

AQI during Lockdown New Benchmark in Pollution Data

MASSIVE EARTH FOUNDATION

https://massivefoundation.org

About Us

- Massive Earth Foundation (MEF) is backed by India's leading Entrepreneurs, VC & Investors. We are a nonprofit entity focused on solving Pollution & Climate change through actionable research.
- MEF is working to build a vibrant ecosystem to support innovation & scale through partnerships, investments and ecosystem building in the area of Clean energy, Clean mobility, smart and sustainable Agriculture, Water and sanitation, and sustainable built environment.
- Core strength of MEF lies in its ability to execute complex projects at scale, doing path breaking research and bringing various stakeholders to a single platform.



Report Authors







Shailesh Vickram Singh

Sumeet Singh

Research Contributors: Abhinav Tyagi, Yatharth Jain

"As far as the laws of mathematics refer to reality, they are not certain;

and as far as they are certain, they do not refer to reality."



AQI Data during Lockdown: The new normal

- In India, pollution study is a statistical nightmare
- Even with the best of intentions it becomes a war between researchers, data analysts & statisticians
- Reason being that there are too many factors impacting pollution



March-April are ideal sample period



AQI in North Indian cities should be similar to AQI in European Cities +/- 20%

But Av. AQI in Delhi is in excess of 200^{*}.

March & April are suited to study Air Pollution:

- No monsoon
- Air Humidity is normal
- Air temperature is normal
 - No SMOG
- Low chances of dust storms in North India
- No crop burning
- No Diwali
- Pollens are high

* Average AQI during March 25 to April 20 in 2017, 2018 & 2019

The COVID Lockdown froze a few elements which was impossible otherwise



At a huge cost

- Economic Cost
 - Unemployment
 - No or Reduced wages
 - Fall in productivity & output
- Social Framework
 - In-human reverse migration of daily wage earners
- Mental Health
 - Combination of personal income & movement restrictions

Δ in Economic Activity during Lockdown



	Pre-Lockdown	Extreme Lockdown	Relaxed Lockdown
	22 nd Jan to 20 th March	25 th March to 25 th April	1 st May to 31 st May
Private Transport	\checkmark	×	Minor d
Public Transport	\checkmark	X	\downarrow
Goods Movement	\checkmark	\checkmark	\checkmark
Industrial Activity*	\checkmark	?	?
Gensets	\checkmark	\checkmark	\downarrow
Construction	\checkmark	X	\downarrow
Power Plants*	\checkmark	\checkmark	\checkmark
Dust Storms*	X	\checkmark	\checkmark
Waste Burning	\checkmark	\checkmark	\checkmark
Bio-Mass Burning*	\checkmark	X ?	\checkmark

*Will differ from each city, considered Delhi for this table



Methodology & Results

© Copyright 2020, Massive Earth Foundation, https://massivefoundation.org

Sources

 All AQI data has been obtained from CPCB's website (<u>https://app.cpcbccr.com/ccr/#/login</u>)

- The number of monitoring stations also vary for each city. For example in Delhi, on some days CPCB is giving the average from 28 monitoring stations & on some days the average is from 32 monitoring stations.
- We have normalized missing data
- Mobility data has been sourced from:
 - Google LLC "Google COVID-19 Community Mobility Reports".
 - https://www.google.com/covid19/mobility/ Accessed: July 13, 2020
 - We have used Maharashtra's movement to workplaces as a standard for Mumbai, and similarly Tamil Nadu for Chennai & data for Karnataka has been used for Bengaluru.

Three date bands are as follows:

- Extreme Lockdown:
 - 25th March to 25th April
- Relaxed Lockdown:
 - 1st May to 31st May
- Pre-Lockdown:
 - 22nd January to 20th March



Bengaluru: AQI Data (Daily)



Date	2017	2018	2019	2020
25-Mar	99	111	98	57
26-Mar	94	95	115	58
27-Mar	76	95	121	54
28-Mar	69	118	140	53
29-Mar	91	138	158	57
30-Mar	74	130	134	63
31-Mar	110	117	139	55
1-Apr	113	112	126	52
2-Apr	88	92	151	59
3-Apr	100	97	122	69
4-Apr	112	106	120	64
5-Apr	90	118	113	64
6-Apr	98	116	120	58
7-Apr	90	128	120	48
8-Apr	82	108	109	52
9-Apr	70	57	122	54
10-Apr	97	66	119	55
11-Apr	85	81	103	49
12-Apr	85	90	118	58
13-Apr	85	71	112	49
14-Apr	111	74	104	58
15-Apr	127	97	111	64
16-Apr	109	49	105	52
17-Apr	72	69	104	66
18-Apr	62	89	101	68
19-Apr	88	103	93	52
20-Apr	67	100	127	41



Bengaluru: AQI Data (7-Day Moving Average)









- The average AQI in 2017, 2018 & 2019 For the same dates

Bengaluru: Relative Pollution Score





Bengaluru: AQI + Google Mobility





- Both AQI & Google's Movement to Workspaces are 7-Day Moving Averages
- For the period 25th March 2020 to 31st May 2020, there is Very High Correlation between the 2 data sets:
 - R = 0.89
 - R² = 0.79

Chennai: Relative Pollution Score





Chennai: AQI + Google Mobility





- For the period 25th March 2020 to 31st May 2020, there is Very High Correlation between the 2 data sets:
 - R = 0.75
 - R² = 0.57

Mumbai: Relative Pollution Score





Extreme & Relaxed Lockdown

The overall impact of the lockdown is very limited in Mumbai. The city is just 20% less polluted all throughout the lockdown.

Mumbai: AQI + Google Mobility





- For the period 25th March 2020 to 31st May 2020, there is Weak Correlation between the 2 data sets:
 - R = (0.70)
 - R² = 0.49
- This is probably because of the impact of Cyclone Nisarga towards the end of May-20.

Delhi: Relative Pollution Score





© Copyright 2020, Massive Earth Foundation, https://massivefoundation.org

of polluting activities on the AQI of Delhi.

Delhi: AQI + Google Mobility





- For the period 25th March 2020 to 31st May 2020, there is Very High Correlation between the 2 data sets:
 - R = 0.82
 - R² = 0.68

UP Cities: Relative Pollution Score





Summary RPS + Correlation



	Extreme Lockdown		Relaxed Lockdown			Correlation between AQI & Office Mobility		
	Av RPS	Av AQI 2020	Av AQI 2017-19	Av RPS	Av AQI 2020	Av AQI 2017-19	R	R ²
Bengaluru	55%	57	102	115%	88	77	0.89	0.79
Chennai	58%	49	84	61%	59	97	0.75	0.57
Delhi	47%	100	213	63%	144	229	0.82	0.68
Mumbai	82%	85	104	80%	61	77	(0.70)	0.49
Agra	60%	90	151	66%	96	146	NA	NA
Kanpur	60%	92	153	53%	88	167	NA	NA
Lucknow	51%	106	208	54%	112	207	NA	NA
Varanasi	56%	130	231	61%	131	214	NA	NA



What is going wrong!



Its obvious that AQI has strong correlation with mobility



However modes of transportation are not equally distributed



 Quick fact: Two Wheelers consume more than 61% of petrol consumed in India²

- Improvements in reduction of emission levels
 - Improvement in engine technologies
 - Improvement in quality of fuel

¹Open Government Data Platform India https://data.gov.in/resources/number-registered-motor-vehicles-india-1951-2017

² Nielsen Report for PPAC on Sectoral Demand of Diesel & Petrol https://www.ppac.gov.in/WriteReadData/Reports/201411110329450069740AllIndiaS tudyonSectoralDemandofDiesel.pdf

Missing Bus Infrastructure



For the period 2007-17

 Buses have grown at a CAGR of 3.3% whereas the growth rate of other categories is 10.5% to 8%.

In the absence of public transport, Indians are creating private assets



INDIA LAGS IN PER CAPITA BUS FLEET

- Only 63 of 458 Indian cities with 100,000+ citizens have a formal city bus system.
- Within this, only 15 cities have a bus or rail based mass rapid transit system.

That crosses breaking point at high level of congestion during peak hours

Source: BCG Mobility India Transport Niti Ayog 2018 https://niti.gov.in/writereaddata/files/document_publication/BCG.pdf



Meanwhile we also need to solve for...

Paddy Burning



- Yes, paddy stubble burning is a critical issues but only in 3 months.
- However, AQI above 200%–300% of normal in the months when there is no paddy burning – is obviously going to be life threatening.
- Focus on paddy removes attention from the real issues which are pushing basic AQI by 200%-300%
 - Swimming Pool Analogy Water is already above our heads.



Stubble burning is a pan-Indian problem but is most acute in Punjab and Haryana, which together account for 46% of the crop fires in the country. In 2018, stubble burning picked up in November after a six-year low in October in these two States. **Vignesh Radhakrishnan** and **Varun B. Krishnan** analyse the data processed from satellite images



Image Source: The Hindu https://www.thehindu.com/news/national/stubble-burning-still-persists/article25991454.ece https://twitter.com/vinuthewriter/status/1084796094247104517

But not for Diwali Crackers



- Diwali crackers gets huge attention and visibility and consumes lot of bandwidth of Govt machinery.
- Again, Diwali pollution is of very short duration and its impact is for less than a week.
- The danger of air pollution happens due to long over-exposure.
- Too much focus on Diwali again shifts attention from key issues which are causing real pollution.



Image Source: News18 compilation from DPCC data https://www.news18.com/news/india/from-163-to-1005-on-air-guality-index-how-delhi-turned-intoa-gas-chamber-on-diwali-in-just-6-hours-2365485.html

Why Odd-Even scheme can't succeed even with high compliance

- Odd even scheme did not have significant impact on AQI.
- Primary reasons was that it exempted 2-wheelers.
- And 2-wheelers were exempted because of lack of public transport.
- India has 1.2 buses per 1000 people (Karnataka is ahead of other states) whereas even other BRICS countries like Russia & South Africa have more than 6 buses per 1000 people.



crossing the city daily, the sheer volume of two-wheelers is humongous. Even after adding 2,000 private buses to our existing fleet of over 5,500 state-run buses during the drive, the city's public transport system won't be able to take the load of 3.65 million two-wheelers that would be off road each day if they are included in the drive," Gahlot said. Source: Hindustan Times

https://www.hindustantimes.com/cities/two-wheelers-will-be-exempted-

from-delhi-s-odd-even-drive/story-9P7DhyYNixW9Dyi4vo44JL.html



Electrification of Indian Transportation sector

that will be the real battle for reducing AQI

Electric Transportation Opportunity



Electric Buses

Rs 2,50,000 cr Annual Sales Short Range Slow Speed Commercial Vehicles Rs 50,000 cr Annual Sales

2-Wheeler Segment

Rs 2,50,000 cr Annual Sales

Policy Support

1. Non-Fiscal Measures:

- Simplify regulatory environment for operating bus services (Central / State rules)
- Ease of operation Inter state rules
- Enabling environment for maximum utilisation of assets
- Enable access of capital Green bond issues for transport sector / ECB quota / masala Bonds

2. Fiscal

- Accelerated depreciation
- Support for VC / PE funds investing in Mobility
- Creation of dedicated mobility funds in line of renewable energy
- FAME focus on building infra for Electrification – charging / swapping / parking



Thank You

MASSIVE EARTH FOUNDATION

https://massivefoundation.org







Δ in Economic Activity during Lockdown





	Pre-Lockdown	Extreme Lockdown	Relaxed Lockdown	
	22 nd Jan to 20 th March	25 th March to 25 th April	1 st May to 31 st May	
Private Transport	\checkmark	×	Minor A	
Public Transport	\checkmark	×	\checkmark	
Goods Movement	\checkmark	\checkmark	\checkmark	



Industries & Thermal Power



 Industrial Activity: Though the final numbers are yet to come, critical industries remained operational during both Extreme Lockdown & Relaxed Lockdown. It would be safe to assume that industrial activity did not change between the 2 periods, expect probably during the initial 2-weeks of the Extreme Lockdown.



Exhibit 7: The all-India plant load factor for **thermal** power plants fell sharply from 60.3% in Feb 2020 to 42.2% in Apr 2020, before recovering modestly to 47.9% in May 2020, in line with the revival in power demand with easing of lockdown restrictions; all-India average thermal PLF likely to decline to ~54% in FY2021 from 56.0% in FY2020



Source: ICRA Research

Other Sources of Pollution



	Pre-Lockdown	Extreme Lockdown	Relaxed Lockdown	
	22 nd Jan to 20 th March	25 th March to 25 th April	1 st May to 31 st May	
Gensets	\checkmark	\checkmark	\checkmark	
Construction	\checkmark	×	\checkmark	
Waste Burning	\checkmark	\checkmark	\checkmark	
Bio-Mass Burning	\checkmark	★?	\checkmark	

- Private Power Generators: As there was a fall in power demand generation, load shedding also reduced.
 We estimate that use of private diesel generators will have been similar in both the Extreme Lockdown & Relaxed Lockdown periods in 2020.
- Bio-mass burning: Over the last few years bio-mass as a source of fuel for cooking has been declining in mega-cities; however in cities in the Gangetic plains it is still a major source of fuel. As people were in lockdown & road-side restaurants (dhabhas) were not open bio-mass burning as a fuel would have remained similar in Extreme Lockdown & Relaxed Lockdown time periods.
- Waste burning: None of the cities have reported exact data on waste burning & investment in AQI sensors is urgently required around large landfills and also in low-income areas where waste collection is erratic.