits better CO result in the first lockdown period compare to second lockdown periods except in the fourteenth week when unlocked phase fully started. Furthermore, reduction in CO level was around 58% during the first lockdown period than that in the second lockdown period.

(vii) O₃

Month wise and weekly time series plots for comparing the values of O₃ [19] as available [8] during the above mentioned periods are presented below.

Figs. 13(a) & 13(b) : O₃ level :Year 2019 - 20 Vs Year 2020 - 21Figs. 14(a) & 14(b) : O₃ level :1st Lockdown VS 2nd Lockdown

The concentration level of O₃ was comparatively less in the year 2020-21 than that of 2019-20 except for the months from June to September of 2020-21. There was around 7% reduction in O₃ in the year 2020-21 as compared to that of 2019-20. It is seen from the yearly time series plot that concentration levels of O₃ were minimum in August 2019 and June 2020. Temperatures of April and May were more in 2019-20 compare to that in 2020-21 leading to more concentration values of O₃ for these months whereas from June to September in 2020-21 the concentration levels of O₃ were high compared to that in 2019-20 because of decreased values of NO and NO₂ [20-21]. The weekly time series plot reveals reduction of 15% in O₃ levels during the first lockdown period as compared to the second lockdown period except the values obtained in the first and ninth weeks.

IV. Conclusions

From the yearly and weekly time series plots we can draw the following conclusions regarding air quality of Dhanbad for the periods 2019-20 and 2020-21 considering above mentioned seven pollutants. It is to be noted that although O₃ is beneficiary for the atmosphere but excessive concentration of O₃ will lead to thermal inequilibrium causing Global warming and its impacts in climate change. That is why O₃ is considered as pollutants in the present study.

- In general, concentration values of PM₁₀ were less (26% less) in 2020-21 compared to that obtained in 2019-20.
- The values of NO and NO₂ were decreased by 32% and 26%, respectively in 2020-21 compared to that available in 2019-20.
- In 2020-21, values of NH₃ and SO₂ were less by 10% and 3%, respectively from the values found in 2019-20.
- Remarkably, a deep fall (40%) in concentration of CO was observed in 2020-21 corresponding to the value provided in 2019-20.
- Interestingly, around 7% reduction in O₃ level was noticed in 2020-21.

Finally, it can be concluded that air quality of Dhanbad district in 2020-21 was better as compared to the air quality found in 2019-20. From the weekly time series plot it can be stated safely that in the first, sixth and ninth weeks of first and second lockdown periods the observations were not uniform for all pollutants. The reasons for the discrepancy were that the first week was the beginning of lockdown period and sixth and ninth weeks were the

gradual process of unlock phases. From the weekly time series plots, the first lockdown period could be identified as better phase of lockdown compared to second lockdown period because of rigid as well as strict restrictions imposed on industries, transportations, gatherings, constructions and social activities. Hence, we can conclude that all the above activities should be carried out in future maintaining proper restrictions and in a disciplined way so that a balance should be preserved between the activities and air quality of atmosphere.

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