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EFFECTS OF LOCKDOWN ON AIR POLLUTION

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Abstract: Due to pandemic COVID-19, "JANTA CURFEW" was introduced by honourable Prime minister of India on 24 march followed by complete lockdown of three weeks starting from 24 onwards. Later, restrictions extended up to 3rd may and extended further for few more months. These imposed restrictions somewhere bought a drastic drop on pollution level across the country within few days after the implementation of lockdown. This observable changes-initiated discussions regarding temporary lockdowns as an alternative pollution control measure. This study focusses on the air quality scenarios pre lockdown, during lockdown and post lockdown period in context to air quality index six parameters (PM2.5, SO_2, NO_2, CO, O_3 and NH_3) are considered. After considering these parameters spatial and Rastor patterns of air quality are derived and an improvement in air quality can be observed spectrum, imaging and mapping results. The results are quite satisfying and shows that there are many others factors that are responsible and must be considered while analysing air pollution.

Index Terms - Covid-19, Lockdown, Air quality index, Changes observed in air quality.

1. INTRODUCTION

In late December 2019, the outbreak of COVID-19 was first detected in Wuhan, China and more than100 countries were affected with disastrous outcomes within three months. Later, it was found that widespread is caused by a new strain named as SARS-COV-2. India documented its first case in Kerala in early January followed by two more sick students returning from China after two months. Till May 2020, the count increased to 40 Thousand nationwide.

To avoid illness many nations restricted civilian interactions, transportation, and movement. Banned large scale gatherings regulated major transportation mediums to break the infection chain. "JANTA CURFEW" was introduced by honourable prime minister of India on 24 march followed by complete lockdown of three weeks starting from 24 onwards. The closure of manufacturing industries, the limitation of human movement and the regulated public transit system have contributed to a decline in pollutants. Studies by numerous researchers have demonstrated how the shutdown has increased the efficiency of the fresher air. Air pollution is a major issue for India at all stages, primarily due to intensified anthropogenic activities such as rapid urbanization, accelerated population growth, increased oil usage, automobile emissions and industrial emissions. The goal of this analysis is to examine air quality improvements and contamination content during lock-down initiatives to counter the COVID-19 pandemic in major cities in India.

2. OBJECTIVES

- Getting an idea of air quality changes during lockdown and pre, post lockdown.
- Understanding and differentiating improvements during these periods.
- Calculate, monitor, and compare criteria pollutants like SO2. NO2, CO, O3,NH3, NO and PM 2.5.
- Provide a preface knowledge and strategy using short periodic closure of pollutant mediums can help in enhancing air quality helping scholars, policy, and law makers to make policies that might help in limiting air pollution.

3. DATA COLLECTION

In this study, various datasets were taken from WAQI, CBCP AND CPAA. Data is aggregated to a single set by combining and averaging the dataset related to various perimeters obtained from different stations available between the geological locations of 13 cities (Ahmedabad, Bengaluru, Bhopal, Chandigarh, Chennai, Delhi, Gurugram, Hyderabad, Jaipur, Kolkata, Lucknow, Mumbai and Patna). And further classified as averaged monthly data. As study focusses on analysis of lockdown effect before, after and during the lockdown, the whole study period is divided into 7 monthly intervals and various analytics related to different phases are derived from it. Data format chosen is csv and is described as-

Month, Day, Year of Date	City	Latitude (generated)	Longitude (generated)	NO	NO2	NOx	O3	PM 2.5	SO2	CO	AQI	
01-Jan-20	Chennai	13.0595	80.2358	6.69	12.66	18.7	24.79	28.25	12.44	0.65	70	
01-Jan-20	Hyderabad	17.3829	78.4579	8.24	25.88	19.3	28.71	41.19	4.18	0.65	82	
01-Jan-20	Chandigarh	30.7308	76.7808	46.81	15.96	45.21	8.1	63.22	7.79	1.11	132	
01-Jan-20	Jaipur	27.1549	75.7512	3.97	37.84	33.18	54.13	68.61	13.52	1.03	154	
01-Jan-20	Mumbai	18.9834	72.8375	40.17	46.39	85.81	45.97	104.06	10.98	1.22	194	
01-Jan-20	Ahmedabad	22.746	72.2951	3.78	12.64	8.99	23.67	79.57	27.7	3.78	216	
01-Jan-20	Bhopal	23.4896	77.3967	7.8	42.22	28.9	40.01	100.55	3.99	1.13	266	
01-Jan-20	Kolkata	22.5671	88.371	84.98	64.93	149.92	26.8	128.62	19.89	2.09	298	
01-Jan-20	Patna	25.4797	85.1376	45.23	36.74	81.09	16.47	214.23	7.99	2.71	364	
01-Jan-20	Gurugram	28.3776	76.9425	105.65	30.83	109.35	39.32	296.06	16.5	3.7	429	

4. METHODOLOGY

After collecting data and breaking it in the simplest form. The data is analysed using basic analytics software like tableau, excel etc. For geospatial and spectrum analysis instead of using advance interpolation methods like Giovanni or Merra service. Traditional geoinformatics software like ArcGIS, ArcGIS online and Arcmap are used.

The software used are analytics software that are not automatics. They need in depth knowledge of data and field handling. Thus allow us to participate, explore and getting exposed to various aspects need to be considered while doing such analysis and research work. Advance software might give you quick and appropriate results but they have their own limits. They can work in that extent only and do not allows use to go deeper in research.

TABLEAU is a software which gives quick and interactive data interpretations and visualisations. Earlier it was designed for business intelligence administration and sale force data only. Till now it is considers as best option for data handling. Later on people started using it for visualization techniques for relational analyzation and exploration of data cubes and databases. It can extract, retrieve, store uses various other data forms to produce graph type visualizations.

With the help of tableau only various graphs, line charts and heat map are made. ArcGIS PRO, ArcGIS online, ArcMAP are application products belonging to ESRI. ESRI is leading developer of GIS mapping software and is proven most powerful mapping and spatial analytics technology.

ESRI is well known for mapping and spatial analytics software that completely satisfies the location intelligence and digital transformation needs. Software like ArcGIS ONLINE and ArcMAP are used to make spatial rastor graph for showing monthly variations over the country based on the API outcome received from analysis.

The AQI typically relies on pollutant parameters where a single pollutant is deliberated using an acceptable aggregation process to become an independent index. The highest solution to the AQI using five contaminants parameters was conventionally expected to be the sub-index. IITM has recently launched a new AQI, which additionally offers a sub-index for O3, by Pune. In five points, IITM-AQI has shown air quality-extremely unhealthy, extremely low, low, mild and decent, for instance.

In the current project we used predetermined average daily CPCB AQI dataset. The dataset gives everyday values. Thus allowing easy analysis. Pollutant concentrations are also based on various other factors like temperature, humidity, wind speed and wind direction. These factors are not considered. The AQI is also analysed on three levels that are monthly variation , difference in monthly averages, %differences in monthly averages. The line chart allows us to understand variation dailywise for different months and then months can be co related to various lockdown phases i.e.

- January, February and upto 23 march- Before lockdown
- 23 March to 07 June – various phases of lockdown
- 08 June to 01july – unlock1

5. RESULTS

A. For parameters

1) Carbon monoxide (CO)

Maximum co for various cities in the month of February usually between 15 to 26 feb . In most of the cities the minimum amount of CO is observed in month of April. In major cities like Mumbai and Delhi a major increase in concentration can be seen in the month of January and February, followed by march. But there is a significant downfall in the 4th week of march because that is the week lockdown was started. There was 13% (Patna), 17.9% (Chennai), 20%(Chandigarh),14.81% (Lucknow) and 25.81% (Jaipur). But if we talk about major cities with heaviest traffics and large number of industries, major downfall ca be seen. cities like Delhi (46.8%), Mumbai (35.43%). Whereas cities like Bhopal there was an enormous decrease of 65.8%).

The proper explanations for these results can be considered as Patna, Chennai, Lucknow, Chandigarh, and Jaipur are the cities having very small number of industries and sectors which emits co by burning of fuels. only source present there is vehicular emission. since these cities don't have much traffic high concentration and changes cannot be seen. Same conclusion can be taken for Bhopal since traffic is the only source of co a huge downfall can be seen. But in Delhi and Mumbai apart from traffic. There are many industries which kept on running during lockdown too thus giving a significant change.

2) Nitric oxide (NO)

NO is found in high acid desposition areas. Once again the maximum count is noted in the month of February and minimum differs from co. For co April was the month with minimum counts but in case of NO May is the month of leat counts. Reasons can be described as CO lifespan is less as compared to NO as CO easily breaks down into co2 and HCO3, Whereas NO takes time.

In terms of graphs and numbers recognizable decrease is seen in the end of march. Even in April and may the graphs are decreasing with a rate of 5 to 9%. But in months of June and July the graph started increasing once again with a climb of 1.32 and 2.63% respectively.

3) Other parameters

The graph of other parameters are similar to each other. Maximum counts can be found in the month of February and January. The trends start decreasing in the end of march to max and increases to a negligible extent during each month simultaneously during different phases of lockdown. As more and more vehicle was allowed and industries were allowed the trend increase slightly and right from the begining of June once counts started increasing because most of the factories and domestic transportations were allowed again.

B. AQI

In terms of AQI a decrease can be seen in case of cities like Ahmadabad (8.34%) , Jaipur (11.8%), Bangalore (1.23%) in the month of January and February and increase in Bhopal (19.2%), Chandigarh (0.7%), Chennai (10.7%), Delhi (15.0%) , Gurugram (18.6%), Hyderabad (9.2%), Kolkata (8.9%), Lucknow (20.5%), Mumbai (5.6%).

On a average basis graphs are increasing in months of February and March, average increase was Ahmedabad (48.3%), Bengaluru (6.0%), Bhopal (14.7%), Chandigarh (40.7%), Chennai (19.5%), Delhi (48.2%), Gurugram (38.1%), Hyderabad (17.1%), Jaipur (19.4%), Kolkata (37.9%), Lucknow (38.6%), Mumbai (34.3%), Patna (21.3%),

Further decrease in month of March and April Ahmedabad (16.49%), Bengaluru (24.47%), Bhopal (3.71%), Chandigarh (19.55%), Chennai (9.66%), Delhi (16.81%), Gurugram (8.90%), Hyderabad (17.45%), Jaipur (14.60%), Kolkata (42.72%), Lucknow (20.35%), Mumbai (28.97%, Patna (17.20%).

Slight increase in the month of April and May was Ahmedabad (6.58%), Bengalur (6.75%), Bhopal (8.20%), Chandigarh (6.26%), Chennai (23.90%), Delhi (31.54%), Gurugram (32.06%), Hyderabad (22.08%), Jaipur (31.39%), Kolkata (24.45%), Lucknow (11.58%), Mumbai (913.99%), Patna (95.60%).

More increase in the month of May and June was Ahmedabad (24.34%), Bengaluru (24.60%), Bhopal (31.39%), Chandigarh (10.29%), Chennai (31.00%), Delhi (15.41%), Gurugram (9.59%), Hyderabad (40.69%), Jaipur (16.92%), Kolkata (12.59%), Lucknow (18.97%), Mumbai (16.63%), Patna (40.54%).

In the month of June-July it was a increase and decrease condition. Bengaluru (22.05%), Bhopal (3.72%), Chandigarh (0.75%), Chennai(10.74%),Delhi(19.67%),Jaipur(25.61%),Kolkata(3.16%), Lucknow(21.24%), Mumbai (0.56%) got increase and Gurugram(18.28%),Hyderabad(1.98%), Ahmedabad(22.23%),Patna (18.98%) got decrease in values.

For a better visualisation comparison the AQI for different months on different days is expressed with the help of a heat map, enabling us to understand the daily difference as well as monthly differences for the various cities.

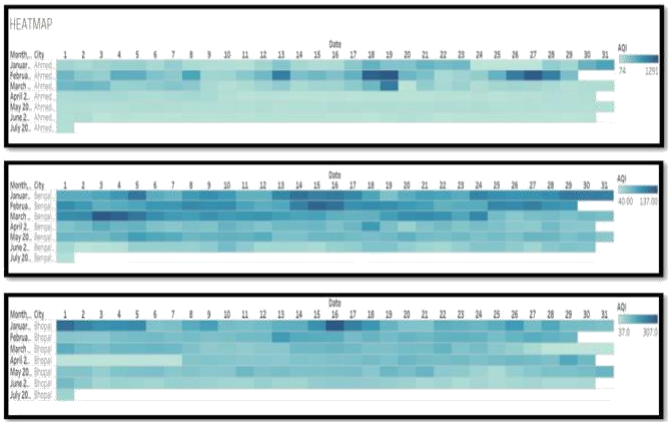

Figure 1 Heat map obtained using Tableau showing Aqi change on daily basis for each city

C. Spacial distribution for AQI

Spacial Rastor distribution technique helps in forecasting and assuming the values of a neighbour area with the fixed knowledge of given data. It also gives a easily understandable variation with help of colour codes. spacial graphs for different months are as follows.

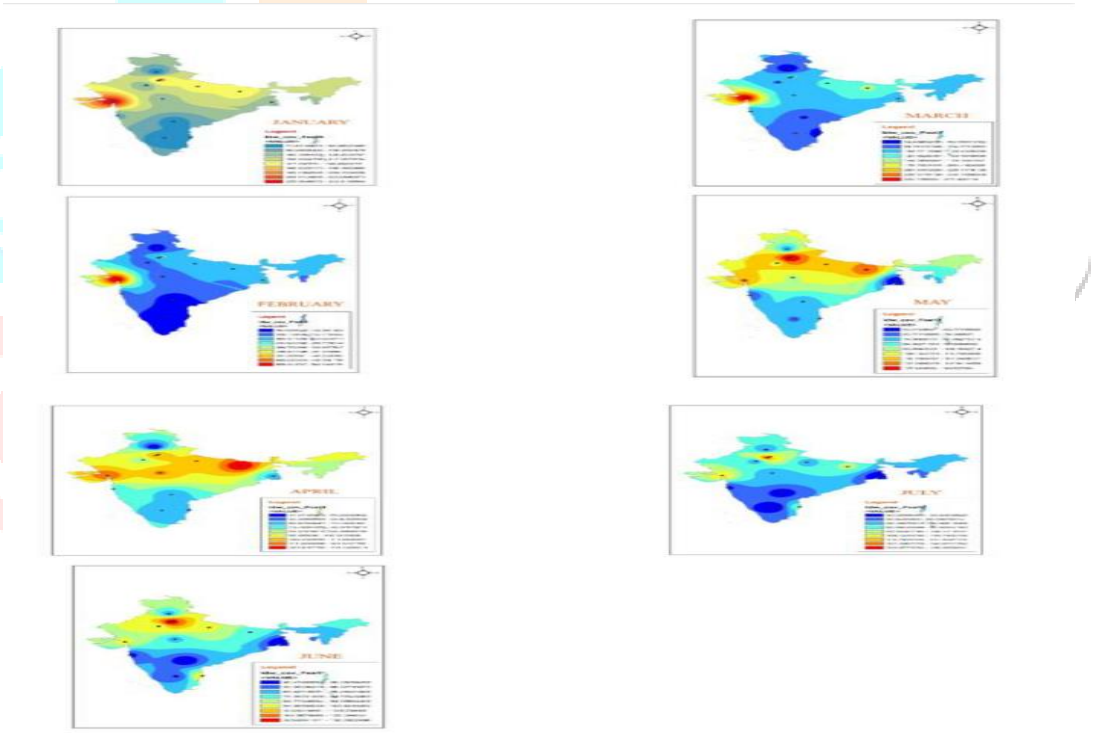

Figure 2. RASTOR mapping for different months throughout the country showing AQI CONC. using ESRI ArcGIS

Clearly from spatial diagram it can be compared that it in month January aqi is lesser as compared to month February. In the month of March the AQI fall from extreme to medium range and in the upcoming months it kept on decreasing up to may. In June and July it again started increasing.

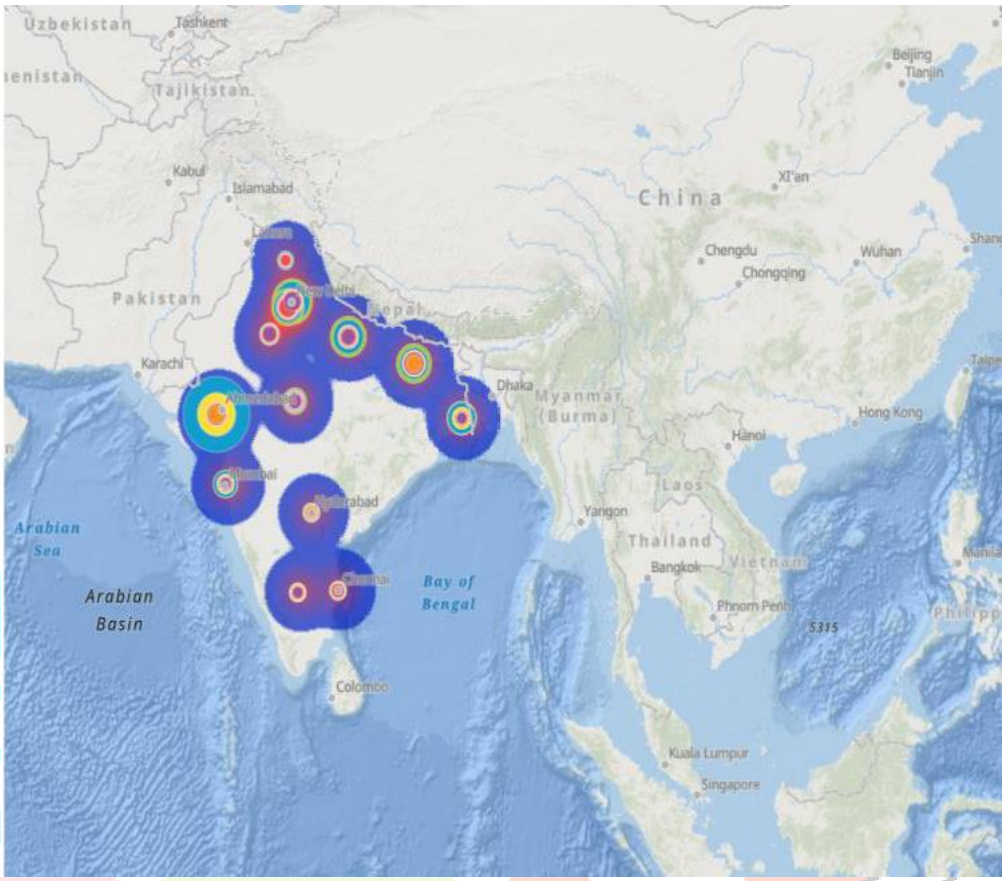

Figure 3. Spatial mapping for different cities showing AQI concentrations obtained through ESRI Arcmap online

6. CONCLUSION

From rastor and spatial distribution it is observed that AQI keeps on increasing in the month of January and February irrespective of vehicular emission may be because of Climate and weather conditions. During the month of march and April when air is much cleaner than preceding months a very slant downfall is observed. In the initial days of May the graph follows the same decreament but in the second half there was a considerable increase in AQI index in many major cities but in small cities it was following the same curve. Unlock -1 can be the major reasons as commercial vehicles were allowed to commute. In the months of June and July the decrease curve starts inclining again.

So when we talk about scheduling temporary lockdown or restriction as a step for decreasing air pollution, we should consider the months of January and February in winters and the month of May is summer. While comparing it with normal scenarios during the months of January and February the conditions are not suitable for driving. Most of the people should use public vehicles and we can restrict them from using private vehicles. In the month of May most of the schools and institutions are closed. people keep on moving and travels more using their private vehicles. Use of public vehicles should be emphasized. Therefore these months are apt for a short term lockdown.

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