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Pragmatic Study of Air pollution, COVID-19 and its impact on GDP in Indian Context using Data Analytics

– Namrata Agrawal*

Arun Jaitley National Institute of Financial Management (AJNIFM)

nagrawal@nifm.ac.in https://orcid.org/0000-0002-3903-625X

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ABSTRACT

Purpose: Air pollution is now considered to be the world's major global environmental health hazard, accounting for 7 million deaths around the world every year. Air pollution causes and exacerbates a number of diseases, ranging from asthma to cancer, pulmonary illnesses, heart disease, Covid. In accordance to recent estimates by the World Health Organization (WHO), exposure to air pollution and the main substances affecting health are: nitrogen oxides (NOx), sulphur oxides (SOx), ozone and particulate matter – especially particulate matter below 2.5 microns (PM2.5). The present study gives an overview of four Indian metro cities affected by air pollution and specifically due to RSPM (Respirable Suspended Particulate Matter) and its impact on spread of Covid-19 instances in the country.

Design/Methodology/Approach: The paper calls for adopting a multi-dimensional endeavour and data for 15 countries with the highest number of Covid-19 cases have been collected from WHO dashboard and the country portals. Country-wise, critical parameters (Cases - cumulative total, Cases - cumulative total per 1 million population, Deaths- cumulative total, Deaths - cumulative total per 1 million population) on Covid cases have been thoroughly studied and analysed. Further, statistics pertaining to air quality of four geographically significant metro cities (Delhi, Mumbai, Kolkata and Chennai) of India have been obtained from CPCB/online air quality information platform and data regarding Covid cases from Cowin portal of India. These statistics have been standardised, studied, processed and analysed using analytical tools and the results have been displayed in the form of charts to depict the loss to the human resources in these countries.

Findings: It is observed that there is no direct correlation evident between the PM-2.5 levels and number of daily confirmed Covid-19 cases. Though some studies have mentioned that the Covid-19 virus piggyback on PM2.5 particles and may enter the human beings through mouth and nose and thus aggravate the number of Covid-19 cases, but apart from PM-2.5 levels, there might be many other reasons which could have caused significant increase in Covid-19 cases in the country. Lastly, analytical findings/results and the resultant trends have been dealt exhaustively for premising suitable recommendations.

Originality/Value: Among list of most ten polluted cities in the world, nine cities of India fall in it (Ghaziabad, Bulandshahr, Bisrakh, Bhiwadi, Noida, Greater Noida, Kanpur, Lucknow and Delhi). Air quality in India has deteriorated significantly over the past two decades; today, air pollution is the second largest risk factor contributing to the country's disease chart. There are 132 cities in India that do not meet the national air quality standard for particulate matter. Delhi's PM2.5 pollution was at least 22 times higher in 2020 than the new WHO guideline- 2021. Covid-19 pandemic has highlighted the urgency to address India's chronic problem of air pollution.

Paper Type: View Point

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**Corresponding Author (Namrata)*

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Introduction

Air pollution is now considered to be the world's major global environmental health hazard, accounting for 7 million deaths around the world every year. Air pollution causes and exacerbates a number of diseases, ranging from asthma to cancer, pulmonary illnesses, heart disease, Covid. Outdoor air pollution and particulate matter, one of its major components, have been classified as carcinogenic to humans by the International Agency for Research on Cancer.

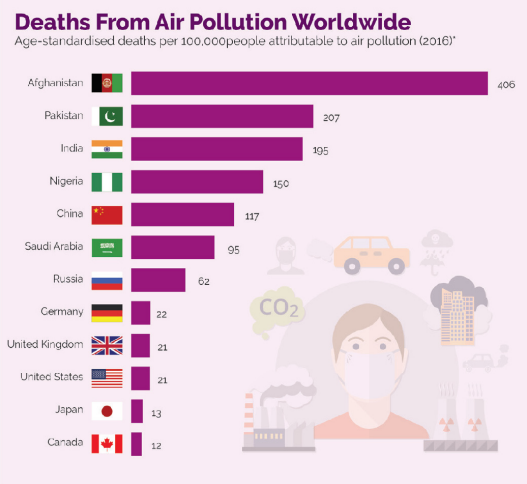

Fig. 1 Deaths from air pollution worldwide

In accordance to recent estimates by the World Health Organization (WHO), exposure to air pollution is one of the important risk factor for major non-communicable diseases than previously thought. Air pollution is the largest contributor to the burden of disease from the environment. The main substances affecting health are: nitrogen oxides (NOx), sulphur oxides (SOx), ozone and particulate matter – especially particulate matter below 2.5 microns ($PM_{2.5}$). The tiny particles penetrate deep into the lungs, affecting both the respiratory and vascular systems.

2021-WHO Air Quality Guidelines have tightened the air quality standards and has defined new thresholds for PM. The average 24-hour exposure to PM2.5 must remain below 15ug/m^3, down from 25ug/ m^3. In case of PM10 particles – typical dust particles – the safe threshold has been lowered from 50 to 45 ug/ m^3. In terms of exposure over a year long period, the threshold for PM2.5 has been brought down from 10 to 5ug/ m^3 and for PM10 from 20 to 15 ug/ m^3. In comparison, India's thresholds are many folds higher. According to the 2009 National Ambient Air Quality Standards still in force, the acceptable PM2.5 exposure limit over 24 hours is 60ug/ m^3 (four times the new WHO limit) and for exposure over a year- long period, 40ug/ m^3 (eight times the revised WHO threshold).

Epidemiological studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO_2. Reduced lung function growth is also linked to NO_2 at concentrations currently measured/ observed in cities of Europe and North America. Another pollutant, Sulphur Dioxide (SO_2) can affect the respiratory system and the functions of the lungs and causes irritation to the eyes. Inflammation of the respiratory tract causes coughing, mucus secretion, aggravation of asthma and chronic bronchitis and makes people more prone to infections of the respiratory tract. Hospital admissions for cardiac disease and mortality increase on days with higher SO_2 levels. When SO_2 combines with water, it forms sulfuric acid; this is the main component of acid rain which is a cause of deforestation. On the other hand, excessive ozone (O_3) in the air can have a marked effect on human health. It can cause breathing problems, trigger asthma, reduce lung function and cause lung diseases.

Air Pollution Levels in India

Air quality in India has deteriorated significantly over the past two decades. Today, air pollution is the second largest risk factor contributing to the country's disease chart. According to the data with the Environment Ministry, there are 132 cities in India that do not meet the national air quality standard for particulate matter. Central Pollution Control Board's National Air Quality Monitoring Programme (NAMP) data indicates that the annual average PM2.5 levels in Delhi last year ranged from 114-145ug/ m^3 in three stations considered by CPCB. Thus, Delhi's PM2.5 pollution was at least 22 times higher in 2020 than the new WHO Guideline-2021. NAMP data also indicates large parts of the Indo-Gangetic Plains region, including several cities in Uttar Pradesh, West Bengal, Punjab and Haryana had very high concentration of PM2.5 and PM10. Among list of most ten polluted cities in the world, nine cities of India fall in it (Ghaziabad, Bulandshahr, Bisrakh, Bhiwadi, Noida, Greater Noida, Kanpur, Lucknow and Delhi).

Several epidemiological studies (Pope, 1989; Schwartz, 1996) have linked PM_{10} (aerodynamic diameter ≤ 10 µm) and $PM_{2.5}$ (aerodynamic diameter ≤ 2.5µm) with significant health problems, including: premature mortality, chronic respiratory disease, emergency visits and hospital admissions, aggravated asthma, acute respiratory symptoms, and decrease in lung function. The State of Global Air (SOGA 2020) estimated that over 116,000 infants in India died within a month after their birth due to exposure to severe air pollution in 2019. The report by US based Health Effects Institute and Global Burden of Disease said that India had the highest burden of infant deaths due to air pollution followed by Nigeria (67,900), Pakistan (56,500), Ethopia (22,900), and the Democratic Republic of Congo (1,200) in 2019.

$PM_{2.5}$ is of specific concern because it contains a high proportion of various toxic metals and acids, and aerodynamically it can penetrate deeper into the respiratory tract. Air pollution affects individual health of citizens,

increases mortality and morbidity rates, and contributes to climate change. A 2018 report by the Health Effects Institute, projects a rise in annual deaths in India due to air pollution from 1.1 million in 2015 to 1.7 million in 2030.

An analysis has found that China and India together were responsible for over half of the total global attributable deaths. The study also finds that Air pollution was the prominent risk factor for premature deaths in India in the year 2019, accounting for nearly 18% of all deaths (more than 1.67 million). Considered separately, ambient particulate matter (PM-2.5) ranked as the 4th leading risk factor and Household Pollution (HAP) ranked 6th.

Covid-19 pandemic has highlighted the urgency to address India's chronic problem of air pollution. The levels of morbidity and mortality have led to losses in welfare that in turn cost India's economy some 5.9 percent of GDP.

Top ten most polluted cities of the world:

Source: World Air Quality Report, 2020

A recent study in US, has statistically concluded that: "A small increase in long-term exposure to PM-2.5 leads to a large increase in COVID-19 death rate with the magnitude of increase 20 times that is observed for $PM_{2.5}$ and all-cause of mortality. The study results underscore the importance of continuing to enforce existing air pollution regulations to protect human health both during and after the COVID-19 crisis. The data and codes of this study are publicly available to facilitate update of the existing data for examination of the hypothesis in future".

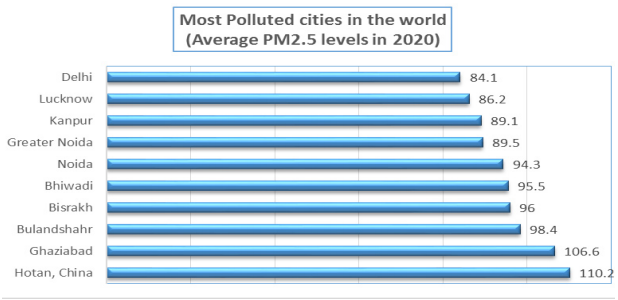

Fig 2: Most polluted cities in the world

The paper calls for adopting a multi-dimensional endeavour and data collection from WHO dashboard and the country portals for 15 countries with highest number of Covid-19 cases (USA, India, Brazil, Russian Federation, United Kingdom, France, Spain, Italy, Turkey, Germany, Colombia, Argentina, Mexico, Poland and South Africa). Country-wise, critical parameters (Cases - cumulative total, Cases - cumulative total per 1 million population, Deaths-cumulative total, Deaths - cumulative total per 1 million population) on Covid cases have been thoroughly studied and analysed.

Further, statistics pertaining to air quality of four geographically significant metro cities (Delhi, Mumbai, Kolkata and Chennai) of India have been obtained from Central Pollution Control Board/online air quality information platform and data regarding Covid cases in the country from March to December, 2020 have been collected from Cowin portal of India.

Literature Review

- Wu, X., Nethery, R. C., Sabath, M. B., Braun, D., & Dominici, F. (2020). Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis. Science advances, 6 (45).

- Konstantinoudis, G., Padellini, T., Bennett, J., Davies, B., Ezzati, M., & Blangiardo, M. (2021). Long-term exposure to air-pollution and COVID-19 mortality in England: a hierarchical spatial analysis. Environment international, 146, 106316.

Research Objectives

The main objectives of the study is to analyse the following using IT analytical tools:

3.1 International: In depth study of world's first 15 worst effected Covid-19 countries of the world, critical analysis and loss to human resource:

i. Confirmed Covid cases in worst effected 15 countries of the world

ii. Deaths- Cumulative total per 1 million population (15 countries)

3.2 Indian Perspective: Study of four Indian metro cities affected by air pollution and specifically due to RSPM (Respirable Suspended Particulate Matter) and its impact on spread of Covid-19 instances in the country:

i. Trend analysis of Covid-19 cases and PM-2.5 variation in the air quality of four metro cities Delhi, Mumbai, Kolkata and Chennai

ii. Comparative study of Covid-19 cases in four metro cities (Delhi, Mumbai, Kolkata and Chennai)

iii. Comparative analysis of variation in PM-2.5 level in the air of four metro cities

iv. Impact of Pandemic on GDP of India

Research Methodology:

The Data, for 15 countries with highest number of cases of Covid-19 cases have been obtained from WHO (dashboard). Country-wise, critical parameters (Cases - cumulative total, Cases - cumulative total per 1 million population, Deaths-cumulative total, Deaths - cumulative total per 1 million population) on Covid cases have been thoroughly studied and analysed.

Further, data on the air pollution/PM-2.5 across four metro cities of India has been obtained from Central Pollution Control Board of India and online air quality information platform.

Statistics with respect to the number of confirmed COVID-19 cases has been collected and analysed for four geographically significant cities of India (Metro cities: Delhi, Kolkota, Mumbai, Chennai). These statistics have been standardised, studied, processed and analysed using analytical tools and the results have been displayed in the form of charts to estimate the loss to the human resources in these countries.

Data Analytics and Observations:

The study and analysis of the data displays interesting results as discussed below:

5.1 International Scenario: In depth study of world's first 15 worst effected Covid-19 countries of the world, critical analysis and loss to human resource:

5.1.1 Confirmed Covid cases in worst effected (Covid-19) 15 countries of the world

i. It is observed that USA was worst effected with more than 2.6 crore cases and 25.21% of cumulative global cases.

ii. The cases were nearly half (1,07,77,284) in case of India and around 10.43 % of the total global cases followed by Brazil with 8.93% cases.

iii. Cases in France, United Kingdom and Russian Federation are between 3 to 3.7 percent of the cumulative global cases, quite controlled as compared to USA and India.

iv. Percentage of global cumulative cases is quite less (between 2.0 to 2.62) in case of Colombia, Germany, Turkey, Italy and Spain.

v. Cases in South Africa, Poland, Mexico and Argentina are between 1.4 to 1.8 percent of the cumulative global cases.

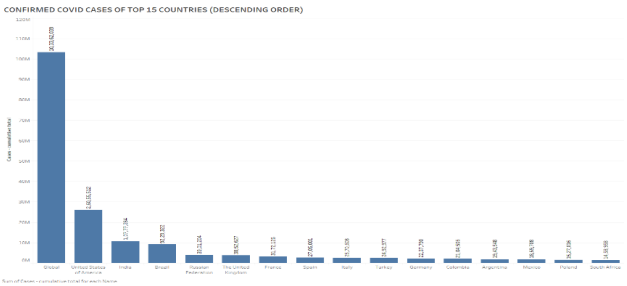

Fig. 3 Confirmed Covid cases of top 15 countries

5.1.2 Deaths- Cumulative total per 1 million population (15 countries)

i. It is observed that the death cumulative total per 1 million population is highest (1591.09) in UK, followed by Italy (1477.69), USA (1328.78), Spain (1236.37) and Mexico (1233.98).

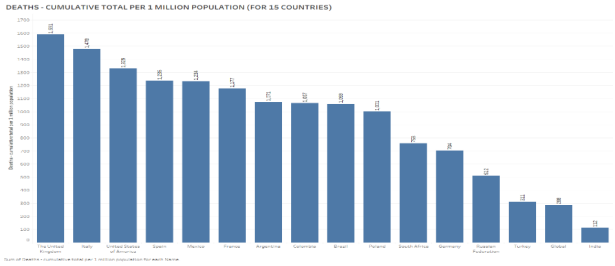

Fig. 4: Deaths- Cumulative total per 1 million population (15 countries)

ii. Further, in the countries: Poland, Brazil, Colombia, Argentina and France, deaths cumulative total per 1 million population is between 1001.33 to 1177.2.

iii. In the countries such as South Africa (757.83), Germany (703.67), Russian Federation (511.76) and Turkey (311.09) deaths cumulative total per 1 million population is quite low and is minimum in India (112.03).

5.2 Indian Perspective:

The study focusses on examining PM 2.5 statistics across 13 geographically significant cities of India, w.r.t. number of confirmed Covid-19 cases from March to December, 2020. It attempts to analyse the impact of air pollution parameter – PM 2.5 on number of confirmed COVID-19 cases.

5.2.1 Covid-19 cases and PM2.5 in Air of Delhi

The country's capital, with vibrant trade, commerce and excellent employment opportunities, Delhi attracts people from all over the country. As per WHO Air Quality Standards 2021, Delhi's prolonged battle for clean air is going much worse than previously thought. Even the handful of good air quality days that Delhi was getting each year were not really so as per the new "safe" norms. As per the data collected from 40 stations in Delhi, the days that Delhi met the 24-hour targets of air pollution in 2019 and 2020 go down drastically and if compared against the revised standards, while in 2021, not a single day has passed where the Capital's air has been acceptable by the new threshold.

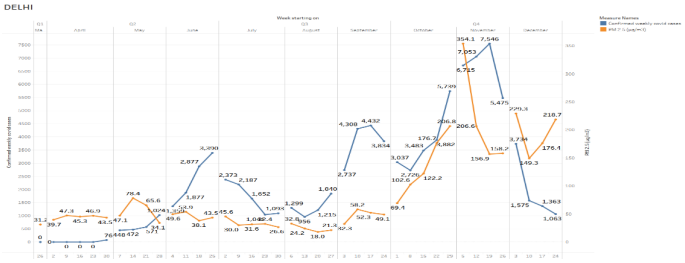

Fig. 5: Covid-19 cases and PM-2.5 in Air of Delhi

i. It is observed from the above graph that from March, 2020 to December, 2020, the levels of PM-2.5 was low from end March, 2020 and remained almost at same level in the range of 31 to 80 µg/m3 till the end of September 2020. It started rising from September, 2020 and reached its peak of 354.1 µg/m3 in November, 2020. Thereafter, it decreased to 149.3 µg/m3 around second week of December and rose to 218.7 µg/m3 in the end of December, 2020.

ii. Further, it is observed that daily confirmed Covid-19 cases also reached its peak of 7546 in November, 2020 and decreased thereafter to 1063 in the end of December, 2020.

iii. Thus, peak values of PM-2.5 and daily confirmed Covid-19 cases, both are high in November, 2020.

5.2.2 Covid-19 cases and PM2.5 in Air of Mumbai

Mumbai, the largest city (by population) is the financial and commercial capital of the country as it generates 6.16% of the total GDP. It serves as an economic hub of India, contributing 10% of factory employment, 25% of industrial output, 33% of income tax collections, 60% of customs duty collections, 20% of central excise tax collections, 40% of India's foreign trade and 40 billion (US$560 million) in corporate taxes.

i. It is observed from the graph that the PM-2.5 levels are low and in the range of 7.54 to 25.23 µg/m3 from March end to September, 2020.

ii. PM-2.5 level rose from 31.43 µg/m3 in the beginning of October to a peak value 71.12 µg/m3 in the beginning of November, dropped to around 58.5 µg/m3 in the beginning of December and again rose to 72.97 µg/m3 in December end.

iii. Further, the daily confirmed number of Covid-19 cases rose steeply from 680 to 1467 in the month of May, remained almost stable in July, and then rose from 910 in the beginning of August to reach its peak value of 2823 in second week of October. Thereafter, it declined to 841 with a moderate increase to 1147 and again came down to around 600 in December end.

iv. It is also observed that in the first fortnight of October, with sharp increase in PM-2.5 levels, there was sharp increase in daily confirmed Covid-19 cases but this trend is not consistent in the second fortnight of October and also in entire November and December.

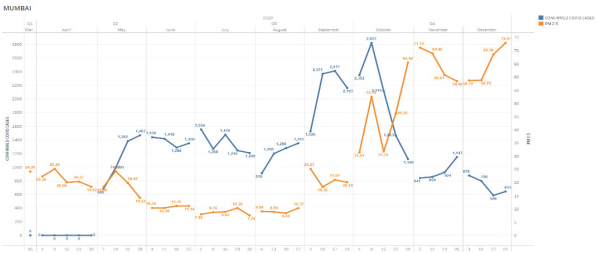

Fig. 6: Covid-19 cases and PM-2.5 in Air of Mumbai

5.2.3 Covid-19 cases and PM2.5 in Air of Kolkata

Kolkata is the commercial and financial hub of East and North-East India and home to the Calcutta Stock Exchange. It is a major commercial and military port. The final population totals of census 2011 stated the population of city as 4,496,694. In 2019, the city also recorded a higher air quality index value than Delhi for many days during the winter season.

It is observed from the graph that from March to December, the daily number of Covid-19 cases did not follow the trend of PM-2.5 from March to September. However, in October and November the rising trend of PM-2.5 is followed by corresponding increase in daily number of Covid-19 cases. Though, this trend does not remain the same in the month of December.

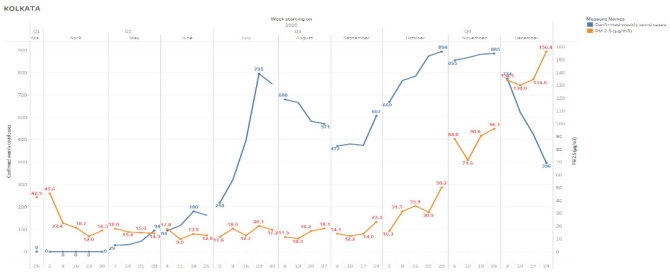

Fig. 7: Covid-19 cases and PM-2.5 in Air of Kolkata

5.2.4 Covid-19 cases and PM2.5 in Air of Chennai

The city is India's second-largest exporter of information technology (IT) and business process outsourcing (BPO) services. A major part of India's automobile industry is located in and around the city. It has a broad industrial base in the automobile, computer, technology, hardware manufacturing and healthcare sectors.

It is observed from the graph that in Chennai, the PM-2.5 value increased from 9.99 µg/m3 in the beginning of May to 35.31 µg/m3 in third week of June and during this period, the daily number of Covid-19 cases also had an increasing trend.

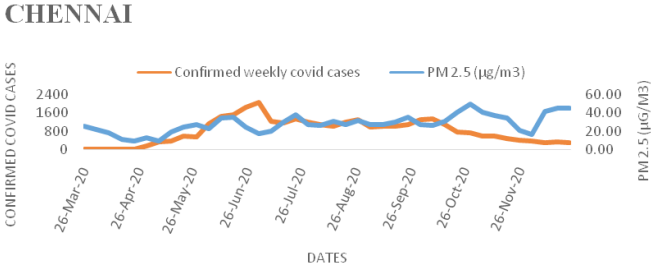

Fig. 8: Covid-19 cases and PM2.5 in Air of Chennai

But this similarity in trend is not observed in August, September and October. However, in November, it is seen that both the parameters almost have similar trend and there is decrease in values of both the

5.2.5 Comparative analysis of variation in $PM_{2.5}$ level in air in the four metro cities of India (Delhi, Mumbai, Kolkata and Chennai)

When PM-2.5 levels of four metro cities – (Delhi, Mumbai, Kolkata and Chennai) are compared, it is observed that it was quite low during the months from March to September in Delhi, Mumbai and Kolkata and October onwards the PM-2.5 levels increased up to December. However, in case of Chennai, PM-2.5 levels is quite high even during the months of May, June and July. Thereafter, it increased in October, decreased in November and then again increased in December.

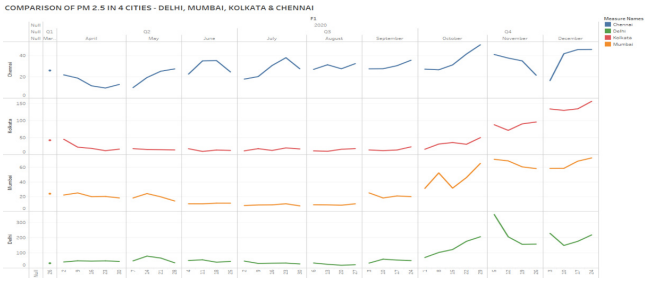

Fig. 9: Variation in PM2.5 level in four metro cities of India

5.2.6 Comparison of number of confirmed Covid-19 cases in the four metro cities of India (Delhi, Mumbai, Kolkata and Chennai)

During the comparative analysis of confirmed Covid cases in the four metro cities of India it is observed that the peak of confirmed Covid-19 cases in these metro cities are in different period/months.

In Delhi, the maximum number of confirmed Covid-19 cases of 7546 are observed in the 3rd week of November whereas 2923 cases are observed in the second week of October in Mumbai. In Kolkata, 931cases are observed in last week of October and 2065 cases in the beginning of July in Chennai.

Finally, it is also observed that there is no direct correlation evident between the PM-2.5 levels and number of daily confirmed Covid-19 cases. Though some studies have mentioned that the Covid-19 virus piggyback on PM2.5 particles and may enter the human beings through mouth and nose and thus aggravate the number of Covid-19 cases, but apart from PM-2.5 levels, there might be many other factors which could have caused significant increase in Covid-19 cases in the country.

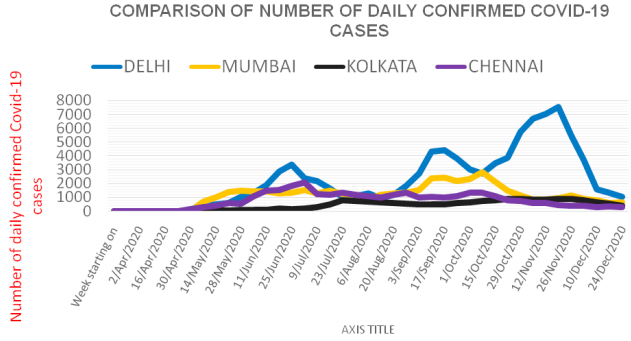

Fig. 10: Comparative Analysis of Covid cases in four metro cities of India

5.3 Impact of Pandemic on GDP of India

The economic growth of India is noteworthy especially before Covid-19. India emerged as the fastest growing major economy in the world and was expected to be one of the top three economic powers in the world over the next 10-15 years, backed by its robust democracy and strong partnerships. It may be noted that before Covid-19, India was the fifth largest economy. GDP in terms of US $ trillion of top 5 countries are shown below:

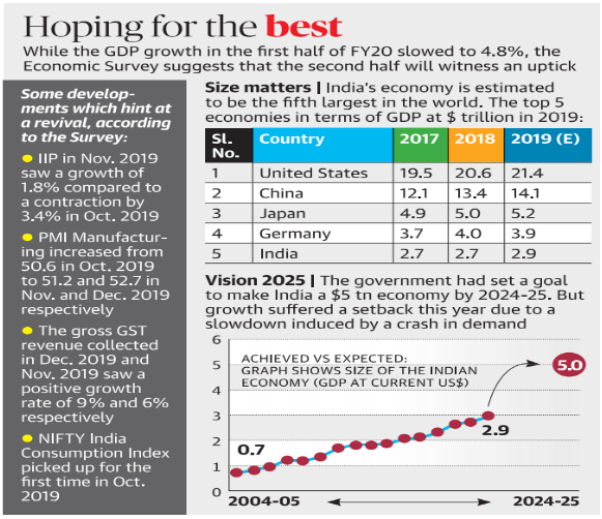

Fig. 11: GDP data of top 5 countries in economy terms

As most of the advanced countries have been facing slow growth rate due to (a) Saturation of economic opportunity in their countries or outside (b) Emergence of China as major manufacturing hub with overall low expenses/cost (c) Low wages and low cost of production in developing countries thereby manufacturing units have shifted to these countries (d) Post WTO agreement wherein no coverage or shield is available to protect the domestic country.

Of late, these advanced countries have started to impose economic barrier on the other countries. Hence, growth above 5% in India could be termed be as very good as compared to the rest of the countries especially developed countries.

Data on GDP during the last 10 years and expected projections may be seen in fig.-10. The growth rate is around 4-9% in these years especially due to liberation of the Indian economy since 1991 onwards. However post Covid, India's real GDP (Gross Domestic Product) is estimated to contract by 7.7% in 2020-21, compared to a growth rate of 4.2% in 2019-20, with Real GVA (Gross Valued added) shrinking by 7.2%, as per advance estimates released by the National Statistical Office (NSO) in January, 2021.

India's economy had grown at 4.2% in 2019-20, but entered a recessionary phase with two successive quarters of sharp contraction triggered by the COVID-19 national lockdowns beginning March 2020.

Following a 23.9% collapse in the economy between April to June 2020 period, the GDP fell by 7.5% in the second quarter – leading to a real GDP contraction of 15.7% in the first half of 2020-21. The second half of the year surface to record near-zero growth or a mere 0.1% contraction, the advanced estimates suggest.

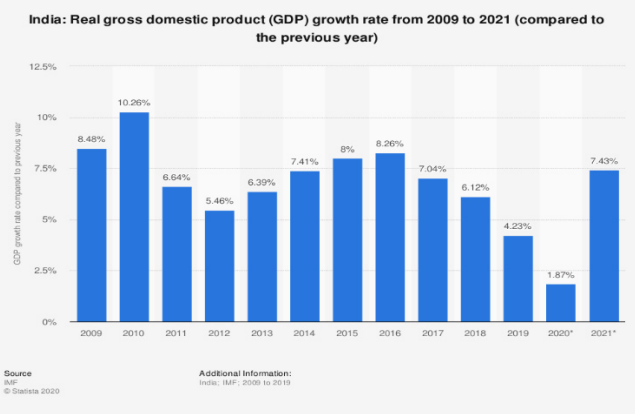

Fig. 12: GDP (India) during the last 10 years with 2 years projection

India's GDP (at constant 2011-12 prices) was estimated at Rs 26.9 trillion (US$ 363.49 billion) for the first quarter of Financial Year 2020-21, against Rs 35.35 trillion (US$ 477.67 billion) in the first quarter of Financial Year 2019-20, showing a contraction of 23.9%, compared with 5.2% growth in the first quarter of FY2019-20. Although, there is less negative impact on foreign reserves mainly due to inward flows of foreign funds due to higher interest in India, huge FIIs inflows due to share price degradation during covid-19 period, increase in Gold value etc. India's foreign exchange reserve was Rs 39 .64 trillion (US$ 542.01 billion) in the week up to September 4, 2020 according to data from RBI.

India's overall exports from April 2020 to August 2020 are estimated to be US$ 182.13 billion, (a 19.32% decrease compared with the same period last year). Overall imports from April 2020 to August 2020 are estimated to be US$ 167.94 billion, (a 38% decrease compared with the same period last year). Gross tax revenue stood at Rs 3.80 trillion (US$ 51.35 billion) in the first quarter (from April 2020 to July 2020) of 2020-21.

India's fight against Air Pollution:

The Government is taking all efforts towards mitigation of air pollution in the country. Central Government has taken a number of regulatory measures for prevention, control and abatement of air pollution in the country.

6.1 The Central Government has launched National Clean Air Programme (NCAP) under the Central Sector "Control of Pollution" Scheme as a long-term, time-bound, national level strategy to tackle the air pollution problem across the country in a comprehensive manner with targets to achieve 20% to 30% reduction in PM10 and PM2.5 concentrations by 2024 keeping 2017 as the base year for the comparison of concentration.

6.2 Monitoring Networks: Under N.A.M.P., three air pollutants viz., Sulphur Dioxide (SO_2), Nitrogen dioxides (NO_2) and Respirable Suspended Particulate Matter (RSPM/PM10) have been identified for regular monitoring at all the locations. The monitoring of pollutants is carried out 24 hours (4-hourly sampling for gaseous pollutants and 8-hourly sampling for particulate matter) with a frequency of twice a week resulting 104 observations in a year. Every state and UT represented in formulating the policy on creating and providing Air Quality Monitoring Stations.

6.3 Monitoring Agencies: The monitoring is being carried out by Central Pollution Control Board (CPCB); State Pollution Control Boards; Pollution Control Committees; National Environmental Engineering Research Institute (NEERI), Nagpur. CPCB co-ordinates with all other agencies to ensure uniformity and consistency of air quality data. The compilation of data is done centrally by CPCB and uploaded on *data.gov.in* and *cpcbenvis.nic.in*. The Environment Ministry is the Apex body and is responsible for sharing the data with the WHO monitoring agencies.

6.4 One hundred and two non-attainment cities mostly in Indo-Gangetic Plains have been identified based on ambient air quality data for the period 2011 – 2015 and WHO report 2014/2018. The city specific Action Plans have been approved for all 102 non-attainment cities for implementation on ground.

6.5 The Central Government has notified a Comprehensive Action Plan (CAP) in 2018 identifying timelines and implementing agencies for actions identified for prevention, control and mitigation of air pollution in Delhi and NCR.

6.6 Graded Response Action Plan (GRAP) was notified on January 12, 2017, for prevention, control and abatement of air pollution in Delhi and NCR. It identifies graded measures and implementing agencies for response to four AQI categories, namely, Moderate to Poor, Very Poor, Severe and Severe or Emergency.

6.7 So far, 375.44 crore have been released to 114 cities during FY 2019-20 and 2020-21 for initiating actions under city action plans to control air pollution. Further 4,400 crore has been released to 42 cities with million plus population as per recommendations of the 15th Finance Commission report for FY 2020-21.

Conclusion:

7.1. As India continues the implementation of the national clean air programme (NACP) and revises its National Ambient Air Quality Standards (NAAQS), it will be important to align with the WHO Air Quality Guidelines, including the interim targets for various air pollutants, and identify and implement policies that will help bring clean air to all. Ironically, as India's air pollution monitoring network improved in the past few years with more cities being monitored, the number of Indian cities in the top polluters' list zoomed.

7.2. With improved air quality monitoring, we are beginning to understand the depth and spread of the air pollution problem in India. While Delhi is at the crossroads and is expected to bend the curve post 2021, other pollution hot spots are proliferating across the country.

7.3. The required change is must and immediate action is essential to tackle the menace of air pollution. India and Indians have to work together to improve upon the RSPM numbers and bring them under immediate control.

Recommendations

8.1. Delhi and Beijing are often compared due to their high air pollution levels and policies like the odd-even road rationing measure or air pollution emergency action plan. However, WHO's recent data shows that Beijing's air pollution levels have been consistently reducing 2013 onwards. In year 2013-14 Chinese cities were in top Pollution index but now reduced to just 1. Thus a change is possible. We may follow the major Chinese like policies to tackle air pollution and implement them stringently.

8.2 India may not be able to get to 5 micrograms per cubic metres in PM 2.5 concentration but it should set out stringent and achievable targets. There is a wide variation in pollution levels across the country so strategies may be different. The southern and western states can strive and look at the WHO guidelines.

8.3. We must consider measures like National Action Plan of Air pollution Control, enforcement of environmental standards, the graded response action plan (GRAP), doubling of the environment budgeting etc. to achieve air pollution control.

8.4 In view of no specific studies in India, for PM2.5, the breakpoints proposed by USEPA may be adopted.

8.5 The present levels of air pollution especially w.r.t. RSPM is a national public health crisis and the newly proposed "National Clean Air Action Plan – 2019" has to ensure stringent action in all cities to comply with clean air standards. Though NACP does not have a legal mandate but aims to achieve a 20% to 30% reduction in PM 2.5 concentrations over 2017 annual levels in over a hundred cities by 2024.

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The Editorial Board had used the Ouriginal – a Swedish anti-plagiarism software tool which is a fully-automatic machine learning text-recognition system made for detecting, preventing and handling plagiarism and trusted by thousands of institutions across worldwide. Ouriginal by Turnitin is an award-winning software that helps detect and prevent plagiarism regardless of language. Combining text-matching with writing-style analysis to promote academic integrity and prevent plagiarism, Ouriginal is simple, reliable and easy to use. Ouriginal was acquired by Turnitin in 2021. As part of a larger global organization GJEIS and Turnitin better equipped to anticipate the foster an environment of academic integrity for educators and students around the globe. Ouriginal is GDPR compliant with privacy by design and an uptime of 99.9% and have trust to be the partner in academic integrity (https://www.ouriginal.com/) tool to check the originality and further affixed the similarity index which is {1%} in this case (See below Annexure-I). Thus, the reviewers and editors are of view to find it suitable to publish in this Volume-14, Issue-1, Jan-Mar 2022.

Annexure 14.5

Submission Date	Submission Id	Word Count	Character Count
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Reviewers Memorandum

Reviewer's Comment 1: Secondary data has been used in a judicious manner to enunciate the alarming situation of air pollution. An attempt to find correlation between Covid19 cases and PM-2.5 levels has been made through comparative analysis, with an observation of no direct relation between the two. The authors have done commendable work in addressing the issue and laying grounds for more extensive work on the issue.

Reviewer's Comment 2: The paper highlights the health hazards of air pollution. Extensive data has been presented to address the problem, further country wise comparison and visual depiction of the data impels the reader to make a difference for themselves and the world.

Reviewer's Comment 3: Although, the recommendations offered are valuable and well structured, the study has room for the analysis of various other patterns and determinants of covid19. The author has provided appropriate references which can help other researchers to work on other possible determinants.

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Conflict of Interest: Author of a Paper had no conflict neither financially nor academically.

Editorial Excerpt

The article has 1% of plagiarism which is the accepted percentage as per the norms and standards of the journal for publication. As per the editorial board's observations and blind reviewers' remarks the paper had some minor revisions which were communicated on a timely basis to the author (Namrata Agrawal), and accordingly, all the corrections had been incorporated as and when directed and required to do so. The comments related to this manuscript are noticeably related to the theme "**Empirical Study of Air pollution, Covid-19 and its impact on GDP in Indian Context using Data Analytics**" both subject-wise and research-wise. Epidemiological studies aim to get to the root of health problems and outbreaks in a community in order to save lives and improve global, long term health. After comprehensive reviews and the editorial board's remarks, the manuscript has been categorized and decided to publish under the "**View Point**" category.

Acknowledgement

The acknowledgment section is an essential part of all academic research papers. It provides appropriate recognition to all contributors for their hard work and effort taken while writing a paper. The data presented and analyzed in this paper (by Namrata Agrawal) were collected first handedly, and wherever it has been taken the proper acknowledgment and endorsement depicts. The author is highly indebted to others who facilitated accomplishing the research. Last but not least endorse all reviewers and editors of GJEIS in publishing in the present issue.

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